ABSTRACT

Background:

Injuries are a leading cause of death and ill-health in children.

Aims:

To explore the potential utility of ambulance call-out data in understanding the burden and characteristics of child injury.

Methods:

Cross-sectional examination of injury-related ambulance call-outs to children aged 0-14 years in the North West of England between April 2016 and March 2017.

Findings:

The majority of the 16,285 call-outs were for unintentional injuries (91.4%), with falls the most prevalent injury type (38.4%).The incidence of child injury ambulance call-outs peaked at age 1 year (233.4 per 10,000 population). Burns in 5-9 year olds were significantly higher at weekends (p=0.003) and on celebration days (p=0.001); poisoning in 10-14 year olds were significantly higher at weekends (p=0.001); and traffic injuries were significantly lower at weekends in 0-4 year olds (p=0.009) and 10-14 year olds (p=0.003).

Conclusion:

Ambulance call-out data can provide epidemiological support in examining the characteristics of child injury and identifying at-risk groups.

BACKGROUND

Injuries continue to be a major public health concern and are a leading cause of death and ill-health among children worldwide. Globally, an estimated 644,855 children aged 0-14 years died due to injury in 2016 (World Health Organization [WHO] 2018a), though many more children suffer non-fatal injuries that can have long-term effects on physical, psychological and social development (Peden et al. 2008; Sethi et al. 2008). This is costly to the health care system and society economically due to disability and inability to work. However, many injuries are avoidable and preventing child injury is a global public health priority (Krug et al. 2000; Peden et al. 2008; Sethi et al. 2008; WHO 2014). Effective prevention strategies require information to understand the extent and characteristics of injury, the populations at risk and what resources are required, and where and when they should be targeted. This can be supported through effective injury surveillance systems, and the availability and use of health data intelligence (Holder et al. 2001).

Child injury is a burden on health services in England; therefore monitoring its extent is a priority of Public Health England (PHE). Hospital admissions caused by injuries in children aged 0-14 years is a key national indicator for assessing the public's health, and reported over 100,000 admissions between April 2016 and March 2017 (PHE 2018). In addition to hospital admissions data, various research studies illustrate the value of other health data sources in understanding and monitoring childhood injury, particularly mortality and emergency department (ED) attendance data sources (Zuckerbraun et al. 2004; Edwards et al. 2008; Sanchez et al. 2010; Espitia-Hardeman et al. 2011; Quigg et al. 2012; Hughes et al. 2014; Baker et al. 2016). Such data sources are used in various regional and national injury surveillance systems, e.g. Trauma and Injury Intelligence Group, England (Quigg et al. 2012); All Wales

Injury Surveillance System (Lyons et al. 2016); National Electronic Injury Surveillance System, USA (Nelson et al. 2011); Canadian Hospitals Injury Reporting and Prevention Program (Crain et al. 2016). A few studies have shown some utility in the use of ambulance service data in injury surveillance; whilst not solely focused on children, they indicate that such data could also be used to develop understanding and monitoring of injury at local and regional levels (Backe and Andersson 2008; Thomas et al. 2011; Quigg et al. 2017).

There are ten ambulance trusts in England, providing accident and emergency services to those in need of medical treatment and transport 24 hours per day, 365 days per year. The demand for urgent and emergency ambulance services is rapidly increasing, while funding, and staff recruitment and retainment are not meeting the rising demand (National Audit Office 2017). Each trust holds its own data collection system; only a subset of aggregated data are collected at a national level. Using data from one trust (North West Ambulance Service NHS Trust [NWAS]), this study aimed to explore the potential utility of ambulance call-out data in child injury surveillance. We examine the nature and extent of child injury ambulance call-outs in the North West of England and its burden on the ambulance service, and consider the utility of the data in informing child injury prevention.

METHODS

Study Design & Setting

This is a cross-sectional examination of injury-related ambulance call-outs to children aged 0-14 years in the North West of England between April 2016 and March 2017.

Data Collection

All emergency calls are answered by an operator who asks which emergency service is required. Once connected to the ambulance service, an Emergency Medical Dispatcher asks for the location of the emergency and gathers information about the problem to determine the priority of the emergency and type of response required, using the Medical Priority Dispatch System (MPDS). Information is captured using a Computer Aided Dispatch (CAD) database system, of which, a subgroup of fields is shared with the Trauma and Injury Intelligence Group (www.tiig.info) on a monthly basis via a secure web-based drop box (SharePoint 2013). Fields include date and time of the call, MPDS details (nature and brief description of the incident), patient age and gender, geographical area of the call-out location, and whether the patient was conveyed to another health care provider (HCP). No clinical records were used in the study, only CAD data that is recorded by Emergency Medical Dispatchers.

Participants

Where a valid age was recorded (96.1% of all ambulance call-outs), data were extracted on ambulance call-outs to 0-14 year olds for the year 1 April 2016 to 31 March 2017. We chose to examine those aged under 15 years in order to correlate with PHE's indicator, hospital admissions caused by injuries in children, which defines children as aged 0-14 years (PHE 2018). Furthermore, other child injury studies categorised children as aged 0-14 years (Edwards et al. 2006; Edwards et al. 2008; Hippisley-Cox et al. 2002; Hughes et al. 2014; Zuckerbraun et al. 2004). Call-outs outside of the North West of England were removed (*n*=348).

Outcomes of Interest

NWAS use their own data recording system which does not follow the same coding system as hospital admissions data; i.e. International Classification of Diseases and Related Health Problems (WHO 2018b). Initial exploration of the dataset illustrated that an injury may be identified in any one of three fields that describe the nature of the call: 1) MPDS chief complaint (e.g. fall); 2) MPDS description (e.g. unconscious post fall); 3) MPDS problem (a descriptive, free-text field; e.g. fallen out of high chair). Thus to ensure that injuries were identified in the dataset, each of these three fields were systematically searched. Based on ICD-10 codes S00-T79 and V01-Y36 (WHO 2016), a list of over 100 words relating to injury was compiled. These words were searched sequentially across the three fields to identify child injury-related call-outs.

Each call-out was assigned an injury type based on the injury mechanism and WHO categorisation (Krug et al. 2002; Peden et al. 2008): assault, burns (including scalds), falls, poisoning (accidental), self-inflicted injuries (i.e. self-harm, intentional poisoning), traffic injuries and other unintentional injuries (including other categories such as choking, and animal bites and stings). Due to low numbers of drowning (*n*=54), these were added to 'other unintentional injuries', as were call-outs where the injury mechanism was not stated but one of the three MPDS fields had a word relating to injury (i.e. contusion, laceration, wound; within ICD-10 codes S00-T79 and V01-Y36). Accidental poisoning was coded as 'poisoning' and intentional poisoning was coded as 'self-inflicted injuries'. Any poisoning-related call-outs that did not state accidental or intentional were coded as 'poisoning'. Each call-out location (i.e. Lower Super Output Area [LSOA]; geographical areas in England and Wales with a population mean of 1,614, designed to improve the reporting of small area statistics [Office for National Statistics 2012]) was assigned a measure of deprivation using the Index of Multiple Deprivation (IMD; Ministry of Housing, Communities and Local Government 2015). Records were then assigned a national deprivation quintile based on the IMD value of the LSOA, as well as a rural/urban classification.

Data Analysis

Data were analysed in SPSS V.24 to explore patient and call-out characteristics (e.g. patient age, call-out location). Generalised linear modelling (GLM) was used to identify independent effects of months, weekends, English bank holidays and celebration days (Halloween and Guy Fawkes Night). Estimated marginal means show the differences in these factors related to child injury ambulance call-outs. Child injury incidence rates of ambulance call-outs were estimated per 10,000 population by age, with 95% confidence intervals (CI).

Ethical considerations

This study was approved by Liverpool John Moores University Research Ethics Committee.

FINDINGS

In 2016/17, there were 16,285 injury-related ambulance call-outs to 0-14 year olds in the North West of England (20.6% of all call-outs to 0-14 year olds). The majority were unintentional injuries (91.4%). Falls were the most prevalent injury type (*n*=6,256), followed by other unintentional injuries (*n*=6,115), traffic injuries (*n*=1,292), self-inflicted injuries (*n*=872), poisoning (*n*=698), assault (*n*=533) and burns (*n*=519). Incidence of child injury ambulance call-outs overall was 126.4 per 10,000 population (CI 124.5–128.4); intentional injuries: 10.9 (CI 10.3–11.5), unintentional injuries: 115.5 (CI 113.7–117.4).

Figure 1 shows incidence of child injury ambulance call-outs by age for all injury call-outs combined, intentional injuries and unintentional injuries. Incidence for all child-injuries combined peaked at age 1 year (233.4 per 10,000 population; CI 223.3–243.8), then gradually decreased by age up until 8 years, and then increased by age. Comparatively, incidence of intentional injuries (assaults and self-inflicted injuries) in 0-7 years was low, and after the age of 7 years incidence increased by age, peaking in those aged 14 years. Unintentional injuries followed the same pattern as all injury call-outs until age 8 years.

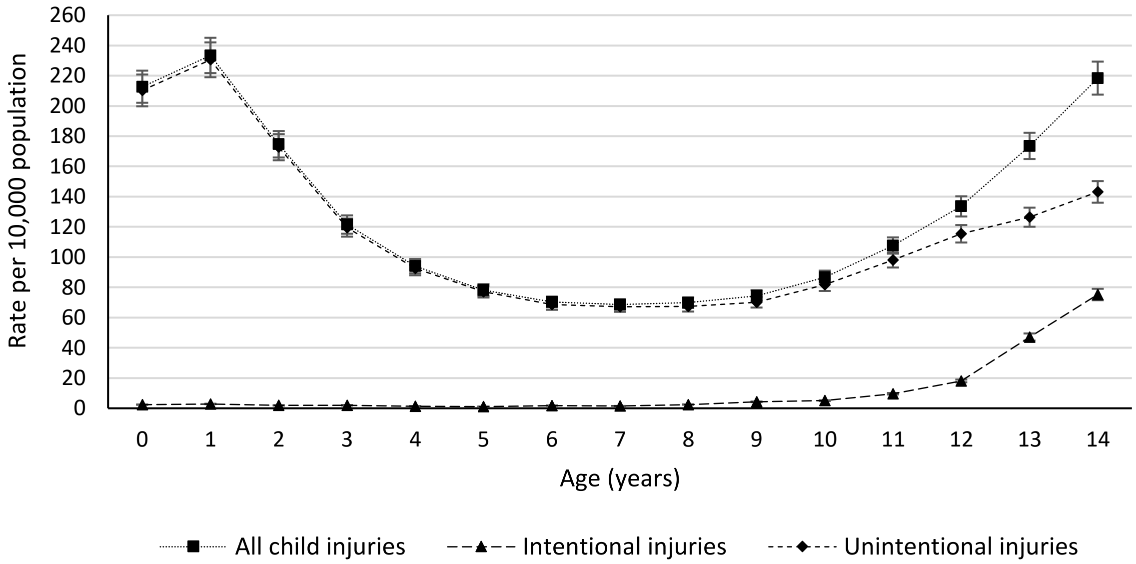

Figure 1

Incidence of child injury ambulance call-outs by age, NWAS (2016/17)

Figure 2 shows incidence of child injury ambulance call-outs for each injury type. There is a notable sharp increase in the incidence of intentional injuries above the age of 12 years, particularly for assaults. There was a small number of self-inflicted injuries recorded for 0-4 year olds (*n*=19), which could be attributed to inaccurate recording of the MPDS description or patients' age. For unintentional injuries, incidence peaked at age 1 year for burns and falls, and at under 1 year for other injuries. For poisoning, incidence peaked at age 1 year and again at 14 years, while incidence of traffic injuries was generally higher for children aged 4 years and over.

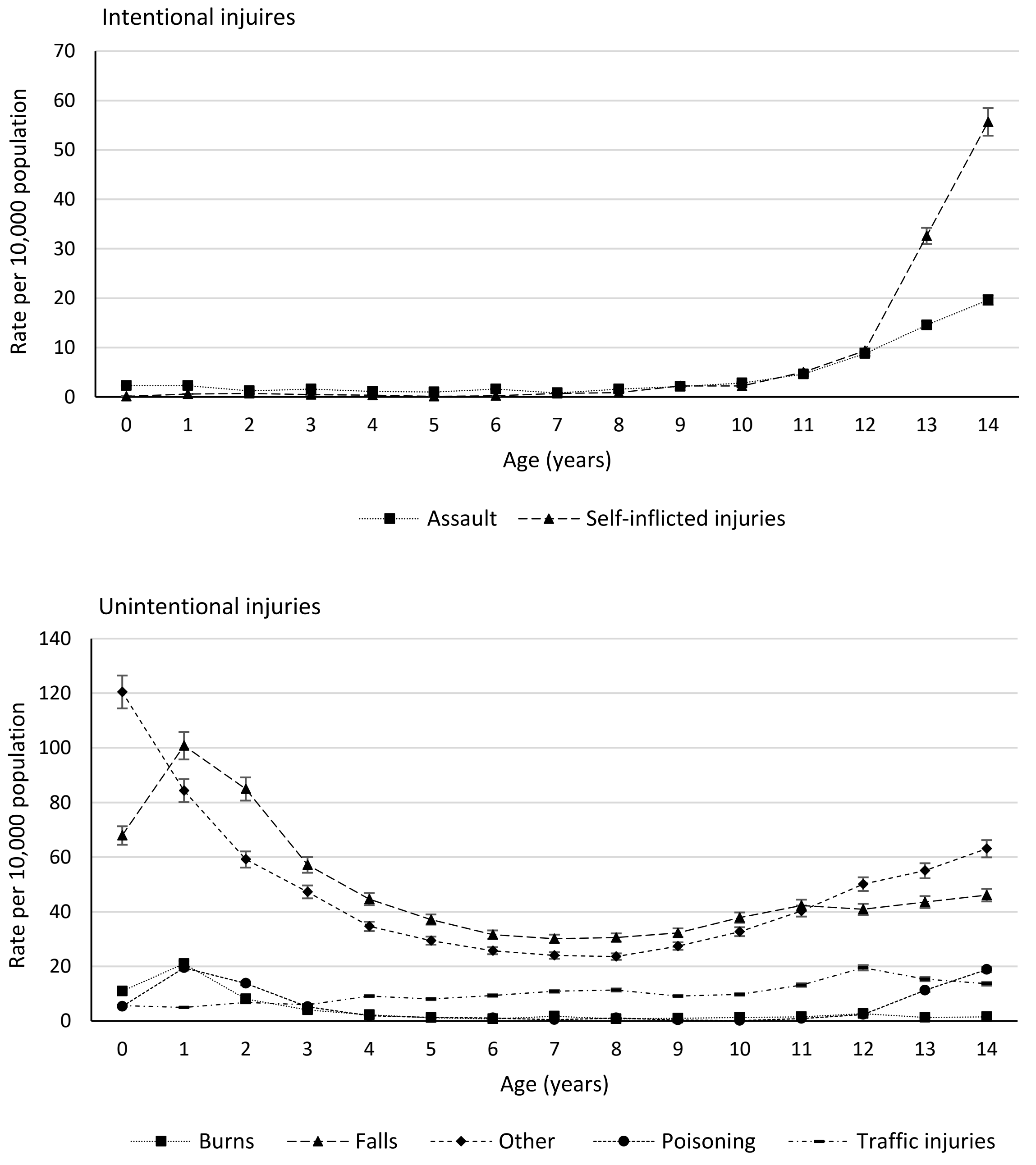

Figure 2

Incidence of child injury call-outs by age and injury type, NWAS (2016/17)

Table 1 shows the distribution of child injury ambulance call-outs by call-out characteristics. Of all child injury call-outs combined, 45.2% were aged 0-4 years, the mean age was 6.5 years (SD=5.0) and 57.1% were male. In terms of the call-out location, 46.2% were to the most deprived areas (quintile 5) and 92.8% were to urban areas (59.3% major conurbation; 33.5% city/town). The majority (80.7%) of child injury call-outs resulted in the child conveyed to another HCP for further treatment.

There were significant call-out characteristic differences between intentional injuries and unintentional injuries (Table 1). The majority (86.3%) of intentional injury call-outs involved children aged 10-14 years, while 48.8% of unintentional injury call-outs were to children aged 0-4 years. Compared to unintentional injuries (41.7%), a higher proportion of intentional injury (55.0%) call-outs were to females, while a lower proportion of children who sustained intentional injuries were conveyed to a HCP compared to unintentional injuries (74.0% vs 81.3%).

Table 1 Distribution of child injury ambulance call-outs by call-out characteristics, NWAS (2016/17)

	All child injuries (*n*=16,285)	Intentional injuries (*n*=1,405)	Unintentional injuries (*n*=14,880)	*p*-value[e]
Mean age (SD)	6.5 (5.0)	12.0 (3.3)	5.9 (4.8)	
Age group (years)				<0.001
0-4	7358 (45.2%)	94 (6.7%)	7264 (48.8%)	
5-9	3205 (19.7%)	98 (7.0%)	3107 (20.9%)	
10-14	5722 (35.1%)	1213 (86.3%)	4509 (30.3%)	
Gender[a]				<0.001
Female	6925 (42.9%)	760 (55.0%)	6165 (41.7%)	
Male	9229 (57.1%)	622 (45.0%)	8607 (58.3%)	
Deprivation quintile[b]				0.001
1 least deprived	1574 (9.7%)	107 (7.6%)	1467 (9.9%)	
2	1978 (12.1%)	147 (10.5%)	1831 (12.3%)	
3	1887 (11.6%)	152 (10.8%)	1735 (11.7%)	
4	3319 (20.4%)	287 (20.4%)	3032 (20.4%)	
5 most deprived	7527 (46.2%)	712 (50.7%)	6815 (45.8%)	
Location area type[c]				<0.001
Rural	1180 (7.2%)	74 (5.3%)	1106 (7.4%)	
Urban: city/town	5454 (33.5%)	415 (29.5%)	5039 (33.9%)	
Urban: major conurbation	9651 (59.3%)	916 (65.2%)	8735 (58.7%)	
Conveyed to HCP[d]				<0.001
Yes	13,143 (80.7%)	1039 (74.0%)	12,104 (81.3%)	
No	3142 (19.3%)	366 (26.0%)	2776 (18.7%)	

[a] Where gender was recorded (*n*=16,154, 99.2%); [b] Deprivation quintile of call-out location; [c] Area type of call-out location; urban: city/town includes city and town in a sparse setting; [d] Conveyed to health care provider (HCP) including Emergency Department, Urgent Care Centre, Minor Injuries Unit, Walk-in Centre, General Practitioner and other HCP; [e] Analysis uses $\chi 2$.

Table 2 shows the distribution of child injury ambulance call-outs by call-out characteristics and injury type. Children aged 0-4 years accounted for 78.0% of burns and 57.3% of poisoning-related call-outs, while 10-14 year olds accounted for 74.3% of assaults and 93.7% of self-inflicted injury call-outs. Two-thirds (68.3%) of assault call-outs were for males, while there were more females than males for self-inflicted injuries (68.9%) and poisoning (53.1%). In terms of the call-out location, across all injury types call-outs generally increased with deprivation, with more than half of assaults (59.8%) and burns (54.1%) call-outs to the most deprived areas (quintile 5). The majority of call-outs were to urban areas for all injury types, which was more pronounced for assaults (97.2%; Table 2). Although the majority of children were conveyed to another HCP for further treatment for all injury types, there were some variations in the proportions across injury types. Call-outs where the child was transported for further treatment were more pronounced for falls (84.8%), burns (84.2%) and poisoning (81.9%).

Table 2 Distribution of child injury ambulance call-outs by call-out characteristics and injury type, NWAS (2016/17)

	Intentional injuries		Unintentional injuries				
	Assault (*n*=533)	Self-inflicted injuries (*n*=872)	Burns (*n*=519)	Falls (*n*=6,256)	Other unintentional injuries (*n*=6,115)	Poisoning (*n*=698)	Traffic injuries (*n*=1,292)
Mean age (SD)	10.6 (4.2)	12.8 (2.1)	3.2 (3.9)	5.7 (4.6)	5.9 (5.0)	6.2 (5.7)	8.2 (4.1)
Age group (years)							
0-4	75 (14.1%)	19 (2.2%)	405 (78.0%)	3132 (50.1%)	3038 (49.7%)	400 (57.3%)	289 (22.4%)
5-9	62 (11.6%)	36 (4.1%)	48 (9.3%)	1434 (22.9%)	1154 (18.9%)	39 (5.6%)	432 (33.4%)
10-14	396 (74.3%)	817 (93.7%)	66 (12.7%)	1690 (27.0%)	1923 (31.4%)	259 (37.1%)	571 (44.2%)
Gender[a]							
Female	164 (31.7%)	596 (68.9%)	223 (43.2%)	2634 (42.2%)	2498 (41.0%)	368 (53.1%)	442 (35.9%)
Male	353 (68.3%)	269 (31.1%)	293 (56.8%)	3606 (57.8%)	3593 (59.0%)	325 (46.9%)	790 (64.1%)
Deprivation quintile[b]							
1 least deprived	22 (4.1%)	85 (9.7%)	47 (9.1%)	627 (10.0%)	648 (10.6%)	60 (8.6%)	85 (6.6%)
2	41 (7.7%)	106 (12.2%)	41 (7.9%)	807 (12.9%)	781 (12.8%)	64 (9.2%)	138 (10.7%)
3	48 (9.0%)	104 (11.9%)	46 (8.9%)	737 (11.8%)	707 (11.6%)	77 (11.0%)	168 (13.0%)
4	103 (19.3%)	184 (21.1%)	104 (20.0%)	1290 (20.6%)	1224 (20.0%)	155 (22.2%)	259 (20.0%)
5 most deprived	319 (59.8%)	393 (45.1%)	281 (54.1%)	2795 (44.7%)	2755 (45.1%)	342 (49.0%)	642 (49.7%)
Location area type[c]							
Rural	15 (2.8%)	59 (6.8%)	42 (8.1%)	502 (8.0%)	437 (7.1%)	36 (5.2%)	89 (6.9%)
Urban: city/town	161 (30.2%)	254 (29.1%)	149 (28.7%)	2139 (34.2%)	2123 (34.7%)	228 (32.7%)	400 (31.0%)
Urban: major conurbation	357 (67.0%)	559 (64.1%)	328 (63.2%)	3615 (57.8%)	3555 (58.1%)	434 (62.2%)	803 (62.2%)
Conveyed to HCP[d]							
Yes	361 (67.7%)	678 (77.8%)	437 (84.2%)	5306 (84.8%)	4833 (79.0%)	572 (81.9%)	956 (74.0%)
No	172 (32.3%)	194 (22.2%)	82 (15.8%)	950 (15.2%)	1282 (21.0%)	126 (18.1%)	336 (26.0%)

[a] Where gender was recorded (*n*=16,154, 99.2%); [b] Deprivation quintile of call-out location; [c] Area type of call-out location; urban: city/town includes city and town in a sparse setting; [d] Conveyed to health care provider (HCP) including Emergency Department, Urgent Care Centre, Minor Injuries Unit, Walk-in Centre, General Practitioner and other HCP.

Tables 3 and 4 show the results of GLM on the effects of months, weekends, English bank holidays and celebration days (Halloween and Guy Fawkes Night) on child injury ambulance call-outs. Estimated marginal means were highest in June for all injury ambulance call-outs combined, intentional injuries and unintentional injuries. Although results were non-significant, all child injury call-outs and unintentional injury call-outs were elevated on celebration days (Table 3).

GLM analyses on the specific injury types found that weekends and celebration days showed an independent increase in burns-related ambulance call-outs to 5-9 year olds (Table 4). Thus, burn injury call-outs significantly increased by 23% (p=0.003) at weekends and 573% (p=0.001) on celebration days in 5-9 year olds. Weekends were associated with a 94% (p=0.001) significant increase in poisoning-related ambulance call-outs to 10-14 years olds. There were significantly fewer call-outs at weekends for traffic injury call-outs to 0-4 year olds and 10-14 year olds with a 54% (p=0.009) and 29% (p=0.003) increase in call-outs midweek respectively.

Table 3 Estimated marginal means (GLM) of temporal patterns in child injury ambulance call-outs, NWAS (2016/17)

	All child injury call-outs				Intentional child injury call-outs				Unintentional child injury call-outs			
	Mean	**95% CI**		***p*-value**	**Mean**	**95% CI**		***p*-value**	**Mean**	**95% CI**		***p*-value**
Month												
Jan	33.16	26.07	40.25	0.063	2.40	0.76	4.04	0.283	30.76	24.00	37.51	0.027
Feb	38.70	31.39	46.00	0.469	2.72	1.03	4.42	0.093	35.97	29.01	42.93	0.724
Mar	47.53	40.29	54.78	<0.001	3.42	1.74	5.09	0.002	44.12	37.22	51.02	<0.001
Apr	42.18	34.92	49.44	0.019	1.67	-0.01	3.36	0.697	40.50	33.58	47.42	0.011
May	52.93	45.84	60.02	<0.001	3.49	1.85	5.14	0.001	49.44	42.68	56.19	<0.001
Jun	53.45	46.19	60.71	<0.001	3.83	2.15	5.52	<0.001	49.62	42.70	56.54	<0.001
Jul	50.94	43.70	58.18	<0.001	3.01	1.33	4.69	0.022	47.93	41.03	54.82	<0.001
Aug	52.48	45.31	59.64	<0.001	2.95	1.29	4.61	0.028	49.53	42.70	56.35	<0.001
Sep	51.68	44.42	58.95	<0.001	3.50	1.82	5.18	0.001	48.18	41.26	55.10	<0.001
Oct	46.32	39.39	53.26	<0.001	2.67	1.06	4.27	0.109	43.65	37.05	50.26	<0.001
Nov	40.31	33.37	47.26	0.139	2.15	0.54	3.76	0.578	38.17	31.55	44.79	0.156
Dec	37.10	30.08	44.12	Ref	1.87	0.24	3.49	Ref	35.23	28.54	41.92	Ref
Weekend												
Yes	45.69	39.03	52.35	0.795	2.71	1.17	4.26	0.398	42.98	36.63	49.33	0.633
No	45.44	38.85	52.03	Ref	2.90	1.38	4.43	Ref	42.54	36.26	48.82	Ref
Bank holiday												
Yes	43.92	35.59	52.25	0.284	2.50	0.57	4.43	0.389	41.42	33.48	49.35	0.360
No	47.21	41.32	53.10	Ref	3.11	1.75	4.48	Ref	44.10	38.48	49.71	Ref
Celebration day												
Yes	48.10	36.01	60.19	0.399	2.09	-0.71	4.89	0.304	46.01	34.49	57.53	0.256
No	43.03	39.99	46.06	Ref	3.52	2.82	4.23	Ref	39.51	36.61	42.40	Ref

Reference categories: December, midweek, non-bank holidays, non-celebration days. Celebration day: Halloween, Guy Fawkes Night.

Table 4 Estimated marginal means (GLM) of temporal patterns in child injury ambulance call-outs by injury type and age group, NWAS (2016/17)

	Intentional injuries						Unintentional injuries											
	Assault			Self-inflicted injuries			Burns			Falls			Poisoning			Traffic injuries		
	0-4	5-9	10-14	0-4	5-9	10-14	0-4	5-9	10-14	0-4	5-9	10-14	0-4	5-9	10-14	0-4	5-9	10-14
Month																		
Jan	0.16	-0.03	0.51	0.02	0.02	1.71	1.53	0.64	0.32	8.21	2.52	1.19	0.94	0.27	0.50	0.38	0.49	1.18
Feb	0.04	0.04	0.49	0.03	-0.08	2.20**	1.35	0.63	0.35	10.63*	2.97	1.90	1.05	0.35	0.39	0.35	0.50	1.23
Mar	0.16	0.22**	1.03	0.06	0.02	1.92*	1.44	0.55	0.37	10.21	4.33*	3.36**	1.21	0.34	0.64	0.65	0.69	1.99
Apr	0.17	0.03	0.71	0.06	0.02	0.68	1.32	0.51	0.34	10.61*	3.54	2.81	1.09	0.24	0.52	0.52	1.15	1.17
May	0.16	0.13*	1.22*	0.15	-0.04	1.87*	1.43	0.61	0.35	11.02**	6.14***	4.81***	1.30	0.50**	0.57	0.80	1.33*	2.14
Jun	0.24	0.03	1.08	0.06	-0.05	2.47***	1.18	0.65	0.41	11.06**	5.83***	5.05***	1.42	0.31	0.43	0.64	1.25	2.05
Jul	0.26	0.09	0.87	0.12	-0.08	1.75	1.38	0.54	0.27	10.15	5.80***	4.94***	1.34	0.27	0.81*	1.05*	1.62**	1.98
Aug	0.29	0.10	1.16	0.09	0.02	1.29	1.26	0.55	0.33	12.63***	5.93***	3.74**	1.32	0.37	0.41	0.75	1.19	1.49
Sep	0.27	0.30***	1.38**	0.16*	0.02	1.37	1.52	0.55	0.41	10.49	4.83**	4.28***	1.22	0.24	0.53	0.68	1.62**	1.89
Oct	0.13	0.06	0.99	0.06	0.05	1.38	1.22	0.58	0.59	10.15	4.11*	3.41**	1.10	0.32	0.89**	0.57	0.85	2.27*
Nov	0.08	-0.03	0.59	0.07	-0.08	1.52	1.52	0.56	0.43	9.52	3.22	2.30	1.10	0.29	0.44	0.35	0.72	1.81
Dec	0.12	-0.09	0.67	0.05	0.03	1.09	1.57	0.55	0.41	8.99	3.02	1.81	1.12	0.24	0.28	0.58	0.70	1.55
Weekend																		
Yes	0.21	0.11	0.88	0.11*	-0.02	1.43	1.36	0.64**	0.38	10.00	4.26	3.31	1.18	0.33	0.70**	0.48**	1.05	1.51**
No	0.14	0.03	0.90	0.05	0.00	1.78	1.43	0.52	0.38	10.62	4.44	3.29	1.19	0.29	0.36	0.74	0.96	1.95
Bank holiday																		
Yes	0.20	0.02	0.94	0.12	-0.07	1.29	1.23	0.57	0.49	11.18	4.17	2.80	1.03	0.31	0.49	0.52	0.80	1.38
No	0.14	0.12	0.84	0.04	0.05	1.92	1.56	0.58	0.27	9.44	4.53	3.80	1.34	0.31	0.58	0.69	1.22	2.08
Celebration day																		
Yes	0.10	0.00	0.65	0.06	-0.06	1.34	1.86	1.01**	0.48	11.34	5.01	2.44	1.43	0.51	0.32	0.56	1.02	2.34
No	0.25	0.14	1.13	0.10	0.04	1.87	0.93	0.15	0.28	9.27	3.70	4.16	0.94	0.12	0.74	0.65	1.00	1.12

Reference categories: December, midweek, non-bank holidays, non-celebration days. Celebration day: Halloween, Guy Fawkes Night. *p<0.05, ** p<0.01, *** p<0.001.

DISCUSSION

Our findings show the burden of child injury on an ambulance trust in the North West of England. Injuries are preventable (Krug et al. 2000; Peden et al. 2008; Sethi et al. 2008; WHO 2014), and with urgent and emergency ambulance services provided by NHS ambulance trusts in England costing £1.78 billion in one year alone (National Audit Office 2017), appropriate action to tackle the burden is required. Injuries are predictable if we know who is most at risk, and when and where they are most likely to occur, through comprehensive surveillance systems (Holder et al. 2001; Peden et al. 2008). Insufficient data result in an underestimation of the burden of injury, particularly if key injury types are missing from data sources, thus the availability of quality data is key in establishing the extent and nature of injury for the purpose of targeted prevention activity (Peden et al. 2008; Sethi et al. 2008).

The ambulance dataset used in this study had the capability of categorising the call-outs into the injury types used by WHO, while research of ED data highlighted a lack of coding for some injury groups. A study of 0-14 year olds attending EDs across England due to injury, using a national monitoring system, was limited due to deficiencies in injury grouping options (Hughes et al. 2014). The study found 88.7% of incidents were categorised as 'other' injury, with falls and other key injury types missing. Comparatively, our recording into WHO injury types using ICD-10 categorisation, found 37.5% of child injury ambulance call-outs were 'other' injuries, with the remaining call-outs categorised as a specific injury type, and falls accounting for the largest proportion (38.4%). In England, falls are the main cause of injury-related hospital admissions in children aged 0-4 years, and thus prevention of falls in the under-5s is a national priority (PHE 2017). Of the fall-related ambulance call-outs, we found 50.1% were aged 0-4 years, and falls in 0-4 year olds accounted for 19.2% of all child injury ambulance call-outs overall. Furthermore, a case study in the development of a comprehensive ED injury surveillance system found more than three in five other injuries were falls (Quigg et al. 2012). As there are falls and other key injury types missing from ED attendance data, our findings highlight a strength in the utilisation of ambulance data to comprehensively understand the epidemiology and characteristics of child injuries.

WHO promotes the sharing and use of data as a public health approach to injury prevention (Holder et al. 2001; Peden et al. 2008; Sethi et al. 2008; WHO 2014). Injury surveillance systems capture key data which can inform new and existing policies for prevention, targeting interventions to specific injury groups and populations. Regional and national injury surveillance systems in high- and middle-income countries are well established; however systems often use data captured in hospitals only (Nelson et al. 2011; Crain et al. 2016; Lyons et al. 2016). To our knowledge, this is the only published research in scientific journals that uses ambulance records to study child injuries. As established by previous research, ambulance data can identify at-risk groups and establish where and when targeted prevention can be applied (Backe and Andersson 2008; Thomas et al. 2011; Quigg et al. 2017). For example, we identified large proportions of burns call-outs to 0-4 year olds, and assaults and self-inflicted injury call-outs to 10-14 year olds. Furthermore, GLM found: burns call-outs significantly increased by 23% at weekends and 573% on celebration days in 5-9 year olds; poisoning significantly increased by 94% at weekends in 10-14 year olds; and traffic injury call-outs significantly increased by 54% in 0-4 year olds and 29% in 10-14 year olds midweek when compared to weekends. Ambulance call-out data can enhance knowledge on the burden of injuries, and overlaying it with ED and hospital admissions data could provide a comprehensive description of the epidemiology of child injuries, where other data sources (i.e. ED attendances and hospital admissions) have limitations.

Furthermore, there is a well-known strong association between deprivation and injury (Bellis et al. 2011; WHO 2014). We found child injury ambulance call-outs increased with deprivation, with 46.2% of all child injury call-outs to the most deprived areas, and numerous studies have concluded serious inequalities in child injuries (Bartlett 2002; Hippisley-Cox et al. 2002; Haynes et al. 2003; Edwards et al. 2006; Edwards et al. 2008; Siegler et al. 2010; Hughes et al. 2014). Several factors have been associated with increased injury risk in children living in deprived areas, including housing conditions, heavy traffic, lack of safe play space, single parenthood, lack of education and unemployment (Bartlett 2002). Our research adds to the body of knowledge surrounding inequalities in child injuries, and at-risk groups, highlighting the importance of targeted interventions.

We found four in five call-outs resulted in the child transported to another HCP for further treatment. Although the data does not indicate the severity of the injury sustained, it is likely that the majority of call-outs to children result in the child conveyed due to paediatric policies. Most ambulance service protocols state that all children under the age of 2 years must be conveyed to a hospital or other healthcare provider and ideally children aged 2-18 years should be conveyed (London Ambulance Service NHS Trust 2016; Yorkshire Ambulance Service NHS Trust 2016). Further research on the severity of injuries sustained is recommended.

Limitations

We examined children aged 0-14 years in order to correlate with a PHE indicator and other child injury studies, which used mortality and ED attendance data sources. Childhood has various definitions (Peden et al. 2008) and it appears that older children and young people are under-represented in the literature; therefore we recommend further research to explore injuries in older children and young people.

This study used CAD data only, which relies heavily on the accurate recording of patient information by the Emergency Medical Dispatcher. Of all ambulance call-outs made by NWAS between 1 April 2016 and 31 March 2017, 3.9% of records did not have a valid age recorded. This is a free-text field and there are no validations, therefore patient age is subject to data entry errors or missing data. However, to compare with a study of ambulance records in Sweden, Backe and Andersson (2008) reported age missing for 19.5% of records, considerably more than in our study.

The NWAS dataset does not follow the International Classification of Diseases and Related Health Problems. We aimed to overcome this by examining three data fields in order to identify injuries, and then categorise them into final injury groups used by WHO. We were somewhat limited by the free-text nature of one of the MPDS fields; therefore it is possible that a number of injury call-outs were missing from the analysis. Not all instances of poisoning indicated whether it was accidental or intentional, and where this was not specified, call-outs were categorised as poisoning (accidental). Our findings show the incidence of poisoning peaked in children aged 1 year and 14 years, suggesting incidents in 1 year olds were unintentional ingestion of household substances (Schmertmann et al. 2013; Groom et al. 2006), while in 14 year olds incidents were likely unidentified cases of intentional poisoning or self-harm (Hughes et al. 2014). For this reason, it is possible that some poisoning (accidental) incidents could have been self-inflicted injuries. Conversely, there was a small number of self-inflicted injuries recorded for 0-4 year olds (*n*=19), which could be attributed to inaccurate recording of the MPDS description or patient's age. It should be noted that there is a dependence on the caller to supply the Emergency Medical Dispatchers with information. As they are not medically trained, this is subjective; therefore it is possible that information recorded in the MPDS description and problem fields do not match the patient's clinical record.

There are ten ambulance trusts in England, each with their own data collection system; therefore our study of one of these trusts may not be representative of the whole country. However, this study provided analysis of a 1-year sample of >16,000 child injury ambulance call-outs to 0-14 year olds in the North West of England, and we found strengths in its potential as a data source for understanding the epidemiology of child injuries and the burden on ambulance services.

CONCLUSION

Our findings strengthen previous research of child injury, highlighting changes in risk of injury throughout childhood, the impact of temporal factors and the strong association between deprivation and injury. Ambulance call-out data has the potential to provide a more accurate description of child injury, if used alongside other health data sources to provide comprehensive child injury surveillance, and can be used to guide child injury prevention activity and ambulance service delivery. A joined-up, comprehensive surveillance system utilising different data sources enables a more accurate description of the characteristics of child injury, where limitations with other data sources exist.

KEY POINTS

- Child injury is a burden on health services in England; however the use of ambulance service data is under-utilised in understanding the full extent of child injury.
- This is the first paper to examine injury-related ambulance call-outs to children and highlights the burden of child injury on an ambulance trust in England.
- Ambulance call-out data can be used to examine the characteristics of child injury, and identify at-risk groups and temporal factors for injury types across age; thus inform targeted prevention activity.
- The majority of injury call-outs to 0-14 year olds were unintentional injuries (91.4%), and falls were the most prevalent injury type (38.4%). As falls and other key injury types are missing from ED attendance data, the utilisation of ambulance call-out data can enhance the knowledge on the burden of injuries.

KEYWORDS

Call-outs, child injury, emergency medical service, injury prevention, public health, surveillance

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