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Pattern of Pedestrian Injuries in the City of Nairobi: Implications for Urban Safety Planning

Japheths Ogendi, Wilson Odero, Winnie Mitullah, and Meleckidzedeck Khayesi

ABSTRACT *Pedestrians are overrepresented in road traffic injuries and deaths in Nairobi, the capital city of Kenya, yet little research has been done to provide better understanding of the characteristics of pedestrian injuries. This paper presents the data obtained from road traffic injury admissions to Kenyatta National Hospital (KNH) over a 3-month period starting from 1 June to 31 August 2011. A total of 176 persons involved road traffic injuries in Nairobi were admitted to KNH during this period. Pedestrians comprised the highest (59.1 %) proportion of road traffic injury admissions, followed by motor vehicle passengers (24.4 %) and motor cyclists (9.7 %). Bicyclists and drivers accounted for 5.1 and 1.7 %, respectively. Cars (39.4 %) were the leading category of motorized four-wheeler vehicles that were involved in collisions with pedestrians, followed by matatus (35.5 %). Seventy percent of pedestrians were hit while crossing the road, 10.8 % while standing by the road, and 8.1 % while walking along the road. The highest proportion of pedestrian crashes occurred on Saturdays (25.5 %) and Sundays (16.7 %). Most of the pedestrian injuries (67.7 %) affected the limbs. The paper argues that safety of pedestrians should be a priority in road safety efforts in the city of Nairobi. Urban road safety planners should adopt existing cost-effective interventions to improve the safety of pedestrians such as area-wide traffic calming to limit the speeds of motor vehicles to 30 km/h, providing sidewalks for pedestrians, traffic calming in residential neighborhoods, people-and-not-car-oriented urban road designs, traffic education, and enforcement of traffic regulations.*

KEYWORDS *Pedestrian injuries, Nairobi, Urban, Kenyatta National Hospital*

INTRODUCTION

Pedestrians, cyclists, and riders of motorized two-wheelers and their passengers account for about 46 % of global road traffic deaths.[1]. In sub-Saharan Africa, the incidences of road traffic crashes involving pedestrians are increasing fast on the urban roads.[2] Pedestrians are overrepresented in road traffic fatalities in most of the cities located in sub-Saharan Africa like Addis Ababa, Ethiopia,[3] and Kampala, Uganda.[4]

Though the existing levels of walking in Nairobi are high, estimated at 49 % of modal share of urban transport, safety for pedestrians remains an important concern.[5,6]

Ogendi is with the School of Public Health and Community Development, Maseno University, Maseno, Kenya; Odero is with the School of Medicine, Maseno University, Maseno, Kenya; Mitullah is with the Institute of Development Studies, University of Nairobi, Nairobi, Kenya; Khayesi is with the Department of Injuries and Violence Prevention, World Health Organization, Geneva, Switzerland.

Correspondence: Japheths Ogendi, School of Public Health and Community Development, Maseno University, Maseno, Kenya. (E-mail: ogendi2003@yahoo.com)

Although studies show that pedestrians are overrepresented in traffic fatalities and injuries in Nairobi City,[7–10] there is a general lack of published research work characterizing road traffic crashes involving them and providing details on the nature the pedestrian injuries. Some of the previous studies such as Ogendi et al.[8] and Khayesi[10] were based on police data. Police data have been reported to underestimate the magnitude of traffic injuries. Previous hospital-based epidemiological studies that examined the magnitude of pedestrian injuries in the city were undertaken in the Emergency Department of Kenyatta National Hospital[11] and Nairobi Hospital.[7] Whereas both studies provided useful information, they were limited by the kind of information that could be collected since both studies abstracted information from ED records without interviewing the road trauma casualties or their caretakers. Moreover, one of the two studies, by Gichuhi,[7] was limited by its setting in Nairobi hospital, a private health facility that predominantly caters for the higher social class. The findings based on this setting are unlikely to present true relative proportions of different categories of road users in Nairobi. The purpose of this study was to examine the characteristics of pedestrian road traffic injuries which occurred in Nairobi and admitted to Kenyatta National Hospital (KNH).

MATERIALS AND METHODS

This was a prospective study design in which all road traffic crash trauma cases that occurred in Nairobi City and admitted to KNH over a period of 3 months from 1 June to 31 August 2011 were enrolled.

Nairobi City has a land size of is 684 km^2, with a population estimated at 3.05 million by 2007.[12,13] It has approximately 12,145 km of roads of which only 8 % are classified as paved roads.[14] The road network is primarily composed of radial routes connecting surrounding regions to the central business district.[15] Infrastructure for walking is inadequate. A study which sampled six major roads in Nairobi, comprising a total distance of 51.4 km, revealed that only three crossing facilities were provided for and that left sidewalk was provided in a distance of 35.2 km (68.5 %).[16] The interaction between vehicles, users, and the road in Nairobi creates risks for pedestrians.[15] The speed limit within the boundaries of any trading center, township, municipality, or city is set at 50 km/h.[17] Walking is the dominant mode of transport used in Nairobi (49 %).[18]

KNH was chosen for this study because it is the largest public hospital in the city, is centrally located, and receives patients through the hospital's active Accident and Emergency Department on a 24-h basis. The hospital has 20 outpatient clinics, 50 wards, and 24 operating theaters with a total bed capacity of 1,804. It also serves as a general hospital for more than 3.0 million inhabitants in Nairobi and its neighboring areas.

A road traffic crash injury was defined as an injury which resulted from any vehicle crash, occurring on a road or highway, and which took place between two or more objects, one of which had to be any kind of moving vehicle.[19] A vehicle comprised any mechanically or electrically powered device, not operated on rails, and included cars, buses, trucks, vans, motorcycles, motorized three-wheeler, and bicycles.[19] *Matatus* are typically 14-seater minibuses, estimated to provide about 80 % of public transport trips in Nairobi.[15]

Road trauma admissions were identified every morning by research assistants. The research assistants were selected from among the staff members of the wards

and received a 2-h orientation session on the research objectives and data collection methods. Those who brought the trauma patients to the hospital, or the relatives taking care of the patients or the road trauma patients themselves, where possible, were interviewed to obtain information using structured questionnaires. Information on the dates of admissions and discharges and the nature of injury were obtained from the case notes in patients' files.

All the recruited trauma admissions were followed up daily by research assistants until the day of discharge, transfer to another hospital, or death. The information collected included patient's demographic characteristics, place and time of the crash, day of the week the crash occurred, date and day of admission and discharge, duration and outcome of admission, category of road user injured, class of vehicle involved, and the main type of injury that resulted in admission as reported in treatment files. Seventy-four pedestrian patient records were successfully matched with police data to analyze the movement activity of the pedestrians at the time of the collision. Road trauma admissions which occurred outside Nairobi or an injury on the road without involvement of a vehicle were excluded. All data were checked for accuracy and completeness by the principle investigator.

The data collected were analyzed using Statistical Package for Social Scientists for Windows version 10.0. Descriptive statistics were generated for demographic characteristics, category of road user, vehicle involved, day the injury occurred, duration of admission, and treatment.

Permission and ethical approval for the study were obtained from the National Council for Science and Technology and Ethics and Research Committee of Kenyatta National Hospital/University of Nairobi.

RESULTS

A total of 253 road traffic trauma cases were admitted to KNH during the study period. Of these admissions, 176 (69.9 %) were injured in crashes which occurred

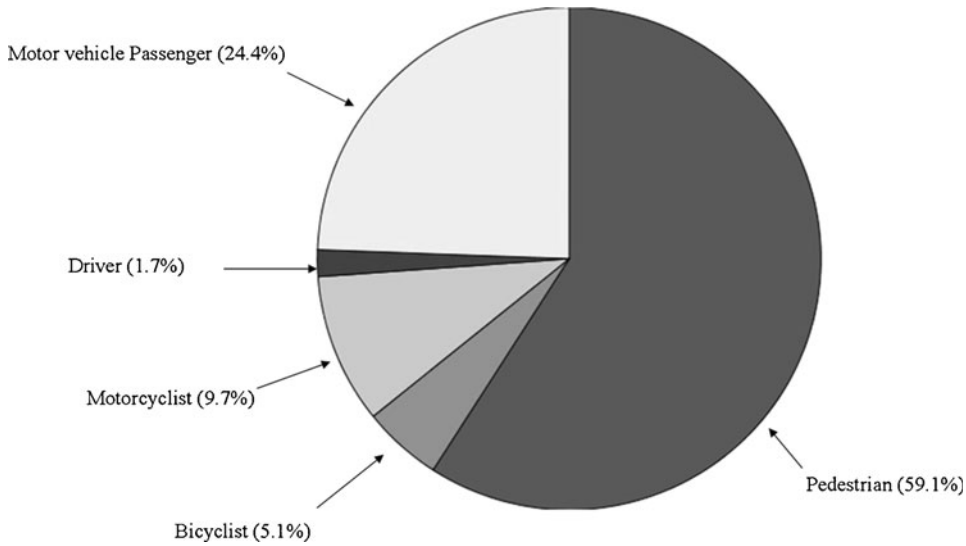

FIGURE 1. Proportion of road trauma admissions by road user categories, KNH, June–August, 2011.

within Nairobi City. The results presented in this section focus on these 176 road traffic injury patients that were admitted to Kenyatta National Hospital. A majority of cases were pedestrians (59.1 %) (Figure 1). Other road users in order of proportions were: motor vehicle passengers, 43 (24.4 %), motor cyclists 17 (9.7 %), bicyclists, 9 (5.1 %), and drivers 3 (1.7 %).

Characteristics of Pedestrians

The mean age of pedestrians was 31.48 years (SD±13.347) with a median age of 30. Eighty (76.9 %) of the admitted pedestrians were males with male to female ratio of 3.3:1 (Table 1). Seventy-seven (74 %) admitted pedestrians were discharged to go home alive, 13 (12.5 %) left the hospital against medical advice, and only 1 (1 %) case died at the hospital. At completion of the study, 12 (11.5 %) cases were still admitted at the hospital. Admitted pedestrians spent a minimum of 2 days and a maximum of 115 days in the hospital, with a mean length of stay of 31.74 days (±24.337). The highest proportion of pedestrian crashes occurred on Saturdays [26 (25.5 %)], followed by Sundays [17 (16.7 %)], and Fridays [16 (15.7 %)]. Saturdays and Sundays combined had a total of 43 (42.2 %) (Table 1).

Vehicles Involved

Cars were the leading [35 (37.6 %)] category of motorized four-wheeler vehicles that hit pedestrians, followed by matatus [33 (35.5 %)], buses [12 (12.9 %)], and lorries [9 (9.7 %)] (Figure 2). Public transport vehicles (matatus and buses) injured a total of 35 (48.4 %) of the admitted pedestrians. Other vehicles responsible for injuries were: pick-

TABLE 1 Characteristics of pedestrians injured admitted to KNH, June–August, 2011

Characteristic/parameter	Pedestrians (n=104)
Gender and age	
Proportion of men (%)	76.9
Mean age (SD)	31.5 (±13.347)
Median age (ı)	30.0
Length of hospital stays (LHS)	
Mean LHS (SD)	31.74 (±24.337)
Median LHS	27.00
Minimum LHS in days	2
Maximum LHS in days	115
Admission outcome, n (%)	
Discharged	77 (74.0)
Left against medical advice	13 (12.5)
Transferred to another hospital	1 (1.0)
Still admitted 2 weeks after study completion	12 (11.5)
Died in hospital	1 (1.0)
Day of the week the crash occurred	
Monday	11(10.8)
Tuesday	11 (10.8)
Wednesday	12 (11.8)
Thursday	9 (8.8)
Friday	16 (15.7)
Saturday	26 (25.5)
Sunday	17 (16.7)

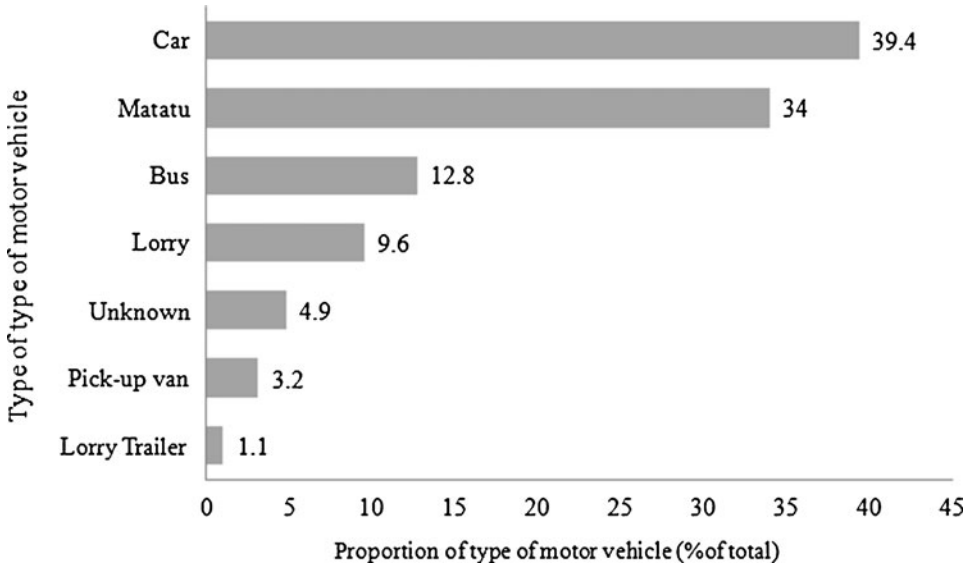

FIGURE 2. Proportion of motorized four-wheeler vehicles responsible for pedestrian injuries, KNH, June–August, 2011.

up vans [3 (3.2 %)] and lorry trailers [1 (1.1 %)]. Information on what pedestrians were doing at the time the crash occurred, corroborated with the police reports, was available from a total of 73 pedestrians and indicated that 53 (72.6 %) pedestrians were injured while crossing the road, 8 (11 %) were standing by the road while 6 (8.2 %) were walking along the road, and another 6 (8.2 %) were hit while engaging in other activities including hawking (Table 2).

Type of Injuries

Most of the injuries [65 (67.7 %)] occurred to both the upper and lower limbs, and ten (10.4 %) to the head and neck regions. Multiple injuries were reported in nine (9.4 %) cases (Table 3).

DISCUSSION

Our findings that pedestrians were the leading category of road users admitted to Kenyatta National Hospital comprising 59 % of all road trauma admissions is consistent with an earlier study in 2004 which reported that pedestrians represented 69.7 % of road trauma casualties treated at the hospital's emergency department.[7] A

TABLE 2 Pedestrians activity at the time of the crash, KNH June–August, 2011 (n=73)

	Frequency	Percentage
Crossing the road	53	72.6
Standing by the road	8	11.0
Walking along the road	6	8.2
Others (including hawking)	6	8.2
Total	73	100

TABLE 3 Injury distribution by body region, admitted pedestrians, KNH, June–August, 2011 (n=96)

Type of Injuries	Frequency	Percentage
Limb injury (upper and lower limb)	65	67.7
Head and neck	10	10.4
Multiple	9	9.4
Abdomen including lumbar spine and pelvic contents	5	5.2
Face	3	3.1
Thorax including dorsal spine	3	3.1
External (including skin and burns)	1	1.0
Total	96	100

hospital-based study in Kampala, Uganda reported comparable findings, indicating pedestrians as the leading category of road users (45.8 %) presenting with serious traffic injuries.[4] Most pedestrians (72.6 %) were hit while crossing the road, consistent with a previous study which reported that 62.5 % of pedestrians attended to at KNH Emergency Department were hit by motor vehicles while crossing the road.[7]

The findings of this study on the proportion of pedestrians admitted, however, are contrary to those of a study which noted that motor vehicle occupants constituted 70 % of road trauma cases that were treated at the Nairobi Hospital's Accident Center.[11] The possible explanation for this great divergence could be explained by the socioeconomic differences of the patients that are treated in the two hospitals. While Nairobi hospital is a private high cost hospital used mainly by the upper socioeconomic strata of the Nairobi population who largely use personal cars as a mode of transport, KNH, on the other hand, is a public health facility that largely caters for low-income individuals and those with middle socioeconomic status in Nairobi that use the private wing of the hospital.

Most of pedestrian injuries occurred on weekends with Saturdays and Sundays registering 42.2 % of pedestrian crashes. The demonstrated temporal clustering of pedestrian injuries during the weekends is consistent with the findings obtained from a review of epidemiological studies of road traffic injuries in developing countries which showed that an average of 52 % crashes occurred during the weekends.[9] Suggested reasons for this high incidence, in excess of the normal expectancy, include the effect of variations in traffic density.[9] Traffic volumes are generally low during weekends, since most people do not go to work. The drivers compensate reduced vehicular density with increase in speed of motor vehicles. Although the speed limit in all urban areas is set at 50 km/h, and various penalties are actually provided for in law,[17] the speed of motor vehicles in Nairobi can be as high as 90 km/h, if there is no congestion on the roads.[20] Enforcement of the speed limit remains a major challenge, and poor coordination between traffic control and the adjudication functions hinders effective law enforcement and traffic regulations.[21] The poor enforcement partly explains the fact that cars which constitute only 7 % of modal transport in Nairobi City are the leading (39.4 %) category of motor vehicle that hit pedestrians in the city of Nairobi. This calls, not only for effective enforcement, but a paradigm shift in the way the city is planned towards people-and-not-car-oriented urban designs.

The study has shown that majority of the pedestrians for whom complementary police data were available were hit when crossing the road. This finding helps to point out specific places that may require micro-level interventions. Whereas studies from other countries show that crossing the road poses greatest danger to pedestrians,[22] research in Kenya has not paid significant attention to this issue.

CONCLUSION

This study has shown that admitted pedestrians in KNH are the leading category of road users injured in traffic crashes, and cars are the leading category of motorized vehicle that hit pedestrians. Considering that the study limited itself to trauma cases admitted to KNH, the magnitude of pedestrian injuries and deaths in this study are an underestimate. The study did not cover cases treated and discharged at the emergency department and those who died either before reaching the hospital and/or at the ED. The study has also shown that most of the pedestrians were hit while crossing the road, although sizeable proportions are hit while walking along the road or standing by the road. These latter cases may to a large extent be due to poor enforcement and carelessness of drivers with many drivers driving on walkways and road reserves.

The findings of this study have implications for pedestrian safety policy in the city of Nairobi. The high proportion of pedestrian injuries observed in this study suggests that more work needs to be done to improve the safety of pedestrians in the city of Nairobi. Unsafe road is a disincentive to walking.[23] A number of cost-effective interventions exist which can be used to improve the safety of pedestrians in urban environments. Among these which road safety planners in the city of Nairobi can adopt include area-wide traffic calming to limit the speeds of motor vehicles to 30 km/h, providing sidewalks and other pedestrian facilities, traffic calming in residential neighborhoods, people-and-not-car-oriented urban designs, traffic education, and traffic regulations and enforcement. Currently, government agencies in collaboration with city authorities are retrofitting non-motorized infrastructure, including fixing barriers on major road corridors of the city aimed at protecting pedestrians from motor vehicles. This intervention is expected to improve the safety of pedestrians.

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