Pedestrian injuries in school-attending children: a comparison of injury data sources in a low-income setting

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ABSTRACT

Objective: To estimate and compare the rate of pedestrian injuries in primary school-attending children of urban Uganda using different data sources.

Design: Data collection from a hospital-based trauma registry, police data, teacher reports, and a cross-sectional community-based survey.

Setting: Kawempe, the largest urban district in the capital Kampala, Uganda.

Patients or subjects: Primary school-attending children aged 4–12 from 39 randomly selected schools were included in the trauma registry, police data, and teacher reports. 1828 households randomly selected from the 39 schools were interviewed for the community survey.

Main outcome measure: A pedestrian injury. For the trauma registry—defined as a pedestrian injury resulting in a visit to the hospital. For the police data—defined as a pedestrian injury reported to the police. For the teacher reports and survey—defined as a pedestrian injury resulting in at least a day off school.

Results: The estimated pedestrian injury rates per 100 000 person-years were 54.0 (95% CI 25.3 to 117.4), <53.97 (95% CI 23.8 to 125.9), 1878.8 (95% CI 1513.1 to 2322.4), and 764.0 (95% CI 523.3 to 1117.2) from the trauma registry, police data, teacher reports, and community survey, respectively.

Conclusions: Pedestrian injury rates differed significantly between different data sources. Users must be aware of the different target populations, definitions, and limitations of the data sources before direct comparisons are made. Injury reports by volunteer teachers may be a feasible source of injury data in other low/middle-income countries.

Road traffic injuries (RTI) are one of the leading causes of death and Disability Adjusted Life Years (DALYs) lost among children aged 0–14 years of age globally.[1] Unfortunately, the burden of disease falls disproportionately on low/middle-income countries,[2] where 96% of all child RTI fatalities occur, with a majority (>60%) of children being injured as pedestrians.[3] Worse, the burden of injury is expected to increase by up to 80% between 2000 and 2020 in low/middle-income countries as development and motorization levels accelerate.[4] Research into child RTI in low/middle-income countries, particularly child pedestrian injuries, has been minimal.[5 6] Clearly, there is an urgent need to increase research and implement interventions in road safety for children in low/middle-income countries.

However, one of the first steps in identifying priorities and allocating resources is the development of accurate and comprehensive injury data sources.[2] Injuries sustained by children, particularly pedestrian injuries, are prone to be under-reported by the most commonly used data sources, namely police data[7–10] and community surveys.[11–13] Although hospital-based registries are often used as the gold-standard in high-income countries, issues unique to low/middle-income settings also limit the use of this data source.[14] Child injury reporting by teachers can therefore be an innovative alternative in low/middle-income countries with limited resources but a huge burden of child pedestrian injuries, especially if a large percentage of the children attend school and if interventions are planned at the school level.[15 16] In addition, studies in high-income and low/middle-income countries have confirmed that school-related travel is dangerous for children, resulting in 33 to over 50% of all child pedestrian injuries.[17 18] Given the known shortcomings of the aforementioned injury data sources, a study conducted in a low/middle-income setting to evaluate and compare these different data sources would be important.

Uganda is a low-income country predominated by a young population (52% under the age of 15),[19] high vehicle ownership,[20] and one of the highest estimated rates of deaths per 10 000 vehicles in the world.[21] Furthermore, all children of school-going age have had access to primary school education since the 1996 implementation of the Universal Primary Education (UPE) program in Uganda. In fact, an estimated 82% of children aged 6–12 attended school in 2006 (88% urban, 81% rural, 81% female, 82% males).[19] Given this environment and the paucity of studies available on child pedestrian injuries and their data sources in low/middle-income countries, we undertook this study to estimate and compare the rates of pedestrian injuries in primary-school-attending children of urban Uganda using different injury data sources.

METHODS

Study setting

Kawempe is the largest district in the capital of Kampala with an estimated population of 1 million. Similar to other low/middle-income countries, Kawempe has a young (>50% of population <14 years old) and heterogeneous (mixture of urban/rural inhabitants, different ethnic/religious groups) population, and is in a state of rapid development and urbanization.

Definition of pedestrian injury

We sought to measure and compare pedestrian injury rates in primary school-attending children

aged 4–12 captured via hospital records, police records, community surveys, and teacher reports. A priori, we decided that a pedestrian injury was significant if it resulted in at least one day off from regular activity, which in this study would be a day off of school. This definition is consistent with previous injury studies in low/middle-income settings,[13 22] where formal medical care may not be regularly sought regardless of the severity of the injury.[14] However, given that the hospital registry and the police data were designed to capture the injuries that present to the hospital and the police, respectively, the definition of the cases captured by those data sources is therefore: a pedestrian injury resulting in a visit to the hospital/reported to the police.

Sample size calculation

There are 250 primary/nursery schools distributed evenly across 18 of the 19 sub-divisions of Kawempe, each with approximately 550–700 pupils per school. There is no national census in Uganda, and hence weighting could not be conducted to ensure accurate representation. Instead, we randomly selected two or three schools per subdivision (see sampling strategy below) to obtain 42 schools to yield a total sample of approximately 20 000 students. Assuming a traffic injury rate of 660 per 100 000 children (with a large percentage being pedestrian injuries),[20] and approximately 20% seeking formal medical care (likely at the main regional hospital—Mulago Hospital),[14] we would expect to identify approximately 100 injuries from teacher reports, approximately 20 injuries from hospital records, and likely similar numbers from police data. For the community survey, using the same previously estimated child road-traffic injury rate in Kampala by Kobusingye *et al* in 2001 of 660 per 100 000 and an estimated 4.5 children per family,[19] we would expect to identify approximately 60 injuries by surveying 2000 households.

Recruitment and sampling strategy

- School sampling (for hospital registry, police data, and teacher reports): Using the RAND function on Excel, 2 schools were randomly selected from each subdivision, and a third school was selected from the six subdivisions with a higher number of schools, resulting in a total of 42 schools. The schools were contacted for their involvement in the study, and after approval was obtained, a student/parent letter was sent home to all of the students, and complete lists of enrolled children were obtained from the school headmasters.
- Household sampling (for survey): The lists of enrolled children obtained from the selected schools were then entered into the computer, and based according to the number of children currently enrolled (numbers ranged from 250 to 8000 for the 39 schools), a weighted proportion of students was randomly selected from each list. Using the RAND function on excel, the students within each school were picked based on a random number between 1 and the number of students in that school. A final list of 2500 students whose households are to be targeted for the survey was achieved, and they were contacted for consent and participation.

Ethics

Ethics approval was obtained at the Hospital for Sick Children and the University of Toronto in Canada. Permission was also obtained from the local authorities in Kampala.

Data sources

Hospital-based trauma registry

Mulago Hospital, a 1500-bed government-run tertiary care and teaching facility in Kampala, is the national referral hospital, with a catchment area that covers the entire Kampala (including Kawempe district). All patients are first seen in the accident and emergency department, and all trauma patients are triaged into the surgical section and entered into the trauma registry by trained nurses and clinical officers (medical assistants). The trauma registry, a one-page, 21-item registry form collecting data on demographics, causes of injury, anatomic and physiologic injury information, and disposition, has been operating at Mulago hospital since 1996.[23] From September 2004 to September 2005, a supplementary form was added to collect data on child pedestrian injuries, and consent was obtained from the parent or care giver.

Police data

The Chief of Police at the Kawempe traffic office authorized the sharing of collected data on child pedestrian injuries. Police officers were requested to obtain details about the school attended from all children injured as a pedestrian from October 2004 to July 2005. The reporting of traffic incidents is not mandatory in Uganda.

Teacher reports

Two volunteer teachers at each of the selected schools were enlisted, trained, and compensated to identify and report on the number of students who sustained pedestrian injuries from October 2004 to June 2005, excluding the holiday months of December, January, and May (see School Data Collection Form, appendix 1).

Community-based survey

Data collectors were enlisted and trained to administer questionnaires to the primary care giver or most eligible adult in the 2500 households of the randomly selected pupils from October 2004 to March 2005. A household was defined as one or more persons living together and sharing meals at least four times a week. Information was collected on all of the children residing within the household about pedestrian injuries sustained over the 12 months, and pedestrian injuries resulting in a death or permanent disability over the lifetime of the child. Only injuries sustained by school-aged children (4–12 years old) were used in the final analysis.

Data management and analysis

The study coordinator reviewed data collected from the hospital every 2 weeks, the police and teacher reports every month, and the survey results every third day to enhance trouble-shooting and ensure accuracy. At the end of the study, surveys were repeated in 5% of the households, and the correlation with the original findings was found to be very high. Data were entered electronically by trained personnel, 10% of the data were re-entered, and the accuracy was found to be very high. Rates were standardized as rates per 100 000 person-years.

RESULTS

A total of 42 schools were contacted for involvement in the study, three of which refused due to shortage of staff, resulting in the collection of data on a total of 11 117 school-aged children for the hospital-registry and police data. Of these 39 schools, 33 schools had teachers participating in injury reporting, resulting

in the collection of teacher report data on a total of 8516 students. For the survey, a total of 2000 households were contacted, of which 1967 gave consent, and 1879 surveys had complete information. A total of 1380 (73.4%) households had school-aged children (aged 4–12), resulting in information on 3403 school-aged children. The calculated pedestrian injury rates for primary school-attending children and confidence intervals for the different data sources are summarized in table 1. Further details on the pedestrian injuries are listed in table 2.

Hospital-based trauma registry

During the study period of 1 year, Mulago hospital treated a total of 417 children. Of the 281 (67.3%) primary school-aged children, 74 (26.3%) sustained pedestrian injuries, of whom six were students from the selected schools. The estimated pedestrian injury rate was therefore 54.0 (6/11 117, 95% CI 25.3 to 117.4) per 100 000 person-years.

Police data

A total of 52 pedestrian injuries were reported during the study period of 10 months, 37 (71.2%) of which occurred within school-aged children. However, we could not determine whether 27 (73.0%) of the injured children were from the selected schools because this information was missing. Of the remaining 10 (27.0%) children with school information, fewer than five were within the selected schools (actual data suppressed due to small cell sizes). The estimated pedestrian injury rate was therefore <53.97 (<5/9264.16, 95% CI 23.8 to 125.9) per 100 000 person-years.

Teacher reports

There was a total of 80 pedestrian injuries recorded over the school year of 6 months, yielding a pedestrian injury rate of 1878.8 (80/4258, 95% CI 1513.1 to 2322.4) per 100 000 person-years. Data were not recorded in six schools for 2 months, and so this rate was likely an underestimate.

Community-based survey

There were 26 pedestrian injuries that required at least 1 day off school over the past year, and one death and 15 permanent disabilities that occurred over the lifetime of the children. The estimated annual pedestrian injury rate was 764.0 (26/3403, 95% CI 523.3 to 1117.2) per 100 000 person-years, and the pedestrian death rate was 29.4 (1/3403, 95% CI 7.1 to 163.6) per 100 000 students. Assuming a constant risk per year from age 4 to 12, 68 children per 1000 or one in 14 school-aged children will have a pedestrian injury severe enough to warrant a day off school during their primary school years.

DISCUSSION

Child injuries, particularly pedestrian injuries, are often under-reported by the conventional methods of injury-data collection.[7–13] This under-reporting is further exacerbated in a low/middle-income setting, where concerns of access and infrastructure can further undermine accurate injury-data collection.[2 14] In our study, we sought to compare the rate of pedestrian injuries in primary-school-attending children estimated through four different injury-data sources in a low-income country, that is: hospital-based trauma registry, police data, teacher reports, and a community-based survey. As expected, given the different definitions of what constituted a pedestrian injury, rates were found to vary significantly between data sources. Rates estimated by the hospital-based trauma registry were found to be similar to those of the police data, that is 54.0 (95% CI 25.3 to 117.4) and <53.97 (95% CI 23.8 to 125.9) per 100 000 person-years respectively. In contrast, despite having the same definition of a pedestrian injury (ie, an injury requiring at least one day off of school), the community survey was found to have substantially underestimated the rate when compared to the teacher reports, that is 764.0 (95% CI 523.35 to 1117.2) and 1878.8 (95% CI 1513.1 to 2322.4) per 100 000 person-years respectively. Interestingly, our survey data are comparable to previously published survey data from Kampala of an annual injury rate (all road-traffic injuries including pedestrian injuries) of 660.0 per 100 000 children.[20]

As stated, pedestrian injury rates reported by the hospital-based trauma registry and the police data were significantly lower than those reported from the survey and teacher reports. Underestimation of RTI rates ranging from 63 to 89% by hospitals and from 18 to 97% by the police have been documented in both high-income countries[7 24] and low/middle-income countries,[8] with child, pedestrian, and less severe injuries being at highest risk of underestimation. Reasons for underestimation by the police can vary from the failure to report to the police to failure of the police to record the incident.[8] Underestimation by the hospital trauma registry in low/middle-income countries is likely due to low hospital utilization rates, which has been found to range as low as 12–51%, regardless of injury severity. Reasons for this include financial constraints, lack of transportation/access, and cultural preferences.[14] Similarly, in our survey, only 65.4% of injured pedestrians sought formal health services, of which 70.6% attended Mulago hospital. Despite the significant rate of underestimation in comparison with other data sources, hospital records and police data remain the most common source of injury data in low/middle-income countries,[5 6 23] due to accessibility and minimal utilization of additional resources. It is thus essential that users be aware of the shortcomings of these two data sources, particularly in a low/middle-income setting, since the injury rates resulting from these sources may be severely underestimated.

As a result of the above-mentioned limitations, community-based surveys have often been advocated as gold-standards for injury reporting in low/middle-income countries.[2 22] In our study, however, the rate detected by the survey was significantly lower than the rate detected by the teacher reports, despite having the same target population. This is likely due to several reasons. First, the survey was only conducted on a subsample of students from the selected schools, for which,

Table 1 Injury rates in primary school-attending children (aged 4–12) per 100 000 person-years, estimated using different injury data sources

Injury data source	Study period (no of months)	No of school-aged children	Total no of person-years	No of pedestrian injuries	Estimated pedestrian injury rate/100 000 person-years
Hospital-based trauma registry	12	11 117	11 117.0	6	54.0 (95% CI 25.3 to 117.4)
Police data	10	11 117	9264.16	<5	<53.97 (95% CI 23.8 to 125.9)
Teacher reports	6 months	8516	4258.0	80	1878.8 (95% CI 1513.1 to 2322.4)
Community-based survey	12 months	3403	3403.0	26	764.0 (95% CI 523.3 to 1117.2)

Table 2 Details of pedestrian injuries by different data sources

	Data source, no (%)		
	Hospital-based trauma registry	Teacher reports	Community-based survey
Age (years)		NA	
4	0		0
5	1 (16.7)		1 (3.8)
6	2 (33.3)		2 (7.7)
7	0		7 (26.9)
8	1 (16.7)		1 (3.8)
9	0		4 (15.4)
10	1 (16.7)		0
11	0		1 (3.8)
12	1 (16.7)		9 (34.6)
Missing data	0		1 (3.8)
Gender		NA	
Male	2 (33.3)		17 (65.4)
Female	4 (66.7)		8 (30.7)
Missing data			1 (3.8)
Child was struck by			
Car	4 (66.7)	14 (17.5)	9 (34.6)
Motorcycle	0	33 (41.3)	11 (42.3)
Bicycle	0	26 (32.5)	5 (19.2)
Unsure	2 (33.3)	0	0
Missing data	0	7 (8.8)	1 (3.8)
Destination		NA	
Going to school	1 (16.7)		7 (26.9)
Coming from school	1 (16.7)		9 (34.6)
Not related to school	2 (33.3)		10 (38.5)
Missing data	2 (33.3)		0

Police data suppressed due to small cell size.

despite the students being randomly selected, there could have been systematic differences that made their risk of injury lower than the rest of the students. Second, the survey was conducted with the most responsible care giver of the household, and this proxy responding by the care giver on behalf of the children may result in underestimation.[11] Third, the survey relied on self-report and a recall of all injuries over the past year and severe injuries resulting in permanent disability or death over the lifetime of the child. Underestimation can occur from recall bias, which has been demonstrated to decrease injury-rate detection by up to 76% when a 1-year versus 1-month recall period is used.[12 13 26] It has therefore been recommended that the most recent month of recall time be used, to estimate annual minor injury rates, and the 1-year recall time to estimate annual major/fatal injury rates.[26]

Injury reporting by teachers is an innovative alternative that in our study yielded very high rates. Despite the well-recognized limitation that data collection would be restricted to children who attend school and to the school year, it is well known that at least 25–50% of child pedestrian injuries occur during school-related travel.[17 18] In our study, the relatively limited financial and time investment (in comparison with the survey) required suggests that teacher reports are a feasible and possibly cost-effective injury data source that may be applicable in other low/middle-income countries with large school-attending populations of children. In addition, if a school-based intervention to minimize pedestrian injuries is proposed, school-based data collection to evaluate its effectiveness makes sense.

This study demonstrated the vastly different child pedestrian injury rates that one can obtain when different data sources are used in a low-income setting. An important limitation from our study was that we failed to obtain information from the teacher reports regarding the details of each injury and whether medical attention was sought. If this information had been available, we could have used the seeking of medical attention as a proxy for the severity of the injury, and compared the rates therein between the different data sources. Mock *et al* demonstrated, in 1997,[14] that the seeking of medical care in a low-income setting is complicated by other issues that may compromise such a comparison. However, despite limitations in medical diagnoses from non-medical data sources, this study does highlight the important point that the source of the data is very important, and numbers can vary greatly depending on the source. Since the majority of the injury data in low/middle-income settings are currently derived from hospital-based registries or surveys,

Key points

- Child pedestrian injuries are a serious and growing problem in low/middle-income countries.
- Child pedestrian injuries are often under-reported in the most commonly used injury data sources—for example: hospital registries, police data, and community surveys.
- Different injury data sources are designed to capture different injured populations, and users must be aware of these discrepancies before direct comparisons are made.
- Pedestrian injuries sustained by school-attending children can be adequately captured by volunteer teacher reports, which may be a feasible alternative injury data source in other low/middle-income countries.

one must be careful before directly comparing rates generated from these two very different resources.

CONCLUSIONS AND RECOMMENDATIONS

Different injury data sources can yield substantially different injury rates, and users must be aware of these discrepancies before direct comparisons are made. Injury reporting by volunteer teachers was feasible and possibly cost-effective, and may be a useful data source for child pedestrian intervention studies in other low/middle-income countries.

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Contributors: AWH conceived and designed the study, and is the guarantor of this paper. AM participated in study design, study implementation, data collection, and data analyses. MM and MN participated in the planning, supervision, and implementation of data collection. PPSL and LR participated in data analyses and manuscript composition. All of the authors critically reviewed the manuscript and approved the final version for publication.

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Notes