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EFFECTS OF ENFORCEMENT OF THE TRAFFIC ACT ON INJURY SEVERITY AMONG PATIENTS ADMITTED AT THE RIFT VALLEY PROVINCIAL GENERAL HOSPITAL, NAKURU

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EFFECTS OF ENFORCEMENT OF THE TRAFFIC ACT ON INJURY SEVERITY AMONG PATIENTS ADMITTED AT THE RIFT VALLEY PROVINCIAL GENERAL HOSPITAL, NAKURU

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ABSTRACT

Background: The Traffic Act was enforced in Kenya from 1st February 2004. Systematic evaluations of the effects of this enforcement on injury severity are unavailable.

Objective: To compare injury severity among victims of public service vehicle (PSV) crashes in the periods one year before and one year after the enforcement of the Traffic Act.

Design: A retrospective pre and post-intervention survey.

Setting: Rift Valley Provincial General Hospital, Nakuru.

Results: There were no changes in injury severity levels among the sampled patients before and after the enforcement of the Traffic Act (Most Absolute difference = 0.087, Kolmogorov-Smimov $Z = 0.722$, $\rho > 0.05$). The patients stayed in hospital for a median of three days in both policy periods. The mean age of the patients was 31.49 years (SD = 14.58) while three quarters of the patients were males. The age and sex profiles of the admitted patients did not change with the enforcement of the Traffic Act.

Conclusion: The enforcement of the Traffic Act did not have any effect on injury severity among admitted PSV crash victims. Measures to lessen the burden of road traffic injury deserve greater attention.

INTRODUCTION

Road Traffic Injuries (RTI) continue to cause much mortality and morbidity globally (1). In 2002, RTI were ranked as the eleventh leading cause of death in the world and are projected to be the sixth leading cause of death worldwide by the year 2020. RTI are further predicted to escalate from the ninth leading contributor of the global burden of disease in 1990 to the third in 2020. In the year 2020, RTI are projected to become the third largest cause of disabilities in the world (2). The critical point at which the RTI will begin to fall will not happen until the year 2049 (3).

A fourfold increase in road fatalities has been experienced since Kenya's independence in 1963 (4). For instance, road traffic crashes tripled from 3,578 in 1963, to 10,106 in 1989 and 11,785 in 1994 (5). By the year 2003 there were over 10,000 traffic crashes in Kenya that resulted in 3,004 fatalities and 25,971 injured persons (4). It is currently estimated that 34.4 per 100,000 people are killed annually on Kenyan roads (1). It is further recognised that following RTI, the costs of prolonged care, loss of

income, and consequences for injured parents and their dependants, pushes families into poverty and imposes an inequitable burden on the nation (6). Appropriate interventions are therefore warranted.

Public service vehicles (PSV) are estimated to account for approximately 19 percent of all road traffic crashes in Kenya (7). Moreover, passengers commuting in PSV are the second largest vulnerable group to traffic crashes in Kenya after pedestrians (8). PSV are among the most popular forms of transport in Kenya, are dominated by small-scale public transport vehicles popularly known as *Matatus* (5,9,10). *Matatus* largely comprise vans, mini-buses and pick-ups. The total number of *Matatus* operating in Kenya rose from less than 400 in the 1960s to around 40,000 in the year 2003 (11). This increase was also met with an increase in the number of road traffic crashes. By the year 2000, road traffic crashes caused by PSV were attributed to disobeying traffic rules, over speeding, playing loud music, reckless driving, overloading, harassing passengers, insecurity and chaos (5,10). The enforcement of road safety measures among PSV was therefore deemed as necessary.

In October 2003, the Minister for Transport and Communications issued Legal Notice No. 161 that sought to regulate the Public Service Vehicle sub-sector (12). Its aim was to make amendments on the Traffic Act (Cap. 40) of the laws of Kenya. The objectives of this notice were to: reduce crashes caused by over speeding; enhance safety of commuters; ensure responsibility, accountability and competence among drivers and conductors; eliminate illegal drivers, conductors and criminals that had infiltrated the industry; and facilitate identification of vehicles and restrict their operation to authorised routes (12). The requirements of this legal notice included fitting of seatbelts and speed governors in order to limit speed to 80 kilometre per hour in all public service and commercial vehicles and indication of route details and painting of a continuous yellow band on both sides and on the rear of *Matatus* for ease of identification. Other requirements included security vetting of drivers and conductors of public service vehicles and compulsory wearing of badges and uniforms when on duty, employment of drivers and conductors of public service vehicles on permanent basis and compulsory retesting of public service vehicle drivers after every two years to ascertain their level of competence. Every driver of a public service vehicle was also required to prominently display his or her photograph in the vehicle. Failure to comply with these regulations would attract a fine, imprisonment or withdrawal of certification.

Enforcement of road safety measures is an effective instrument in preventing motor vehicle crashes and their consequences (13, 14). Effectiveness is hereby defined as the percent reduction in injuries and deaths of people complying with road safety measures when compared to those who do not when crash occurs. A growing stream of literature has established that speed enforcement, limiting drink-driving and the use of seatbelts and other restraints are effective in reducing injury severity from road traffic crashes (15, 16).

The effective date for the enforcement of the Traffic Act was 1st February, 2004. Throughout the year 2004 the provisions of the Traffic Act were vigorously enforced by the Ministry of Transport, traffic police and the Transport Licensing Board. There were arrests by police, crackdowns and hotlines that were used by the public to report non-compliers to the police (10). Few systematic evaluations of road safety measures in Kenya have been conducted. One such report that used data provided by the police indicated that the number of road traffic crashes declined by 73 percent in the first six months of the enforcement of the Traffic Act (17). Another report also using data from the police indicated that the number of motor vehicles crashes reduced by 2.2 percent whereas the number of deaths reduced by 25.1 percent in the eleven month period before and after the enforcement of the Traffic Act,

with both reductions being statistically significant (18). Such statements on the reduction of RTI rates after enforcement of the Traffic Act need to be supported by systematic investigations using multiple data sets (police, hospital and insurance) and appropriate indicators of change (10). The enforcement of the legislation provided the opportunity to establish injury severity and lengths of hospital stay before and after its enforcement using data of patients admitted at the Rift Valley Provincial General Hospital between 1st February 2003 and 31st January, 2005 following road traffic crashes involving PSV, and thereby determine the potential benefits of the enforcement in Nakuru County.

MATERIALS AND METHODS

Research Design: This was a retrospective pre and post-intervention study that examined the effects of the enforcement of Traffic Act on the severity of injuries among motor vehicle crash victims admitted at the Rift Valley Provincial General Hospital, Nakuru between 1st February 2003 and 31st January, 2005. This is the period corresponding to one year before the enforcement of the Traffic Act (1st February, 2003 to 31st January, 2004) and one year thereafter (1st February, 2004 to 31st January, 2005).

Research Setting: This study was conducted at the Rift Valley Provincial General Hospital, a 640 bed public hospital located in Nakuru town. The hospital serves a majority of the people in Nakuru County. This hospital has a very high number of trauma admissions that are related to its proximity to the busy Trans-African highway (19). The department of surgery with approximately 200 beds is the largest department of this hospital. In the year 2007, the hospital attended to 59,612 new patients and 39,340 inpatients. Among these patients 6,247 were trauma related complaints.

During the study period, patient data were processed either in outpatient and inpatient medical departments. The first contact with a patient was usually at the casualty department. Here all patients were issued with a patient number before any services were offered. It was also in the casualty department that filtering of patients was done. Outpatients were treated and sent home and their records were not filed because of shortage of space. Patients requiring admission were screened and referred to the inpatient department. This inpatient department had one admission centre where an inpatient number was issued. Each patient was offered a medical file where his or her details were recorded. Coding and indexing in these files was done using the International Classification of Diseases, 9th Revision Clinical Modification (ICD9-CM) codes (20). Inpatient's files were stored using the straight numerical system of filing.

As a rule, inpatients information was also summarised using the cardex system for ease of reference. For example, upon discharge trauma patients records in the cardex include three ICD9-CM mechanism of injury codes (or "E codes") and up to six ICD9-CM nature of injury codes (or "N codes"), date of admission and discharge, major outcomes and patient age and gender. Consequently, trauma patients admitted with ICD9-CM external cause of injury codes in the range E810-E825 (.0, .1), "motor vehicle related injury, occupant or driver", were initially searched and reviewed in order to identify PSV crash victims.

The Study Population and Sampling Procedures: The population of this study included all patients who were admitted at the Rift Valley Provincial General Hospital from motor vehicle crashes involving PSV between 1st February 2003 and 31st January, 2005. Inclusion criteria were all persons presented alive at the hospital's admission wards as a result of road traffic crash involving PSV during the specified period. There were 854 road traffic crash victims involving PSV admitted in the Rift Valley Provincial General Hospital during the study period, 499 patients were admitted in the hospital before the enforcement of the Traffic Act and 355 thereafter. A sampling list of these patients was constructed from hospital records.

Simple random sampling was used to select the study sample. Following the formula described in Lwanga and Lemeshow (21), the minimum sample size for this study was taken to be 276 patients, 138 each in the pre and post enforcement periods. Only those patients whose medical records were available and complete were included in this study. Sampling was deemed necessary in order to maximize patient confidentiality as required by the study hospital, save resources (time and money) and surmount difficulties arising from missing files.

Data Collection: The severity of injury was coded for all the sampled victims according to Abbreviated Injury Severity Scale (AIS) codes, using the AIS90 manual (22). In the absence of any routine injury severity coding system in Kenya, the study used trauma and orthopaedic specialists to estimate injury severity from patients' records. This was done through converting injury diagnosis and text description of injuries into AIS codes. The AIS categorises each injury by body region (head or neck, chest, abdominal or pelvic contents, extremities or pelvic girdle and general) and by severity (0: no injury; 1: minor; 2: moderate; 3: serious, not life-threatening; 4: severe, life-threatening-survivable; 5: critical, survivable uncertain; 6: incompatible with life) (23,24). AIS scores are subjective assessments assigned by experts

and are implicitly based on four criteria: threat to life, permanency of injury impairment, treatment period and energy dissipation. Injuries with greater magnitude of these criteria are weighted to reflect greater severity. Accordingly, the sampled patients' injuries in the pre-and post-enforcement periods were assigned AIS severity scores. For multiple injuries affecting more than one body region, the codes were assigned on the basis of injury with the highest severity score.

The days of hospitalisation per patient were calculated by counting the difference between the date of admission and the date of discharge from hospital. The overall outcome at discharge was recorded as either dead or alive.

Data collection involved retrieving medical files of all the sampled PSV crash related patients admitted at the hospital within the period of interest and meeting the inclusion criteria. A coding scheme was developed to gather data. This coding scheme was made up of a coding schedule (data abstraction form) and a coding manual. The coding schedule captured the biodata, date of index attendance, injury severity and duration of hospital stay. The coding manual contained instruction to coders. The coding scheme was developed using experts in health information and surgery to improve its validity and reliability.

The research instruments used in this study were pre-tested on 20 road traffic injury victims in a district level hospital within Nakuru County. These research tools were used to gather data by the researcher with the help of two research assistants who were trained for this purpose. A team of seven trauma and orthopaedic surgeons helped in the scoring of injury severity in one session. Each scored every case alone and differences in scoring were resolved by discussion. During data collection, the research assistants were closely supervised by the researcher.

Data Analysis: Variables for this study were summarised and presented using frequencies, percentages, means, standard deviations (SD) and tables. The numbers of days spent in hospital by patients in the two periods of interest were compared using the two sample Wilcoxon's ranksum (Mann-Whitney) test (25). Chi-square tests were used to examine differences in sex, the presence of major injury (AIS \geq 3) and prevalence of multiple injuries while t-test was used to examine age differences in the two periods of interest. Finally, to determine whether the distribution of injury severity differs significantly between the two periods of interest, a Kolmogorov-Smirnov test for two unrelated samples was conducted (26). A p-value of less than 0.05 was considered significant. Data variables for this study were coded and analysed using the Statistical Package for Social Sciences (SPSS) Version 12.

Ethical Consideration: Initial clearance to conduct this study was sought from the medical superintendent of the Rift Valley Provincial General Hospital. Further research clearance was sought from the Ministry of Science and Technology and a Research Permit Number MOST 13/001/37C 544/2 obtained. Confidentiality in handling of patient data was maintained throughout the study.

RESULTS

Characteristics of the Study Sample: In the pre-enforcement period (1st February, 2003 to 31st January, 2004) a sample of 138 cases was enrolled. Overall, 71 percent were males and the sample had a mean age of 31.71 years (SD = 14.19). Children aged below 18 years comprised five percent of the sampled patients. The median AIS was three (25th = 2, 75th = 5 percentile). Majority of the victims (76 percent) sustained major trauma, that is AIS \geq 3 (Table 1). The sampled patients spent a median period of three hospital bed days (25th = 2, 75th = 11 percentile). Five percent of the admitted patients died in hospital.

In the post-enforcement period (1st February, 2004 to 31st January, 2005) a sample of 138 patients was enrolled. The mean age of the sample was 31.28 years (SD = 15.03) and most of the patients were males (78 percent). Children aged below 18 years consisted of 9 percent of the sampled patients. The median AIS was three (25th = 2, 75th = 6 percentile).

Overall, 77 percent of the patients sustained major trauma (Table 1). The patients spent a median period of three hospital bed days (25th = 2, 75th = 7 percentile) with a hospital mortality of five percent.

The Effects of the Enforcement of the Traffic Act: There were 206 males (75 percent) and 70 females (25 percent) showing a male to female ratio of 3:1. This ratio did not change with the enforcement of the Traffic Act ($\chi^2 = 1.914$, $df = 1$; $p > 0.05$).

The mean age of the study sample was 31.49 years (SD = 14.58 years). There were no differences in mean ages among patients in the two policy periods ($t = 0.206$, $P > 0.05$). Moreover, there were no significant differences among the proportion of children and adults in the two periods ($\chi^2 = 1.41$, $p > 0.05$).

The comparative analysis of the pre and post enforcement periods revealed no significant statistical differences in injury severity from PSV crashes among patients admitted at the study hospital (Table 2). In the assessment of the overall effect of the enforcement, when the group of casualties which sustained major trauma (AIS \geq 3) was compared in both periods, the proportion was 75 percent in the post enforcement period compared to 72 percent in the pre-enforcement period, proportions that were not significantly different ($\chi^2 = 0.295$, $\rho > 0.05$). The individual comparison for each AIS injury category did not reveal any significant differences (Most Absolute difference = 0.087, Kolmogorov-Smirnov $Z = 0.722$, $\rho > 0.05$).

Table 1

Distribution of major and minor trauma pre- and post-enforcement of the Traffic Act

	Pre-enforcement Frequency (%)	Post-enforcement Frequency (%)	Total Frequency (%)
Major Trauma (AIS \geq 3)	105 (76)	106 (77)	211 (76)
Minor Trauma	33 (24)	32 (23)	65 (24)
Total	138	138	276

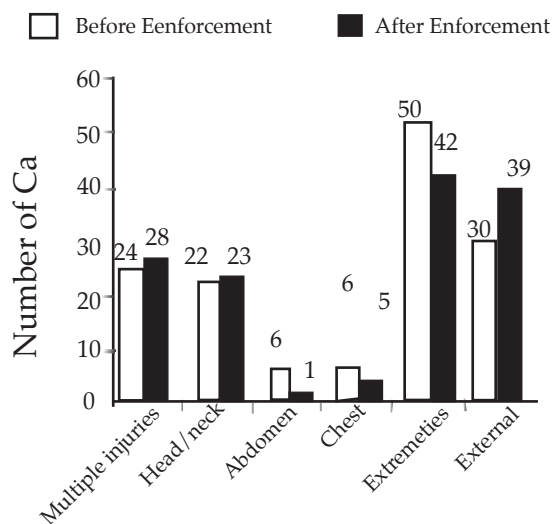
Table 2

Comparison of AIS Scores in the Two Study Periods

AIS	Before enforcement Frequency (%)	After enforcement Frequency (%)	Total Frequency (%)
Minor	33 (23.9)	32 (23.2)	65 (23.6)
Moderate	6 (4.3)	3 (2.2)	9 (3.3)
Serious	59 (42.8)	51 (37.0)	110 (39.9)
Severe	2(1.4)	5 (3.6)	7 (2.5)
Critical	8 (5.8)	8(5.8)	16 (5.8)
Incompatible with life	30 (21.7)	39 (28.3)	69(25.0)
Total	138	138	276

Overall 19% of the patients sustained multiple injuries. Injuries of the extremities (33%) were most common, followed by external injuries (25%), head and neck injuries (16 percent), chest injuries (4%) and abdominal injuries (3%) in that order. In the assessment of the overall effect of the enforcement, when the group of casualties which sustained multiple injuries was compared in both periods, the proportion was 20% in the post enforcement period compared to 17% in the pre-enforcement period, proportions that were not significantly different ($\chi^2 = 0.379$, $p > 0.05$). The comparisons for each body region injured are shown in Figure 1.

Figure 1
Distribution of types of injuries before and after enforcement of the Traffic Act



The analysis of duration of hospital stay among the patients in the pre- and post- enforcement periods using Wilcoxon's rank-sum (Mann-Whitney) test, did not show any significant change ($z = -1.53$, $p > 0.05$). The patients stayed in hospital for a median on three days in both policy periods. The mortality rate among the admitted patients stood at 5% before and after the enforcement of the Traffic Act.

DISCUSSION

The main aim of this study was to compare the levels of injury severity before and after the enforcement of the Traffic Act in Kenya using data from PSV crash patients admitted at the Rift Valley Provincial General Hospital in Nakuru. The results demonstrate that 75% of the patients admitted in the post enforcement period sustained major trauma ($AIS \geq 3$) while 72% in the pre-enforcement period had similar injuries, proportions that were not significantly different. Individual comparison for each AIS injury category did not also reveal any significant differences.

Further, the number of days of hospitalisation for the PSV crash victims did not show any reduction in the two policy enforcement periods. The patients stayed in hospital for a median of three days in both periods. These findings together suggest that there was no decline in injury severity from PSV crashes among patients admitted at the Rift Valley Provincial General Hospital in Nakuru following the enforcement of the Traffic Act. The result does not support previous statement on the reduction of RTI rates after enforcement of the Traffic Act (17, 18). The findings are also not consistent with the widely discussed observation that enforcement of road safety measures leads to a reduction in the burden of injury after road traffic crashes (13, 14). The results also contradict empirical evidence obtained elsewhere. For example a study in the United Arab Emirates showed that the proportion of moderate to fatal injuries declined from 54 percent to 17 percent and the median number of hospital bed days declined from five to three following the implementation of safety belt legislation (15). In the United States of America, the enactment of the Navajo Nation occupant and child restraint laws led to a reduction of injury severity in children zero to four years, that is, the median AIS score decreased from one point five (25th = 1, 75th = 3 percentile) to one (25th = 1, 75th = 2 percentile) (16). The reasons for having no decline in injury severity following the enforcement of the Traffic Act are not apparent. It is possible that there was an inadequate supply of PSV on the roads, dishonest operators tampered with speed governors and seatbelts were of sub-standard quality and were not frequently used, practices that would not guarantee safety in case of a crash (4, 10). The empirical data provided reveals that the magnitude of injury severity in the study area warrants more focused interventions.

In the post-enforcement period 20% of the admitted patients sustained multiple injuries compared to 17% in the pre-enforcement period, proportions that were not significantly different. The results indicate that injuries of the extremities are most common, followed by external injuries, head and neck injuries, chest injuries and abdominal injuries in that order, a pattern of the individual body regions injured that does not change significantly before and after the enforcement of the Traffic Act. The pattern is similar to that of patients admitted at Kenyatta National Hospital, Nairobi, where fractures contributed to 69% of the total injuries recorded while head injuries contributed to 25.6% (27). Other studies have also reported that fractures are pre-dominant in road traffic crashes (28). In this study, injuries were reported in all anatomical sites with the majority of the patients having injuries of the extremities. Identification of the injured anatomical site is critical as it can lead to serious consequences if neglected during primary survey and management of trauma

patients. The country's post crash care systems should therefore be made aware of the patterns of injuries in the human body following RTI. Further, the reasons for the above noted pattern of injured body regions require investigations.

The descriptive analysis of socio-demographic data in the pre- and post-enforcement periods revealed that the sex distribution of PSV crash casualties remained similar in both periods, with three quarters of victims being males. This finding is similar to that reported in the study in United Arab Emirates which found that the proportion of males before and after implementation of seat belt legislation remained above 80% (15). This result mirrors findings reported in previous studies in Kenya which show that men are over represented in road traffic crashes (6, 27, 28). This study recorded a mean age of 31.49 years (SD = 14.58 years) among the sampled patients, which was not statistically different before and after the enforcement of the Traffic Act. Further, the study established that the proportion of children aged below 18 years was not different before or after the enforcement of the Traffic Act. Together, these findings show that the enforcement of the Traffic Act did not alter the age profile of patients admitted at the Rift Valley Provincial General Hospital in Nakuru due to PSV crashes.

Several limitations should be considered when interpreting the results of this paper. The study is restricted to cases that were admitted at the Rift Valley Provincial General Hospital due to PSV crashes. Therefore, an increase or decrease in the rates of those who died prior to arriving in hospital or who did not require any hospitalisation could bias the results. The data were collected retrospectively from medical records. This resulted in failure to obtain important epidemiological information such as the use of restraints among PSV occupants, as such information is usually not collected.

This study demonstrates that there were no changes in injury severity levels among patients admitted at the Rift Valley Provincial General Hospital in Nakuru due to PSV crashes before and after the enforcement of the amended Traffic Act. It also shows that socio-demographic profile of these patients was similar in both periods. These observations warrant deeper reflection at the policy and research levels.

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