CURRENT PATTERN OF ROAD TRAFFIC ACCIDENTS, MAXILLOFACIAL AND ASSOCIATED INJURIES IN NAIROBI

DR. MATHEW K. AKAMA

A THESIS SUBMITTED TO THE UNIVERSITY OF NAIROBI IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF DENTAL SURGERY IN ORAL AND MAXILLOFACIAL SURGERY

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DECLARATION:

I declare that this Thesis is my original work and has not been presented for the award of a degree in any other university.

Signed: _____ Date: 19.10.05

Dr. Mathew Akama

(Candidate)

SUPERVISORS:

This Thesis has been submitted with our approval as University Supervisors.

1. PROF. SYMON W. GUTHUA.
   PROFESSOR,
   DEPT. OF ORAL AND MAXILLOFACIAL SURGERY,
   FACULTY OF DENTAL SCIENCES,
   UNIVERSITY OF NAIROBI,
   P. O. BOX 19676, KNH-00202, NAIROBI.

   SIGNATURE: _____ Date: 21/10/05

2. DR. MARK L. CHINDIA,
   SENIOR LECTURER,
   DEPT. OF ORAL AND MAXILLOFACIAL SURGERY,
   FACULTY OF DENTAL SCIENCES,
   UNIVERSITY OF NAIROBI,
   P. O. BOX 19676, KNH-00202, NAIROBI.

   SIGNATURE: _____ Date: 19/10/2025

3. DR. FRANCIS G. MACIGO,
   SENIOR LECTURER,
   DEPT. OF PERIODONTOLOGY/COMMUNITY
   AND PREVENTIVE DENTISTRY,
   FACULTY OF DENTAL SCIENCES,
   UNIVERSITY OF NAIROBI,
   P. O. BOX 19676, KNH-00202, NAIROBI.

   SIGNATURE: _____ Date: 21/10/05

DEDICATION

To the Residents in Maxillofacial surgery for therein lies the future of the profession.

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ACKNOWLEDGEMENTS

I would like to thank **Kenyatta National Hospital** and the **University of Nairobi** for allowing me to conduct this research. Many thanks to **my lecturers** in the department who have been my mentors and have guided me throughout my studies. Special thanks to my supervisors; **Prof. Guthua, Dr. Chindia and Dr. Macigo** who ably provided scholarly guidance throughout the project, from proposal development to the completion of writing this thesis. I would like to recognize **Prof.Opinya** who, in the spirit of offering academic leadership in the faculty, went through this thesis and made useful suggestions. Many other people were involved in this project. Special thanks go to **Ms Caroline Imbayi** for her secretarial services during proposal development. Also thanks to **Gladys Nyakaru** and **Brenda Kabesa** for their secretarial services during the writing of the thesis. A big thank you to **Mr. Josphat Nthiya** and fellow nurses at the casualty department,KNH who organized and made it easy to conduct interviews and examine patients . Special recognition to **Dr. Okemwa** of the Department of Pathology, University of Nairobi for his valuable assistance during the examination of the fatally injured victims.

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ACRONYMS

GCS - Glasgow Coma Scale

RTAs - Road Traffic Accidents

STIs - Soft Tissue Injuries

KNH - Kenyatta National Hospital

UON - University of Nairobi

Matatus - Passenger service vehicles with a capacity of between 9 to about 30 passengers

SPSS- Statistical Package for Social Sciences

ABSTRACT

Objective: To describe the characteristics and pattern of maxillofacial and concomitant injuries sustained in Road Traffic Accidents (RTAs).

Study Area: Kenyatta National Hospital (KNH).

Study Design: A descriptive cross sectional study including all patients involved in RTAs brought to casualty and dental departments of KNH as well as accident victims admitted to the KNH mortuary over a four- month period from September 2004 to December 2004.

Results: A total of 482 people involved in RTAs were included in the study. Four hundred and thirteen (85.7%) had non-fatal injuries whereas 69 (14.3%) had sustained fatal injuries.

*Non-fatal injuries*The 21-30-year-old age group was the most affected. The male to female ratio was 4:1. Day time injuries were recorded among 60.3% of the participants. The incidence of RTAs was highest on Fridays. There were 245 (59.5%) pedestrians and 139 (33.7%) passengers involved. Most accidents were caused by passenger service vehicles (*matatu*) which were responsible for 256 (62%) casualties whereas private saloon cars were involved in 150 (36.3%) cases. Non- use of safety belts was reported in 90 (56.6%) cases whereas over-speeding was reported by 120 (29.1%) casualties. Alcohol use by drivers was reported in 26 (6.3%) cases whereas vehicle defects accounted for 62 (15%) cases.Three hundred and seventy (89.6%) casualties had soft tissue injuries (STIs) involving the craniofacial region with facial cuts being the majority (69.2%) . Two hundred and seventy three (66.1%) incidents of other STIs than those of the head region were noted, the lower limbs accounting for 45.4% of these. Only 5.1% of the casualties had fractures involving the maxillofacial skeleton. Skeletal injuries other than those involving the maxillofacial region were found in 142 (34.1%) incidents. The lower limbs were more affected with 61 (43%) incidents followed by the upper limbs (24.6%). Pedestrians were

most involved in sustaining skeletal injuries than other categories of road users.

Fatal RTAs: Sixty nine (14.3%) of the 482 participants were fatally injured. The 21-30- year-old age group was the most affected (20%). The male to female ratio was 3.3:1. *Matatus* and mini-buses were the leading cause of fatal accidents together having been responsible for 28 (40.6%) of the accidents. Pedestrians (71.4%) were by far more involved than other categories of road users. Most participants had multiple injuries with chest injuries having been the most common (50 cases). Fourty six (66.7%) victims had injuries to the head region with subdural haemorrhage having been the commonest injury found at autopsy (47.8%). Injuries to the chest were found in fifty (72.2%) victims whereas abdominal and limb injuries were recorded in 42 (60.9%) and 34 (49.3%) victims respectively. Head injury alone was the leading cause of death (37.7%) followed by head and chest injuries combined (13.0%)

Conclusion: The majority of people involved in RTAs were in their third decade of life with males having been the predominant group affected. Pedestrians were the leading casualties amongst road users. Most of the accidents were caused by passenger service vehicles. The lower limbs sustained most soft tissue and skeletal injuries compared to other anatomic sites other than the craniofacial area. The leading cause of death was head injury.

CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

1.1 BACKGROUD

Road Traffic Accidents (RTAs) are a major cause of morbidity and mortality in Kenya. Global estimates by the World Bank indicate that of the 865,000 traffic deaths occurring annually, 74% are in the developing countries [1] where a steady increase in the proportion and absolute number of fatalities from RTAs is being experienced [2,3] . Studies done in Nigeria and Kenya reveal a five-fold increase in the numbers of RTA fatalities over the period 1970-1990.[4,5] Developing countries experience much higher fatality rates per 10,000 vehicles than the developed countries. The economic implications on these countries is immense and is estimated to cost 1%–2% of a country's GNP per annum [6].

At independence in 1963, the number of accidents recorded by police were 3,578 with 4,784 casualties among whom 548 died and 4,236 were injured. The situation continued to worsen and by 2002 the number of reported accidents had risen to 13,418 with 28,774 casualties among whom 2,782 were killed and 25,992 were injured (CBS statistical abstract 2003) . This represents an increase of 407.7% of people killed and 513.6% of people injured. The corresponding population increase during this period was 218.7%. This implies that the rate of accidents is way above that of the population growth. Motor vehicle transport has become a popular mode of transport and the number of vehicles has increased phenomenally since independence. However, compared to the developed world, there is a high incidence of RTAs despite there being a very low vehicle to population ratio (the number of vehicles per 100 people) as shown in Table 1.1[7].

Table 1.1. **International comparisons in road deaths and rates for 1983.**

Country	No. of road accidents	Motor vehicle per 100 people	Road deaths per 100,000 People
UK	5,618	36	10
France	12,728	48	23.4
USA	42,584	71	14.4
Sweden	779	39	9.4
Kenya	8,229	14	8

1.2 Casualty demographics

A survey done for the period 1983 – 1990 involving 12,615 fatally injured victims of RTAs revealed that most of them (90%) were aged 16 years and above [8] and were, therefore, within the most economically active segment of society. Unpublished data show that victims aged between 20 – 24 years had the highest rate of admissions and accounted for 36% of the total traffic casualties admitted at the Nakuru General Hospital in the Rift Valley Province,Kenya, in the year 1992. Regarding gender distribution, males were more involved in RTAs than females probably because they are more involved in outdoor activities. Similar findings have been noted in Nigeria [9] where males (37.5%) in the 21 – 30-year age range were the most in involved.

1.3 Causes of RTAs

Various causative factors of RTAs have been identified. These can be categorized into human, vehicle and road condition factors. One study shows that about 83% of all accidents are caused by human behaviour, 10% by traffic environment and the rest by vehicle defects[10] According to the police records, human causes can be attributed to driver errors, pedestrians, pedal cyclist and passenger errors. Driver errors, however, pre-dominate and account for a half of all the human causes. For example in the year 2002 there were a total of 10,990 accidents attributed to human causes of which 5,331 were due to driver error[11] . These include loosing control, overspeeding, misjudgment, and improper overtaking. Alcohol and other substance abuse is thought to impair the driver's judgmental abilities and, therefore, directly contributes to these errors. Road defects that have been blamed for accidents include potholes, poor road geometry and opposing carriage ways amongst others[12].

1.4 Vehicles responsible

Over the years private salon cars have been the leading vehicles primarily responsible for accidents followed by lorries, buses and taxis put together, and *matatus*(passenger service vehicles with a carrying capacity of between 9-30 people). For example, in 2002, private salon cars were responsible for 6,931 accidents, lorries, buses and taxis 2,781 and *matatus* 2,558 accidents [11]. Poor vehicle maintenance increases the possibility of RTAs. Studies done in different parts of the world show pedestrians to be the most vulnerable group of road-users injured in RTAs [13,14]. A similar trend has been observed in Kenya where pedestrians are most affected [10]. According to the Road Safety Unit of the Ministry of Roads and Public Works[15], 1,152 pedestrians and 1,041 passengers were killed annually for the period 1999 to 2002. An annual average of 2,804 persons were killed for the period 1999 to 2002 and 10,209 people sustained serious injuries (Table 1.2) which ranged

from orthopaedic injuries such as spinal injuries to head injury leading to paralysis.

Table 1.2 . **Victims of RTAs .**

	1999	2000	2001	2002
Persons Killed	2823	2819	2790	2782
Seriously Injured	10160	9659	10504	10912
Slightly Injured	15896	17038	16114	9098

1.5 Road Safety Measures

The Government is determined to reduce the number of accidents, and a legislation through legal notice number 161 has been enacted requiring all passenger service vehicles to be fitted with speed governors as well as seat belts. The main purpose of the regulations was to save lives, restore sanity and create comfort in the public transport sector. The outcome of these measures is yet to be evaluated, though, initial data show improvement in road safety. At the end of the month of June 2004, the Ministry of Transport and Communications reported that within a span of four months, accidents reduced by 73.5% as shown in Table 1.3[16]

Table 1.3. **Traffic accident statistics .**

Accidents	**Feb to June 2003**	**Feb to June 14 2004**	**change (- +)**	**% change**
Fatal accidents	876	261	-615	-70.2
Serious injury	1,768	464	-1,304	-73.6
Slight injury	2,942	756	-2,186	-74.3
Total	5,586	1,481	-4,105	-73.5
Persons killed and injured				
Persons killed	1,091	327	-764	-70.0
Seriously injured	3,999	854	-3,145	-79.1
Slightly injured	6,701	1,690	-5,011	-74.8

Other measures that have been instituted to curb road carnage include enforcement of the Highway Code, regular inspection of motor vehicles to validate their roadworthiness, improving the road network in the country, as well as, controlling bribery. A number of motorist commuters and the general public are either unaware of the Highway Code or have flagrantly decided to disobey it. This unawareness or negligence is one of the major contributors of road accidents. This calls for road safety awareness campaigns to be mounted in both the print and electronic media to remind people of the need to obey the Highway Code. The law requiring mandatory wearing of seat belts

has been enacted in Kenya and it is being implemented at the moment. In Western countries where this law was enacted earlier, a reduction of injuries as well as fatalities due to RTAs has been reported. In one study, the injury reduction effects occurred primarily through reduction in the number of head and facial injuries, particularly those that occur from contact with windshields and instrument panels [17].

In assessing the impact of safety belt use on the extent of injuries sustained in motor vehicle accidents and the incurred health care costs in 1,364 patients, Orsay et al.[18] found that safety belt wearers had a 60.1% reduction in the severity of injury, a 64.6% decrease in hospital admissions, and a 66.3% decline in hospital charges. Their findings demonstrated a significant societal burden of nonuse of safety belts in terms of morbidity and the costs of medical care. Similar conclusions were drawn by Chorba et al.[19] whose study in North Carolina projected that a reduction of 1,100 severe or fatal injuries per year could be attributed to the seat-belt law in North Carolina.

Alcohol-related traffic injuries are a major cause of death, pain and suffering, and a major contributor to healthcare costs. In a study by Colquitt et al.[20] in St. Mary's Hospital in Waterbury, Connecticut, USA between 1981 and 1985, out of 252 motor vehicle accidents involving drivers, 84 (30%) had a blood alcohol concentration equal to or above the legally defined threshold for intoxication. Imposing heavy penalties for driving under the influence of alcohol as well as increasing drinking age has been found to result in a decline of alcohol related motor vehicle deaths[21]. Another contributor to RTAs is the state of the roads and traffic conditions. Marking edges of highways without street lights reduces the incidence of night time accidents by as much as 30% [22]. Switching on headlights during bad weather enables others to see one. Potholes are a common feature on Kenyan roads. Drivers attempting to avoid them may loose control and cause

accidents or if the potholes are deep and wide they may cause vehicle instability leading to an accident. Other road conditions which contribute to accidents include narrow roads, sharp bends / corners and inadequate road signs.

RTAs place a heavy economic burden on the individuals involved as well as the country. Components of accident costs can be categorized into loss of output, medical expenses, damage of vehicles and other property and administrative costs. Casualties from RTAs in Kenya are estimated to comprise between 45% and 60% of all admissions to surgical wards, and up to 75% in the National Spinal Injury Hospital [23].

1.6 Maxillofacial Injuries in RTAs

The incidence of maxillofacial injuries varies with age, region, season, climatic conditions, socio-economic differences, traffic volume and preventive measures taken in different countries [24,25]. Studies done in Kenya [26,27] show the leading causes of maxillofacial skeletal injuries to be interpersonal violence, followed by RTAs. However, data from Nigeria[28] and Libya [29] implicate RTAs to be the leading causes. The maxillofacial region is the most exposed part of the body and it is not uncommon for it to be involved in trauma resulting from RTAs. It has been variously reported that 20 – 60% of all the people injured in RTAs had some form of maxillofacial injury [30,31]. The forehead has been cited as the most commonly involved site of soft tissue injury while the mandible is the most often fractured facial bone [9,32]. Maxillofacial injuries may directly contribute to the fatal outcome in the fatally injured RTA victims. A study carried out in Finland involving 84 victims of maxillofacial injuries sustained in RTAs(86% of whom were occupants of motor cars) attributed facial injuries to have been the definitive fatal trauma in 20 cases [33]. Seatbelt usage can reduce injuries to the maxillofacial skeleton. Seatbelt legislation in the United

Kingdom for example, was introduced in February 1983. The compliance with seat belt usage rose to 90 – 95% for all front seat occupants after the legislation [34]. The incidence of maxillofacial trauma cases arising in the front seat occupant group of patients dropped from 20.9% (78 patients) in the two years before the legislation to 5.9% (18 patients) in the 2 years after the legislation. Injuries in the maxillofacial region may be limited to the face or may be associated with multiple injuries to the chest, head, cervical spine, abdomen and the extremities [35] . Knowledge of concomitant injuries in patients with maxillofacial injuries is important in the rapid assessment and treatment planning as well as prevention of further complications. Concomitant injuries that have been reported include neurological injuries, orthopaedic injuries, chest injuries, abdominal injuries, pulmonary and urological injuries[36,37].

1.7 RESEARCH PROBLEM

Injuries sustained during RTAs constitute a major portion of trauma and emergency patients seeking treatment at health facilities nationwide. The losses caused by these accidents place a heavy burden on the economy and pose a great human tragedy to the families and the nation as a whole. This raises a major public health concern and ways and means of curbing this tragedy, which is largely preventable, must be found. Preventive measures can only be instituted if the causative factors are identified. Understanding the pattern of RTAs as well as associated maxillofacial and concomitant injuries and the parties involved is one way of doing this.

1.8 JUSTIFICATION

Many studies have been conducted worldwide to assess the magnitude of the problem associated with RTAs and the associated maxillofacial and concomitant injuries but hardly any has been done locally. Most data on such injuries emanate from the developed world, which might not directly

concur with the Kenyan situation due to major socio-economic, cultural and environmental differences. Further, the law requiring mandatory fitting of speed governors and seatbelts by PSVs is currently being enforced. Its impact has hardly been studied. Thus a hospital based study at the national referral hospital to assess the magnitude, pattern and characteristics of RTAs and the associated maxillofacial and concomitant injuries is necessary. This is a descriptive cross sectional study of the current pattern of RTAs, maxillofacial and associated injuries focusing on their characteristics. Information obtained from this study will be useful in formulating interventional programmes as well as treatment strategies for the multiply injured patient. Data on the fatally injured RTA victims may also be useful. It will also act as a baseline for future planning and conducting more detailed studies.

1.9 OBJECTIVES

MAIN OBJECTIVE

To describe the characteristics and pattern of RTAs and associated maxillofacial and concomitant injuries.

SPECIFIC OBJECTIVES

1. To describe the pattern of RTAs.
2. To describe the pattern of facial bone fractures.
3. To describe the pattern of soft tissue injuries.
4. To describe other associated injuries than those in the maxillofacial area.
5. To describe injuries arising from fatal RTAs.

CHAPTER 2

MATERIALS AND METHODS

2.1 STUDY AREA

2.1.1 The Kenyatta National Hospital (KNH)

KNH is the national referral and University Teaching Hospital in Kenya. It is situated 3.5 kilometres from the Nairobi City Centre. It has a 2,400 - bed capacity and receives patients from other countries in the East and Central African region for specialized care. It also serves the population of Nairobi which is currently estimated at 2.3 million. It is the main teaching hospital for the College of Health Sciences, University of Nairobi. It provides training for doctors at undergraduate and postgraduate levels and for nurses and all categories of paramedical staff from the Kenya Medical Training College. The staff of the University of Nairobi and the Kenya government personnel run the hospital and work as a team.

The hospital caters for a large number of medical and dental specialties and subspecialties, Oral and Maxillofacial surgery being one of them. Trauma and emergency cases are attended to at the casualty department. Some patients with maxillofacial injuries report directly to the maxillofacial unit.

2.1.2 CASUALTY DEPARTMENT

The casualty department is headed by a general surgeon. The other medical staff include medical officers, nurses and paramedical staff employed by the hospital and medical and surgical registrars from the University of Nairobi. Accident and emergency cases are attended to at the casualty department. General surgical registrars attend to general trauma cases whereas those with oral and maxillofacial injuries are seen by oral and maxillofacial registrars. Those with severe injuries are

admitted while the rest are treated and discharged or referred to other specialized units for management and follow-up. All patients seen at the call room are recorded in the call register where the patient identification number, date and treatment offered are entered. Accident victims who die while undergoing treatment in casualty or wards are taken to the KNH mortuary while those who die at the scene of accident are taken to the city mortuary.

2.2 STUDY DESIGN

This was a descriptive cross- sectional study including all patients involved in RTAs brought to the casualty and dental departments of KNH, as well as the fatally injured accident victims admitted at the KNH mortuary. The study covered a four-month period, from September to December 2004 and involved all age groups.

2.3 SAMPLE SIZE AND SAMPLING

All patients involved in RTAs attended to through the casualty and dental departments, as well as, the fatally injured victims admitted in the KNH mortuary during the defined study period were included. Studies done in Nigeria have found that up to 30% of the people involved in RTAs have maxillofacial injuries[28,37]. It is assumed that a similar pattern may obtain in Kenya since no evaluation has been done locally to determine the prevalence of maxillofacial injuries. Therefore, the prevalence value (P) is assumed to be 30% (0.3). To estimate the prevalence of maxillofacial injuries to within 5% of the true value with 95% confidence, a minimum sample of 323 were required. The following formula was used for sample size computation:

$$n = \frac{Z_{1-\alpha/2}\, P(1-P)}{d^2}$$

where n = Sample size to be determined

Z = Standard errors from the mean corresponding to 95% Confidence level

α = Level of significance (5%)

d = Absolute precision (5%)

P = Prevalence (assumed to be 30%)

$Z_1 - \alpha/2$ = 1.96

2.4 DATA COLLECTION INSTRUMENTS AND TECHNIQUES

All participants were requested to give an informed consent before any procedure was carried out by way of signing a consent form (Appendix 1), detailing what the study was about and what procedures were to be carried out. Filling of the consent form did not apply for the dead, however, permission to examine them was obtained from the Director of KNH .

A specially designed data collection form (Appendix 2) was used by the investigator to record all relevant information. The information being sought included demographics, case notes from other specialties, radiological investigations and any other laboratory tests done. The investigator examined all patients with RTA injuries and entered all the required information in the data collection form. Where indicated head injury was scored according to the Glasgow Coma Scale . For fatalities, autopsy reports were sought to determine the actual cause of death. The investigator examined the victims for general and maxillofacial injuries. Police records were examined for information regarding the circumstances that led to the accidents.

2.5 SELECTION AND TRAINING OF ASSISTANTS

The investigator recruited two field assistants who were chosen from amongst the dental officers attached to the Oral & Maxillofacial Unit of the Dental Department, KNH. These officers had successfully finished their internship training. The assistants were asked to study the data collection form on their own and thereafter they held a discussion with the investigator. Each variable or question and expected response were discussed as well as how to enter the responses in the data collection form. A demonstration on how to administer the form was done by the investigator as the assistants observed. Each assistant was then asked to collect data from two patients and the recorded responses were discussed. After this, two groups of patients were selected each comprising of five people. The investigator collected data from the two groups and then each assistant was assigned a group to collect data. The groups were interchanged between the assistants and data collected once again. The recorded responses were compared between the assistants, between the investigator and the first assistant and between the investigator and the second assistant. No differences were observed between the assistants; and between the assistants and the investigator.

2.6 VARIABLES

The variables that were sought included demographics, type of maxillofacial and concomitant injuries, cause of the accident, seat-belt use, time of occurrence of the accident, and class of persons involved amongst others.

2.7 ETHICAL ISSUES

Prior to the study, the proposal was peer reviewed and approved by the Kenyatta National Hospital and the University of Nairobi Ethics, Research and Standards Committee (appendix 3).Information obtained from respondents was kept in strict confidence by the investigators. Any

findings requiring remedial action to improve services and road safety will be communicated to heads of the relevant hospital and other government departments in strict confidence. In order to prevent loss of records, the investigators ensured that all records retrieved were registered and returned to the records departments as soon as they were studied. The receiving officer signed against the registration number to indicate the records had been returned.

2.8 LOGISTICAL ISSUES

Permission to conduct the study was obtained from the following:

- Ethics, Research and Standards Committee of KNH – UON.
- Director, KNH.
- The Police Commissioner.

Local running to and from the study area and other related movements were done using a personal vehicle.

2.9 DATA ANALYSIS

Data was analyzed using the Statistical Package for Social Sciences (SPSS) Version 12.

The data were cleaned and all errors corrected. Descriptive Statistics were done whereby all categorical variables were calculated in terms of proportions and presented in tables, texts and bar charts. Continuous variables were analyzed using measures of central tendency and confidence intervals were calculated using 95% confidence level. The Chi-square test was used for categorical variables. Statistical significance was assessed at alpha level $x=0.05$.

CHAPTER 3

RESULTS

NON-FATAL INJURIES

3.1 Demographic characteristics

A total of 482 subjects were examined among whom 413 (85.7%) sustained non-fatal injuries. The males (80.9%) were by far more involved than females (19.1%) as shown in Fig.1 giving a male to female ratio of 4:1. The age range was 1-75 years (mean= 29.65). The 21-30-year- old age group was the most involved (40%) followed by the 31-40-year age group (22. %). 3This difference was found to be statistically significant(p 0.017) The age distribution is shown in Fig.2.

Fig. 1. Distribution of the injured participants according to gender.

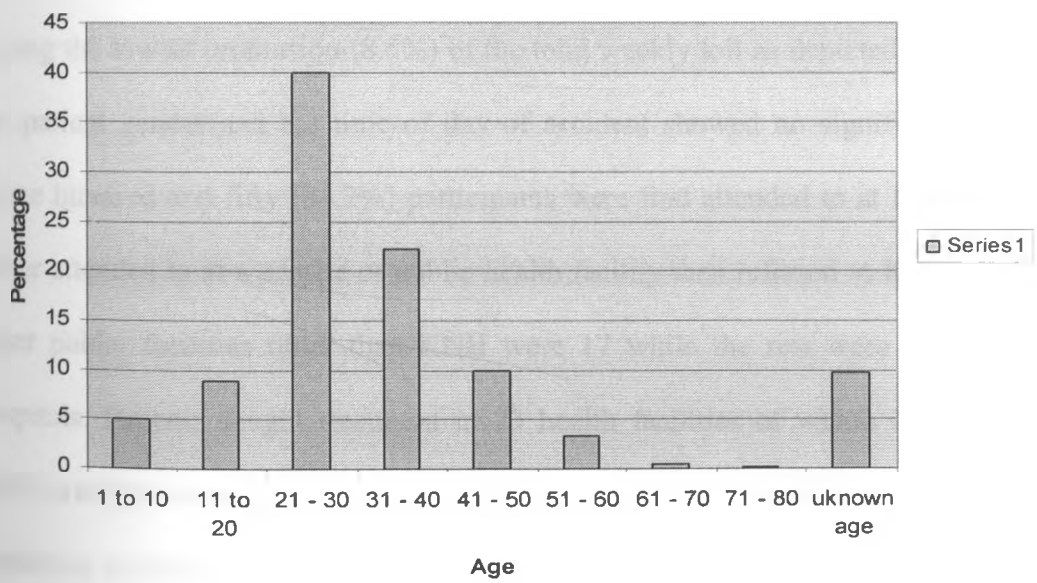

Fig. 2. Distribution of the injured participants according to age groups.

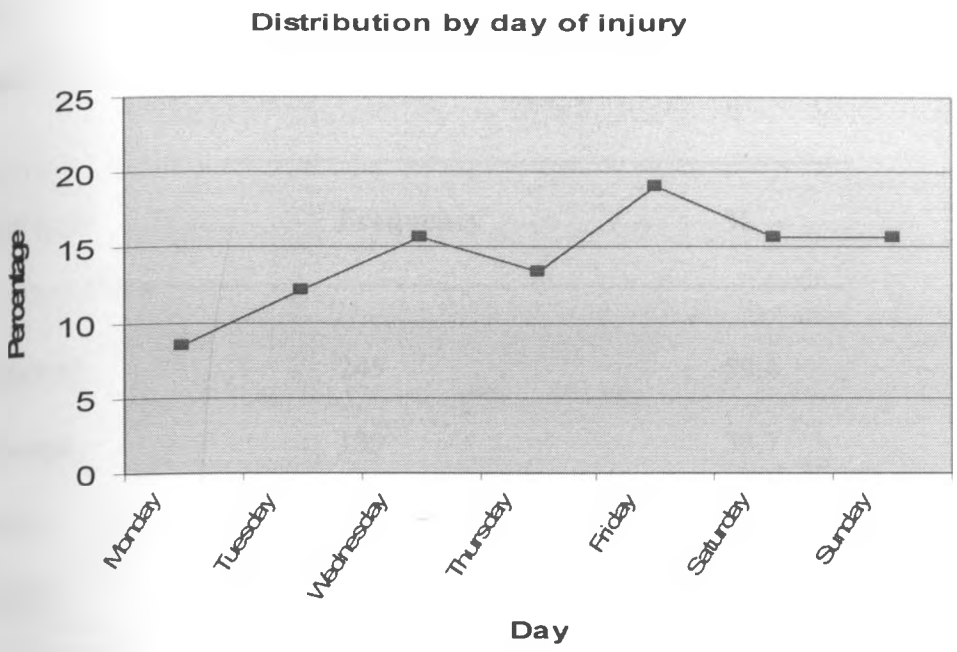

Fig. 3. Distribution by day of injury.

3.2 Pattern of injury occurrence per day of the week

Daytime injuries were recorded in 60.3% of the participants while only 39.7% occurred during the night. The incidence of RTAs was highest on Fridays but lowest during weekdays with Mondays having the lowest proportion (8.5%) of the total weekly toll as depicted in Fig.3. A statistical test on .patient gender and the time of day of accident showed no significant difference (p 0.734). Three hundred and fifty (84.7%) participants were first attended to at KNH. The remainder were either attended to at a private or public health facility then referred to KNH. Those attended to at other public facilities other than KNH were 17 while the rest were seen at private clinics or hospitals. Patients sought treatment in 23 health facilities of which 11 were public (excluding KNH) and the remainder were private. There were four types of road users. The proportion of casualties involved in RTAs showed over- representation of pedestrians. There were 245 (59.4%) pedestrians and 139 (33.7%) passengers involved. The other category of road users involved were

cyclists and drivers as shown in Table 1.

Table 1. Class of Road Users.

Road user	Frequency	%
Pedestrian	245	59.4
Passenger	139	33.7
Driver	20	4.8
Cyclist	9	2.2

3.3 Vehicles Involved

Most of the accidents were caused by passenger service vehicles which were responsible for 256 (62%) casualties whereas private vehicles were involved in 150 (36.3%) cases. Non -use of safety belts was reported in 90 (56.6%) whereas over- speeding (speed of over 80 Kph) was reported by 120 (29.1%) casualties. Alcohol use by drivers was reported in 26(6.3%) cases whereas vehicle defects accounted for injury to 62 (15%) cases. A test to compare wearing of safety belts with age group showed no significant difference (p 0.936). Similarly a comparison between sex and taking safety precautions like wearing a safety belt showed no significant difference (p 0.195).

3.4 Distribution of soft tissue injuries

Three hundred and seventy (89.6%) casualties had soft tissue injuries (STIs) involving the head. Facial cuts accounted for the majority of these injuries 256(69.2%) as shown in Fig.4. Two hundred and seventy three (66.1%) incidents of other STIs other than those of the head region

were noted, of these, the lower limbs accounted for 124(45.4%) and was followed by STIs to the upper limbs 99 (36.3%) as presented in the Fig. 5.

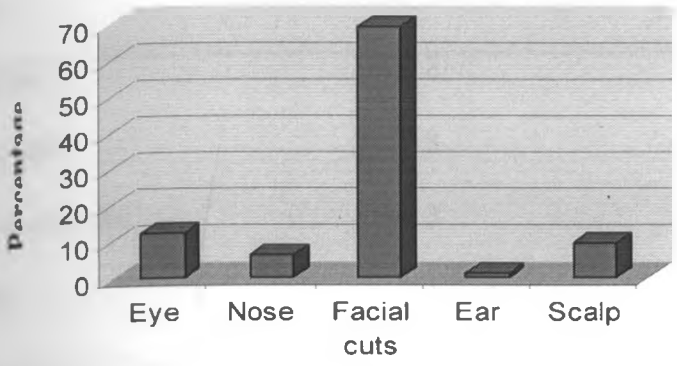

Fig. 4. Distribution of soft tissue injuries of the head.

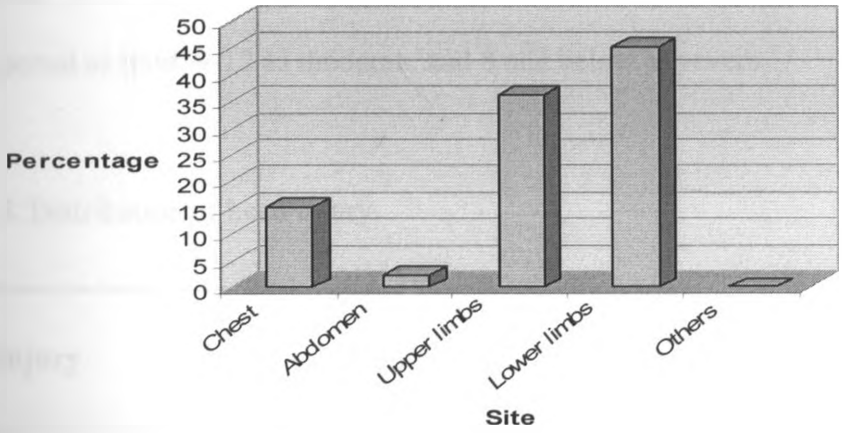

Fig. 5. Distribution of soft tissue injuries involving other areas of body.

There were 21(5.1%) casualties with fractures involving the maxillofacial skeleton (Table 2). The midface was involved in 8 cases while a similar number had fractures of the mandible.

Table 2. Distribution of maxillofacial fractures.

Site	Number of casualties
Midface	8
Mandible	8
Dento-alveolar	3
Orbit	1
Isolated nasal bone	1
Total	**21**

Where indicated head injury was categorized by using the Glasgow Coma Scale (GCS). It was applied to 29 (7%) patients who appeared to have suffered head injury (Table 3). GCS of 13-15 was reported as mild, 9-12 as moderate and 8 and below as severe.

Table 3. Distribution of head injury.

Head injury	Number
Mild	15
Moderate	9
Severe	5
Total	**29**

When head injury was cross-tabulated against type of road user, it was found that pedestrians were injured more often (16 cases) than either passengers (7 cases) or drivers (6 cases).

3.4 Other skeletal injuries

Skeletal injuries other than those involving the maxillofacial region were found in 142 (34.1%) incidents. The lower limbs were more affected with 61(43%) incidents followed by the upper limbs which accounted for 35(24.6%) cases. Thirteen (9.2%) casualties had spinal injurries of which 7 were cervical, 4 lumbar and 2 thoracic. Fig. 6 shows the distribution of the skeletal injuries.

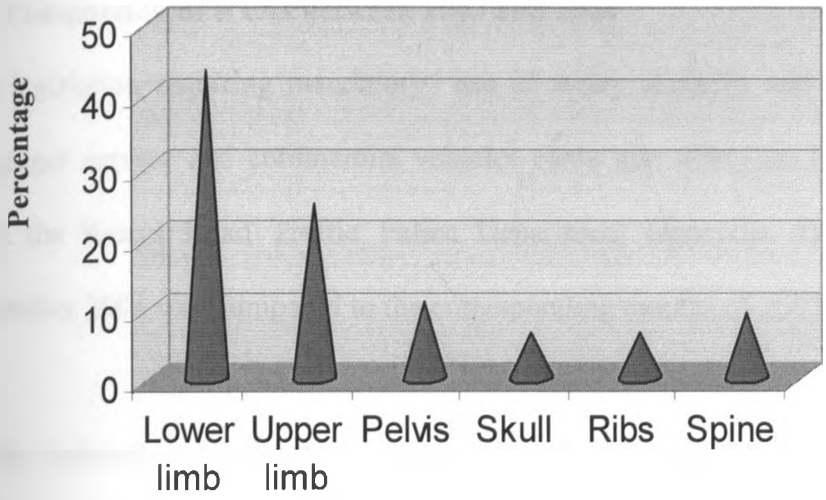

Fig. 6. Other skeletal injuries.

Sixty one casualties suffered lower limb fractures among whom pedestrians accounted for more than one half of them (43 or 66.2%) whereas only 12 passengers were involved. Pedestrians were as well leading in fractures of the upper limbs where they accounted for 23 (65.7%) of these fractures. In general, pedestrians were most involved in sustaining skeletal injuries than other categories of road users as shown in Fig. 7.

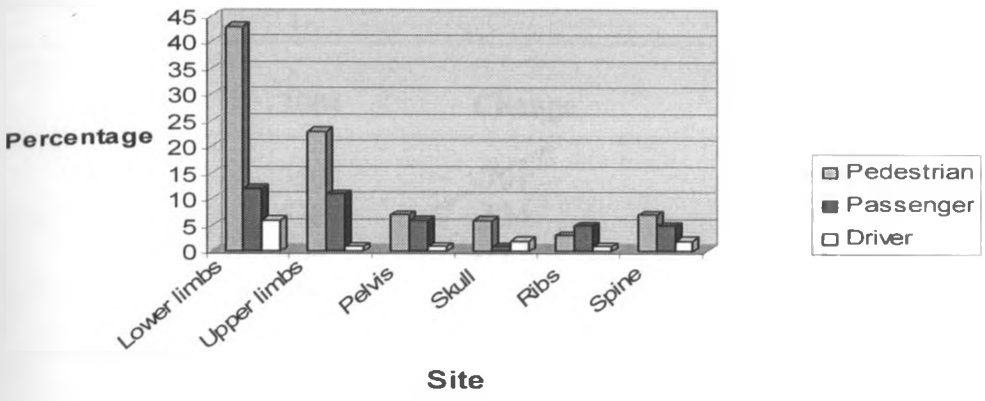

Fig. 7. Distribution of skeletal injuries according to class of road user.

1.6 Comparison of RTAs between 2003 and 2004

The legislation requiring mandatory use of safety seatbelts and fitting of speed governors by passenger service and commercial vehicles came into effect on February 2004. Data obtained from the Kenya Road Traffic Police Department (appendix 4) on RTAs from February to December 2004 was compared to the corresponding months of 2003.

When analyzed on a month by month basis, there was a marked reduction of accidents in the months immediately following the implementation of the legislation requiring mandatory usage of the safetybelt and fitting of speed governors by public service and commercial vehicles. The number of accidents reduced by 2,737 (2.2%) whereas the fatalities reduced by 753 (25.1%) as depicted in Tables 4 and 5 respectively.

Table 4. Comparison of RTAs between 2003 and 2004.

	2003	2004	Change	% Change
Feb	1051	350	-701	-66.70
March	1154	520	-634	-55.0
April	1121	404	-717	-64.0
May	1098	460	-638	-58.1
June	1162	1087	-75	-6.5
July	1026	1146	120	11.7
Aug	1192	1219	27	2.3
Sept	1180	1107	-73	-6.2
Oct	1177	1131	-46	-4.0
Nov	1073	1061	-12	-1.1
Dec	1158	1170	12	1.0
Total	**12392**	**9655**	**-2737**	**-2.2**

Table 5. Comparison of RTA fatalities between 2003 and 2004.

	2003	2004	Change	% Change
Feb	178	92	-86	-48.3
March	205	71	-134	-65.4
April	253	114	-139	-54.9
May	215	93	-122	-56.7
June	240	209	-31	-12.9
July	258	249	-9	-3.5
Aug	325	270	-55	-16.9
Sept.	269	225	-44	-16.4
Oct	262	260	-2	-0.8
Nov	259	272	13	5.0
Dec	302	265	-37	-12.1
	3004	**2251**	**-753**	**-25.1**

The average number of accidents in the year 2003 was 1126.54 whereas that for 2004 was 877.73.

The difference between the two years was significant (t=2.421, p=0.036). For fatal accidents, the average number of fatalities in the year 2003 was 251.45 while in 2004 it was 192.73. This difference was statistically significant (t=3.607, p=0.005).

3.7.0 FATAL RTAs

Sixty nine (14.3%) of the 482 participants were fatally injured. The 21-30- year- old age group was the most involved (20%) followed by the 31-40 and 41-50- year-old age groups both at 15.7%. The least involved groups were the 61- 80- year-old age group (1.4%) and 0-10- year- old age group (2.9%). There was a high percentage of those whose age was not known (26.1%), however, all of them were adults. Fig. 8 depicts the age distribution of the fatally injured cases.

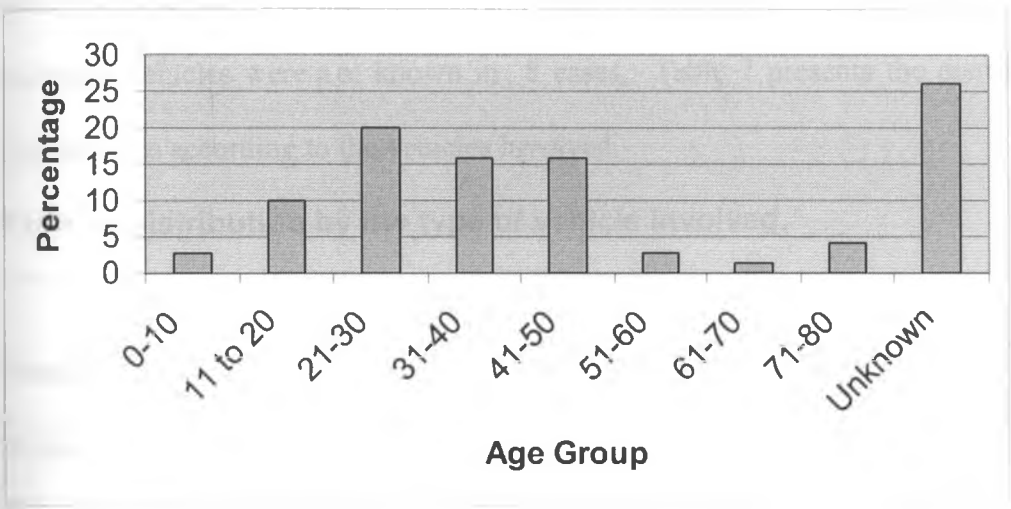

Fig. 8. Distribution by age of the fatally injured victims.

Men (53) were by far more involved than women (16) giving a M:F ratio of 3.3:1

Most fatal accidents occurred on the highways (72.5). Residential areas and the central business district (CBD) had 11.6% and 5.8% respectively. Table 6 shows the distribution of fatalities by the roads involved.

Table 6. Distribution of fatal accidents by road.

Road	Frequency	Percentage
Highway	50	72.5
Residential	8	11.6
CBD	4	5.8
Other	4	5.8
Unknown	3	4.3
Total	**69**	**100.0**

Matatus and minibuses were the leading cause of fatal accidents together having been responsible for 28 (40.6%) of the accidents. Other vehicles that were involved included 14 saloon cars (20.3%), 8 trucks (11.6%),4 buses (5.8%), 4 bicycles (5.8%) and 1 motor cycle (1.4%). The causative vehicles were not known in 8 cases. Table 7 presents the distribution of the fatally injured cases according to the vehicles involved.

Table 7. Distribution by the type of vehicle involved.

Vehicle	Frequency	Percentage
Matatu/ Minibus	28	40.6
Saloon car	14	20.3
Truck	8	11.6
Bicycle	4	5.8
Bus	4	5.8
Motor cycle	1	1.4
Unknown	10	14.5

Pedestrians (50, 72.5%) were by far more involved than other categories of road users. Only 10

passengers and 9 drivers were fatally injured. The duration of stay in hospital ranged from zero to 157 days. Zero day implies that they either were certified dead on arrival or died soon after arrival and this category was the majority comprising of 28 (40.6%) cases. Those who stayed for between 1 and 5 days before they died were 25 (36.2%). Only 3 individuals stayed in hospital for more than 90 days before they succumbed to their injuries. Table 8 shows the distribution by number of days spent in hospital.

Table 8. Distribution by number of days spent in hospital.

Number of days	Frequency	Percentage
0	28	40.6
1 - 5	25	36.2
6 - 20	10	14.5
20 - 33	3	4.3
90 - 157	3	4.3

3.7.1 Distribution of injuries by anatomical site among the fatally injured.

Most of the dead had multiple injuries including those to the chest (50), head (46) and the pelvis (13 cases). Fig. 9 shows the distribution of injuries according to the anatomical site.

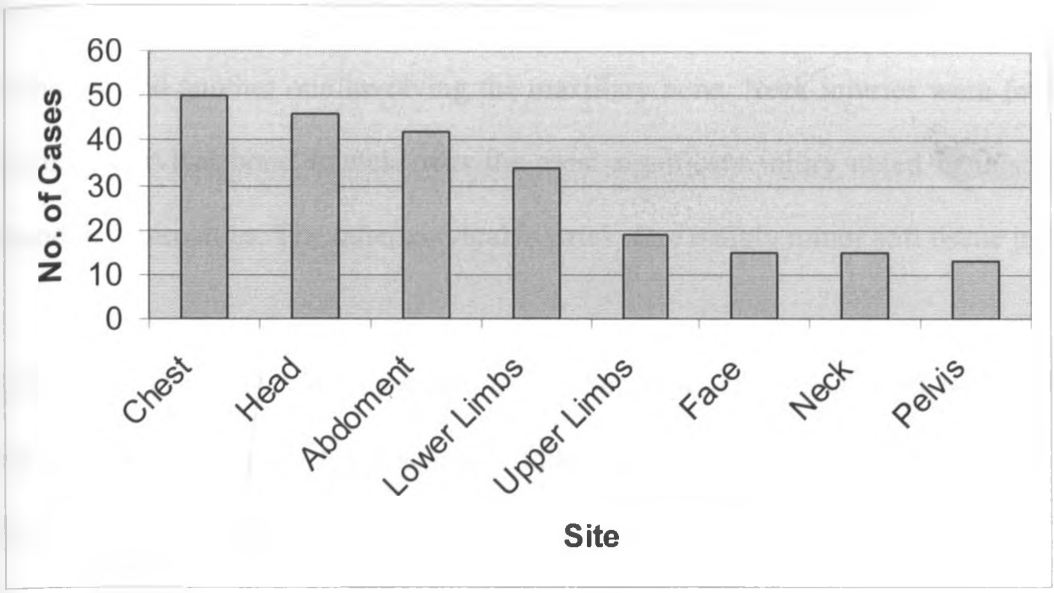

Fig. 9. Distribution of injuries by anatomical site.

Injuries to the head region ranged from abrasions to brain evisceration. Forty six (66.7%) victims had injuries to the head region at autopsy. The commonest type of injury noted was subdural haemorrhage which was found in 33 (47.8%) cases. Skull fracture was recorded in 20 (29%) victims. Table 9 depicts the distribution of injuries found in the head region.

Table 9. Distribution of Head injuries.

Type of injury	Frequency	Percentage
Subdural haemorrhage	33	47.8
Scalp injuries	28	40.6
Skull fracture	20	29.0
Brain contusion	9	13.0
Brain laceration	7	10.1
Brain evisceration	4	5.8
Epidural haemorrhage	2	2.9
Cerebral infection	2	2.9
Subarachnoid haemorrhage	2	2.9

Fifteen (21.7%) casualties had facial injuries all of which were STIs except one involving the mandible and another one involving the maxillary bone. Neck injuries were found in 17 (24.6%) victims. Cervical bone fracture was the most significant injury noted in this region and it was found in 5 casualties. The other cervical injuries were mainly minor soft tissue injuries.

Fifty (72.2%) victims sustained injuries to the chest. The commonest of this was haemothorax which was found in 22 (31.9%) cases followed by fracture of the ribs which was noted in 21 (30.4%) victims. Fig. 10 shows the distribution of chest injuries.

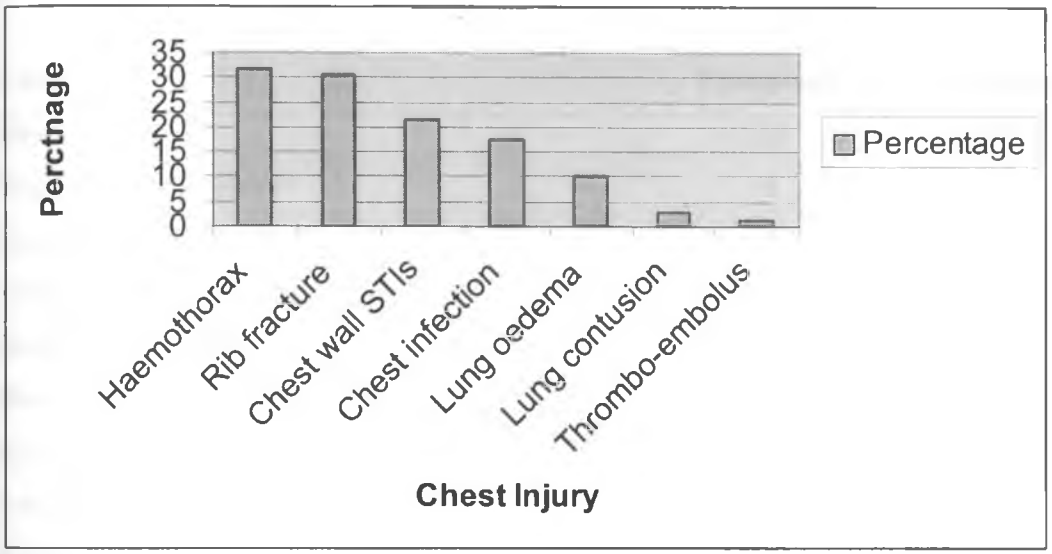

Fig. 10. Distribution of chest injuries.

Injury to the abdomen was found in 42 (60.9%) cases with peritoneal haemorrhage having been the commonest (18, 26.%). Injury to the viscera was noted in 14 (20.3%) cases. Eleven (15.9%) victims developed severe peritoneal infection. Injuries to the lower limbs were more common than those of the upper limbs. Thirty four (49.3%) victims sustained injuries to lower limbs whereas only 19 (27.5%) had upper limb injuries. Fracture of the limbs was the commonest injury recorded, 21 (30.4%) involving the lower limbs and 9 (13.0%) involving the upper limbs. Thirteen (18.8%) victims had injuries to the pelvis. Pelvic fracture was noted in 9 cases whereas pelvic infection

occurred in 4 cases. Severe pelvic haemorrhage occurred in one victim.

Cause of death

The cause of death was varied, ranging from head injury to pulmonary fat embolism. However, head injury was the predominant cause of death in the majority of victims. It was identified as the sole cause in 26(13.7%) cases whereas combined head and chest injuries were responsible for 9(13.0%) deaths.Combined head and abdominal injuries accounted for 2 deaths as was the case with combined head, chest and lower limb injuries as shown in Table 10.

Table 10. Cause of death.

Cause	Frequency	Percentage
Head Injury	26	37.7
Head and Chest injury	9	13.0
Massive Haemorrhage	6	8.7
Chest and abdominal injury	6	8.7
Head and abdominal injury	2	2.9
Head, Chest and lower limbs	2	2.9
Chest injury	2	2.9
Peritonitis	2	2.9
Abdominal injury	1	1.4
Lower Limb	1	1.4
Head and C-spine fracture	1	1.4
Head and lower limbs injury	1	1.4
Milliary TB	1	1.4
Acute renal failure	1	1.4
Brain Abcess	1	1.4
Thrombo – embolism	1	1.4
Pulmonary fat embolism	1	1.4
Congestive Cardiac failure	1	1.4
TOTALS	**69**	**100**

CHAPTER 4

DISCUSSION

This study highlights the main features of RTAs in Nairobi with respect to the magnitude and trend, contributing factors, pattern of distribution and the characteristics of casualties involved. The legislation requiring mandatory fitting of speed governors by passenger service and commercial vehicles and the use of safety seatbelts may have markedly reduced RTAs since the legislation came into effect in February 2004. Within a span of eleven months (from February 2004 to December 2004) a reduction of accidents by 2.2% was achieved and this may be attributed to the enforcement of this piece of legislation. The positive effect of this law is further demonstrated by the reduction of persons killed by 25.1% during this period. These findings are in agreement with findings from the rest of the world [17,18]. When analyzed on a month by month basis, there was a significant reduction of accidents and casualties in the first four months following the implementation of this legislation. However, after this period the change becomes less steep. The explanation for this may be that the enforcing agencies may have became less vigilant in enforcing the law giving rise to fitting of faulty speed governors or using devices which could be manipulated to exceed the required speed of 80Km per hour as well as the return of unroadworthy vehicles on the roads. It is also not uncommon for passengers not to use safety belts even when already fitted. In addition it has been claimed that in some cases, passengers only buckle up their safety belts when approaching a police check point, thus denying themselves the benefits of the safetybelt in the event of an accident.

In a study on traffic law enforcement and risk of death from motor vehicle crashes in Canada, it was established that traffic law enforcement effectively reduces the frequency of fatal motor-vehicle crashes in countries with high rates of motor vehicle use [38]. This study involved 8,975

licencsed drivers who had fatal crashes during an 11- year study period in which 21,501 driving convictions were recorded for all drivers from the date of obtaining a full license to the date of a fatal crash. It was found that the risk of a fatal crash in the month after a conviction was about 35% lower than in a comparable month with no conviction for the same driver.

Reduction of RTAs during this period, however, cannot be attributed to the use of speed governors and seat belts only. Other factors like the increased motor vehicle inspection which usually results in identifying unroadworthy vehicles as well as increased police presence on the roads and perhaps also the on - going road rehabilitation may have played a role. The crackdown on *matatu* cartels and weeding out of unqualified drivers probably contributed to the reduction of accidents. According to the traffic police department, over the years, drivers have consistently been identified as the leading cause of accidents. The conduct and behaviour of drivers come into question. Excessive speed may lead to loss of control of the vehicle or misjudgment leading to mistakes such as overtaking improperly. However, in the background there can be fatigue, alcohol consumption, sickness or improper training and experience. While over-speeding, there is little time to react to the situation as a whole. The higher the speed the more the damage caused and vice versa. The effect of speed governors, therefore, cannot be underestimated as demonstrated by this study.

Information on the prevalence of drug or alcohol abuse among drivers or traffic casualties in Kenya is lacking. Furthermore, objective assessment of alcohol use by drivers cannot be undertaken by the police as they lack equipment to do so. In a number of developed countries, a strong relationship has been demonstrated between alcohol consumption and increased risk of RTAs [17,18,36]. In the present study a causal relationship between alcohol and RTAs is implied. This is similar to findings from other developing countries, for example Zambia [40] and Papua New

Guinea [41,42,43] A high case fatality from RTAs occurred during weekends, a finding similar to that of an earlier study done in Kenya[8]. Another peak was noted on Wednesday, a day whose evening is popularly known as *ladies* night, when revelers entertain themselves in their favourite drinking spots implying an influence of additional risk factors during this period including alcohol. It is suggested that further investigations are required to quantify the extent of contribution of the various risk factors.

In Australia, co-ordinated legislative and voluntary sector action has had a substantial impact on public behaviour through the introduction and enforcement of strict drink-driving laws and speed limit back - up by forceful television advertisement which have produced a large reduction in deaths from RTAs, the death rate in relation to the number of vehicles in 1991 being amongst the lowest in the world [44]. It is suggested that the Kenyan traffic police should be equipped with alcohol breath analysers to detect drivers driving under the influence of alcohol. Other legislative measures that can be enacted to reduce RTAs include increasing the age at which drinking of alcohol is allowed. Tennessee State in the US increased its drinking age to 21 years in 1984 and this had the effect of reducing alcohol related deaths by 33% among persons aged 19 - 20 years.

Age and gender appear to influence the pattern and probability of accident involvement. Men were by far more involved in RTAs than females with M:F ratio of 4:1. Traditionally men are more involved in outdoor activities than women thereby exposing themselves to accidents. The vulnerability of those in the third decade may be explained by their exposure to a hazardous traffic environment. This age group accounted for 40% of persons involved in RTAs followed by those in their fourth decade which accounted for 22.3% of the casualties. These two age groups are at the prime of their lives and the economic loss to their families and the country as a whole is

immense not to mention the psychological trauma caused to their loved ones. Psychological effects of RTA injuries have been reported elsewhere [45]. These individuals are likely to suffer psychiatric illness relating to injuries or their involvement in motor vehicle accidents thereby reducing their productivity. Mayou et al. [46] found in their study that psychiatric symptoms and disorders had been frequent after major and less severe road accident injury. They studied 188 victims aged over 18 years and found that acute, moderately severe emotional stress was common, with 20% of the subjects suffering from an acute stress syndrome characterized by mood disturbances and horrific memories of the accident. Development of more focused interventional programmes targeting these age groups is required. The age of 40 (9.7%) of the patients could not be accurately ascertained. These were mainly elderly patients and those with severe injuries who could not state their age. This presents a management as well as medico – legal problem. Certain treatment modalities, for example prolonged maxillomandibular fixation or open reduction and fixation of fractures, are appropriate at certain age groups and not others. Accurate determination of damages for insurance purposes may be difficult to calculate if the age of the victim is not known.

There were more accidents occurring during weekends with Fridays having the highest proportion of the total weekly toll. This increment during weekends could probably be attributed to the leisure activities during the weekend including over-indulgence in alcohol consumption and perhaps other substance abuse. Among road-users, pedestrians were more vulnerable to injury and fatality. This could be explained by the increased number of pedestrians and vehicle volume within the city. Non-observance of road traffic regulations by both pedestrians and motorists could have played a role as well as the lack of special pedestrian facilities such as side-walk lanes and fly-overs at high risk road crossing points. Obviously there is need for greater public awareness on

road safety and provision of specialised facilities to pedestrians. In a study in New Zealand to evaluate the effect of environmental factors on risk of injury of child pedestrians by motor vehicles, it was established that reducing traffic volume in urban areas could significantly reduce rates of child pedestrian injury [47]. This may well apply in Nairobi as the traffic police department records have consistently shown the city to have the highest number of pedestrian casualties as compared to the rest of the country. Curbing rural-urban migration will decongest the city and may be expected to reduce the number of pedestrian casualties.

In the present study pedestrians suffered more severe skeletal injuries as compared to other categories of road users. For example, in injuries involving the lower limbs, pedestrians accounted for 66.2% whereas only 18.5% of the passengers suffered such injuries. Similar findings were reported in a study done in Oxford in the United Kingdom, in which the incidence of death among pedestrians was significantly higher than among car occupants or motor cyclists; and the principal determinant of death was the weight of the vehicle concerned[48] . That study found that the most common site of injury included the head, but the most common site of serious injuries was the legs, a finding similar to the present one.

It is significant to note that the incidence of STIs to the head region (85.6%) was far much higher than that of the rest of the body (66.1%) bearing in mind that the head region comprises of less than 10% of the total body surface area. Of these injuries, the face alone accounted for 69.2% of them. These findings are similar to those of other studies elsewhere [49]. The high incidence of STIs involving the face may be attributed to the fact that it is one of the most exposed parts of the body. In motor vehicle accident dynamics, during the deceleration phase of the accident, the body is propelled forwards by momentum and the face may crash against the dashboard for front seat occupants or against the front seats for back seat occupants. Use of safety seat belts minimizes the

probability of sustaining such injuries. Other studies have underscored the importance of safety belt usage [18,19]. In a study by Orsay et al. [18] in Chicago involving 1304 patients among whom 58% were wearing a safety belt whereas 42% were not, safety belt wearers had a 60.1% reduction in the severity of injury, a 64.6% decrease in hospital admissions and a 66.3% decline in hospital charges. The societal burden of non - use of safety belts in terms of morbidity and the costs of medical care cannot be over-emphasized.

In the present study there was a high degree of non-use of seat belts (56.6%). The high proportion of casualties with facial injuries necessitates the involvement of maxillofacial surgeons in the management of RTA victims. Another study done in Southampton, United Kingdom, also underscored the importance of seat belt use in reducing maxillofacial injuries [33]. The study involved 678 patients who presented with maxillofacial injuries between 1981 and 1985, the period during which the seat belt legislation was introduced. The compliance with seat belt usage rose to 90-95% for all front seat occupants after the legislation. The incidence of maxillofacial trauma cases arising in the front seat occupant group of patients dropped from 78 patients (20.9%) in the two years before the legislation to 18 patients (5.9%) in the two years after the legislation. The difference was statistically significant (P 0 .001).Surprisingly there were very few fractures involving the maxillofacial region (21) as compared to STIs of the face (256) in the present study. There are various probable explanations to this. One, there has been a general observation that the soft tissues cushion the skeleton and therefore when there is extensive injury to the soft tissues, there is little or no injury to the skeleton. Secondly, it is probable that the force of impact was not sufficient enough to cause skeletal injuries and this could be attributed to the introduction of speed governors. However, it was difficult to quantify the effect of speed governors in this study. Casualties were asked to give their subjective opinion about the speed at which the vehicle was

being driven at the time of the accident and 29.1% thought the vehicle was over speeding.

The incidence of head injury (7.0%) and spinal injury (3.1%) was low for reasons that were not apparent. It is possible that the majority of patients who sustained head injury were fatally injured as a review of USA mortality data from 1979 to 1986 revealed [50]. This study identified 315,328 deaths associated with head injury of which 57% were due to motor vehicle accidents. It can also be assumed that since the introduction of speed governors, the speed at which the vehicles were driven was low and could not lead to many head injuries. It is noteworthy that 55.2% of those with head injury in the present study were pedestrians.

The limbs in general were more involved when comparing soft tissue as well as skeletal injuries other than those occurring in the maxillofacial region, together accounting for 81.7% of soft tissue injuries and 67.6% of skeletal injuries. Between the two, lower limbs sustained more injuries than the upper limbs. These findings are similar to those from other studies. The preponderance of limb injuries could be due to their mobility as well as being long "appendages" from the trunk exposes them to injury. The sitting arrangement in vehicles is such that the lower limbs are in a restricted and confined place which could be the reason why they sustain more injuries than the rest of the body. Further research is required to identify the actual reasons for this disparity which in turn will facilitate designing interventional measures. Injury to the spine was noted in 9.2% of casualties, the majority of which were cervical. This type of fracture is critical as it can lead to serious consequences if neglected during the primary survey and management of trauma patients.

Fatal RTAs

Age and gender appear to influence the probability of being involved in a fatal RTA as was the case with non-fatal RTAs. Men were more prone to fatal accidents as this study revealed. Fifty three (76.8%) of the fatalities involved men. It is not surprising that people between the age of 21 and 50 years were the most affected as this is the age bracket when people are most active in their lives. This pattern of involvement is similar to that of non-fatal accidents. It is noteworthy that 18 (26.1%) victims' ages were not known. This may have serious implications in terms of medico-legal issues as well as calculation of damages for insurance purposes. Unlike in the non-fatal RTAs, *matutus* plying highways were the leading cause of fatal accidents. Human error cannot be ruled out especially with regard to over- speeding and careless overtaking. The highways are the commonest sites of fatal RTAs accounting for 50 (71.4%) fatalities in this study. The condition of highways may come into question as most of them are narrow and riddled with pot-holes. Just as was the case with non-fatal injuries, pedestrians were the most frequently involved in fatal injuries than other classes of road users. There is need for intervention programmes targeting this category of road users. This may involve road safety programmes in the print and electronic media especially on the highway code.

Injuries were reported in almost all anatomical sites with a majority of victims having sustained multiple injuries. Injuries to the chest were the most common followed by those to the head and abdomen. However,from autopsy reports, head injury appeared to have been the most lethal as it was implicated in 41 (59.4%) deaths either as the sole cause or part of the other injuries that caused death. It was followed by chest injuries which were responsible for 19 deaths. Facial injuries were noted in only 15 (21.7%) casualties and none of them was attributed directly to the fatal outcome. The pattern and severity of injuries is significant in the triaging of patients who

arrive at the casualty following a road accident. After primary survey and initial stabilization, patients presenting with head and chest injuries need close attention with early involvement of the neurosurgical and cardiothoracic teams. Orthopaedic as well as maxillofacial injuries may probably need to be definitively attended to at a later stage.

CONCLUSION

In conclusion, this study has established the following;

- The legislation requiring mandatory fitting of speed governors by passenger service vehicles and use of safety belts may have markedly reduced RTAs since its implementation in February 2004.
- More men than women were involved in RTAs .
- The commonest age groups involved in RTAs were the 21-30- year –old followed by the 31-40- year-old.
- There were more accidents occurring during weekends than weekdays.
- Pedestrians were more vulnerable to injury and fatality than other classes of road users.
- The head region sustained more STIs than other anatomic sites.
- There were fewer fractures involving the maxillofacial skeleton as compared to STIs in the same region.
- The lower limbs were more vulnerable to fractures than other anatomical sites.
- Most victims of fatal RTAs sustained multiple injuries with chest injury having been the commonest.
- Head injury was frequently implicated as the cause of death.

RECOMMENDATIONS

- Interventional programmes should be designed targeting pedestrians and those in their third and fourth decades of life.
- These programmes may be in the form of educating the general public about the highway -code through the print and electronic media.
- Strict enforcement of the highway- code by the enforcing agencies.
- There is need for provision of special facilities for use by pedestrians such as fly-overs and side-walk lanes.
- Decongesting the city centre of vehicular volume by erecting parking bays on the out-skirts of the city and allowing in only a limited number of vehicles.
- There is need for early involvement of neurosurgical and cordiothoracic teams in the management of RTA casualties.
- To achieve good cosmetic results, early involvement of maxillofacial surgeons is required after other life threatening injuries have been managed.

CHALLENGES AND LIMITATIONS OF THE STUDY

- Difficulties of collecting data over a 24- hour period.
- Difficulties were encountered in examining and collecting data from the critically injured patients as their initial management was often prolonged.
- It sometimes took a long time to determine all the injuries sustained by a multiply injured patient as collaboration with other specialties was required.
- Congestion in casualty made it difficult to examine patients.
- Accident victims whose bodies were taken to city mortuary were not included.

- Some patients may have been discharged before being examined.

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APPENDIX 1

CONSENT FORM

THE PURPOSE OF THE STUDY

This study aims to investigate the type of injuries that are sustained during the occurrence of road traffic accidents with specific emphasis on injuries to the facial skeleton.It involves a physical examination to establish the nature and extent of these injuries. A lot of care will be taken to ensure that you are not subjected to undue discomfort. You are kindly requested to answer a written questionnaire.Information obtained in this study will enable us to understand the current trend of facial injuries and associated injuries during road traffic accidents. This in turn will enable us to plan the delivery of services in a better way and to device preventive mechanisms. All information obtained in this study will be kept in strict confidence.

VOLUNTARY PARTICIPATION

I voluntarily agree to participate in this study. I also understand that I can terminate my participation at will without any consequences. I also understand that participation in the study does not entail any financial benefit.

Anticipated Risk

No risk is anticipated for participating in the study.

Confidentiality

The information given to the researcher will be kept in strict confidence. No information, by which your identity can be revealed, will be released or published.

I..... do hereby willfully give consent to participate in the study.

Signed..... Date.....

Appendix 2

QUESTIONNAIRE

1. Name of patient.....
2. I.P/O.P No.....
3. Sex.....
4. Age.....
5. Occupation.....
6. Current residence.....
7. District of Origin.....
8. Date when injury occurred.....Time.....am.....pm.....
9. Hospital/clinic where patient was first attended.....
10. Place of accident.....
11. Was patient ☐ Pedestrian? ☐ Passenger? ☐ Driver?
12. If passenger or driver, was vehicle ☐ Private? ☐ Passenger Service Vehicle?
13. Was patient using seat belt? Yes☐ No.☐
14. Had driver used alcohol or other substance? ☐ Yes ☐ No.
15. Was vehicle overspeeding? ☐ Yes ☐ No.
16. Was vehicle defective? Yes No.
17. Was vehicle overloaded? ☐ Yes ☐ No.
18. Was it at ☐ Night? ☐ Daytime?
19. Was Road ☐ Marrum? ☐ Tarmac?
20. Was accident fatal ☐ Yes ☐ No
21. Maxillofacial soft tissue involvement

    (a) Eyelid tear

(b) Nasal alla injury

(c) Lips

(d) Tongue

(e) Facial cuts

(f) Others.....

(g) 22. Midface skeletal injuries

(i) Frontal bone fracture

(ii) Orbital fractures

(a) Floor of the orbit

(b) Medial wall

(c) Lateral wall

(d) Roof

(iii) Le Forte category

(a) Le Forte I

(b) Le Forte II

(c) Le Forte III

(iv) Zygomatic bone fractures

(a) Zygomatic complex fracture

(b) Zygomatic body fracture

(c) Isolated zygomatic arch fracture

(v) Isolated naval bone fracture

(vi) Dento-alveolar fracture

(vii) Others.....

23. Mandibular fractures

(a) Symphisis

(b) Parasymphisis

(c) Body

(d) Angle

(e) Ramus

(f) Condyle

(g) Coronoid

24. Associated injuries

a.. Ophtamological injuries

i. Eye ball rapture

ii. Corneal laceration

iii. Retinal detachment

iv. Others.....

b. Head injury

i. Skull fracture

ii. Concusion

iii. Subdural/epidural haemorrhage

iv. Intracerebral haemorrhage

c. Spinal Injury

i. Cervical-spine fracture

ii. Lumbar spine fracture

iii. Thoracic spine fracture

d. Orthopaedic injuries

i. Upper limb fracture

ii. Lower limb fracture

iii. Pelvic fracture

iv. Others.....

e. Chest injury

i. Rib fracture

ii. Haemothorax

iii. Pneumothorax

iv. Lung injury

v. Heart injury

vi. Others.....

f. Abdominal injuries

i. Liver

ii. Spleen

iii. Stomach/intestines

iv. Kidney

v. Others.....

APPENDIX 3

KENYATTA NATIONAL HOSPITAL
Hospital Rd. along, Ngong Rd.
P.O. Box 20723, Nairobi.

Tel: 726300-9
Fax: 725272
Telegrams: "MEDSUP", Nairobi.
Email: KNHplan@Ken.Healthnet.org

Ref: KNH-ERC/01/2383 **Date: 11 August 2004**

Dr. Mathew Akama
Dept. of Oral and Maxillofacial Surgery
Faculty of Dental Sciences
University of Nairobi

Dear Dr. Akama

RESEARCH PROPOSAL "A PROSPECTIVE EVALUATION OF MAXILLOFACIAL AND CONCOMITANT INJURIES OCCURRING DURING ROAD TRAFFIC ACCIDENTS" (P36/3/2004)

This is to inform you that the Kenyatta National Hospital Ethics and Research Committee has reviewed and **approved** the revised version of your above cited research proposal for the period 11 August 2004 – 10 August 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 M Bhatt, Chairperson, KNH-ERC
The Deputy Director (C/S), KNH
The Dean, Faculty of Dental Sciences, UON
The Chairman, Dept. of Oral and Maxillofacial Surgery, UON
CMRO
Supervisors: Prof. Symon W Guthua, Dept. of Oral and Maxillofacial Surgery, UON
Dr. Mark L Chindia, Dept. of Oral and Maxillofacial Surgery, UON
Dr. F G Macigo, Dept. of Periodontology/Comm & Prev Dentistry, UON

APPENDIX 4

TC8/VOL. 1/.....

POLTRAFF OPSROOM

21st. JANUARY 2004

PROVINCIAL ANNUAL ACCIDENTS RETURNS FOR THE YEAR 2004

1.CAUSE CODES	NBI	CENT	RVP	COST	NZA	EAST	WST	NEP	TOTAL
Drivers & M/Cyclists	1264	690	526	573	379	548	257	20	4257
Pedal Cyclists	133	160	483	112	188	121	167	5	1369
Pedestrians	1242	334	169	362	195	205	112	9	2628
Passengers	222	39	53	35	33	70	49	4	505
Animals	0	11	32	5	8	1	4	0	61
Obstruction	4	12	92	5	7	3	9	0	132
Vehicle Deffects	26	94	126	58	49	108	30	0	491
Road Deffects	4	15	105	10	13	17	8	2	174
Weather	3	7	52	1	3	0	3	0	69
Other causes	343	197	228	31	64	120	44	4	1031
PARA 1 TOTAL	**3241**	**1559**	**1866**	**1192**	**939**	**1193**	**683**	**44**	10717
2.AGE GROUPS OF INJURED PERSONS									
Over 16 years killed	412	359	390	198	184	298	109	11	1961
Seriously injured	710	1342	670	672	1079	1094	518	40	6125
Slightly injured	3048	1593	1906	1665	715	1545	487	18	10977
Up to 16 years killed	29	49	92	36	32	26	24	2	290
Seriously injured	85	110	113	57	77	112	59	7	620
Slightly injured	341	112	155	139	33	88	28	4	900
PARA 2 TOTAL	**4625**	**3565**	**3326**	**2767**	**2120**	**3163**	**1225**	**82**	20873
3. CLASSES OF PERSONS INJURED									
Drivers killed	32	48	69	31	9	41	13	1	244
Seriosly injured	77	142	111	66	65	106	48	2	617
Slightly injured	336	174	86	170	66	136	36	0	1004
Motor cyclists killed	3	3	34	7	1	4	2	0	54
Seriosly injured	19	10	45	43	11	19	7	0	154
Slightly injured	116	12	24	86	7	20	10	1	276
Pedal cyclists killed	17	43	115	24	44	26	37	0	306
Seriously injured	45	124	195	75	120	94	107	1	761
Slightly injured	165	96	268	184	96	107	140	1	1057
Passengers killed	73	127	113	72	72	189	40	8	694
Seriously injured	274	876	405	372	815	834	305	33	3914
Slightly injured	1227	1214	1103	1049	431	1155	240	13	6432
Pedestrians killed	316	188	162	100	90	64	42	4	966
Seriously injured	380	300	329	172	165	153	110	10	1619
Slightly injured	1545	208	267	316	128	215	88	8	2775
PARA 3 TOTAL	**4625**	**3565**	**3326**	**2767**	**2120**	**3163**	**1225**	**82**	20873
4. DAY AND TIME									
Monday 7am -7p	219	154	185	99	83	140	67	8	955
Tuesday " "	237	111	169	88	100	108	69	3	885
Wednesda y	227	119	181	99	88	117	69	8	908
Thursday " "	244	111	153	86	111	111	82	7	905
Friday " "	322	139	270	89	105	146	87	3	1161
Saturday " "	297	187	244	119	96	137	71	5	1156
Sunday " "	229	147	153	71	99	113	73	5	890
DAY TOTAL	**1775**	**968**	**1355**	**651**	**682**	**872**	**518**	**39**	6860

NIGHT TIME	NBI	CENT	RVP	COST	NZA	EAST	WEST	NEP	TOTAL
Monday 7pm -7a	176	61	61	64	36	48	26	1	473
Tuesday " "	161	63	68	85	29	46	14	1	467
Wednesday " "	183	79	68	76	35	43	20	0	504
Thursday " "	182	65	32	67	40	40	25	1	452
Friday " "	293	103	108	60	49	55	28	1	697
Saturday " "	269	109	110	111	34	51	26	1	711
Sunday " "	202	111	64	78	34	38	26	0	553
NIGHT TOTAL	**1466**	**591**	**511**	**541**	**257**	**321**	**165**	**5**	**3857**
DAY TOTAL	**1775**	**968**	**1355**	**651**	**682**	**872**	**518**	**39**	**6860**
DAY/NIGHT TOTAL	**3241**	**1559**	**1866**	**1192**	**939**	**1193**	**683**	**44**	**10717**
5. DRIVERS OR OTHER PERSONS RESPONSIBLE									
Europeans	64	10	10	46	0	4	0	0	134
Africans	2654	1481	1480	980	890	1158	649	42	9334
Asians	195	7	67	66	0	4	0	0	339
Others	79	4	136	73	8	4	16	0	320
Not Known	249	57	173	27	41	23	18	2	590
PARA 5 TOTAL	**3241**	**1559**	**1866**	**1192**	**939**	**1193**	**683**	**44**	**10717**
6. VEHICLES OR PERSONS (A) PRIMARILY RESPONSIBLE									
Cars & utilities	875	619	444	332	310	550	175	22	3327
Lorries	46	152	97	93	56	131	28	11	614
Trailers	22	7	31	21	7	5	4	0	97
Petroleum tankers	17	2	50	18	6	3	5	0	101
Other tankers	4	0	20	1	2	0	3	0	30
Tractors	0	7	35	11	15	18	26	0	112
Urban buses	419	6	9	5	0	0	8	0	447
Country buses	39	115	13	61	72	77	9	5	391
School/college buse	16	6	13	2	4	2	0	0	43
Other instit - buses	1	2	2	12	5	1	4	0	27
Tourist vans	0	2	5	2	0	1	0	0	10
Taxis	154	26	55	12	90	6	2	0	345
Matatus	636	236	244	236	105	101	120	2	1680
Motor cycles	138	27	37	42	26	29	11	3	313
Motor tricycles	0	0	0	0	0	0	0	0	0
Invalid carriages	0	0	0	0	0	0	0	0	0
Hand carts	11	11	27	12	15	16	0	0	92
Animal drawn carts	0	9	12	1	0	0	0	0	22
Pedal cycles	186	110	334	96	115	68	136	0	1045
animals	0	9	47	3	4	8	4	0	75
Persons	401	134	228	198	78	132	124	0	1295
Not known	276	79	163	34	29	45	24	1	651
PARA 6 TOTAL	**3241**	**1559**	**1866**	**1192**	**939**	**1193**	**683**	**44**	**10717**
7. TYPES OF ACCIDENTS									
Fatal accidents	409	337	362	162	180	222	128	12	1812
Serious injury accdts	540	578	660	450	434	463	314	23	3462
Slight injury accidts	2292	644	844	580	325	508	241	9	5443
PARA 7 TOTAL	**3241**	**1559**	**1866**	**1192**	**939**	**1193**	**683**	**44**	**10717**

NOTE: The totals of paragraphs 1, 4, 5, 6A and 7 (which are accidents) should agree
The totals of paragraphs 2 and 3 (w me) should agree

PREPARED BY

YEAR 2003

TC8/VOL. 1/.....

POLTRAFF OPSROOM

Date...10/8/04.....

P 69 MONTHLY ACCIDENT RUNNING TOTAL DRAFT FORM FOR THE YEAR 2003

1.CAUSE CODES	JAN.	FEB.	MAR	APR.	MAY	JUNE	JUL	AUG.	SEP	OCT.	NOV.	DEC	TOTAL
Drivers & M/Cyclists	423	413	520	489	468	521	471	506	493	515	479	443	5741
Pedal Cyclists	123	133	120	135	110	125	94	144	133	145	126	122	1510
Pedestrians	212	250	259	227	251	249	242	276	252	250	202	288	2958
Passengers	52	47	68	61	47	54	39	42	68	68	43	65	654
Animals	5	7	9	12	5	2	4	5	9	5	3	16	82
Obstruction	8	11	2	9	8	9	12	2	7	6	13	8	95
Vehicle Deffects	47	57	45	45	67	42	42	81	57	64	50	44	641
Road Deffects	12	15	11	17	9	11	11	15	18	13	27	33	192
Weather	3	6	2	7	3	6	0	16	8	4	9	11	80
Other causes	101	112	118	119	125	143	111	105	135	107	121	128	1425
PARA 1 TOTAL	**986**	**1051**	**1154**	**1121**	**1098**	**1162**	**1026**	**1192**	**1180**	**1177**	**1073**	**1158**	**13378**
2.AGE GROUPS OF INJURED PERSONS													
Over 16 years killed	214	155	180	227	182	211	233	291	241	234	220	247	2635
Seriously injured	731	675	794	870	693	651	699	900	874	716	880	768	9251
Slightly injured	1092	961	1126	1204	1378	1565	1121	1553	1260	1093	1161	1209	14723
Up to 16 years killed	31	23	25	26	33	29	25	34	28	28	33	54	369
Seriously injured	64	51	32	98	61	74	57	56	81	74	59	77	784
Slightly injured	57	107	76	75	88	121	126	92	150	100	70	151	1213
PARA 2 TOTAL	**2189**	**1972**	**2233**	**2500**	**2435**	**2651**	**2261**	**2926**	**2634**	**2245**	**2423**	**2506**	**28975**
3. CLASSES OF PERSONS INJURED													
Drivers killed	24	18	13	19	18	18	24	34	33	25	25	27	278
Seriosly injured	56	60	95	60	83	70	75	66	78	84	78	70	875
Slightly injured	53	95	128	105	122	132	107	130	133	110	94	95	1304
Motor cyclists killed	6	1	0	3	9	2	1	4	0	0	4	3	33
Seriosly injured	12	22	11	18	13	14	11	2	19	11	9	3	145
Slightly injured	14	25	24	22	14	23	22	12	23	19	16	11	225
Pedal cyclists killed	26	21	23	38	23	30	24	27	26	30	26	39	333
Seriously injured	74	64	57	122	55	78	49	52	97	61	84	74	867
Slightly injured	76	83	81	120	103	87	82	79	151	97	77	90	1126
Passengers killed	71	61	75	109	63	86	108	112	102	98	101	98	1084
Seriously injured	507	434	527	625	436	423	487	669	580	467	566	521	6242
Slightly injured	779	610	733	726	973	1135	782	1175	774	680	815	877	10059
Pedestrians killed	118	77	94	84	102	104	101	148	108	109	97	134	1276
Seriously injured	145	146	136	143	167	140	134	169	181	167	202	177	1907
Slightly injured	228	255	236	306	254	309	254	247	329	287	229	287	3221
PARA 3 TOTAL	**2189**	**1972**	**2233**	**2500**	**2435**	**2651**	**2261**	**2926**	**2634**	**2245**	**2423**	**2506**	**28975**
4. DAY AND TIME													
Monday 7am -7pm	85	111	115	123	107	100	87	83	96	83	98	90	1178
Tuesday " "	77	80	106	103	100	97	80	107	97	108	90	94	1139
Wednesda y	80	95	93	120	92	88	88	100	94	90	78	112	1130
Thursday " "	80	91	96	84	88	102	102	101	98	107	79	109	1137
Friday " "	122	113	130	109	118	136	97	152	117	128	106	113	1441
Saturday " "	116	109	161	108	128	139	103	122	153	101	126	115	1481
Sunday " "	97	95	120	123	105	116	94	101	92	93	87	95	1218
DAY TOTAL	**657**	**694**	**821**	**770**	**738**	**778**	**651**	**766**	**747**	**710**	**664**	**728**	**8724**

NIGHT TIME	JAN.	FEB.	MAR	APR.	MAY	JUN	JUL	AUG.	SEP	OCT.	NOV.	DEC	TOTAL
Monday 7pm -7am	41	42	46	45	49	44	43	57	60	63	40	51	581
Tuesday " "	41	50	34	37	46	42	49	51	49	58	56	55	568
Wednesday " "	50	42	41	45	43	47	58	63	70	46	49	61	615
Thursday " "	40	48	52	39	48	45	56	46	39	62	45	70	590
Friday " "	61	68	68	63	74	82	67	74	92	82	75	80	886
Saturday " "	64	61	48	70	62	65	55	64	77	95	74	65	800
Sunday " "	32	46	44	52	38	59	47	71	46	61	40	48	584
NIGHT TOTAL	329	357	333	351	360	384	375	426	433	467	409	430	4654
DAY TOTAL	657	694	821	770	738	778	651	766	747	710	664	728	8724
DAY/NIGHT TOTAL	986	1051	1154	1121	1098	1162	1026	1192	1180	1177	1073	1158	13378
5. DRIVERS OR OTHER PERSONS RESPONSIBLE													
Europeans	12	9	19	20	6	14	16	5	22	12	14	11	160
Africans	872	923	1007	989	969	1031	882	1086	1037	1047	953	1001	11797
Asians	29	30	47	33	49	49	51	40	43	20	32	38	461
Others	9	13	16	11	17	10	13	10	36	37	24	36	232
Not Known	64	76	65	68	57	58	64	51	42	61	50	72	728
PARA 5 TOTAL	986	1051	1154	1121	1098	1162	1026	1192	1180	1177	1073	1158	13378
6. VEHICLES OR PERSONS (A) PRIMARILY RESPONSIBLE													
Cars & utilities	245	313	338	350	297	315	310	346	314	387	304	316	3835
Lorries	57	43	58	64	43	60	52	82	70	79	52	66	726
Trailers	9	9	11	3	18	14	12	9	5	5	15	23	133
Petroleum tankers	0	5	8	4	12	13	10	1	0	2	9	10	74
Other tankers	2	9	5	6	2	3	0	13	2	0	0	2	44
Tractors	5	7	9	12	16	24	14	9	11	16	10	20	153
Urban buses	56	51	58	42	52	56	62	66	58	62	54	4	621
Country buses	27	29	38	26	32	41	18	29	39	25	52	55	411
School/college buses	6	9	10	6	6	11	8	5	2	2	6	4	75
Other instit - buses	1	4	4	0	0	6	0	0	0	3	1	5	24
Tourist vans	0	4	3	0	3	5	4	0	0	0	2	2	23
Taxis	29	64	58	66	46	40	30	62	52	51	27	34	559
Matatus	217	171	193	169	255	192	185	230	224	195	189	223	2443
Motor cycles	18	40	33	32	27	37	38	28	50	34	35	25	397
Motor tricycles	0	0	0	0	0	0	0	0	0	0	0	0	0
Invalid carriages	0	0	0	0	0	0	0	0	0	0	0	0	0
Hand carts	6	9	13	6	9	11	6	3	7	2	9	9	90
Animal drawn carts	0	0	0	0	10	12	1	0	0	0	3	3	29
Pedal cycles	93	101	98	119	58	92	98	104	134	134	118	125	1274
animals	4	10	24	7	5	6	3	1	9	6	6	7	88
Persons	135	114	132	139	152	138	119	143	147	122	133	142	1616
Not known	76	59	61	70	55	86	56	61	56	52	48	83	763
PARA 6 TOTAL	986	1051	1154	1121	1098	1162	1026	1192	1180	1177	1073	1158	13378
7. TYPES OF ACCIDENTS													
Fatal accidents	197	160	165	190	174	187	171	263	191	209	216	234	2357
Serious injury accdts	348	350	390	336	309	383	342	352	352	399	339	340	4240
Slight injury accidts	441	541	599	595	615	592	513	577	637	569	518	584	6781
PARA 7 TOTAL	986	1051	1154	1121	1098	1162	1026	1192	1180	1177	1073	1158	13378

NOTE: The totals of paragraphs 1, 4, 5, 6A and 7 (which are accidents) should agree
The totals of paragraphs 2 and 3 (wh ms) should agree

PREPARED BY