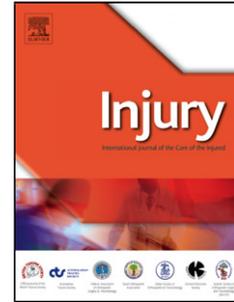


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Childhood injury in Tower Hamlets: Audit of children presenting with injury to an inner city A & E department in London

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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. 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 incident⁶ 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 Medicine²³ 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 IMD.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 used³, 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/uncategorised 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 be 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 frameworks³⁰ 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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Figure 1: Audit questionnaire

Figure 2: Figure 2: Spearman's rank correlation between injury incidence and deprivation

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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)
<u>Sex (% male)</u>	<u>64.0</u>	<u>59.8</u>	<u>1.743 (0.08)</u>
Time of arrival	n (%)		
<u>00:00-06:59</u>	<u>11 (2.7)</u>	<u>213 (3.4)</u>	<u>0.764 (0.448)</u>
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)
<u>18:00-20:59</u>	<u>98 (23.7)</u>	<u>1420 (22.3)</u>	<u>1.474 (0.140)</u>
21:00-23:59	41 (9.9)	822 (12.9)	3.335 (<0.001)
Ethnicity	n (%)		
<u>White</u>	<u>99 (23.9)</u>	<u>1666 (26.6)</u>	<u>1.029 (0.30)</u>
Asian/British Asian	156 (37.7)	3135 (49.3)	4.586 (<0.001)
<u>Black/Black British</u>	<u>31 (7.5)</u>	<u>613 (9.6)</u>	<u>1.447 (0.15)</u>
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*			Correlation
n=384			(p value)
	<u>0.58 (0.55)</u>	--	0.448 (<0.001)

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

Figure 1

Please Complete and put in box in treatment room

Paediatric Unintentional Injury Audit The Royal London Hospital

Patient MRN Data collected from patient or care giver? Yes No Collected from notes retrospectively

Data collected by: _____

Job: _____

Time of injury: __: __

Date of injury: __/__/__

Time of attendance: __: __

Date of attendance: __/__/__

Place where injury happened Post code: _____ or Street name: _____

Exact location (i.e living room or bus stop opposite the park): _____

Where was the patient when the injury happened?

3	Home	
4	Residential institution	
5	Medical service area	
6	School, educational area	
7	Athletics and sports area	
8	Road, street or Highway	
9	Industrial or construction area	
10	Farm	
11	Licensed premises	
12	Trade or service area	
13	Public/recreation area	
14	Countryside / beach / sea	
15	Unspecified place	
1	Other specified place	

Was patient trauma called Yes No

If patient was playing sport, which sport?

2	Not applicable	
38	Football	
39	Rugby union	
40	Ruby league	
41	Netball	
42	Basket ball	
43	Cricket	
44	Hockey	
45	Baseball/softball	
46	Running/jogging	
47	Aerobics	
48	Trampoline	
49	Gymnastics (not trampoline)	
50	Weightlifting/strength building	
51	Combat sports	
52	Cycling	
53	Skateboarding	
54	Roller-skates/blades	
55	Ice-skating	
56	Motorsports-wheeled	
57	Skiing	
58	Snowboarding	
59	Swimming	
60	Scuba-diving (recreational)	
61	Water sports – non-motorised	
62	Water sports – motorised	
63	Horse riding	
64	Golf	
65	Climbing/mountaineering/caving	
66	Hiking	
67	Airsports – not motorised	
68	Badminton	
69	Tennis	
70	Squash	
1	Other specified sport	
122	Playground equipment	

Other: _____

What was the patient doing at the time?

16	RTC Pedestrian	
17	RTC Cyclist	
18	RTC Motorcycle rider	
19	RTC Motorcycle Passenger	
20	RTC Motor vehicle passenger not public transport	
21	RTC Motor vehicle Driver	
22	RTC Other	
23	RTC Unspecified	
24	Motorised recreational vehicle	
25	Railway (public) passenger	
26	Aviation (public) passenger	
27	Bus/coach public passenger	
28	Other public transport	
29	Working for income	
30	Voluntary work	
31	Other work	
32	Sports/exercise – organised	
33	Sports/exercise – informal/casual	
34	Leisure	
35	Education	
36	Being nursed, cared for	
37	Unspecified	
1	Other	

Other: _____

Figure 1 con't

Please Complete and put in box in treatment room

Paediatric Unintentional Injury Audit
The Royal London Hospital

What was the mechanism of the injury?

2	Not applicable	
71	Fall/slip/trip – low (<1m or no info)	
72	Fall/slip/trip – high (>1m)	
122	Fall from window	
73	Blunt force/pushed	
74	Blow from object	
75	Punched and or kicked	
76	Crushing injury	
77	Stabbed/cut with knife	
78	Stabbed/cute with glass object	
79	Cutting, piercing by other sharp object	
80	Shot	
81	Burn – thermal	
82	Burn – Electrical	
83	Burn – Chemical/radiation	
84	Poisoning/overdose	
85	Drowning/near-drowning	
86	Threat to breathing – inhaled object/substance	
87	Threat to breathing – hanging or strangling	
88	Threat to breathing object covering mouth	
89	Physical overexertion	
90	Hypothermia/hyperthermia	
91	Unspecified external cause	
1	Other specified	

Other:

Were any substances involved?

2	Not applicable	
92	Alcohol	
93	Heroin (street drug)	
94	Cocaine/crack (street drug)	
95	Amphetamines/ meth (street drug)	
96	Ecstasy (street drug)	
97	GHB/GBL (street drug)	
98	Other (street drug)	
99	Paracetamol	
100	Asprin	
101	Benzodiazepine (prescription)	
102	Opiates (prescription)	
103	Non TCA Antidepressant (prescription)	
104	Tricyclic antidepressant (prescription)	
105	Unknown	
1	Other prescription drug	

Other:

Other:

Was the injury intentionally inflicted? If yes by who?

2	Not applicable	
106	Non intentional harm	
107	Intentional self harm	
108	Complication of medical care	
109	Apparent assault – spouse/partner	
110	Apparent assault – ex-spouse/partner	
111	Apparent assault – parent/step-parent/legal guardian	
112	Apparent assault – other relative	
113	Apparent assault – unrelated caregiver (not parents partner)	
114	Apparent assault – neighbour/acquaintance	
115	Apparent assault – stranger	
116	Apparent assault other specified relationship	
117	Apparent assault unspecified relationship	
118	Animal related	
119	Intent deliberately withheld	
120	Intent not-specified	
1	Other specified intent e.g euthanasia	

Other:

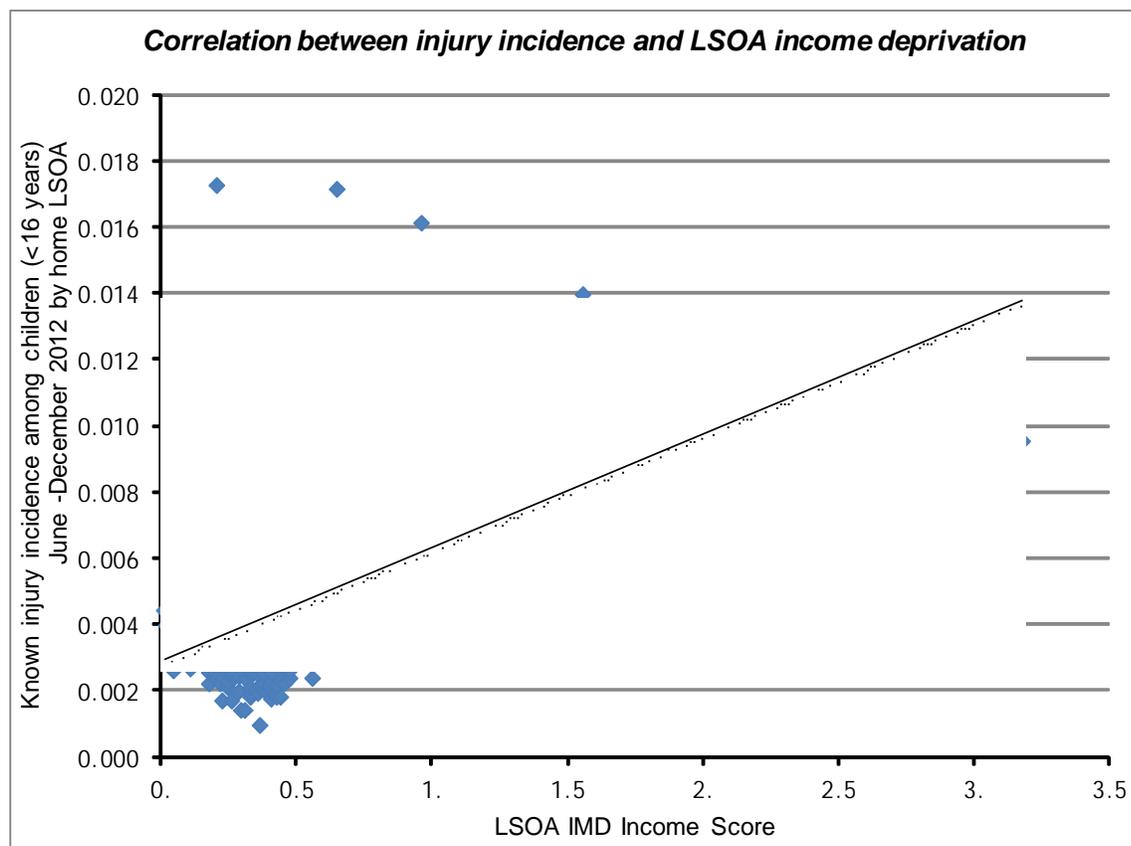


Figure 2