Childhood injury in Tower Hamlets: Audit of children presenting with injury to an inner city A & E department in London

Introduction: Childhood injury is a leading cause of mortality and morbidity worldwide with the most socio-economically deprived children at greatest risk. Current routine NHS hospital data collection in England is inadequate to inform or evaluate prevention strategies. A pilot study of enhanced data collection was conducted to assess the feasibility of collecting accident and emergency data for national injury surveillance.

Aims: To evaluate the reliability and feasibility of supplementary data collection using a paper-based questionnaire and to assess the potential relationship between income deprivation and incidence of paediatric injury.

Methods: Clinical staff conducted an audit of injuries in all patients under 16 years between June and December 2012 through completion of a questionnaire while taking the medical history. Descriptive statistics were produced for age, sex, time of arrival, activity at time of injury, mechanism and location of injuries. The association between known injury incidence and area level income deprivation (2010 English Index of Multiple Deprivation [IMD] Income Deprivation Domain from home postcode) was assessed using Spearman's rank correlation. Representativeness of the audit was measured using z-test statistics for time of arrival, age, sex and ethnicity.

Results: The paper audit captured 414 (6.5%) of the 6,358 under-16 injury-related attendances recorded on the NHS Care Record Service Dataset. Comparison of the audit dataset with NHS records showed that the audit was not representative of the larger dataset except for sex of the patient. There was a positive correlation between injury incidence and income deprivation measured using IMD score where data were available (n=384, $p< 0.001$). Nearly half of the attendances were due to falls, slips or trips (49.8%) and more than half were due to either leisure (32.9%) or sport (18.1%) activities.

Conclusion: There is evidence of area level income inequalities in injury incidence among children attending the Royal London Hospital. The audit failed to capture a high proportion of cases, likely due to the paper-based format used. This study highlights the importance of routinely collecting enhanced injury data in computerised hospital admission systems to provide the necessary evidence base for effective injury prevention and the findings have contributed to plans for implementation.

INTRODUCTION

Injury is a major cause of serious morbidity and mortality for children. Road traffic collisions and falls rank in the top 15 causes of disability-adjusted life years (DALYS) worldwide lost for children aged 0-14 years.[1] Data from the UK show a similar pattern. Data collected across Great Britain in 2012 report 2,412 children under the age of 16 were killed or seriously injured in road traffic collisions.[2] Falls contributed to head injuries more than any other mechanism in a recent audit based in England.[3] The Home Accident Surveillance System (HASS) confirms that falls are the most frequent cause of childhood injury in the home, with boys and children age 0-4 years at the greatest risk of injury.[4]

Paediatric injuries present a substantial challenge to public health in the UK, with costs estimated at more than £200 million each year.[5] The impact of injury may continue well beyond the initial incident[6] to affect the individual’s ability to fully participate in education and recreational activities. In the case of serious injuries the immediate family may be required to provide temporary or longer-term care, which can adversely affect household income due to necessary changes in working arrangements or required modifications to the home. Estimates for the non-NHS costs are limited, however, an example provided by the charity Making the Link estimates the cost of a traumatic brain injury (TBI) at the age of three to be £1.73 million from potential lost employment for the child and the lost employment for mother who becomes a full-time carer. Sixteen percent of mothers with a disabled child work, while 61% of mothers to children without disability work.[7] An earlier study into the implications of TBI for families in North Staffordshire, England confirmed that emotional stress increased following injury and 44% of parents whose children had been injured had to take time off work, resulting in financial loss2003.[8]

There is a social gradient in childhood injury rates not only between but also within countries. In high income countries, the most socio-economically deprived children are at the greatest risk of injury.[9] Whether social status is defined by individual or area-level characteristics such as deprivation measures, research based in the UK illustrates a pattern of greater injury or death from injury for children from lower social groups.[3,10-13] This social gradient in childhood injuries influenced the establishment of Safe at Home - National Home Safety Equipment Scheme by The Royal Society for the Prevention of Accidents (RoSPA), which targeted disadvantaged families in regions with high rates of injuries. This programme ended in 2011, however, the final report indicated that 70% of the families who received equipment as part of the scheme lived in the 20% most disadvantaged areas of the country, measured using the 2007 English Index of Multiple Deprivation (IMD) score. Unfortunately the assessment of any impact on injury reduction for children under 5 years was not completed due to funding cuts, so this level of impact is unknown.[14] Tower Hamlets, the setting for this study, is one of the most deprived areas in England.[15] This borough had the highest levels of child poverty in England in 2007 and is the local authority with the highest percentage of children in poverty.[16]

Prevention is key and injury surveillance systems are necessary to inform and evaluate effective injury prevention strategies.[17,18] This may be especially important for lower socioeconomic groups. A recent systematic review concluded that adoption of in-home safety interventions varied by social group, with greater uptake of some measures among non-owner occupied households.[19] Of the four countries in the UK, only Wales has an effective injury surveillance system in place.[20] Apart from recent pilot studies in London and Oxford, the UK falls short of progress seen in other European countries.[21] The Royal London Hospital (RLH) has a large inner city accident and emergency (A&E) department serving the borough of Tower Hamlets. The Cerner millennium electronic Care Records Service (CRS) used by RLH, is an important source of data for local strategic planning, however in its current form it does not collect detailed information on injury location, mechanism or activity at the time of injury. Establishing the extent, causes and risk factors of childhood injury is crucial to effective injury prevention.[14] Reliable data on why people visit A&E are essential to inform local injury prevention campaigns or intervention strategies. Age-specific strategies have been suggested to prevent falls following a similar audit.[22]

The purpose of this research is to report and analyse data from a pilot study in order to test the feasibility of enhanced routine data collection for paediatric injury using paper-based questionnaires and then to establish whether there is a significant association with income deprivation.

Ethical approval

This project was registered as a service evaluation project with Barts Health Clinical Effectiveness unit. We were advised that ethical approval was not required as the study was designed to inform implementation of the College of Emergency Medicine (CEM) data set, the national standard for injury surveillance, into the service and IT system.

PATIENTS AND METHODS

The study design was a prospective audit of injuries in patients under 16 years of age presenting to A&E at the RLH. A&E staff collected audit data for 24 hours, seven days a week between 1 June and 31 December 2012 using a paper questionnaire (Figure 1). The questionnaire was based on the enhanced injury dataset of the College of Emergency Medicine[23] which is compliant with the WHO injury core minimum dataset.[24] Medical staff completed the form at the time medical histories were collected from patients when they were seen at A&E as most of the data was already collected as part of the medical history. Data related to seriously injured patients who were 'trauma called' (arriving to the department via air or land ambulance and whose injuries necessitated immediate specialist trauma care) were reviewed manually and added to the audit sample retrospectively. It was intended that all patients under the age of 16 years who attended A&E due to injury would be included in the sample. The purpose of the paper-based questionnaire was explained to staff, who were guided in the process of completing it by some of the authors (LK, VJ, JP). Senior clinicians in the A&E department actively encouraged completion of the form. No formal incentives were offered for staff to complete the audit form.

We compared data collected by the audit against the routinely collected NHS Care Record Service (CRS) data to assess the completeness and representativeness of our sample dataset. The CRS dataset should provide a full set of records for all attendances, allowing for robust analysis of the audit's completeness. We compared the two datasets on age, sex, time of arrival at A&E and ethnicity to assess the proportion of the total CRS sample collected using the audit both overall and for each of these attributes. Statistical tests (Z test) establish the representativeness of the audit as a sample of all under-16 injury-related attendances. This test is appropriate for the type of data collected and intended analysis. We used a five percent significance level ($p<0.05$) to make comparisons between our data sample and the larger all patient CRS dataset. Data from the audit are also analysed using descriptive statistical tests (mean, proportions) to identify the most prevalent mechanisms of injury for the study population.

Data collected for the audit are analysed in isolation to test for any correlation between income deprivation of the patients (based on home postcode) and known injury incidence of children within small residential areas, Lower Super Output Areas (LSOA). Injury incidence as a proportion of the local population under the age of 16 years is calculated using the patients included in the audit as the numerator and estimated population under the age of 16 years as the denominator for each LSOA. Estimated age-sex population data are available annually from the Office for National Statistics.[25]

Income deprivation data is provided for small local areas, 2001 Census LSOAs from the 2010 English IIMD.[26] The LSOAs included in the audit dataset (n=215) were assigned the income score from the 2010 IMD classification and ranked for Spearman's rank correlation analysis, a non-parametric test suitable for non-normally distributed data. The income deprivation score was used with the injury incidence in the under 16s to test for a statistically significant relationship between the areas ranked using these variables. We elected to classify areas using income deprivation rather than the entire IMD score because the overall score includes a measure of road traffic collisions which would risk collinearity between the predictor and outcome variables.

All statistical analysis was completed using Microsoft Excel 2007 and SPSS 21.0.

When exploring potential relationships between a measure of deprivation and health outcome, the classification of individuals by home location is often used[3], however, we are aware that not all individuals living in an area of higher deprivation are themselves deprived. In the absence of individual-level information on social status or income this is the best possible alternative.

RESULTS

Descriptive data

During the seven month study period, there were 6,358 injury-related attendances to RLH for children aged less than 16 years, of which 471 children were captured by the paper audit. Of these, 414 included full demographic data (Table 1). This represents 6.5% of the 6,358 attendances for under-16s recorded in the CRS dataset.

<Table 1 here>

The proportion of injury incidence in local populations was calculated as described above, to include all reported attendances to A&E captured by the audit with population estimates for the under 16 population in each LSOA as the denominator. Injury incidence for the study period by LSOA ranged from 0.09 – 1.7%, of the under-16 population with a mean incidence of 0.5% (standard deviation = 0.31). Audit respondents lived in 215 different LSOAs, with between one and six attendances recorded for each LSOA. In this sample 136 children (32.9% of the audit sample) were injured at home.

For sex, age, time of arrival and ethnicity the data from the audit sample were compared to the CRS dataset as described above. There was no evidence that our sample was unrepresentative of CRS data for sex (p=0.08) (Table 1). However there was evidence that age (p<0.001) and three time segments (morning, afternoon and late evening) differed significantly between the two datasets (p<0.001). There was no statistical evidence that injuries occurring in early morning (00:00-06:00) and early evening (18:00-20:59) were inaccurately represented in the audit (Table 1).

Ethnicity data showed mixed representativeness. Most of the patients were either Mixed, White or Asian British (Table 1). The audit sample did not differ significantly from the distribution of CRS data for the White and Black/Black British attendees. However, for the three ethnic categories of Asian/British Asian, Mixed/Other or for patients that refused to answer the ethnicity question during medical history the audit data sample was not representative (Table 1).

Mechanism of injury was predominantly falls (49.8% of the audit sample) or other/ uncategorised mechanism, (34.0%); for instance other/uncatgorised encompasses burns (1.4%) or crushing injuries (5.6%) and those unspecified in the audit (3.1%). The activity at time of injury was most frequently grouped into uncategorized/other (38.1%) which includes education or being cared for, or leisure (32.9%) Location of injury was often home (32.9%), school (22.0%) or roads (20.3%) with the remaining injuries occurring in a range of locations including public recreation areas (12.3%), sports areas (2.2%) or not specified (1.4%) (detail not included in Table 1). These data on location and mechanism are not collected fully or using the same categories by the CRS dataset so a direct comparison was not feasible.

Arrival time was recorded for each patient in the audit. The mean arrival time for this sample was 15:45 (SD = 4.05 hours). Compared with the larger sample of all admissions, the mean arrival time was half an hour earlier, at 15:11 (SD = 4.75 hours). The audit sample was not representative of the larger dataset when the arrival hour data were tested for significance using a z test statistic ($p<0.01$) (Table 1). The lack of statistically significant results may due to relatively small sample size in the audit of 414 attendances.

Income deprivation and injury incidence

The income deprivation scores for home LSOAs of audit respondents ranged from 0.01 – 3.18 (mean 0.58, standard deviation 0.55). The result from the two-tailed Spearman's rank correlation of 215 pairs is 0.448, with a p value of <0.001 (Figure 2). This result indicates a statistically significant positive relationship between area rankings of income deprivation and under-16s injury incidence as reported in the audit; areas with higher rankings of income deprivation had higher rankings for injury incidence. This linear relationship between income deprivation and injury incidence in this sample is shown in the scatterplot (Figure 2) where much of the data are clustered at the low end of the IMD income score. The linear trendline gives an indication of the relationship evident in the data from the correlation analysis.

DISCUSSION

Results from the pilot study are consistent with findings in existing literature on feasibility of data collection and relationship between injury incidence proportion and area deprivation. The proportion of responses gathered using the paper audit is low at 6.5% but this compares with a year-long study conducted in Scotland, where 12.1% of A&E attendances were collected using a paper-based questionnaire.[27] There was a significant correlation between income deprivation based on home postcode and injury incidence for under-16s in this sample. Similar results are reported elsewhere in England for minor paediatric head injury using the overall IMD score to classify cases of attendances.[3]

The audit dataset provided a good representation of data recorded by the NHS with regards to patient sex. Results presented here are similar to previous studies which show that attendance to A&E for injury is higher among males compared to females.[27,28] The audit dataset also showed that most injuries occur in and around the home, which is similar to results from a UK-wide study of injury among over-5 year olds.[29] However, there were statistically significant differences between the samples when hour of arrival, some ethnic groups and age were compared. This could present a challenge if we attempt to create recommendations for our local community interventions based on the injury data detailed in the audit.

The audit was designed to capture additional data which is currently not collected in a useable form in the mandatory CRS dataset. Data on injury mechanism, which indicates that falls contribute to nearly half of the records in the audit, is consistent with literature on mechanisms of childhood injury[3,18,22] but without more detail it will not be possible to target an intervention. We cannot be certain that falls comprise a similar proportion of all under-16 injury cases in the RLH.

Additional limitations to this study include the mixed retrospective and prospective data collection led to some loss of detail and potential sources of bias. For example, ethnicity is not consistently recorded for children brought in to A&E, unlike name and age. In addition, the most severe injuries are prioritised when the data are collated retrospectively. This leads to a loss of records for minor injuries including burns, and potentially over-represents more serious injuries. One area to explore in the future is the time of day the document is completed, as this may also influence the level of detail included. Injury incidence for children by LSOA is only available using data captured in the audit, which will not include children who were injured and did not attend this A&E. The relationship between area-level income deprivation and injury incidence for all children living in these areas cannot be conclusively stated from this dataset as we do not have a complete report of all injuries in this age group for the study period. Injury location (home, school), mechanism, and activity are collected in the audit but are not collected adequately by CRS in terms of completeness or specificity so we cannot comment on representativeness of this data for the specific setting. As discussed above the patterns observed of more falls and more injuries occurring in the home are consistent with wider datasets for the UK.[4,7-9]

Prevention strategies and interventions must be adapted to suit local populations through integrated and dynamic surveillance systems. This is particularly important in culturally diverse and deprived communities such as those seen in Tower Hamlets. Enhanced injury data collection at the RLH Trust could help inform and evaluate injury prevention strategies among the most deprived children in the UK and contribute towards the establishment of national injury surveillance. The recent inclusion of under-18s hospital admissions due to accident and injury as an indicator in public health frameworks[30] is positive as is the development of enhanced injury data collection in Wales, where injury prevention measures are being implemented subsequent to analysis.[31] England should follow examples set by other countries where the enhanced data is recorded in an electronic system with the patient record.

As a result of this study, the hospital is taking steps to implement enhanced routine electronic injury data collection this year (2014), a valuable outcome from this audit. This audit used paper-based questionnaires which required staff to go back and retrospectively add data to patient records. By incorporating injury data collection as part of the medical history/admission process, the intention is to minimize the burden on staff in a time-pressured environment, following discussion with senior clinicians and nurses at the pilot site. The impact on staff of additional data collection should be explored after the new data collection templates are introduced to address this pressure on staff time more fully; however, there is enthusiasm and support from staff and IT services at Barts Health NHS Trust to collect enhanced data on injuries electronically as it will improve our knowledge relating to circumstances surrounding injuries to facilitate more effective service provision and/or intervention schemes.

CONCLUSION

This paper adds to the existing literature on injury incidence and socioeconomic settings. The research presented here provides greater detail about childhood injury in an inner London trauma centre. The audit shows that enhanced routine injury data collection at the point of attendance is feasible, though inherent problems with a paper based data collection system means data collection needs to be integrated into routine electronic information systems. The Trust plans to do so later this year.

The potential for well-informed, targeted interventions following analysis of detailed data is clear; the groups most vulnerable to injury risk will enjoy greatest benefit from better data collection, more powerful analysis and stronger evidence leading to appropriate changes in infrastructure or behaviour. However, political will for intervention is influenced by availability of high-quality evidence; until electronic, enhanced data collection is adopted across A&E departments in England such action may be slow to occur.

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Table 1 Descriptive data and representativeness of data in the audit sample

Variable	Audit dataset (n= 414)	NHS CRS (n= 6,358)	z-test statistic (p value)
Age (years)*	8.3 (4.7)	6.7 (4.7)	7.117 (<0.000)
Sex (% male)	64.0	59.8	1.743 (0.08)
Time of arrival	**n (%)**		
00:00-06:59	11 (2.7)	213 (3.4)	0.764 (0.448)
07:00-11:59	48 (11.6)	1201 (18.9)	8.042 (<0.001)
12:00-17:59	216 (52.52)	2702 (42.5)	10.667 (<0.001)
18:00-20:59	98 (23.7)	1420 (22.3)	1.474 (0.140)
21:00-23:59	41 (9.9)	822 (12.9)	3.335 (<0.001)
Ethnicity	**n (%)**		
White	99 (23.9)	1666 (26.6)	1.029 (0.30)
Asian/British Asian	156 (37.7)	3135 (49.3)	4.586 (<0.001)
Black/Black British	31 (7.5)	613 (9.6)	1.447 (0.15)
Mixed/Other	111 (26.8)	855 (13.4)	-7.534 (<0.001)
Refused	17 (4.1)	89 (1.4)	-4.300 (<0.001)
Activity at time of injury	**n (%)**		
Leisure	136 (32.9)	--	--
Sport/exercise	75 (18.1)	--	--
RTC	45 (10.9)	--	--
All other/unspecified	158 (38.1)	--	--
Injury mechanism	**n (%)**		
Falls	206 (49.8)	--	--
Blunt force/push	67 (16.2)	--	--

All other/unspecified	141 (34.0)	--	--
Location of injury	**n (%)**		
Home	136 (32.9)		
School	91 (22.0)		
Road	84 (20.3)		
All other/unspecified	103 (24.9)		
Income deprivation* n=384			Correlation (p value)
	0.58 (0.55)	--	0.448 (<0.001)

* Mean (SD), n = number, % = percentage of sample. Statistically significant relationships underlined