

# **The short-term cost of falls, poisonings and scalds occurring at home in children under 5 years old in England: multicentre longitudinal study**

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**Abstract word count: 250**

**Word count excluding tables and references: 2990**

**Keywords: child, unintentional, home, costs, economic**

**What is already known on this subject**

- Falls, poisoning and scalds are amongst the most common injuries in 0-4 year olds resulting in use of healthcare services in England
- There is little data on the healthcare or family costs of these common and mainly minor injuries in England

**What this study adds**

- Mean short-term healthcare costs were typically £2000-£3000 for admissions for 2 or more days and £700-£1000 for admissions for 1 day or less
- Mean short-term healthcare costs were typically £100-£180 for emergency department attendances
- Mean short-term family costs were typically £100-£400 for admissions for 2 or more days, £40-£200 for admissions for one day or less and £20-£70 for emergency department attendances

## **Abstract**

**Background:** Childhood falls, poisonings and scalds, occurring predominantly in the home, are an important public health problem, yet there is limited evidence on the costs of these injuries to individuals and society.

**Objectives:** To estimate NHS and child and family costs of falls, poisonings and scalds.

**Methods:** We undertook a multi-centre longitudinal study of falls, poisonings and scalds in children under 5 years old, set in acute National Health Service (NHS) Trusts across four UK study centres. Data from parental self-reported questionnaires on health service resource use, family costs and expenditure were combined with unit cost data from published sources to calculate average cost for participants and injury mechanism.

**Results:** 344 parents completed resource use questionnaires until their child recovered from their injury, or until 12 months, whichever came soonest. Most injuries were minor, with >95% recovering within 2 weeks, and 99% within one month of the injury. 61% ED attendees were not admitted, 35% admitted for one day or less and 4% admitted for 2 or more days. The typical healthcare cost of an admission for 2 or more days was estimated at £2000-£3000, for an admission for one day or less was £700-£1000 and for an ED attendance without admission was £100-£180. Family costs were considerable and varied across injury mechanisms. Of all injuries scalds accrued highest healthcare and family costs.

**Conclusion:** Falls, poisonings and scalds incur considerable short-term healthcare and family costs. These data can inform injury prevention policy and commissioning of preventive services.

## Introduction

In England, unintentional injuries occurring in or around the home are a leading cause of preventable death and disability in children under 5 years old. [1] Falls, poisoning and scalds are common in this age group, leading to 18,300, 5,100 and 1,420 admissions respectively in 2012/13.[2] In 2002 (the most recent year for which national surveillance data were collected), falls, poisoning and thermal injuries (data not presented separately for scalds) accounted for more than 280,000 ED attendances. [3]

In the UK, there is very limited evidence on the costs of unintentional home injuries to children under 5 years old. Based on the average cost of an ED attendance of £114[4], 280,000 attendances would cost the national health service (NHS) nearly £32 million. The 24,820 hospital admissions would cost the NHS £19.1 million (based on an average of £586 per short stay case and £2,461 for long stay cases). [5] However, average costs cover all ages and all reasons for attendance or admission and may not accurately reflect costs of treating home injuries to children under 5 years old. In addition, they exclude costs of additional treatment by family doctors and other healthcare practitioners. [6 ,7] They exclude indirect costs, such as lost output due to reduced productivity caused by injury, costs to the family or society and losses due to premature death. Information on the costs of injuries is important for prioritising spending on prevention, treatment and rehabilitation services and for economic evaluations of interventions. [8-11] Several studies have attempted to quantify economic costs associated with unintentional injuries, [5 ,12-17] but estimates are not always specific to children, [5 ,13 ,16 ,17] or to children under 5 years old. [18]

Estimates of short and long-term cost of injuries, predominantly based on UK data, were highlighted in the Chief Medical Officer's (CMO) 2012 Annual Report [18] and a report by Public Health England. [1] Both report high financial costs, with average hospital and other health service costs per case immediately after injury (across all injury types and all ages), being almost £2,500 [13], and note that lifetime cost of a childhood traumatic brain injury can be £4.95 million at 2012 prices. [19 ,20] While there are estimates from other countries, these cannot easily be compared between countries and across time due to differences in health care systems, absence of standardised methodologies and different approaches used. [21] This paper presents detailed information on direct and indirect costs resulting from unintentional home injuries in children under 5 years old in the UK who were participating in a series of case-control studies exploring modifiable risk factors for falls, poisonings and scalds.

## **Methods**

### *Study Design*

Multi-centre longitudinal study set in four acute National Health Service (NHS) Trusts in Nottingham, Newcastle, Bristol and Norwich, UK.

### *Participants*

Participants were parents of injured children (cases) who were participating in one of five case-control studies. To be eligible for the case-control studies, the children had to be aged under 5 years old and attending an ED, minor injury unit or admitted to hospital following a fall, poisoning or scald. Full methodological details for these studies have been published.[22] [23] [24] [25] Parents were recruited to the case-control studies either face-to-face at attendance or admission for their child's injury or were approached by post within 72 hours of attendance or admission. Recruited parents were asked if they were interested in participating in one of three other child injury research projects nested within the case-control studies. Those expressing interest within two weeks of their child's injury were eligible for the costs of injury study and were preferentially entered into the study to minimise the time between injury and questionnaire completion, except where the other nested studies had not met recruitment targets. Parents were recruited between June 2010 and February 2013.

### *Data collection*

Participants were given (if recruited face-to-face) or sent (if recruited by post) a study information leaflet, a consent form and a questionnaire to complete covering the first two weeks after the injury. Further questionnaires were sent at 1, 3 and 12 months post injury to those who had not fully recovered at previous time points. Non-responders received up to three reminders: a postal reminder containing the full questionnaire, a telephone reminder and a postal reminder containing a mini-questionnaire to determine whether the child was fully recovered. Questionnaires covered health service resource use, family costs and expenditure for the time period since the previous questionnaire was completed. Participants were sent £5 gift vouchers for use in local stores for each completed questionnaire returned.

### *Analysis*

Self-reported resource use data were combined with the unit cost data obtained from NHS Reference Costs 2012 [4], Personal Social Services Research Unit (PSSRU) unit costs of health and social care 2012 [5] and the British National Formulary (BNF) 2012 [26],

and summed together to obtain the average cost per participant. Unit costs and sources are shown in supplementary tables 1 and 2 online. All costs were inflated to 2012 UK sterling.[27] Participant data were included in all cost categories where resource use was reported. Not all participants reported information for all categories; therefore average costs for each category were calculated using variable numbers of responders. Total average costs were calculated only for participants with complete data on all cost categories. Average costs for each type of injury were estimated.

The main analysis was a complete case analysis. Sensitivity analyses were undertaken for NHS costs, non-NHS costs and total costs to check the robustness of findings to missing data. Multiple imputation was undertaken assuming data were missing at random. The imputation model included all cost component variables (listed in tables 4 and 5) which sum together to produce the total overall cost. Due to non-normality of the cost component variables, predictive mean matching was used for the imputation. The imputation model also included the socioeconomic and injury characteristics listed in table 1. Fifty datasets were imputed and were combined using Rubin's rules.[28]

### **Ethical approval**

The study was approved by Nottinghamshire research ethics committee. Informed consent was assumed through return of completed study questionnaires.

### **Results**

Parents of 435 children were invited to participate, 351 (81%) agreed of which 344 (98%) provided data on recovery from injury and were included in the analysis (figure 1). Seven participants who were known not to have fully recovered at 2 weeks but who were subsequently lost to follow up were similar in terms of age, sex, injury mechanism, admission status and NHS costs to those not lost to follow up and their characteristics are shown in supplementary table 3. Complete data were available for NHS costs on 288 (84%) participants, for non-NHS costs on 314 (91%) participants, and for combined NHS and non-NHS costs on 268 (78%) participants. Parents of 95% of children reported full recovery within two weeks and 99% (n=340) within one month of injury. Most (75%) injuries were falls, with 18% being poisonings and 7% scalds. The mean age was 23 months and 49% were male. Participants were relatively disadvantaged with 43% receiving state benefits, 37% living in non-owner-occupied accommodation and 15% of households without any adults in paid work. Few children (8%) had long-term health conditions prior to the injury (Table 1).

### **Table 1. Characteristics of study participants**

<b>Characteristics</b>	<b>Frequency</b> n= 344 (%)
Study centre	
Nottingham	103 (29.9)
Bristol	126 (36.6)
Norwich	96 (27.9)
Newcastle	19 (5.5)
Injury mechanism	
Fall:	
On one level	76 (22.1)
From furniture	96 (27.9)
On stairs or steps	86 (25.0)
Poisoning	63 (18.3)
Scald	23 (6.7)
Mean age in months (SD)	22.9 (13.0)
Male	169 (49.1)
Ethnic Origin: White	312 (94.0) [12]
Number of children aged under 5 years old in family	[12]
1	200 (60.2)
2	115 (34.6)
≥3	17 (5.1)
First child	143 (45.1) [27]
Maternal age ≤ 19 at birth of first child	48 (14.8) [19]
Single adult household	46 (13.9) [14]
Median weekly hours out of home child care (IQR)	6 (0, 20) [23]
Adults in paid work	[12]
≥ 2	168 (50.6)
1	114 (34.3)
0	50 (15.1)
Receives state benefits	143 (43.2) [13]
Overcrowding >1 person per room	26 (8.1) [23]
Non-owner-occupier	124 (37.4) [12]
Household has no car	45 (13.5) [10]
Mean index of multiple deprivation score (SD)	19.6 (14.4)
Median distance (km) from hospital (IQR)	3.7 (2.2, 6.5)
Long term health condition	25 (7.6) [13]
Child health prior to injury (visual analogue scale, range 0-10) (median (IQR))	9.9 (9.0, 10) [11]

[missing values]

Table 2 shows NHS and non-NHS resource use. Most children (61%) attended ED or the MIU (hereafter referred to as ED) and were not admitted, 35% were admitted for 0-1 days and 4% were admitted for 2 or more days. Three quarters (76%) received low cost investigations and treatment in ED (category 1 investigations and category 1 or 2 treatments, see table 2 for examples). The proportions were similar across all injury mechanisms (ranging from 70% to 82%) but were higher for scalds (100%). Hospital admission was most common for poisoning (65%) and scalds (47%). Few used GP (7%), outpatient (8%) or health visiting services (5%). Only 7% were prescribed medication after their injury but more (46%) used over-the-counter medications. These were rarely

used for poisonings (5%), with similar percentages across the other injury mechanisms (ranging from 33%-52%). One fifth (18%) purchased aids or appliances, most commonly items of safety equipment, after the injury. Few parents incurred travel costs (9%), 16% lost time from work, 18% used informal childcare for the injured child and 33% used formal childcare for other non-injured children in the family, most commonly for poisonings and scalds.

**Table 2. NHS and non-NHS resource use reported by parents by injury mechanism**

	Fall			Poisoning (%)	Scald (%)
	on one level (%)	on stairs or steps (%)	from furniture (%)		
NHS resource use by injury mechanism					
No. responders	64	77	75	57	15
ED treatment & investigation*					
VB03Z Emergency Medicine, Category 3 Investigation with Category 1-3 Treatment	0 (0)	1 (1)	2 (3)	0 (0)	0 (0)
VB04Z Emergency Medicine, Category 2 Investigation with Category 4 Treatment	1 (2)	2 (3)	1 (1)	0 (0)	0 (0)
VB05Z Emergency Medicine, Category 2 Investigation with Category 3 Treatment	1 (2)	0 (0)	0 (0)	1 (2)	0 (0)
VB06Z Emergency Medicine, Category 1 Investigation with Category 3-4 Treatment	5 (8)	1 (1)	1 (1)	0 (0)	0 (0)
VB07Z Emergency Medicine, Category 2 Investigation with Category 2 Treatment	3 (5)	5 (6)	10 (13)	1 (2)	0 (0)
VB08Z Emergency Medicine, Category 2 Investigation with Category 1 Treatment	9 (14)	2 (3)	4 (5)	9 (16)	0 (0)
VB09Z Emergency Medicine, Category 1 Investigation	45 (70)	63 (82)	53 (71)	43 (75)	15 (100)



	Fall			Poisoning (%)	Scald (%)
	on one level (%)	on stairs or steps (%)	from furniture (%)		
with Category 1-2 Treatment					
VB11Z Emergency Medicine, No Investigation with No Significant Treatment	0 (0)	3 (4)	4 (5)	3 (5)	0
<i>Hospital admission at initial ED visit</i>					
≥ 2 days	1 (2)	2 (3)	3 (4)	3 (5)	1 (7)
0-1 day	17 (27)	26 (34)	19 (25)	34 (60)	6 (40)
<i>GP Surgery</i>					
1 visit	5 (8)	5 (6)	3 (4)	2 (2)	2 (13)
≥ 2 visits	0 (0)	2 (3)	1 (1)	0 (0)	0 (0)
<i>Outpatients</i>					
1 visit	3 (5)	2 (3)	7 (9)	0 (0)	2 (13)
≥ 2 visits	0 (0)	4 (5)	0 (0)	0 (0)	4 (27)
<i>Health visitor</i>					
1 visit	3 (5)	2 (3)	1 (1)	4 (7)	3 (20)
≥ 2 visits	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
<i>Subsequent hospital admissions <sup>#</sup></i>					
1 day	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)
≥ 2 days	0 (0)	0 (0)	0 (0)	0 (0)	1 (7)
<i>Prescribed medication</i>					
Prescribed medication	6 (9)	6 (8)	3 (4)	1 (2)	5 (33)
<b>Non-NHS resource use</b>					
No. responders	70	77	87	59	21
Taking over the counter medication	31 (44)	31 (40)	29 (33)	3 (5)	11 (52)
Purchased aids or equipment†	9 (13)	19 (25)	12 (14)	12 (20)	4 (19)
Incurred travel costs	6 (9)	7 (9)	7 (8)	5 (8)	3 (14)
Incurred time off work	7 (10)	15 (19)	13 (15)	9 (15)	6 (29)
Injured child: Used formal childcare	0 (0)	1 (0)	1 (1)	0 (0)	0 (0)
Used informal childcare	12 (17)	17 (22)	13 (15)	7 (12)	6 (29)
Other children: Used formal childcare	19 (27)	22 (29)	29 (33)	25 (42)	10 (47)
Used informal childcare	0 (0)	2 (3)	1 (1)	0 (0)	1 (5)

\*Examples of Investigations[4]: Category 1= urine test; Category 2 = blood test, x-ray; Category 3 = scan, and Examples of treatments: Category 1 = observation, advice, cream to put on their skin, medicine to take home, bandage, sling or support. Category 2 = medicine given by mouth, dressing for wound or burn, paper stitches or wound glue, splint, cast to hold broken or fractured bone in place, physiotherapy, stomach wash out, local anaesthetic, tetanus injection, drip. Category 3 = medicine given by injection, stitches, oxygen through mask or tube to help breathing. Category 4 = manipulation of broken or fractured bone or dislocated joint, general anaesthetic, blood transfusion, chest drain, tube in throat for child who cannot breathe for themselves. Category 5 = resuscitation. \*These inpatient stays are in addition to those resulting from the initial ED visit, which may also have incurred an inpatient stay. † Aids and equipment were typically for falls: safety gates, furniture corner protectors or bed guards; and for poisonings: cupboard locks

Table 3 shows NHS, non-NHS and total costs per child by admission status, length of stay and injury mechanism. As expected, the highest NHS costs were for children admitted for 2 or more days, followed by those admitted for 0-1 days. The very small number of children admitted for 2 or more days precludes comparisons of costs by injury mechanism. The mean costs for admissions for 0-1 days were similar for all types of falls and poisonings (range £720 to £747), but the cost of scalds (£1011) was considerably higher. Mean ED costs were very similar for all types of falls (range £115 to £127). They were lowest for poisonings (£97) and highest for scalds (£178).

Non-NHS costs followed a similar pattern to NHS costs and illustrate the financial burden that injuries place on families. They were highest for children admitted for 2 or more days, followed by those admitted for 0-1 days and lowest for those attending ED but not admitted. Mean costs were highest for scalds amongst those admitted for 2 or more days (£399) and those admitted for 0-1 days (£200). Mean costs for those attending ED but not admitted were highest for falls from furniture (£68) and scalds (£48).

**Table 3. NHS, non-NHS and total costs by admission status, length of stay and mechanism of injury**

	Cost per child by injury mechanism				
	Fall			Poisoning	Scald
	on one level	on stairs	from furniture		
NHS costs (based on 288 participants with complete data)					
Admitted for ≥ 2 days					
No. responders	1	2	3	3	1
Mean	£2810.42	£2688.96	£2988.67	£2598.05	£2588.13
Std Error	-	£16.80	£227.60	£23.04	-
Median	£2810.42	£2688.94	£2861.61	£2575.01	£2588.13
Min	£2810.42	£2672.14	£2673.65	£2575.01	£2588.13
Max	£2810.42	£2705.74	£3430.74	£2644.14	£2588.13
Admitted for 0-1 days					
No. responders	17	26	19	34	6
Mean	£719.59	£746.55	£735.48	£725.47	£1010.92
Std Error	£5.73	£17.33	£13.73	£7.99	£231.22
Median	£700.01	£700.73	£700.01	£677.47	£781.14

Min	£700.01	£700.01	£700.01	£677.47	£702.24
Max	£769.14	£1026.06	£850.11	£855.88	£2150.01
<i>Attended ED and not admitted</i>					
No. responders	46	49	53	20	8
Mean	£119.91	£114.99	£126.80	£96.71	£178.10
Std Error	£9.93	£10.37	£11.12	£7.81	£52.00
Median	£91.47	£91.47	£91.47	£91.47	£114.35
Min	£57.52	£57.52	£57.52	£57.52	£57.52
Max	£437.79	£474.69	£437.79	£227.27	£508.47
<b>Non-NHS costs</b> (based on 296 participants with complete data*)					
<i>Admitted for ≥ 2 days</i>					
No. responders	2	3	4	3	3
Mean	£213.17	£177.68	£99.16	£284.77	£399.17
Std Error	£154.14	£112.44	£31.27	£122.01	£161.77
Median	£213.17	£68.52	£108.69	£279.98	£397.32
Min	£59.03	£61.99	£14.47	£75.88	£119.91
Max	£367.31	£402.54	£164.80	£498.44	£680.29
<i>Admitted for 0-1 days</i>					
No. responders	16	24	21	37	7
Mean	£38.14	£73.73	£65.41	£52.76	£199.51
Std Error	£12.74	£17.15	£20.71	£11.63	£74.45
Median	£4.89	£30.81	£8.88	£22.84	£4.89
Min	£0.00	£0.00	£0.00	£0.00	£0.00
Max	£145.7	£228.40	£266.84	£277.84	£474.43
<i>Attended ED and not admitted</i>					
No. responders	46	46	57	17	9
Mean	£17.58	£37.45	£68.26	£17.91	£48.21
Std Error	£4.67	£11.15	£18.10	£8.34	£28.36
Median	£4.89	£6.89	£8.88	£0.00	£4.89
Min	£0.00	£0.00	£0.00	£0.00	£0.00
Max	£116.33	£412.14	£605.30	£123.05	£239.38
<b>Total NHS and non-NHS costs</b> (based on 268 participants with complete data)					
<i>Admitted for ≥ 2 days</i>					
No. responders	1	2	3	3	1
Mean	£3177.73	£2921.21	£3065.95	£2882.82	£2708.04
Std Error	-	£153.48	£252.61	£142.62	-
Median	£3177.73	£2921.21	£2964.39	£2854.99	£2708.04
Min	£3177.73	£2767.73	£2688.12	£2650.89	£2708.04
Max	£3177.73	£3074.68	£3545.33	£3142.58	£2708.04
<i>Admitted for 0-1 days</i>					
No. responders	14	24	19	34	6
Mean	£754.14	£817.57	£800.97	£780.70	£1191.90
Std Error	£17.77	£27.64	£28.15	£16.90	£249.19
Median	£732.23	£731.58	£725.90	£731.42	£971.52
Min	£704.00	£700.01	£700.01	£700.01	£734.68
Max	£914.84	£1126.32	£1097.58	£1133.72	£2314.81
<i>Attended ED and not admitted</i>					
No. responders	44	44	49	17	7
Mean	£135.95	£154.62	£197.07	£115.55	£224.59

Std Error	£12.08	£17.87	£26.49	£12.20	£70.34
Median	£102.77	£98.36	£107.78	£96.36	£212.72
Min	£57.52	£71.40	£71.40	£57.52	£57.52
Max	£498.33	£555.06	£1043.08	£227.27	£513.36

\*8 participants with complete non-NHS cost data had admission status missing

Tables 4 and 5 show components of overall NHS and non-NHS costs. Table 4 shows ED costs were higher for children admitted to hospital for 2 or more days, followed by those admitted for 0-1 days and lowest for those attending ED but not admitted. ED costs were similar across injury mechanisms for those attending ED but not admitted and for those admitted for 0-1 days. Again the small numbers admitted for 2 or more days precludes comparisons between injury mechanisms. Table 5 shows costs for admissions far outweigh costs for other NHS services. For parents, the major costs were for informal childcare and time off work. These costs were highest for scalds (mean costs: £91 informal childcare; £78 time off work) and lowest for falls on one level (mean costs: £17 informal childcare; £9 time off work).

**Table 4. Mean costs per child for ED services by admission status and injury mechanism**

	Attended ED and not admitted					Admitted for $\geq 2$ days					Admitted for 0-1 days				
	Fall			Poisoning	Scalds	Fall			Poisoning	Scalds	Fall			Poisoning	Scalds
	on one level	on stairs	from furniture			on one level	on stairs	from furniture			on one level	on stairs	from furniture		
No. respondents	46	49	53	20	8	1	2	3	3	1	17	26	19	34	6
Mean	£98.97	£94.48	£96.66	£87.03	£82.98	£210.42	£227.58	£233.30	£137.06	£114.01	£132.35	£122.03	£124.62	£124.43	£114.01
Median	£91.47	£91.47	£91.47	£91.47	£91.47	£210.42	£227.58	£244.74	£114.01	£114.01	£114.01	£114.01	£114.01	£114.01	£114.01
Min	£57.52	£57.52	£57.52	£57.52	£57.52	£210.42	£210.42	£210.42	£114.01	£114.01	£114.01	£114.01	£114.01	£91.47	£114.01
Max	£142.92	£190.71	£142.92	£130.76	£91.47	£210.42	£244.74	£244.74	£183.14	£114.01	£183.14	£162.06	£162.06	£162.06	£114.01

**Table 5. Mean costs per child for NHS and non-NHS services by injury mechanism**

	Fall			Poisoning	Scald
	on one level	on stairs	from furniture		
No. responders	64	77	75	57	15
<b>NHS costs (based on 288 participants with complete data)</b>					
<i>Admitted for 0-1 days or ≥ 2 days</i>					
Mean	£194.11	£261.79	£246.89	£479.07	£398.47
Std Error	£48.50	£51.09	£60.21	£72.47	£165.26
Median	£0.00	£0.00	£0.00	£0.00	£0.00
Min	£0.00	£0.00	£0.00	£0.00	£0.00
Max	£2461.00	£2461.00	£2461.00	£2461.00	£2461.00
<i>GP visits</i>					
Mean	£2.75	£2.06	£0.00	£0.20	£2.33
Std Error	£2.75	£1.27	£0.00	£0.20	£1.68
Median	£0.00	£0.00	£0.00	£0.00	£0.00
Min	£0.00	£0.00	£0.00	£0.00	£0.00
Max	£176.00	£88.00	£0.00	£11.63	£23.25
<i>Outpatient visits</i>					
Mean	£6.52	£16.82	£16.68	£0.00	£70.93
Std Error	£3.70	£6.93	£5.88	£0.00	£32.52
Median	£0.00	£0.00	£0.00	£0.00	£0.00
Min	£0.00	£0.00	£0.00	£0.00	£0.00
Max	£139.00	£278.00	£278.00	£0.00	£417.00
<i>Health visitor</i>					
Mean	£0.74	£0.13	£0.28	£1.19	£1.40
Std Error	£0.47	£0.09	£0.28	£0.63	£1.40
Median	£0.00	£0.00	£0.00	£0.00	£0.00
Min	£0.00	£0.00	£0.00	£0.00	£0.00
Max	£21.00	£5.09	£21.00	£21.00	£21.00
<i>Subsequent inpatient days *</i>					
Mean	£0.00	£0.00	£7.81	£0.00	£78.13
Std Error	£0.00	£0.00	£7.81	£0.00	£78.13
Median	£0.00	£0.00	£0.00	£0.00	£0.00
Min	£0.00	£0.00	£0.00	£0.00	£0.00
Max	£0.00	£0.00	£586.00	£0.00	£1172.00
<i>Prescribed medication</i>					
Mean	£0.16	£0.10	£0.05	£0.03	£2.39
Std Error	£0.08	£0.05	£0.03	£0.03	£1.18
Median	£0.00	£0.00	£0.00	£0.00	£0.00
Min	£0.00	£0.00	£0.00	£0.00	£0.00
Max	£3.64	£2.23	£2.23	£1.75	£13.12
<b>Non-NHS costs (based on 314 participants with complete data)</b>					
No. responders	70	77	87	59	21
<i>Over-the-counter medication</i>					
Mean	£2.29	£2.20	£2.32	£0.17	£5.49
Std Error	£0.32	£0.33	£0.38	£0.12	£2.25
Median	£0.00	£0.00	£0.00	£0.00	£3.99
Min	£0.00	£0.00	£0.00	£0.00	£0.00

	<b>Fall</b>			<b>Poisoning</b>	<b>Scald</b>
	<b>on one level</b>	<b>on stairs</b>	<b>from furniture</b>		
Max	£8.88	£9.78	£17.76	£4.89	£47.01
<i>Aids</i>					
Mean	£0.07	£3.47	£0.62	£1.83	£1.14
Std Error	£0.07	£1.48	£0.33	£1.31	£0.96
Median	£0.00	£0.00	£0.00	£0.00	£0.00
Min	£0.00	£0.00	£0.00	£0.00	£0.00
Max	£4.80	£100.00	£20.00	£75.88	£20.00
<i>Formal childcare</i>					
Mean	£0.00	£5.47	£4.10	£0.00	£0.77
Std Error	£0.00	£4.26	£3.96	£0.00	£0.77
Median	£0.00	£0.00	£0.00	£0.00	£0.00
Min	£0.00	£0.00	£0.00	£0.00	£0.00
Max	£0.00	£320.08	£344.39	£0.00	£16.21
<i>Informal childcare</i>					
Mean	£17.40	£20.88	£44.15	£27.80	£91.01
Std Error	£5.95	£5.63	£11.71	£9.01	£36.42
Median	£0.00	£0.00	£0.00	£0.00	£22.84
Min	£0.00	£0.00	£0.00	£0.00	£0.00
Max	£363.32	£228.40	£589.73	£498.44	£671.40
<i>Time off work</i>					
Mean	£8.90	£22.79	£19.73	£22.20	£78.36
Std Error	£3.40	£6.96	£5.63	£7.67	£33.21
Median	£0.00	£0.00	£0.00	£0.00	£0.00
Min	£0.00	£0.00	£0.00	£0.00	£0.00
Max	£111.44	£334.32	£229.04	£222.88	£572.60
<i>Travel</i>					
Mean	£0.52	£0.70	£0.61	£0.92	£0.95
Std Error	£0.29	£0.27	£0.26	£0.68	£0.55
Median	£0.00	£0.00	£0.00	£0.00	£0.00
Min	£0.00	£0.00	£0.00	£0.00	£0.00
Max	£17.40	£12.58	£14.47	£39.40	£8.40

\* These inpatient stays are in addition to those resulting from the initial ED visit, which may also have incurred an inpatient stay.

NHS and non-NHS costs were not found to be correlated with deprivation, although there was some evidence that participants on benefits on average had lower non-NHS costs than those not on benefits (see supplementary figures 1 and 2). NHS and non-NHS costs by injury mechanism were similar across study centres, except for Newcastle which was difficult to compare due to the low number of participants recruited (N=19, Table 1).

The multiple imputation model used the cost component level data together with socioeconomic and injury data, to estimate the total NHS and non-NHS costs for all participants (Supplementary Table 4 reports the number of missing observations for each variable included in the imputation analysis). Findings from the multiple imputation analysis were comparable to the complete case analysis with the exception of mean total

cost of falls on one level (£2022; SE £1177) and falls from furniture (£2448; SE £651) for those admitted for 2 or more days. This is likely to be due to the small number of children admitted for 2 or more days resulting in substantial uncertainty in cost estimates as portrayed by the large standard errors.

## **Discussion**

### *Main findings*

Our study provides new information on the costs to the NHS and families of unintentional home injuries in England in children under 5 years old. The majority of our study population were children attending ED (61%), with 35% admitted for one day or less and 4% admitted for 2 or more days. Most injuries were relatively minor, with over 95% recovering within 2 weeks, and 99% within one month of the injury; hence our cost estimates predominantly represent the short term costs of injuries. Despite this, the mean healthcare cost of an admission for 2 or more days was typically £2000 - £3000, for an admission for one day or less was £700 - £1000 and for an ED attendance without admission was £100 - £180. For admissions for one day or less and for ED attendances healthcare costs were highest for scalds. Costs for admissions for more than 2 days were difficult to compare across injury mechanisms due to small numbers. Mean family costs were considerable (up to £400 for an injury requiring admission for 2 or more days, £200 for an injury requiring admission for one day or less and £70 for and ED attendance not requiring admission) and mainly comprised costs for childcare and for time off work. Family costs varied across injury mechanisms, being highest for scalds.

### *Strengths and limitations*

This is the first study to our knowledge reporting parent and health care costs for a range of common injuries in children under 5 years old in England. Seventy eight percent of participants were included in the complete case analysis. Multiple imputation produced similar estimates to the complete case analysis, with the exception of costs of falls on one level and falls from furniture for children admitted for 2 or more days. The number of children admitted for 2 or more days was small, especially for each injury mechanism, giving rise to considerable uncertainty around cost estimates and possibly explaining differences between the complete case and multiple imputation analyses. The last data collection from the national Home Accident Surveillance System (HASS) in 2002, [3] reported 5% of children who attended ED following an injury were admitted. As admissions are over-represented in our study, we analysed costs for admitted and non-admitted children separately. Our large number of admissions for one day or less may partly reflect development of short-stay paediatric assessment units which assess,



investigate, observe and treat more minor injuries, most commonly head injuries and ingestions. [29-31] We also only studied five injury mechanisms, so findings are not generalisable beyond these injuries. Although differences in healthcare systems and costs can limit the generalisability of single country economic studies, our finding that minor injuries result in substantial healthcare and family costs is likely to be similar in other high income countries.

Virtually all (99%) participants in our study fully recovered from their injuries within one month of the injury, so we have not been able to study the longer term costs of injuries. In addition, our study included only 10 children admitted for 2 or more days, eight who had 2 or more out-patient visits post injury and only two who had a further hospital admission for the same injury. Consequently our estimates will underestimate the total costs of injuries in young children, in particular the cost of relatively rare, but resource intensive injuries such as head injuries or complex fractures resulting from falls or scalds requiring longer term care.

Our study participants were recruited from five case-control studies. We collected anonymised data on age and sex of children attending ED who were not recruited to the case-control studies, and found only one significant difference in age between those recruited and those not recruited to one study (stair falls study; 19% recruited aged 0-12 months, vs. 15% of non-recruited;  $p < 0.001$ ). No significant sex differences were found across the five studies between recruited and non-recruited children. Therefore, our study population is probably representative of ED attenders in terms of age and sex, but representativeness in terms of other sociodemographic characteristics is unknown. Participants may have been more interested in child safety and may have been more likely to incur costs (e.g. purchase of home safety equipment after an injury) than non-participants. However, as the costs of home safety equipment were small, this is unlikely to have had a major impact on our findings.

#### *Comparison with other studies*

It is difficult to compare our findings with other studies because of differences in study populations or healthcare services, the inclusion only of healthcare costs, specific types of (usually) more severe injuries or those with long-term consequences, or different age ranges. [14 ,17 ,18 ,20 ,21 ,32 ,33] One study reported an uncomplicated hot drink scald resulting in healthcare costs of £1,850, [34] a figure similar to our maximum cost for scalds for admission for one day or less. We have been unable to find UK studies reporting the costs to families in the under-fives with which to compare our findings.

An alternative approach to assessing the costs of injuries would have been to estimate the burden of childhood injuries by measuring what society would be prepared to pay in order to avoid childhood injuries (willingness to pay). This methodology has been used to estimate the cost of road casualties in the UK since 1988. Although the concept is appealing, well-documented practical difficulties include formulation of the questions asked and interpretation of the responses given.[35] Despite this, Walter[36] applied the road casualty methodology to estimate costs of home accidents, estimating the average cost of a non-fatal hospital-treated casualty aged under 5 years to be £11 338 (updated to 2012 prices).

#### *Implications for research and practice*

Our study, and the lack of other published studies, highlights the importance of measuring the cost of both major and minor childhood injuries to inform evidence-based policy making for injury prevention and commissioning of preventive services. To enable calculation of the costs of injuries in children aged under 5 years old on a national level, larger studies are needed that cover all injury mechanisms that are representative of ED attenders and hospital admissions in the UK. It is important not only to measure the costs of injuries, but also to undertake economic evaluations of interventions to prevent child injuries in the home. Future costing studies and economic evaluations of interventions should measure the financial burden to families resulting from unintentional injuries in childhood as these can be substantial and explore economic impact by family characteristics.

**Competing Interests:** none declared

**Funding acknowledgement:** This paper presents independent research funded by the National Institute for Health Research (NIHR) under its Programme Grants for Applied Research Programme (RP-PG-0407-10231). The views expressed in this article are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health.

**Contributions:** All authors interpreted the data, critically revised the manuscript and approved the final version. NJC, DK and MH designed the study. CT, BK and AH collected data. NJC and KM analysed the data. NJC, DK, CT, MH and GMN drafted sections of the manuscript.

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