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Paediatric road traffic injuries in Lilongwe, Malawi: an analysis of 4776 consecutive cases

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Abstract

This was a retrospective review of all children aged ≤16 who were treated in the casualty department at the central hospital in Lilongwe, Malawi, between 1 January 2009 and 31 December 2015. A total of 4776 children were treated for road traffic injuries (RTIs) in the study period. There was an increase in incidence from 428 RTIs in 2009 to a maximum of 834 in 2014. Child pedestrians represented 53.8% of the injuries, but 78% of deaths and 71% of those with moderate to severe head injuries. Pedestrians were mostly injured by cars (36%) and by large trucks, buses and lorries (36%). Eighty-four (1.8%) children were brought in dead, while 40 (0.8%) children died in the casualty department or during their hospital stay. There has been a drastic increase of RTIs in children in Lilongwe, Malawi. Child pedestrians were most affected, both in terms of incidence and severity.

Keywords

Trauma, paediatric, Malawi, road traffic injuries, epidemiology, mortality, head trauma, injury mechanism

Introduction

Road traffic injuries (RTIs) are a major threat to the lives and health of children, particularly those living in low- and middle-income countries (LMICs). Although the incidence of RTIs has stabilised in high-income countries, it is still on the rise in LMICs.[1] In 2013, 93% of the estimated 220,064 child and adolescent RTI deaths worldwide took place in LMICs.[2]

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Malawi had 82,218 registered motor vehicles and a population of 10.7 million in 1995,[3] or 7.7 vehicles/1000 persons. In 2014, this number had increased to 26.7 vehicles/1000 persons.[1] Although this vehicular density is very low, Malawi's estimated RTI-related death rate of 35 deaths per 100,000 inhabitants per year is the third highest in the world after Libya and Thailand.[1] According to the same estimates, 66% of RTI fatalities in Malawi are cyclists or pedestrians, while the corresponding number for Europe is 30%.[1]

Prevention efforts aimed at RTI mortality have been very effective in high-income countries. However, strategies from high-income countries cannot be imported and implemented in resource-poor settings without a thorough evaluation and cost-benefit analysis.[4] Local RTI epidemiology is essential to developing effective country- and region-specific prevention strategies.

The aim of our study was to report on the patterns of paediatric RTIs in Lilongwe, Malawi, in order to enable appropriate focus for prevention strategies.

Methods

Ours was a retrospective review of data prospectively entered in the Kamuzu Central Hospital (KCH) trauma surveillance database. KCH is a 900-bed, public tertiary-care hospital in the capital city of Malawi, Lilongwe. It has an estimated catchment population of 6 million and serves as the referral hospital for eight district hospitals in the Central Region of Malawi, as well as a primary care hospital for the city's estimated 1.1 million inhabitants. The KCH trauma database contains demographic and clinical information on all injured patients seen in the casualty department. Our study was approved by the National Health Sciences Research Committee (approval no. 813). Trained data collection clerks track each trauma patient, from admission to final outcome.

All children aged ≤16 years at the time of their accident, who were entered into the database between 1 January 2009 and 31 December 2015, were included in the study. The whole cohort was analysed as a group, as well as by age and road user categories. Age categories corresponded to the Malawian school system: 0–6 years is pre-school; 7–12 years is primary school; and 13–16 years is secondary school. Road user categories were as follows: pedestrians; bicyclists (usually children using bicycle taxis, sitting on the bicycle rack behind an adult); car occupants; mass transport users (this reflects mainly minibus occupants and children riding on the open bed of lorries); and 'others' (ox cart riders, motorcycle passengers and autorickshaw users).

All analyses were done using STATA (StataCorp, 14.2, College Station, TX, USA) and SPSS (Version

Table 1. Characteristics of paediatric road traffic accident victims treated at Kamuzu Central Hospital, 2009–2015.

	Entire cohort	Pedestrian	Bicyclist	Car occupant	Public transport	Other
Total, n (%)	4776	2570 (53.8)	1303 (27.2)	421 (8.8)	332 (7.0)	150 (3.1)
Proportion of males (%)	64	62	68	62	56	89
Age (years)						
Median (IQ range)	8 (4–12)	8 (5–12)	8 (4–13)	8 (4–13)	9 (4–14)	10 (6–13)
Age categories						
Preschool, n (%)	1562 (32.7)	826 (32.1)	477 (36.6)	125 (29.7)	103 (31)	31 (20.7)
Primary school, n (%)	1915 (40.1)	1191 (46.3)	408 (31.3)	152 (36.1)	103 (31)	61 (40.7)
Secondary school, n (%)	1299 (27.2)	553 (21.5)	418 (32.1)	144 (34.2)	126 (38)	58 (38.7)
GCS on presentation						
13–15, n (%)	2086 (96.8)	1045 (95.5)	651 (99.2)	134 (95.7)	182 (96.8)	74 (96.1)
9–12, n (%)	17 (0.8)	9 (0.8)	–	3 (2.1)	2 (1.1)	3 (3.9)
3–8, n (%)	52 (2.4)	40 (3.7)	5 (0.8)	3 (2.1)	4 (2.1)	–
Initial outcome in casualty						
Discharge from casualty, n (%)	3616 (76.1)	1912 (74.7)	1045 (80.6)	319 (76.7)	247 (74.6)	93 (62.4)
Admitted to ward, n (%)	937 (19.7)	501 (19.6)	243 (18.7)	78 (18.8)	64 (19.3)	51 (34.2)
Admitted to HDU/ICU, n (%)	104 (2.2)	67 (2.6)	8 (0.6)	13 (3.1)	14 (4.2)	2 (1.3)
Died during initial evaluation, n (%)	12 (0.3)	10 (0.4)	–	–	2 (0.6)	–
Brought in dead, n (%)	84 (1.8)	70 (2.7)	1 (0.1)	6 (1.4)	4 (1.2)	3 (2.0)
Final outcome						
Died after transfer from casualty, n (% of total)	28 (0.6)	17 (0.7)	4 (0.3)	3 (0.7)	3 (0.9)	1 (0.7)

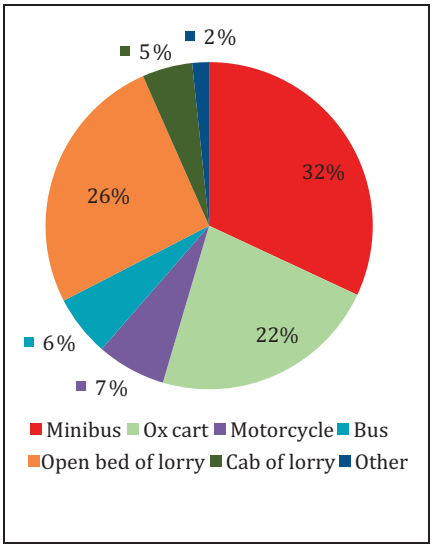

Figure 1. Paediatric public transport RTI victims, type of public transport.

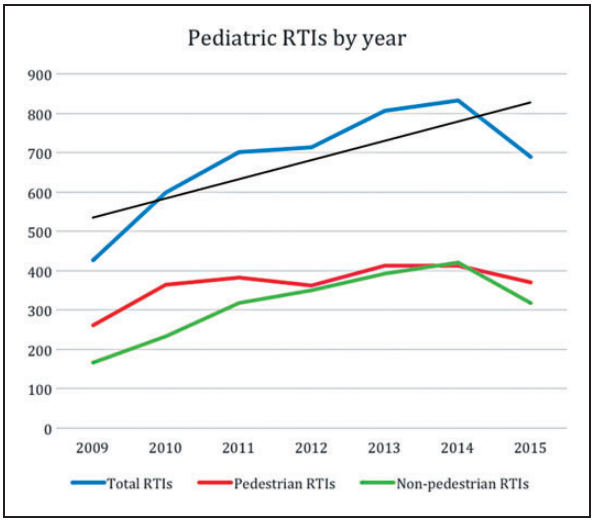

Figure 2. Annual number of pedestrian and non-pedestrian paediatric RTI victims treated at Kamuzu Central Hospital, 2009–2015. The straight line is linear regression curve estimation confirming apparent increase ($P = 0.042$).

22, IBM Corporation, Armonk, NY, USA). Medians are presented with interquartile ranges (IQR). Some patients had missing data; these patients are still included in the analyses where data were present.

Results

A total of 98,642 patients with traumatic injuries were registered over seven years, of whom 35,653 (36.1%) were children aged 0–16 years. Among paediatric trauma cases, 4776 (13.4%) were due to RTIs. These had a male preponderance (64%). Their median age at injury was eight years (IQR = 4–12). Table 1 shows the age categories, the Glascow Coma Scale at admission and final outcomes for the different road user categories; discrepant totals in each category versus total recorded RTIs are due to missing data. A breakdown of the different public transportation vehicles used by children when injured is seen in Figure 1.

There was a steady increase in the incidence of paediatric RTIs in the study period (Figure 2), from 428/year in 2009 to a high level of 834/year in 2014 and declining slightly to 690/year in 2015. Both girls and boys showed an approximately bimodal age distribution of RTIs, with peaks occurring at the age of 4–6 years and then again at 12–15 years (Figure 3).

Types of injuries

The 4776 paediatric RTI victims had a total of 7057 injuries recorded, the majority (4999, 70.8%) of which included a diagnosis of soft-tissue damage (contusions, lacerations, burns or abrasions); 1339 (19%) were orthopaedic (fractures, dislocations or traumatic amputations); and 528 (7.5%) were head or spinal injuries. Of patients, 1864 (39%) had at least two injuries recorded and 449 (9.4%) patients had three injuries recorded.

Almost half (249, 47.2%) of the children with a primary neurologic injury had at least one other injury, and 86 (16.3%) had at least three injuries recorded. The most common secondary or tertiary injuries for children with a primary injury to the head or spine were soft-tissue injuries (206, 61.5%), orthopaedic injuries (87, 26%), and injuries to internal organs (32, 9.6%).

Outcomes

A total of 3616 (75.7%) children were treated for their RTI trauma in casualty and discharged; however, 1041 (21.8%) were admitted. Of these, 937 (90%) were admitted to regular ward care and 104 (10%) to the Intensive Care Unit (ICU) or High Dependency Unit (HDU). The median length of stay for all admitted patients was eight days (IQR = 3–20), seven days (IQR = 3–20) for those admitted to ward care and 11 (IQR = 3–24) for those admitted to higher levels of care (ICU/HDU).

Eighty-four children (1.7%) were brought in dead, 12 died in casualty during initial evaluation and a further 28 deaths were recorded later during the hospital stay, giving a 0.8% mortality for those arriving alive to the hospital and a total mortality of 2.6%. The mortality of the children who were not discharged from casualty but admitted for in-hospital treatment was 3.8%. Pedestrians accounted for 97/124 (78%) deaths

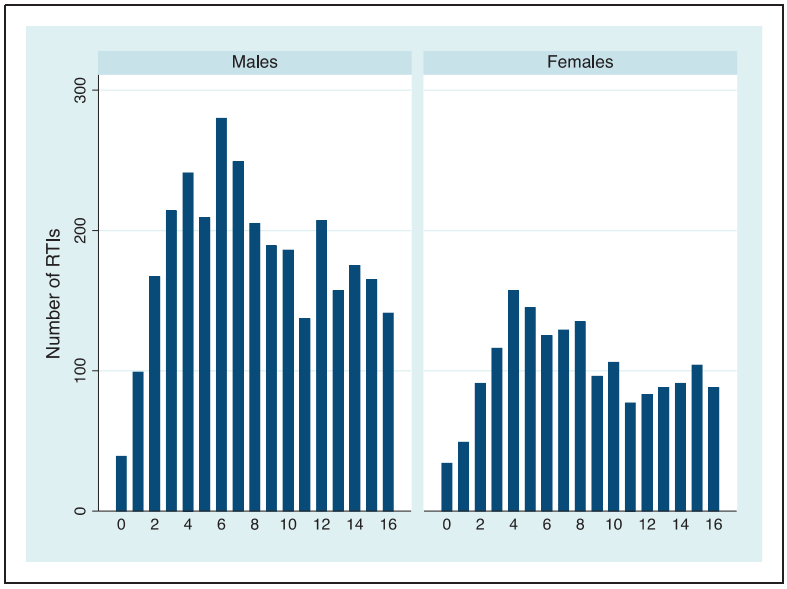

Figure 3. Age distribution of paediatric RTI victims treated at Kamuzu Central Hospital, 2009–2015.

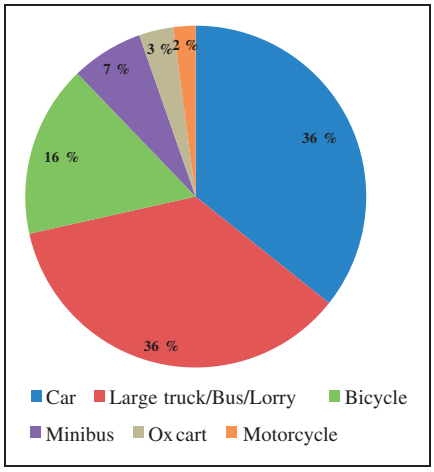

Figure 4. Mechanism of injury in paediatric pedestrian RTIs.

recorded, being 50/1707 girls (2.9%) and 74/3044 boys (2.4%) ($P = 0.3$).

Pedestrian injuries

Of injured pedestrians, 62% were boys. The vehicles involved in the injury of child pedestrians are tabulated in Figure 4.

Pedestrians were more likely than non-pedestrians to suffer multiple injuries, with 1196 pedestrians and 668 non-pedestrians (46.5% vs. 30.2%, $P \leq 0.001$) having a second injury, and 310 (12.1%) vs. 139 (6.3%) having a third injury. Child pedestrians were nearly twice as likely as non-pedestrians to suffer a head or neck injury (294 [11.5%] vs. 135 [6.2%], $P \leq 0.001$). Pedestrian RTI victims had the highest mortality (3.8%) of all road traffic user categories.

Bicycle riders/passengers

Out of all RTIs, 27.2% involved bicycle riders or passengers, excluding pedestrians hit by a bicycle. We saw more bicycle injuries in pre-school and secondary school children, than in primary school children. In contrast to pedestrians, bicyclists had the lowest overall mortality (0.4%) of all road traffic user categories (Table 1).

Neurological injuries

Under half (n = 2155) had an initial Glasgow Coma Score (GCS) recorded, the majority (96.8%) presenting with no or mild neurological deficit (GCS 13–15). More pedestrians than non-pedestrians presented with a severe head injury (GCS ≤ 8) on initial evaluation (40 [3.6%] vs. 12 [1.1%], $P \leq 0.001$). Of the 69 children with a GCS ≤ 12 on admission, 49 were pedestrians while 20 were non-pedestrians (4.5% vs 1.9%, $P \leq 0.001$).

Discussion

In this study, we observed a rapid increase in the number of paediatric RTIs from 2009 to 2015. Our study showed clearly that child pedestrians suffered the largest number of injuries, the most severe injuries and the highest mortality. Pedestrians represented 53.8% of paediatric RTI victims, but 78% of deaths

and 71% of those with moderate to severe head injuries. We also found that pedestrians were mostly hit by cars (36%) and by large trucks, buses or lorries (36%). According to official statistics, heavy trucks and buses comprise only 20% of four-wheel motor vehicles in Malawi,[1] the remaining 80% comprising minibuses and cars in an unknown ratio. In our study, however, heavy trucks, lorries and large buses were responsible for 46% of the injuries to pedestrians caused by four-wheel motor vehicles, making these heavy vehicles clearly more liable to cause injury.

Our findings suggest that efforts to prevent paediatric RTIs in Malawi should be primarily aimed at pedestrians and bicyclists. Specifically, interventions that are likely to result in the most harm reduction should aim at preventing cars, minibuses and especially large vehicles from hitting these vulnerable road users.

There are several pedestrian RTI prevention measures that are estimated to be cost-effective in LMIC settings. These include erecting speed bumps,[5,6] enforcing speed limits[7] and passing and enforcing strict legislation to prevent drunk driving.[8] Reducing the speed limit around schools and play areas is also a recommended intervention to prevent paediatric traffic injuries.[9] Increased presence of traffic police has also been shown to be effective in Uganda[10] and Iran.[11]

In this pedestrian population, with a predominance of school-aged children, educational efforts aimed at both the children and their caregivers may help reduce RTI, but evidence for the reduction of injuries by this intervention alone is lacking.[12] A recent controlled study from Tanzania demonstrated the effectiveness of a combined programme of education and simple infrastructure modifications on paediatric RTIs around schools, especially on motorcycle–pedestrian RTIs and private vehicle–pedestrian RTIs.[13]

We have no data indicating the role of alcohol in this study, but alcohol-related RTIs are a well-documented problem in other African countries,[14–16] and a recent study from our hospital showed that alcohol was involved in about 9.5% of admissions for all types of adult injuries.[17] The WHO recommends strong policies and enforcement of drunk driving laws[1,18] and this would likely improve the safety of all road traffic users, but further studies on alcohol use in Malawian drivers are needed.

It is important to note that even if the pedestrians constitute the largest group, there are also a significant amount of injuries sustained by paediatric car passengers. Children who were passengers in cars represented 8.8% of the injuries and 7% of deaths. These figures are also very likely to increase, as the number of cars on the roads in Malawi is growing rapidly.

Appropriate use of seat belts and child restraints will be highly effective in preventing injuries and deaths.[19] Seat belt laws exist[20] but are not enforced. Improved legislation and enforcement concerning these issues are shown to be effective in reducing deaths and severe injuries elsewhere[21–23] and should be implemented as soon as possible in Malawi.

A similar increase is anticipated also in motorcycle RTIs; these vehicles are currently quite rare in Malawi. With only 2% of paediatric pedestrian injuries caused by motorcycles, the country currently escapes the high burden of mortality and morbidity from motorcycle related RTIs compared to other countries in sub-Saharan Africa.[24–26] However, with increased economic growth a rapid increase in motorbike sales and concomitant associated trauma is anticipated in Malawi in the near future, and proactive development and enforcement of evidence-based legislation are necessary to prevent the mortality and morbidity that is anticipated.

Modifications of roadway infrastructure are less studied but are also likely to be effective. For example, the physical separation of pedestrian and vehicular traffic on raised pavements or sidewalks lessens pedestrian traffic on roadways. Our experience suggests that many pedestrians are injured while trying to cross the roads. The provision of sufficient numbers of raised pedestrian crossings in the cities and trade centres along the highways, preceded by speed bumps to slow down traffic, would most likely be an effective intervention.

Although we do not have precise details of the circumstances surrounding the 36% mass transport RTIs that involved large trucks, lorries and buses, roadway quality and driver factors are likely relevant, in addition to small children not being easily visible to the drivers on crowded roads. The alertness, training and sobriety of the drivers of these vehicles, the roadworthiness of the vehicles and the condition of roadways should be addressed by legislation and police enforcement.

Of the registered deaths in this study, 68% were dead on arrival at the hospital. Many severely injured children most likely never make it to our referral centre and so mortality figures are probably even higher. Severely injured children are more likely to die at the scene or before transfer to a centre with a trauma service, as Malawi has no formal system of prehospital trauma care, making transport of the gravely injured child to the hospital a challenging endeavour.[27,28] Secondary prevention efforts must target this,[29] along with improvement of the surgical emergency services and the surgical workforce situation in the hospitals.

The strengths of this study include its duration, large number of cases, prospectively collected data, and thorough and independent data registration procedures. Limitations include the usual limitations of a

retrospective registry study, as well as the lack of prehospital data.

Conclusion

Paediatric RTIs in Lilongwe, Malawi, increased rapidly from 2009 to 2015. Child pedestrians were most affected, both in terms of incidence and severity. Large trucks, buses and lorries were responsible for a disproportionately large number of injuries. Of deaths, 68% occurred in the prehospital period, a number that surely is higher in reality as all data are collected in-hospital. Preventive measures are urgently needed.

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