

**PATTERNS OF INJURIES IN ROAD TRAFFIC ACCIDENT
FATALITIES SEEN AT THE KENYATTA NATIONAL
HOSPITAL**

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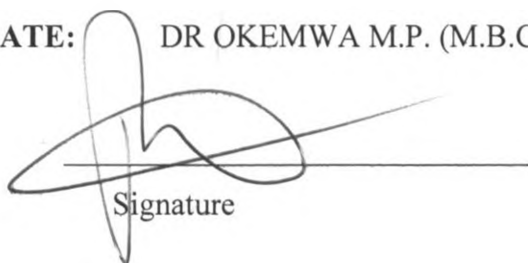
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DECLARATION

I declare that this presentation is my original idea and has not been presented anywhere as research for a degree award in any other university.

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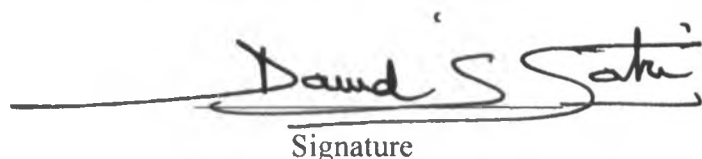

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25/11/05
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LIST OF ABBREVIATIONS

A & E	Accident and Emergency
AIS	Abbreviated Injury Scale
CDC	Center for Disease Control
CBD	Central Business District
DALYS	Disability Adjusted Life Years
GBDS	Global Burden of Disease Study
GNP	Gross National Product
ISS	Injury Severity Score
KNH	Kenyatta National Hospital
LOS	Length of Stay
MVC	Motor Vehicle Crash
NISS	New Injury Severity Score
ORIF	Open Reduction and Internal Fixation
PM	Post Mortem
RTA	Road Traffic Accident
SD	Standard Deviation
WHO	World Health Organization
NCC	Nairobi City Council
NCM	Nairobi City Mortuary

ABSTRACT

Few people can be ignorant of or unmoved by the enormous increase in the mortality and the morbidity caused by trauma caused by RTAs. The number of road traffic accidents has increased in recent years to pandemic proportions. The health, medical and legal problems posed affect all branches of surgery and medicine and fatal results are particularly relevant to the pathologist.

In Kenya, it is estimated that over 13,000 accidents occur annually, killing 2,600 people and seriously injuring another 11,000. In terms of economic losses up to 14 billion shillings are lost annually not withstanding the human and emotional suffering ⁽³²⁾.

This study was carried out at the Kenyatta National Hospital. It was a descriptive cross sectional study that attempted to document the patterns of injuries, determine the cause of death, correlate the fatalities as seen in pedestrians, drivers and passengers, determine the proportion of those who die on the spot and those that die while undergoing treatment; and determine injury severity scores.

One hundred (100) autopsies were performed after obtaining an informed consent over a period of 25 weeks.

The study involved 81 males and 19 females with an age range of 4-80 years and a median age of 33.5 years. 45% arrived at casualty dead while 55% were admitted for a period ranging between 1-730 days with a mean of 14 days.

Vulnerable groups were Pedestrians 62%, passengers 24%, drivers 9%, cyclists 4% and one case was not specified.

Head injuries were commonest accounting for 76%, followed by chest injuries 70%, abdominal injuries 60%, lower limb injuries 57%, upper limb injuries 35%, neck injuries 29% and pelvic injuries 16%.

The commonest cause of mortality was head injury 57%, followed by chest injury 33%, abdominal injuries 17%, other secondary injuries 8% and lower limb injuries was least accounting for 5%.

Majority 48% had a severe injury severity score (ISS) ranging 50-75, 44% had moderate score of between 25-49 and 8% mild scores of up to 24.

INTRODUCTION

Mortality due to road traffic accidents or motor vehicle accidents refers to deaths that arise from automobile injuries. These includes cars or taxis, public transport vehicles such vans, buses, minibuses, goods vehicles such as trucks, bicycles/pedal cycles, motor cycles, scooters, mopeds and trains.

Injury may be defined as damage to the body caused by acute exposure to energy. Trauma on the other hand is the medical term for injury that describes serious injury that requires specialized surgical care.

Patterns of injuries refer to distribution of injuries as seen on the body during autopsy and are classified as follows:

1. Skeletal Injuries: These include injuries to the Skull, Cervical Spine, Thoracic Spine, Ribs, Upper Limb, Lumbar spine, Pelvis and Lower Limb as seen on an upright skeleton.
2. Principal Visceral Injuries: These include injuries to the Brain, Lungs, Aorta, Heart, Liver, Spleen and Kidneys.

Death from trauma follows a trimodal pattern - immediate, early and late.

Immediate death follows injuries to the heart, great vessels, spinal cord and the brain. In this class of death, resuscitation and early care have little role. Early death refers to death within a few hours of the injury and is attributable to conditions where immediate resuscitation and surgery would prevent the death. Late deaths appear days or weeks after injury. Majority of these are secondary to sepsis and organ failure. Good critical care of injuries would reduce these late deaths. Overall, 40% of trauma deaths are preventable. ⁽¹⁷⁾

Death due to a road traffic accident is legally defined as that which occurs within one year and one day as a result of injuries sustained from that accident. ⁽⁸⁾

The distribution and severity of the injuries sustained in an accident will depend upon:

1. Where the casualty was seated;
2. The direction of the impact;
3. The design of the cabin;
4. The vehicular behavior of the after impact e.g. overturning
5. The speed or force of impact;
6. Ejection of the casualty;
7. The intervention of some other hazard e.g. fire.

Though it is difficult to determine or evaluate these parameters after an accident the severity of the injuries can give an insight to the speed and safety measures used in the vehicle at the time of the accident. Clinically this is assessed using an Injury Severity Score (ISS) by which injuries sustained in each region are scored ⁽¹⁵⁾.

The Nairobi City Mortuary (NCM) managed by the Nairobi City Council in collaboration with the National Health Laboratory Services (NPHLS) is the largest mortuary in the city of Nairobi with a capacity of 200 bodies. Most autopsies on victims of road traffic accidents are performed in the NCM. Currently it has two pathologists who conduct autopsies on a regular basis.

On average 200 post mortems are conducted on victims of road traffic accidents monthly at the NCM. Legally, all deaths following RTAs must have an autopsy done and the findings documented and certified on Form A23, the medico legal autopsy form in Kenya. Medico legal autopsies are not routinely done at the KNH Mausoleum except with relevant authority prior.

LITERATURE REVIEW

A. History of the Motor Vehicle

Nicholas-Joseph Cugnot of Lorraine, France, was the constructor of the first true motor vehicle. His vehicle was huge, steam-powered tricycle and the 1769 model is said to have run for 20 minutes at 3.6 kilometers per hour while carrying four passengers. It got enough steam to move again after resting for 20 minutes. ⁽¹⁾

Carl Benz and Gottlieb Daimler of Germany are honored as the pioneer contributors to the petrol engine motor vehicle. Benz ran his first car in 1885 at a speed of ten kilometers per hour. Daimler ran his in 1886. ⁽¹⁾ Since then, the manufacturing of motor vehicles has undergone a tremendous evolution with the modern models able to cruise at speeds in excess of 300 kilometers per hour.

The motor vehicle made its debut in East Africa in 1905⁽²⁾. The number of motor vehicles has steadily increased over the years with Kenya alone having about two million vehicles on its roads by 2003.

B. Trends in Road Traffic Accidents

The first human fatality associated with a motor vehicle was a pedestrian killed in 1899⁽³⁾. While then the patterns of injury from man's interaction with the motor car may have been somewhat modified by crash protection devices, including helmets, seat belts and air bags, the injuries due to road traffic related trauma are worsening each year.

Trauma is the most common cause of death in the 1-34 age group and a leading cause of disability and years of life lost ⁽¹⁸⁾. In terms of health care costs, injuries contribute substantially to the health expenditures. In the western world, various forms of injuries have become a major public health problem. Trauma due to traffic accidents forms a significant

portion of this problem. Globally, road traffic accidents are the leading cause of deaths in the young ^(19, 20).

In the USA, there were 150,956 reported deaths from injuries in 1994: 61% of which were due to unintentional injuries and 39% due to intentional injuries. Out of the unintentional trauma, half of the deaths were due to motor vehicle crashes (MVC). Car crashes result in over 523,000 hospitalizations in the United States each year (21). In the USA, 39% of fatal injuries from car crashes is associated with the use of alcohol ⁽³⁰⁾.

Road traffic crashes cause some 320 000 injuries, 40 000 serious injuries, and 3400 deaths a year in the United Kingdom ⁽⁴⁾.

The World Bank estimates that of the 865,000 traffic deaths occurring annually worldwide, 74% are in the developing world. Kenya followed by Korea rank top among the countries with the poorest road safety records ⁽²²⁾.

In a recent study on vehicular accidents in the country, Macharia *et al.* found an incidence rate of 12,745 accidents per year attended by an increasing trend of severe injuries ⁽²⁹⁾. Over 3000 people are killed annually on Kenyan roads. This is the highest accident rate in the world with 510 accidents occurring for 100000 motor vehicles on the road ⁽⁵⁾. On average seven (7) people are killed per day. The fatality has been calculated to 10.6 per 100000 population. ⁽¹⁶⁾ A four-fold increase in road fatalities has been experienced over the last 30 years ⁽⁶⁾.

Road traffic crashes exert a huge burden on Kenya's economy and health care services. Current interventions are sporadic, uncoordinated and ineffective ⁽⁶⁾.

More than 75% of road traffic casualties are economically productive young adults. Pedestrians and passengers are the most vulnerable; they account for 80% of the deaths. Passenger carrying vehicles particularly buses and 'matatus' are the vehicles most frequently involved in fatal crashes. Characteristics of crashes vary considerably between urban and rural settings: pedestrians are killed most in urban areas, whereas passengers are killed most

on intercity highways that transverse rural setting. Road safety interventions have not made any measurable impact in reducing the number, rate and consequence of road crashes. Despite the marked increase in road crashes in Kenya, little effort has been made to develop and implement effective interventions ⁽⁶⁾.

C. Mechanisms of Injury

Motor vehicle-related injuries can be arbitrarily divided into:

- Collision between the occupant and the external environment (the vehicle, or a stationary object if the occupant has been ejected).
- Acceleration or deceleration forces acting on the patient's internal organs.

Collisions

In a *frontal collision*, the unrestrained occupant of a vehicle continues to move forward due to inertia as the vehicle comes to an abrupt stop. This forward motion is arrested as the victim connects with the, by now, stationary vehicle chassis. The initial impact point is often the lower extremities, resulting in fracture/dislocation of the ankles, knee, hip or femur. As the body continues moving, the head, cervical spine and torso impact on the windscreen and steering column.

In a *lateral impact*, the victim is accelerated away from the side of the vehicle. Compressive pelvic injuries, pulmonary contusion, intra-abdominal solid organ injury and diaphragmatic rupture are common. *Rear impacts* also accelerate the victim; if head restraints are incorrectly fitted, the inertia of the head makes the cervical spine vulnerable to whip-lash injury. *Ejection* from a vehicle is associated with a significantly greater incidence of severe or critical injury ⁽⁷⁾. Other injuries after impact are due to explosions leading to burns.

When a car hits an adult, front bumper usually strikes first, hitting the victim at or just below the knee level either on the front or side of the legs. Primary injury on the thigh or hip will be due to the radiator grill, lamps or bonnet (hood) striking the body.

If the vehicle is large e.g. truck or bus primary injuries may be higher affecting chest, arms or head.

Even at low speeds the body might be thrown violently away and at higher speeds (60-100 kph) the victim may be projected up into air and travel a considerable distance before striking the ground or an obstruction giving rise to scooping-up injuries.

These cause secondary injuries especially on head, chest and pelvis. Running over injuries occur when a wheel passes over the body. It causes great distortion if on the head, chest, pelvis or abdomen. Tyre marks are impressed by intradermal bruising.

Where a motor wheel rotates against a body on the ground, large areas of skin and subcutaneous tissue may be ripped off giving rise to flaying injury ⁽¹⁸⁾.

Deceleration/acceleration injuries

Such injuries occur when differential movement occurs between adjacent structures; for example the distal aorta is anchored to the thoracic spine and decelerates much more quickly than the relatively mobile aortic arch. Shear forces are generated in the aorta by the continuing forward motion of the arch in respect to the distal thoracic aorta. Similar situations occur at the renal pedicles, the junction of the cervical with the thoracic spine and also between the white and grey matter within the brain ⁽¹⁸⁾.

In motor cycles due to projection from a machine to roadway due to high speeds and instability, they sustain;

1. Head injuries commonly.
2. Unique 'Tail Gating' injuries due to a motor cyclist driving under the rear of a truck, causing severe head injuries or decapitation.

Pedal cycle injuries are less severe due to low speeds. An injury unique to cycles is stripping of the skin from the leg due to the limb being forced between the wheel spokes. ⁽¹⁸⁾

The principle fatal sequel to injury include hemorrhage, fat embolism due to long bone fractures, pneumonia (especially following thoracic or abdominal which interfere with respiratory movement and serious head injuries), pulmonary embolism and cardiovascular sequel (endocardial hemorrhages, endocardial fibrosis and hypertrophy, arrhythmias) ⁽⁹⁾

D. Patterns Of Injuries

At the time of inception of this study, no study had been carried out to document the pattern of injuries that occur in fatalities arising from road traffic accidents in Kenya.

In the western world the most common causes of death include: Head injury 60%; Thoracic injury 20-25%; Aortic injury 15%. In addition, tracheobronchial injuries contribute to a small number of patients admitted to trauma centres. While the spleen is the most commonly injured visceral organ ⁽¹⁰⁾

A study carried by Odero W. ⁽¹¹⁾ revealed that of all fatalities reported, pedestrians comprised 42%, passengers 38%, drivers 12% and cyclists 8%. Vehicle-Pedestrian collisions were most severe and had a case fatality rate of 24% while only 12 % of injuries resulting from vehicle accidents were fatal.

A study carried by Said et al ⁽¹²⁾ revealed that trauma documentation was poor with less than 30% accuracy in most cases seen at the Nairobi Hospital Accident and Emergency Department. This can lead to poor management as documented by a study in India which showed that 23% of RTA deaths were felt to be preventable, 41% possibly preventable, and the rest not preventable. The majority of preventable deaths resulted from a failure to diagnose or manage a treatable injury. ⁽³¹⁾

Another study carried at the Kenyatta Hospital ⁽¹³⁾ showed that fractures were the most common form of injury recorded in emergency surgical admissions was fractures of long bones and pelvis followed by head injury. Fractures contributed to 48.4% of the total injuries recorded while head injuries contributed to 22.8%.

The most common fractures seen were those of the femur (15%), combined fractures of the tibia and fibula (10.6%) and pelvic fractures (6.1%).

There was a 9.2% mortality rate with 75% of them being due to head injury. Pedestrians accounted for 50% of the deaths followed by passengers at 40%. Five (5%) of the drivers died while motorcyclists and cyclists contributed 2.5% respectively.

The recorded cases of death were due to either head injury or hemorrhagic shock with the former being the leading cause of death (75%).

E. Injury Severity Score

The Injury Severity Score (ISS) is an anatomical scoring system that provides an overall score for patients with multiple injuries. Each injury is assigned an Abbreviated Injury Scale (AIS) score and is allocated to one of six body regions (Head, Face, Chest, Abdomen, Extremities including Pelvis and External). Only the highest AIS score in each body region is used. The three most severely injured body regions have their score squared and added together to produce the ISS score. An example of the ISS calculation is shown in Table 1(14)

An accurate method for quantitatively summarizing injury severity has many potential applications. The ability to predict outcome from trauma (i.e. mortality) is perhaps the most fundamental use of injury severity scoring, a use that arises from the patient and the family's desires to know the prognosis. More recently, physicians have suggested that severity scoring can provide objective information for end-of-life decision-making and resource allocation. Unfortunately, trauma mortality prediction in the individual patient is limited and fraught with uncertainty. In fact, decisions for individual patients should not be based solely on a statistically derived injury severity score⁽¹⁴⁾.

Field trauma scoring also is used to facilitate rational prehospital triage decisions, minimizing the period between when injury occurred and the beginning of definitive management. Similarly, physicians suggest that it can enhance appropriate use of resources and timely transfer of severely injured patients to trauma wards. Trauma scoring

for quality assurance by allowing evaluation of trauma care both within and between trauma centers, a contentious and controversial area that is likely to only increase in importance ⁽¹⁴⁾.

The ISS score takes values from 0 to 75. If an injury is assigned an AIS of six (6) (unsurvivable injury), the ISS is automatically assigned to 75. The ISS is virtually the only anatomical scoring system in use and correlates linearly with mortality, morbidity, hospital stay and other measures of severity.

TABLE 1 INJURY SEVERITY SCORING (15)

Region	Injury Description	AIS	Square Top Three
Head & Neck	Cerebral Contusion	3	9
Face	No Injury	0	
Chest	Flail Chest	4	16
Abdomen	Minor Contusion of Liver	2	
	Complex Rupture Spleen	5	25
Extremity	Fractured femur	3	
External	No Injury	0	
Injury Severity Score:			50

Its weaknesses are that any error in AIS scoring increases the ISS error. In addition many different injury patterns can yield the same ISS and injuries to different body regions are not weighted ⁽¹⁵⁾.

F. Prevention of Injury

Many countries made concerted efforts in the early 1970s have to address the high number of deaths after RTA. The strategies involved traffic control, vehicular designs, vehicular engineering, improved highway designs, reduced impaired driving due to alcohol and drugs; and improved care of the injured. Studies have now shown that the above national efforts have demonstrable benefits ⁽²⁶⁾.

Despite these preventive efforts, vehicular injury is projected to become the number one cause of DALYS by 2020 and number two cause of DALYS in developing countries. Prevention will still remain the answer. Though current strategies employ both passive and active methods of prevention, it is envisioned that the passive component may be emphasized more as it has been shown to give better results ⁽¹⁸⁾.

As regards the central role of alcohol in the causation of vehicular trauma, preventive efforts in the United States between 1983 and 1993 bore fruits as alcohol related injuries reduced by 26%. This was attributed to harsh penalties for driving while impaired, change in attitude of law enforcement personnel and change in the attitude of the public towards efforts to curb alcohol intake. It has been suggested that physicians could play an important role in this regard by identifying patients with alcohol related problems and referring them for treatment. Reports from thirty-two randomized controlled studies do show that brief interventions and counseling were more effective than no counseling. ⁽²⁷⁾

Significant research has gone into vehicular designs to reduce levels of injury. Modifications have included creation of energy absorbing steering columns, padded interior contact points, enhanced side impact protection and the use of seat belts. The latter, introduced in 1968, has been shown to reduce the risk of death or serious injury by 45%. Seat belts or air bags reduce the risk of both severe head injury and hospitalization by 61% and 33% respectively in the event of a crash.

In motorcycle related injuries, the use of helmets is strongly recommended. In California for example, after laws requiring the use of helmets were introduced, its use increased from below 50% to 95% and the risk of head injury reduced by 34% (28). Helmets have also been demonstrated to reduce the risk of facial injuries by 66% ⁽²⁵⁾. Legislation to have motorcycles with lights on during the day has resulted in the reduction in the risk of fatal daytime crashes.

Use of helmets among bicyclists is also effective in reducing the risk of head injuries. A population based case-control study found that the use of helmets decreased the risk of head injury by 85% and brain injury by 88% (24). A recent case-control study of 33,390 injured

cyclists found that helmets were effective for cyclists of all ages including collisions that involved motor vehicles as well as those that did not ⁽²⁴⁾.

Preventive aspects for pedestrian injuries have involved the practice of traffic calming. This, pioneered in northern Europe, involves the diversion of high volume, high-speed traffic away from the core of the city and residential areas and slowing traffic down to 16-32 Kp/h. The streets are also narrowed. These changes do reduce the risk of injury for pedestrians of all ages but especially, children and the elderly ⁽¹⁸⁾.

RATIONALE OF STUDY

Deaths due to Road Traffic Accidents are a common cause of death in Kenya with an average number of 7 people dying daily. The documentation of injuries in fatalities and those seen in Emergency Rooms was scanty as shown by Said et al. (12). The present was aimed at study documenting the patterns of injury in fatalities due to RTAs.

It was hoped that the findings of this study could help in the following ways:

- Highlight the patterns of injuries and causes of death seen in fatalities of Road Traffic Accidents.
- Determine the commonest cause of death in Road traffic Accidents.
- Help Health Care Workers in screening for lethal injuries in the seriously injured victims and help formulate methods of evacuation of injured victims as happens in the developed countries.
- Create the awareness in use of Injury Severity Score in triage of injured patients useful in evaluation of treatment modalities especially surgery.

OBJECTIVES

The broad objective of the study was to assess the pattern of injuries at autopsy on road traffic accident victims at the Kenyatta National Hospital.

The specific objectives were:

1. To determine the pattern of injuries on all fatal Road Traffic Accidents at the Kenyatta National Hospital.
2. To determine the cause of death.
3. To correlate the fatalities as seen in passengers, drivers and pedestrians.
4. To determine the proportion of victims that die before arrival to hospital and those that die while undergoing treatment.
5. To determine the injury severity score of the victims.
6. To make recommendations on treatment based on the common patterns of injuries in RTAS.

METHODOLOGY

A. Study Design

This was a descriptive cross-sectional study. One hundred (100) fatalities of RTA were recruited randomly. Ninety (90) autopsies were conducted at the KNH Mausoleum and ten (10) autopsies at the Nairobi City Mortuary (NCM).

B. Study Location

The study area was the KNH Mortuary with few cases studied at City Mortuary. The NCM is the largest mortuary within Nairobi and is run by the NCC.

The KNH Mausoleum is located within the precincts of Kenyatta National Hospital.

C. Data Collection

Data on the victims' demographics and circumstance of the accident were obtained from the Police narration as recorded in form 23A and manually abstracted onto a proforma sheet (APPENDIX I).

These included:

Demographics

- age
- gender
- residence

Circumstances surrounding death

- time of accident
- time of death
- type of car
- site of accident
- Use of drugs e.g. alcohol

Where data on the form 23A was incomplete, additional information was sought verbally from the investigating officer and relatives/witnesses.

D. Autopsy

The autopsy was conducted in a standard manner as outlined in **APPENDIX II**. The procedure included:

- Identification- By investigating officer and/or relatives.
- External Examination
- Internal Examination

The autopsy findings were recorded on the standard postmortem form used by the Government pathologist for medicolegal cases (form 23A). A model of this standard autopsy form is provided in **APPENDIX III**.

Data from the autopsy form specific to this study was then transferred onto the coded proforma sheet (**APPENDIX IV**) for eventual analysis. These included:

- anatomical site
- type of injury
- injury severity score
- cause of death
- Other significant finding including histological findings from specimens taken from major organs e.g. heart, kidney, brain, liver and lungs.

E. Study Population

Victims of RTA brought to the KNH Mortuary for postmortem/medico legal evaluation

Inclusion Criteria

- All those who died after road traffic accidents and brought to Kenyatta National Hospital with some history of the accident either through casualty or directly to the Hospital Mortuary.

Exclusion Criteria

- Those who died of trauma not related to a road traffic accident
- Those who cannot be identified.

F. Sampling

The study subjects included all those who died at KNH due to road traffic accidents. The investigator used simple random sampling to select cases from the case population.

G. Sample Size

100 subjects; using formula

$$n = \frac{(1.96)^2 p(1-p)}{d^2}$$

n= sample size

p= prevalence = 7.0%

d= level of precision = 0.05

H. Data Analysis

The data from the post mortem form and questionnaire was fed into coded proforma sheets that were entered onto a computer database. Computer generated spreadsheets were prepared from the database and the transferred to EPI-Info 3.2.2® statistical software for analysis. The descriptive summary statistics were presented as proportions and percentages in form of tabulations, charts and graphs using EPI-Info 3.2.2®. Tests for statistical significance were used to analyze differences and compare proportions from computer generated contingency tables and cross-tabulations.

RESULTS

A. GENDER AND AGE DISTRIBUTION

Out of 100 cases 81 were males and 19 were females as illustrated in the table 2 below.

Table 2

Sex	Frequency	Percent	Cum Percent
Male	81	81.0%	100.0%
Female	19	19.0%	19.0%
Total	100	100.0%	100.0%

The age ranged from four (4) years to 80 years with a mean age of 34.7 years and median age of 33.5 years. Majority of the cases (80%) lie within the economically productive age group of 15- 49 years. The ratio of those within productive age group compared to those outside this age bracket is 4:1.

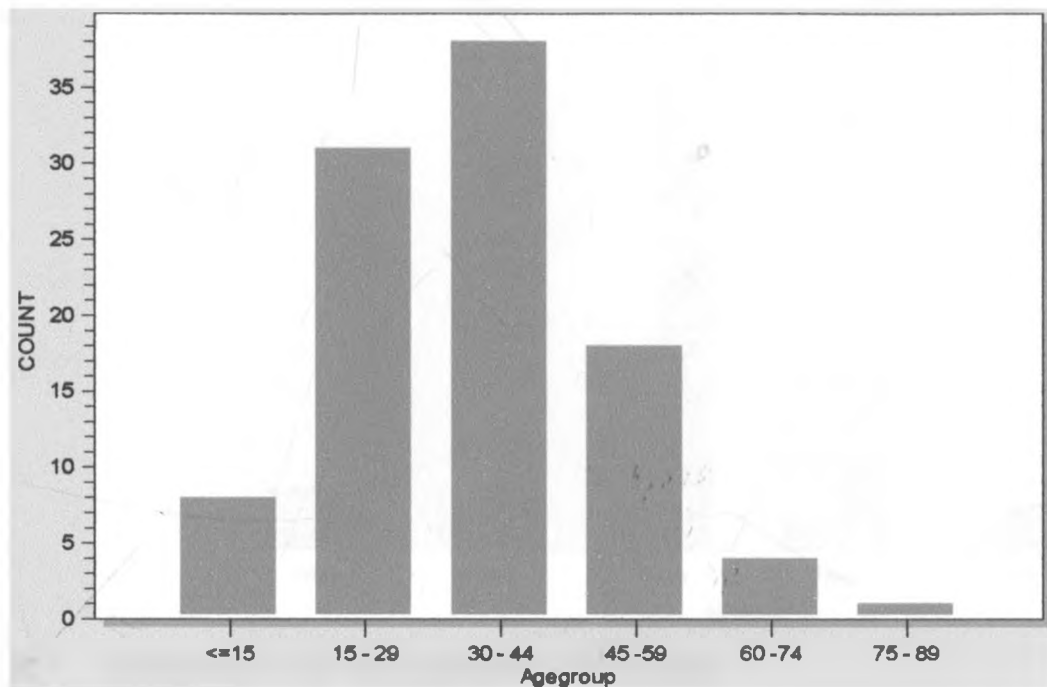
Table 3

Age group	Frequency	Percent	Cum Percent
15-49	80	80.0%	88.0%
0-15	8	8.0%	8.0%
>50	12	12.0%	100.0%
Total	100	100.0%	100.0%

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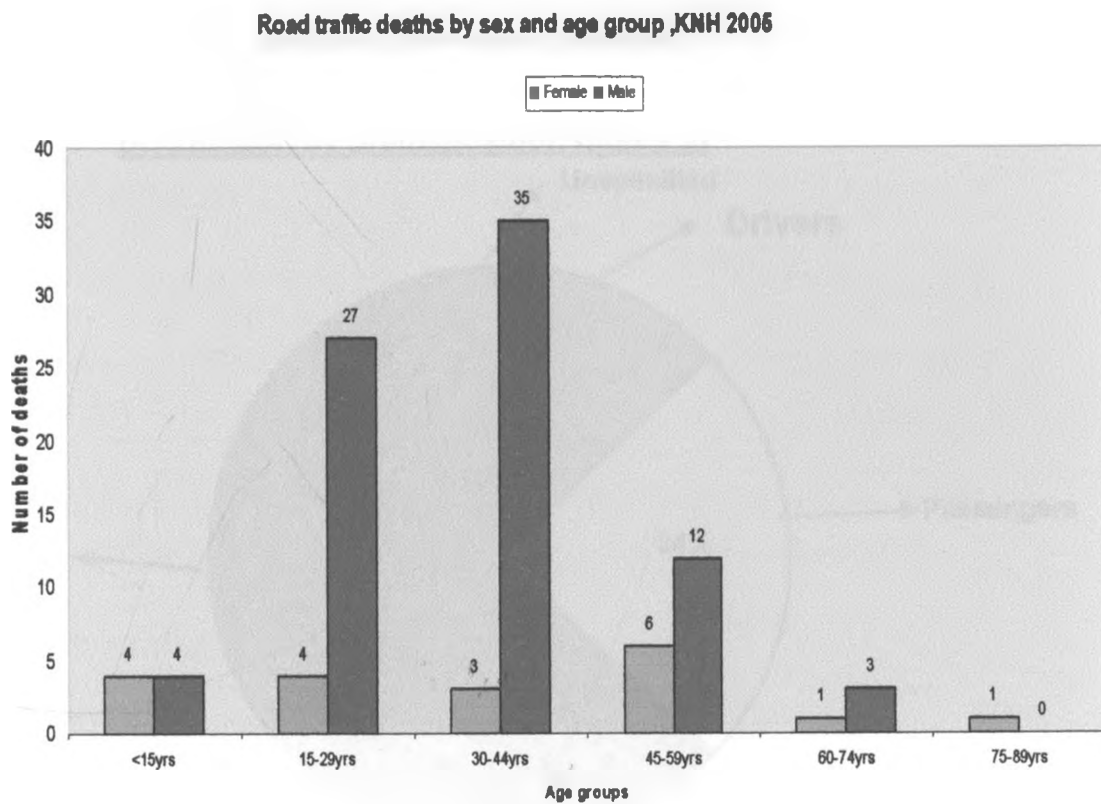
The distribution in the different age groups shows a preponderance of accidents in the 30-44 age group in Figure 1.

Figure 1: Age Distribution



When the age groups were stratified on gender basis, males constituted more in the productive age group as shown in Figure 2.

Figure 2



B. PROFILE OF ACCIDENT VICTIMS

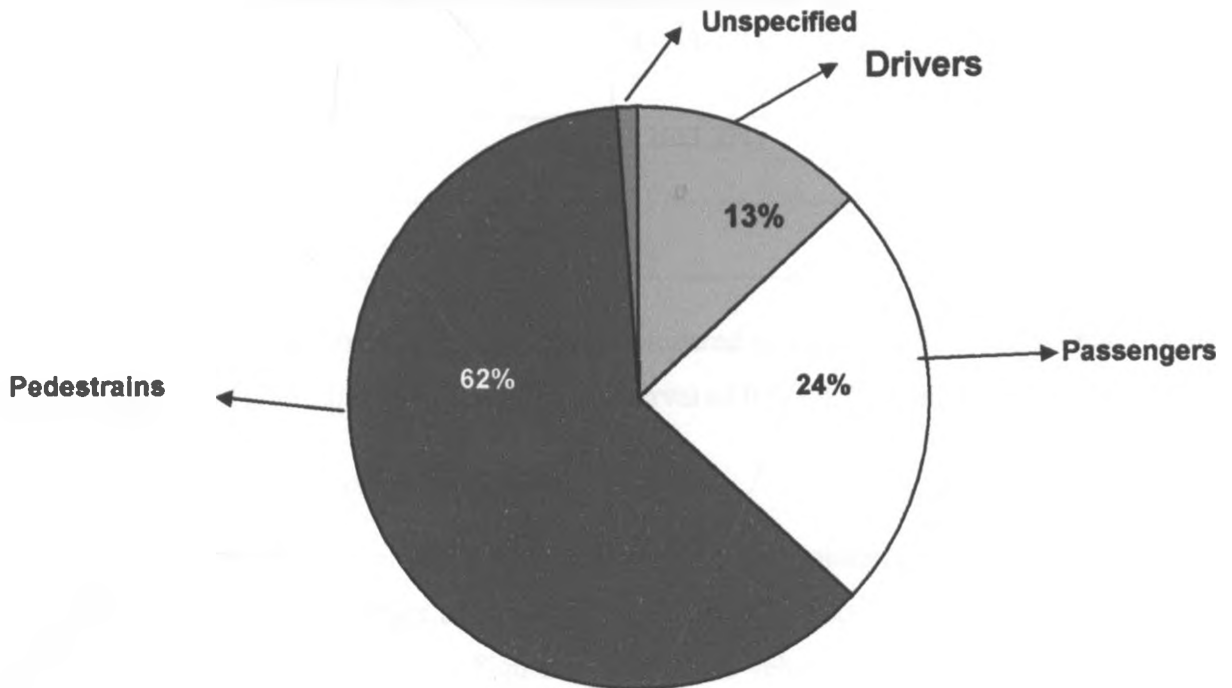
The most vulnerable were pedestrians, passengers then drivers in that order as illustrated in the Table 4 and Fig. 3.

Table 5: Profiles

Predisposition	Frequency	Percent	Cum Percent
Unspecified	1	1.0%	100.0%
Pedestrian	62	62.0%	99.0%
Passenger	24	24.0%	37.0%
Driver	13	13.0%	13.0%
Total	100	100.0%	100.0%

The pie chart below shows the variation in the various categories.

Distribution by predisposition (figure 3)



When stratified on gender basis the table illustrates the variation.

Table 5: Stratification on gender basis of the study profile

Predisposition	Male	Female
Pedestrian	50 (61.7%)	12 (69.3%)
Passenger	17 (21%)	7 (30.7%)
Driver	9 (16.1%)	0
Cyclists	4	0
Unspecified	1	0
TOTAL	81	19

Analysis of the time of death showed that 45% were dying prior to admission compared to 55% who died after being admitted.

Table 6: Time of Death

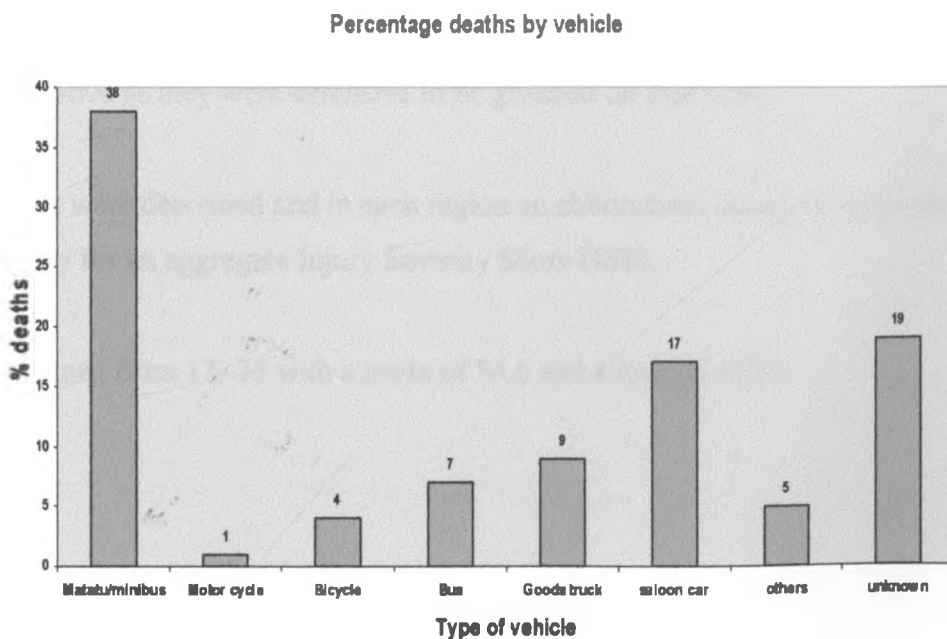
	Died before admission	Died after admission	Total
Male	38(46.9%)	43(53.1%)	81
Female	7(36.8%)	12(63.2%)	19
Total	45	55	100

Male were more likely to arrive at casualty dead compared to female {46.9% vs. 36.8%} with an odds ratio {OR = 1.5: 95% Confidence Interval of 0.5 – 4.8 (p value 0.4)}

C. VEHICLE AND ROAD PROFILE

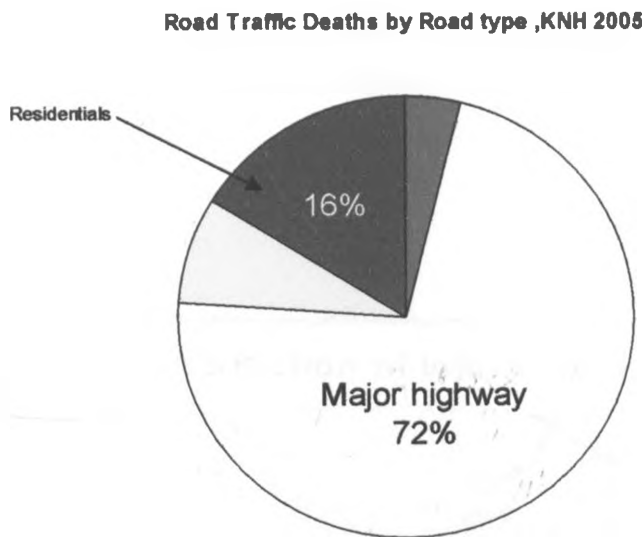
A profile of the vehicles involved showed that matatus and minibuses caused 40% of the accidents followed by saloon cars as shown in Figure 4. The saloon cars were a mixture of both private and taxis. As shown in Figure 4 hit and run vehicles were involved in 19% of accidents and by completion of the study they had not been identified hence classified as unknown.

Figure 4



Main highways were the commonest site of most accidents (72%) compared to other roads. In this study a major highway constituted exit roads from Nairobi such as Mombasa highway, Thika road, Nairobi-Nakuru highway, Langata road and Ngong road. In other areas other than Nairobi, the busy roads were considered as major highways. This is illustrated in

Figure 5



D. PATTERNS OF INJURIES

The injuries were assessed in anatomical regions of the Head, Neck, Chest, Abdominal, Pelvis and Extremities. In this study External injuries were described under the regions described above as they were extensive to be grouped on their own.

The Injuries were described and in each region an abbreviated injury score given for the most severe injury for an aggregate Injury Severity Score (ISS).

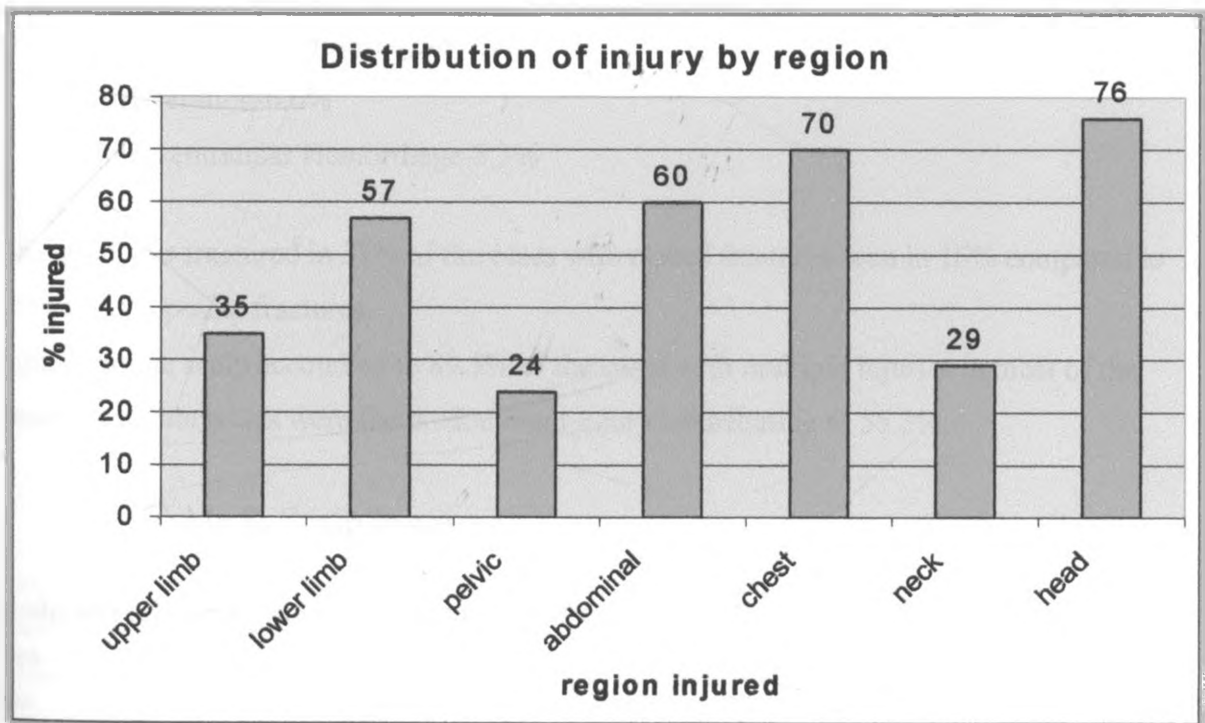
The ISS ranged from 17- 75 with a mean of 54.6 and a median of 50.

Table 7: Injury Severity Scores

Severity score groups	Frequency	Percent	Cum Percent
Severe(50-75)	48	48.0%	100.0%
Moderate injury (25-49)	44	44.0%	52.0%
Mild injury(0-24)	8	8.0%	8.0%
Total	100	100.0%	100.0%

Analyses of distribution of injuries according to the anatomical regions were distributed as follows:

Figure 6



During hospitalization and treatment some developed secondary injuries that contributed to their death.

Some organs were also found to have incidental disease processes not related to the accident such schistosomiasis and tuberculosis.

INJURIES TO THE HEAD

Head injuries accounted for 76% of all cases with the skull in 31 and scalp in 68 of the 76 cases.

The distribution of brain injuries was as follows.

1. Acute Subdural hemorrhage-50%
2. Brain Contusion-28.9%
3. Brain Laceration-21.1%
4. Subarachnoid Hemorrhage- 15.8%
5. Brain Edema-15.8%
6. Diffuse Axonal Injuury-3.9%
7. Extradural Hemorrhage-6.6%
8. Intracerebral Hemorrhage-6.6%
9. Evisceration-6.6%
10. Intraventricular Hemorrhage-5.3%

The skull was fractured in 31% of the cases with closed fractures seen in 16% compared to 15% for compound fractures.

Injuries to the scalp accounted to 89.5% of the cases with multiple injuries in most of the cases. Scalp abrasions were the predominant injury contributing to 55.3%.

Table 8: Scalp Injuries

Scalp abrasion	Frequency	Percent	Cum Percent	
Yes	42	55.3%	55.3%	
No	34	44.7%	100.0%	
Total	76	100.0%	100.0%	

Secondary brain infections were seen in five (5) cases with three (3) cases exhibiting meningitis and two (2) cases encephalitis.

NECK/ FACE INJURIES

Neck injuries constituted 29% out of which severe injuries accounted for 16%. Cervical spine fractures were documented in 9% with cervical spine fracture/ dislocation with cord involvement in 7% of all cases.

The severe facial injuries included three cases of broken teeth, two maxillary fractures and one case of mandible fractures. Soft tissue injuries of the face were noted with predominant facial abrasions highest at 11% and lacerations at 5%.

CHEST INJURIES

Chest injuries were the second most common injury constituting 70% of injuries.

Table 9:

Distribution of chest injuries		
Description	Number injured (N=70)	%
Ribs with fractures	34	48.6%
Hemothorax	30	42.9%
Pulmonary oedema	22	31.4%
Lacerated lung	21	30.0%
Contused lung	12	17.1%
Collapsed lung	2	2.9%

Table 10: Secondary Chest Pathology

INFECTION	FREQUENCY	PERCENTAGE %
Bronchopneumonia	10	14.3
Aspiration	2	4.9
ARDS	3	4.3
Pulmonary Thromboembolism	4	5.7
Pulmonary Tuberculosis	3	4.3
Pyothorax	2	2.9
Lung Infarct	1	1.4
Pulmonary Schistomiasis	1	1.4

Injuries to the heart were few with pericardial hemorrhage constituting 7.1% followed myocardial perforation at 4.3%. The other incidental heart lesions were cardiac hypertrophy at 2.9%, chamber dilation at 1.4% and endocardial thrombi at 1.4%.

ABDOMINAL INJURIES

These constituted 60% of all recorded injuries. The commonest abdominal injury involved the liver at 46.7% of all the abdominal injuries. They occurred in this order

- Lacerated liver- 15cases (25%)
- Contused liver- 10 cases (16.7%)
- Ruptured liver- 5 cases (8.3%)
- Liver with features of congestion-5 cases (8.3%)

The other underlying hepatic conditions included liver schistomiasis, chronic hepatitis, passive venous congestion and liver steatosis.

The liver was followed by intestinal/ mesenteric injuries at 23.3%. This is illustrated in the table 11.

Table 11: Intestinal/Mesenteric Injuries

INJURY	FREQUENCY	PERCENTAGE
Bruised Mesentery	10	16.7%
Contused/lacerated Jejunum	5	8.3
Contused/ lacerated Ileum	5	8.3
Contused/ lacerated Colon	5	8.3
Lacerated Mesentery	2	3.3
TOTAL	27	44.9

After liver injuries peritoneal injuries followed occurring in 20% of all abdominal injuries. These were as peritoneal hemorrhage or retroperitoneal hemorrhage or secondarily as peritonitis. The kidney injuries constituted 7% of all abdominal injuries and included.

1. Contused kidney-1 case (1.7%)
2. Lacerated kidney-3 cases (5.0%)
3. Ruptured kidney-1 case (1.7%)

Table 12: Kidney Injuries

Kidney Injuries	Frequency	Percent	Cum Percent
No	56	91.6%	100.0%
Yes	5	8.4%	8.4%
Total	60	100.0%	100.0%

Two (2) cases exhibited underlying renal pathology which included diabetic nephropathy, hypertensive renovascular changes and pyelonephritis. One (1) case showed stress changes in the form of adrenal lipid depletion.

The other injuries included lumbosacral fracture and dislocation at 8.4%, Gall bladder rupture at 3.3%, inferior vena cava thrombosis 1.7% and duodenal perforation 1.7%.

External injuries such abdominal wall grazing or impact abrasions, bruises and hematomas contributed to 16.7% of abdominal injuries.

PELVIC INJURIES

Pelvic injuries constituted 24% of injuries all cases.

- ❖ Pelvic fractures- 12 cases (50%) of all pelvic injuries distributed as follows: - Ischium-three (3) cases (12.5%), Ilium- four (4) cases (16.7%), Pubis- five (5) cases (20.8%)
- ❖ Perivesical hematoma- five (5) cases (20.8%)
- ❖ Contused urinary bladder – four (4) cases (16.7%)
- ❖ The other injuries included ruptured urinary bladder three (3) cases (12.5%) and contused testis two (2) cases (8.3%).

Decubitus septic sores arising from pressure sores were noted in six (6) cases (25%). One (1) case was found to have severe bladder cystitis presumably due to catheterization.

INJURIES ON EXTREMITIES

In this study, injuries to the shoulder girdle were grouped together with Upper limb injuries due to anatomical proximity and function.

Upper limb injuries constituted 35% of all body injuries. The severe injuries were fractures distributed as shown.

Table 12: Distribution of Upper Limb Injuries

Upper limb fracture/ dislocation	Frequency	Percentage %
Radius/ ulna comp fracture	0	0
Clavicle fracture	1	2.9
Elbow dislocation	1	2.9
Wrist joint dislocation	1	2.9
Hand fractures	1	2.9
Shoulder dislocation	2	5.7
Comp humerus fracture	2	5.7
Radius/ulna closed fracture	5	14.3
Closed humerus fracture	9	25.7
Total	22	63.0

Lower limb injuries contributed to 57 % of body injuries. Fractures and dislocations, representing severe injuries were distributed as shown in Table 14.

Table 13 Distribution of Lower limb Injuries

Lower limb Fracture/ Dislocation	Frequency	Percentage
Closed femur fracture	20	35.1
Compound tibia/ fibula fracture	14	24.6
Comp femur fracture	7	12.3
Closed tibia /fibula fracture	7	12.3
Ankle joint dislocation	5	8.8
Foot fractures	3	5.3
Knee joint dislocation	1	1.8
Hip joint dislocation	0	0
TOTAL	57	100

Soft tissue injuries in both the upper and lower limb i.e. abrasions, bruises and lacerations were as shown in Table 15.

Table 14: Soft Tissue Injuries of Extremities

Soft Tissue Injury/SITE	Lower limb	Upper limb
Abrasions	32(56.1%)	22.8%
Lacerations	28(49.1%)	10.5%
Degloving injuries	3(5.3%)	0%

Severed major vessels were seen in 4 cases (7%) as a result of lower limb crush injuries.

E. CAUSE OF DEATH

Figure 7:

Causes of death among RTI fatalities KNH 2005

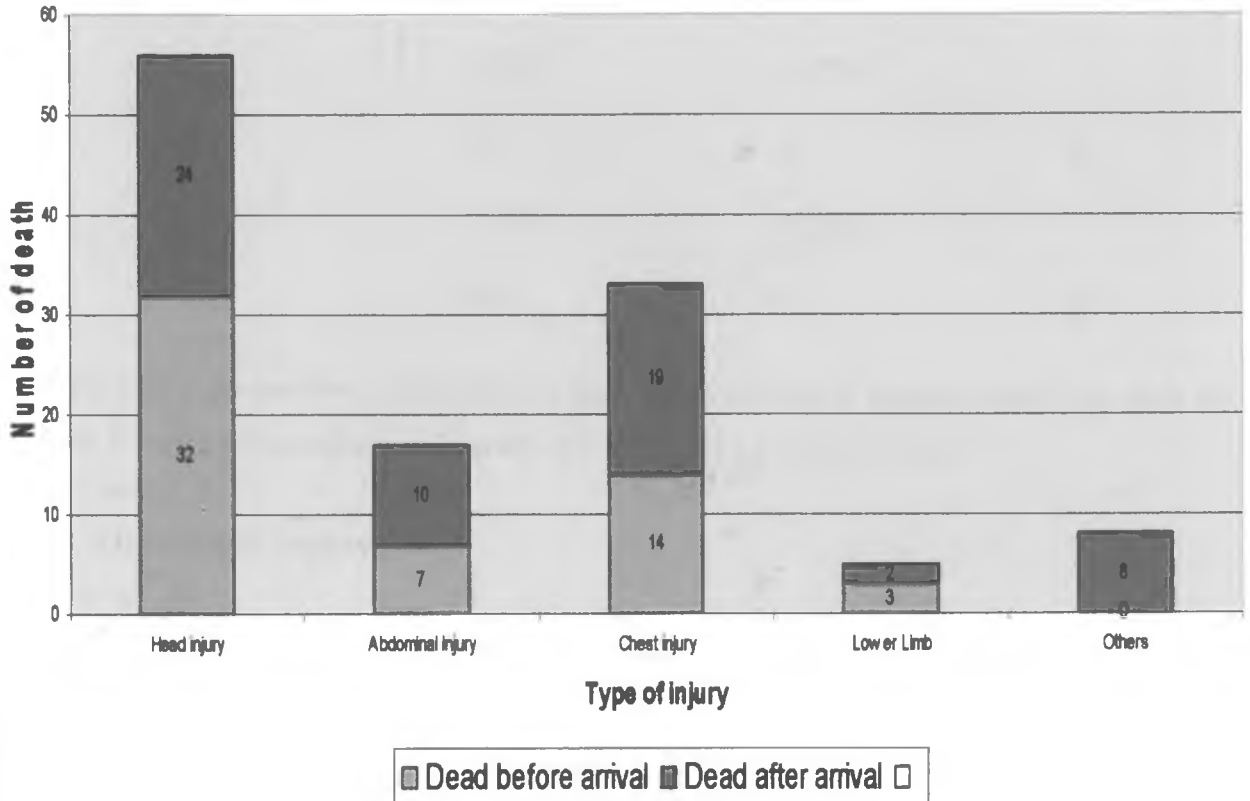


Table 15: Cause of death in Pedestrians

Cause of death head injury	Frequency	Percent	Cum Percent
Yes	37	59.7%	59.7%
No	25	40.3%	100.0%
Total	62	100.0%	100.0%

1. Head injury outcome

TABLE 20

Head Injury as cause	Dead before admission	Dead after admission	Total
Yes	32 57.1%	24 42.9%	56
No	12 27.9%	31 72.1%	43
Total	44	45	99

57% of the people who on PM died of head injury arrived to casualty dead! The odds ratio was 3.4 with 95% confidence interval of 1.4-8.9 and a p value of 0.004.

2. Abdominal injury

They accounted for 17% of deaths.

3. Chest injury

They were the second commonest cause of death accounting for 30%.

4. Lower limb injury

Crush injuries to lower limb account for 5% of deaths.

5. Others

These included uremia due to renal failure and septicemia which together accounted for 8% of the deaths.

6. Unascertained

One case had an anesthetic cause of death.

DISCUSSION

A. AGES AND AGE GROUPS

Of the 100 study subjects randomly selected, males were more likely to be involved in accidents compared to females in the ratio 4:1 (Table 1). Eighty percent of the accident victims were in the economically productive age group of 15-49 (Table 2). These findings are similar to study carried out by Odero W et al, which showed that more than 75% of road traffic casualties are economically productive young adults⁽⁶⁾.

Within this economically productive age group, the most affected was 30-44 years at 37% followed by 15-29 years at 31%. Of the male study subjects 86.4% compared to 52.6% of the female study subjects were within the economically productive age group of 15-49(Figure 1,2). This could be a reflection of the general population where the sample was picked from or may represent the most affected group.

B. VULNERABILITY

Comparison of the mortality by accident victim profiles shows that pedestrians were the most vulnerable consisting of 62%, while the other vulnerable groups include passengers 24%, drivers 13% and unspecified 1% (Figure 3). This is similar to a local study done by Odero W. et al that showed that pedestrians and passengers are the most vulnerable accounting for 80% of the fatalities. ⁽⁶⁾

Another study done in Eldoret, a town North of Nairobi, by Odero W. et al showed a variation in the different categories which reflects the different users though the pedestrian was most vulnerable. It showed that of all fatalities recorded pedestrians comprised 42%, passengers 38%, drivers 12% and cyclists 8%⁽¹¹⁾.

The differences seen in these two studies were explained due to the difference in setting and time of the studies. Eldoret is a smaller town with fewer vehicles though comparatively has more cyclists. Also, new regulations in the Kenyan transport sector now emphasize more on vehicle occupants' safety at the expense of pedestrians.

A study of emergency admissions at KNH due to RTA'S by Muyembe V. showed that pedestrians accounted for 50% of the deaths followed by passengers at 40%. Five (5%) of the drivers died while motorcyclists and cyclists contributed 2.5% each. ⁽¹³⁾

In a Nairobi hospital study by Saidi H, the predominant road user injured was a vehicle occupant (70%). Pedestrians only constituted 21.3%. Major city roads or highways were the commonest scenes of injury (38.3%). These observations were expected for the reason that Nairobi Hospital is a high cost hospital compared to KNH, a low cost hospital, where this study was done. ⁽¹²⁾

In this study comparison of gender with predisposition showed that majority of the female who died (69.3%) and male 61.7% were pedestrians. 30.7% of the female subjects were passengers compared to 21% of the males. There were no female drivers compared to the 13 male drivers comprising 16.1% of the male subjects (Table 6). This reflects the few female drivers generally where the sample was picked and also that the few present are rarely involved in fatal accidents.

This study also noted that Road Traffic Injury casualties are more likely to arrive at hospital alive (55%) than dead (45%). Male were more likely to arrive at casualty dead compared to female (46.9% vs 36.8%) with an odds ratio (OR = 1.5 : 95% Confidence Interval of 0.5 – 4.8 (p value 0.4) (Table 7). Although this was statistically insignificant, this is the first local study to document this.

C. VEHICLE AND ROAD PROFILE

This study shows that matatus/ minibuses were more likely to cause accidents at 38% followed by saloon cars 17%. The hit and run vehicles contributed to a significant 19%, good trucks 9%, buses 7%, then others 5% which included 4 wheel drive cars. Bicycles and motorcycles contributed to 5% reflecting little use of these two means of transport in the city.

The study also showed that matatus/minibuses and hit and run vehicles contributed to close to 60% of those who died prior to admission (Figure 4).

Most accidents 72% occurred along major highways. Highways in the cities were the exit or entry routes while busy roads in other parts of the country were considered. Similarly 64.4% of those who died prior to admission had accidents on major highways. This severe outcome is a reflection of the number of vehicles using the roads, their speeds and pedestrians using them.

Accidents in residential areas contributed to 16%, Central Business District 4% and other roads 8% (Figure 5).

D. PATTERNS OF INJURIES

HEAD

A study carried by Muyembe at Kenyatta Hospital (13) showed that fractures were the commonest injuries recorded in emergency admissions followed by head injury. Fractures contributed to 48.4% of the total injuries recorded while head injuries contributed to 22.8%. There was a 9.2% mortality rate with 75% being due to head injury.

In this study, of the recorded injuries, those involving the head contributed to 76% (Figure 6). Of all the study cases head injuries contributed to 56% of all mortalities. Fifty seven percent (57%) of these arrived to casualty dead or died prior to admission (Table 17). The commonest form of head injury was subdural hemorrhage 50% followed by brain contusions 28.9%. In all fatalities due to head injury multiple head injuries were the norm. It was clearly the commonest injury with high fatality rate.

Twenty nine percent (29%) of all cases had neck injuries. Severe injuries contributed to 16% of these injuries which include nine percent (9%) with cervical spine fracture and seven percent (7%) fracture/dislocation with cord involvement.

These patterns of injuries are seen in pedestrians- or vehicle occupants who have been ejected –as a result of the head violently striking the road or a solid object ⁽¹⁶⁾. The anticipated vulnerability of the head in motor and bicycle accidents is related to their relative instability. Head Injury amongst pedestrians has been attributed mainly to speeding vehicles, lack of walkways and flyovers for pedestrians though drunkenness has been noted in other studies especially in accidents occurring in the evening and night hours.

The pattern of injuries due to ‘running-over’ resulted to gross distortion of the head, chest, abdomen and pelvis as a result of crush injuries.

The severe facial injuries included three cases of broken teeth, two maxilla fractures and one case of mandible fractures. Cerebrocervical and facial injuries could have been more than recorded in present study due to lack of radiographic machines at KNH Mausoleum that aid in diagnosis of these injuries.

CHEST

Chest injuries were responsible for 70% of the fatalities (Figure 6). Thirty three percent (33%) of all mortalities were due to chest injuries. Around 15% of these were directly related to cervical spine injuries.

Rib fractures accounted for 48.6% followed by hemothorax 42.9% and pulmonary edema 31.4% (Table 9).

The commonest secondary chest pathology was secondary infections. Hypostatic bronchopneumonia was leading seen mainly in those admitted to ICU due to head injury. This was followed by pulmonary thromboembolism seen in four cases (Table 13).

ABDOMEN

Abdominal injuries accounted for 60% of study subjects and were associated with 17% mortality (Figure 6).

The liver was the most commonly injured organ 46.7%, mesentery and intestines at 23.3%, peritoneum 20%, spleen 10% and kidney 6.7%.

This demonstrates the anatomical vulnerability of the liver due to its big solid size, fixation and anterior placement compared to kidneys and spleen which because of their anatomical location in the paravertebral gutters are protected by muscle and vertebral column. Also the more fixed retroperitoneal parts of the small intestines like the proximal jejunum and terminal ileum were more involved than the mobile parts attached to the mesentery like duodenum and distal jejunum (Table 11).

Underlying or secondary events were also seen notably liver schistomiasis in four cases, diabetic nephropathy in two cases, liver steatosis and nutmeg changes in multiple others.

In respect to this, it has been noted that disease should be sought and noted with care in the case of elderly pedestrian casualties- proof of its existence may be of major value in apportionment of blame. Disease as a cause of accidents is more circumscribed and to be significant it must be immediately incapacitating which limits relevant conditions to diabetes, epilepsy and cardiovascular disease ⁽³³⁾.

PELVIS

The pelvis had 24% injuries with fractures leading by 50% and perivesical hematomas 20.8%. Decubitus bed sores were the commonest secondary event seen in 25% of the pelvic injuries. The earliest decubitus pressure sore was recorded at 21 days after hospitalization and inevitably after 90 days.

Decubitus pressure sores result from lying in one position for long especially on bony prominences. They arise when one is afflicted by a condition that does not enable turning while in bed. They have been used as a marker of the quality of nursing in some trauma units.

EXTREMITIES

Lower limb injuries were recorded in 57% of the cases while upper limbs were involved in 35% (Figure 6). Fractures combined were the commonest with femur affected in 47.4% of the lower limb injuries followed by tibia fibula fractures at 36.9%. In the upper limb humeral fractures contributed to 31.4% followed by radioulnar fractures at 14.3%

Compound fractures were commonly seen in pedestrian especially to the lower limb as a result of being struck by bumper primarily and secondarily as a result of being scooped by vehicles at high speeds.

In the study done in KNH by Muyembe V. (13) in the late 80's in emergency surgical admissions due to Road Traffic Injuries, the most common fractures were those of the femur 15%, combined fractures of tibia and fibula 10.6% and pelvic fractures 6.1%.⁽¹³⁾

In this study more injuries were recorded affecting all regions indicating that injuries due to RTA'S have increased and also due to contribution by those who died prior to admission. The disparity between upper and lower limb injuries is due to high number of pedestrians knocked down by moving vehicles particularly *matatus* (Figure 4).

E. INJURY SEVERITY

The ISS ranged from 17- 75 with a mean of 54.6 and a median of 50 (Table 10).

This was commensurate to the high mortality rates recorded though this anatomical scoring is deficient in that secondary infections cannot be scored.

In good trauma centers though, 50% of moderate scores and 100% of severe scores are predicted to die. Of the mildly injured none is expected to die. Hence according to this study, with good management, 30 of them should have survived.

This was also reflected in the period of hospital stay with a range of one (1) day to two (2) years, with a mean of 17 days.

CAVEATS

1. This was a convenient sample size and relatively small.
2. Lack of radiological services at the mortuary may have contributed to some injuries not being detected.
3. No clinical summary routinely given except for cases from Intensive Care Unit. This negates correlation of autopsy findings with clinical data.
4. Police narrations give inadequate details on road traffic accidents.

RECOMMENDATIONS

1. Enforcement of traffic laws especially the 'Michuki' rules to control speed, use of safety belts and roadworthy vehicles should be enhanced especially on major highways because their use have already started bearing fruit in reducing RTA'S from 3000 to 2000 in 2004.
2. More focus to protect pedestrians should be undertaken such as walkways, cycling ways and flyovers especially along the major highways where most accidents were noted to occur.
3. As most fatal injuries involved the head, bicycle riders and motor cycle drivers with their pillion passengers must have helmets on.
4. Hospitals with trauma units should be built along major highways for quick access for post crash victims. For example any major accident along Mombasa road between Sultan Hamud and Mombasa has to be referred to Coast General Hospital 300 km away and for specialized care referred back to Nairobi 450km away as noted in one of the study subjects.
5. Trauma unit with consultants, mainly neurosurgeons and nurses, should be set up in KNH for wholistic management of RTI casualties. This is due to high mortality and morbidity following head injury and the attendant decubitus pressure sores.
6. KNH Mausoleum should provide adequate forensic facilities including a portable X-ray unit.

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APPENDIX I

POLICE FILE NO: _____ STUDY NO: _____

AUTOPSY NO: _____

Date of Death: _____ Date of AUTOPSY: _____

Age _____ Sex _____

1. Vehicle type: (a) Saloon Car (b) Matatu/Minibus (c) Bus (d) Goods Truck
 (e) Bicycle (f) Motor Cycle (g) Other (h) Not known

2. Victim's disposition (a) Passenger (b) Driver (c) Pedestrian

3. Was the victim belted (a) Yes (b) No

4. Road Type (a) Major Highway (b) CBD (c) Residential area (d) Other

APPENDIX II

TECHNIQUE OF A MEDICOLEGAL AUTOPSY

- 1) The dead body must be identified before autopsy is performed in good light. A relative or police officer does this. Length of the body and assessment of age is done. The external appearance is recorded by photographs, sketches and description. Anatomical location and size of injury and position the diameter, length and breadth of each injury and relation to fixed landmarks on the body are recorded.
- 2) Where possible radiographs will be taken to discern certain injuries.
- 3) The sequence of the internal examination will be as follows:
 - An incision is made from over the prominence of the larynx down to the pubis. Alternatively (esp. in children) a Y- shaped incision can be made under the angles of each jaw, meeting over the manubrium. Another incision is made from behind each ear, meeting at the posterior part of the crown of the head.
 - The skin over the front of the chest and abdomen is reflected widely and the anterior abdomen wall is opened, taking care not to penetrate the intestines.
 - The third part of the duodenum is dissected through and the small and large intestines removed down to rectum by cutting along the mesentery.
 - The front of the thoracic cage is removed by saw-cuts from the lateral costal margin to the inner part of each clavicle.
 - The tongue and the pharynx are mobilized by passing a knife into the floor of the roof of the mouth close to inside the mandible. The neck structures are gently withdrawn downwards, carrying tongue, larynx and trachea towards the root of the neck.
 - The axillary bundles are divided under the clavicles and the attachment of the esophagus and aorta dissected as the thoracic organs are lifted forwards from the thorax.
 - The diaphragm is dissected through at the lateral attachments and the knife passed medially to release the diaphragm from the posterior ribs and spine.

- The whole neck, thoracic and abdominal organs are then lifted out, the iliac vessels being dissected through at the brim of the pelvis.
- . The viscera are then dissected with an adequate stream of water.
- The pelvic organs are removed by shelling the pelvic contents.
- The scalp is reflected from the coronal incision, the skullcap carefully sawn through and removed, leaving the dura intact. This is then opened and the brain removed by gently lifting the frontal lobes and progressively cutting through the cranial nerves, tentorium and upper spinal cord.

The order of examination shall be tongue, carotid arteries, esophagus, larynx, trachea, thyroid, lungs, great vessels, heart/pericardium, stomach, intestines, adrenals, kidneys, spleen, pancreas, liver/gall bladder, urinary bladder, uterus and ovaries or testis, brain/cerebral vessels, pituitary gland and the skeletal system. ⁽¹⁶⁾.

Samples from major organs shall be taken for histological examination to ascertain the cause of death in a standard manner as outlined in Ackermann's Surgical Pathology textbook.

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APPENDIX III

Postmortem Report Form Adapted From Articles By Prof. Derrick Pounder

DATE OF ADMISSION	STUDY NUMBER
DATE OF DEATH	AGE SEX
DATE OF PM	PM NO.

2. IDENTIFICATION

The body was identified as being that of the above deceased by

CLOTHING

The body is clothed in:

3. EXTERNAL EXAMINATION/ INJURIES

3.1 POST MORTEM CHANGES

- 3.1.1 Refrigerated
- 3.1.2 Rigor mortis
- 3.1.3 Post mortem lividity
- 3.1.4 Decomposition

3.2. SIGNS OF MEDICAL INTERVENTION

- 3.2.1. Surgical
- 3.2.2. Medical

4.0. INTERNAL EXAMINATION

4.1. CARDIOVASCULAR SYSTEM

- 4.1.1. Pericardial Sac
- 4.1.2. Atria

- 4.1.3. Right Ventricle
- 4.1.4. Left Ventricle
- 4.1.5. Valves
- 4.1.6. Coronary Arteries
- 4.1.7 Aorta
- 4.1.8. Carotid Arteries
- 4.1.9. Vena Cava
- 4.1.10. Pulmonary Arteries

4.2. RESPIRATORY SYSTEM

- 4.2.1. Hyoid bone and Laryngeal cartilages
- 4.2.2. Larynx
- 4.2.3. Soft tissues and Neck
- 4.2.4. Trachea and Main Bronchi
- 4.2.5. Lungs
- 4.2.6 Pleural Cavities
- 4.2.7. Diaphragm

4.3. DIGESTIVE SYSTEM

- 4.3.1. Mouth/esophagus
- 4.3.2. Peritoneal Cavity
- 4.3.3. Stomach
- 4.3.4. Duodenum
- 4.3.5. Intestines

4.3.6. Appendix

4.3.7. Liver

4.3.8. Gall bladder

4.3.9. Pancreas

4.4. GENITOURINARY SYSTEM

4.4.1. Kidneys/Ureters

4.4.2. Urinary Bladder

4.4.3. Internal Genitalia

4.4.4. Gonads

4.5. LYMPHATIC SYSTEM

4.5.1. Spleen

4.5.2. Thymus

4.5.3. Lymph nodes

4.6. CRANIUM AND NERVOUS SYSTEM

4.6.1. Scalp

4.6.2. Skull

4.6.3. Meninges

4.6.4. Cranial Vessels

4.6.5. Brain

4.6.6. Spinal Cord

4.7. MUSCULOSKELETAL SYSTEM

- 4.7.1. Spinal Column
- 4.7.2. Long Limb Bones
- 4.7.3. Limb Girdles
- 4.7.4. Hands and Feet
- 4.7.5. Ribs / Sternum

4.8. ENDOCRINE ORGANS

- 4.8.1. Pituitary
- 4.8.2. Adrenals
- 4.8.3. Thyroid

5.0. OTHER LABORATORY INVESTIGATIONS

- 5.1. X-rays

6.0. OPINION AS TO THE CAUSE OF DEATH

- I (a)
- (b)

7.0. ATTESTED ON SOUL AND CONSCIENCE

PATHOLOGIST.....

APPENDIX IV

Autopsy Findings

PM NO. _____

STUDY NO. _____

Anatomical Site	Injury noted (Tick ✓ if Yes)	Injury Description (Coded: See Key)	AIS	Square of Top Three
Head				
Neck				
Face				
Chest				
Abdomen				
Upper Limb				
Lower Limb				
Pelvis				
External				
Injury Severity Score (Total Score):				

Remarks: _____

CAUSE OF DEATH:

Key:

- | | |
|--------------------|---------------------------------|
| A Abrasions | L Laceration |
| B Bruises | M Amputation |
| E Evisceration | U Burns |
| F Fracture | S Friction Burns |
| H Haemorrhage | V Visceral injury (Specify) |

APPENDIX V

SCORING SYSTEM

- In the determination of the Injury Severity Score (ISS), six body regions are considered: Head/neck, Face, Thorax, Abdomen, Pelvis/ Extremity and Skin.
- Injuries sustained in each of the regions will be scored on a scale of 1-6 (minor to critical)
- The ISS will then be computed from the sums of the squares of three highest regional scores.
- The ISS takes values from 0-75. Severe injuries will be defined as having an ISS >15, moderate injury 9-15, and mild injury <9
- An regional injury assigned a score of 6 is an unsurvivable injury and automatically gets an ISS of 75



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Ref: KNH-ERC/01/2246

Date: 13 May 2004

Dr. M P Okemwa
Dept. of Human Pathology
Faculty of Medicine
University of Nairobi

Dear Dr. Okemwa

**RESEARCH PROPOSAL "PATTERNS OF INJURIES IN ROAD TRAFFIC ACCIDENT FATALITIES
AT THE NAIROBI CITY MORTUARY"** (P39/4/2004)

This is to inform you that the Kenyatta National Hospital Ethics and Research Committee has reviewed and **approved** your above cited research proposal for the period 13 May 2004 - 12 May 2005. You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given.

On behalf of the Committee, I wish you fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of database that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely,


PROF. A. N. GUANTAI
SECRETARY, KNH-ERC

Cc Prof. K Bhatt, Chairperson, KNH-ERC
The Deputy Director (C/S), KNH
The Dean, Faculty of Medicine, UON
The Chairman, Dept. of Human Pathology, UON
CMRO

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