ELPS

The full version of this article appears on bmj.com

Cross sectional survey of socioeconomic variations in severity and mechanism of childhood injuries in Trent 1992-7

Julia Hippisley-Cox, Lindsay Groom, Denise Kendrick, Carol Coupland, Elizabeth Webber, Boki Savelyich

Division of General Practice, Tower Building University Park, Nottingham NG7 2RD
Julia Hippisley-Cox *senior lecturer in general practice*
Lindsay Groom *research unit coordinator*
Denise Kendrick *senior lecturer in general practice*
Carol Coupland *senior lecturer in medical statistics*
Elizabeth Webber *researcher in general practice*
Boki Savelyich *researcher in general practice*

Correspondence to: J Hippisley-Cox julia.hippisley-cox@nottingham.ac.uk

BMJ 2002;324:1132–4

Abstract

Objective To determine the relation between morbidity from injury and deprivation for different levels of injury severity and for different injury mechanisms for children aged 0-14 years.
Design Cross sectional survey of routinely collected hospital admission data for injury 1992-7.
Setting 862 electoral wards in Trent Region.
Subjects 21 587 injury related hospital admissions for children aged 0-4 years and 35 042 admissions for children aged 5-14.
Main outcome measures Rate ratios for hospital admission for all injuries, all injuries involving long bone fracture, and all injuries involving long bone fracture requiring an operation; rate ratios for hospital admission for six types of injury mechanism divided by quintiles of the electoral wards' Townsend scores for deprivation. Rate ratios calculated by Poisson regression, with adjustment for distance from nearest hospital admitting patients with injuries, rurality, ethnicity, and percentage of males in each electoral ward.
Results Both total number of admissions for injury and admissions for injuries of higher severity increased with increasing socioeconomic deprivation. These gradients were more marked for 0-4 year old children than 5-14 year olds. In terms of injury mechanisms, the steepest socioeconomic gradients (where the rate for the fifth of electoral wards with the highest deprivation scores was ⩾3 times that of the fifth with the lowest scores) were for pedestrian injuries (adjusted rate ratio 3.65 (95% confidence interval 2.94 to 4.54)), burns and scalds (adjusted rate ratio 3.49 (2.81 to 4.34)), and poisoning (adjusted rate ratio 2.98 (2.65 to 3.34)).
Conclusion There are steep socioeconomic gradients for injury morbidity including the most common mechanisms of injury. This has implications for targeting injury prevention interventions and resources.

Introduction

Children from social classes four and five have a death rate from injury five times that of children from social classes one and two, and this difference is increasing.[1] Similar differences also exist for deaths from most injury mechanisms, most notably for fire, pedestrian and cyclist injuries, falls, and poisoning.[2]

While much research has focused on death from injury, there is also considerable morbidity related to injury. There is, however, conflicting evidence about socioeconomic gradients in injury morbidity in childhood. Important gaps in our knowledge about socioeconomic gradients for injury mechanisms leading to morbidity need to be filled, not only for health service planning but also to inform the targeting of injury prevention strategies and to prevent widening inequalities.[1]

The aim of our study was to determine (*a*) whether there is a socioeconomic gradient for injury morbidity and whether this changes as injury severity and case ascertainment increases, and (*b*) whether there is a socioeconomic gradient for different injury mechanisms.

Subjects and methods

Sample

Our sample consisted of all admissions for unintentional injury from the 862 electoral wards in Trent between 1 April 1992 and 31 March 1997 for children aged 0-4 years and 5-14. We identified admissions from Trent NHS regional admissions databases by using the diagnosis codes and codes for external causes of injury from the ICD-9 and ICD-10 (international classification of diseases, ninth and 10th revisions) (see bmj.com for details) as well as relevant OPCS (operative procedure coding scheme) codes.

We allocated each patient to his or her respective electoral ward and aggregated the patient level data at electoral ward level in three ways: by the total number of admissions, by admissions for long bone fracture, and by admissions for long bone fracture requiring an operation (representing different measures of severity).

We identified those mechanisms of injury known to have a socioeconomic gradient for mortality in children[2] and aggregated them to produce totals for each electoral ward for all admissions of children aged <15 years during the five year study. The mechanisms were pedal cyclist and pedestrian injuries, other transport injuries, falls, burns and scalds, and poisoning and chemical burns.

Census data

We used the Townsend score associated with each electoral ward as a proxy for material deprivation, with high scores being associated with greater deprivation. The Townsend score contains the variables unemployment, overcrowding, lack of a car, and non-owner occupation.[3] We calculated the distance from the centroid of each ward to the nearest hospital admitting patients with injuries during the study period using the appropriate grid references.

Statistical analysis

We used Poisson regression to determine univariate and multivariate rate ratios with 95% confidence intervals for admission rates by electoral ward. We used the mid-year population of each ward as the denominator term. Our main explanatory variable was the Townsend score associated with electoral ward where each patient lived. Confounding factors included in the multivariate analysis were the proportion of males in each age group in the ward, rurality, percentages of Asian and black residents, and distance from nearest hospital (categorised into fifths). We chose a significance level of 0.01 (two tailed).

Results

Characteristics of the study population

We identified 21 587 admissions for unintentional injury for children aged 0-4 years, of whom 21 481 (99.5%) could be linked to one of the 862 electoral wards in Trent. We identified 35 042 admissions for injury to children aged 5-14, of whom 34 888 (99.6%) could be allocated to an electoral ward. Of the 21 481 admissions for children aged 0-4 years, 2517 (11.7%) were for long bone fractures, and 1721 (68.4%) of these required an operation. Of the 34 888 admissions for children aged 5-14, 12 007 (34.4%) were for long bone fractures, of which 10 455 (87.1%) required an operation. The admission rates by Townsend deprivation score are presented on bmj.com

Table 1 Rate ratios of hospital admission for different levels of injury severity for children aged 0-4 years in Trent Region for 1992-7 by Townsend deprivation score

Townsend scores*	Adjusted rate ratio† (95% CI)	P value‡
Total admissions		
Lowest fifth	1.00	
2nd	1.06 (0.99 to 1.13)	0.09
3rd	1.27 (1.20 to 1.35)	<0.0001
4th	1.41 (1.33 to 1.49)	<0.0001
Highest	1.88 (1.78 to 1.99)	<0.0001
Admissions with long bone fractures		
Lowest fifth	1.00	
2nd	1.13 (0.94 to 1.35)	0.20
3rd	1.29 (1.09 to 1.53)	0.004
4th	1.45 (1.23 to 1.70)	<0.0001
Highest	1.70 (1.45 to 1.99)	<0.0001
Admissions with long bone fractures needing operations		
Lowest fifth	1.00	
2nd	1.23 (0.98 to 1.53)	0.07
3rd	1.32 (1.07 to 1.63)	0.01
4th	1.52 (1.24 to 1.85)	<0.0001
Highest	1.83 (1.51 to 2.22)	<0.0001

*Townsend scores divided by quintiles, with the highest fifth representing the most deprived electoral wards.
†Adjusted for rurality, percentage males, percentage Asian, percentage black, and distance from nearest hospital.
‡Compared with value for lowest fifth of Townsend scores.

Table 2 Causes of injury (according to ICD-9 and ICD-10 codes) for hospital admissions of children aged <15 years in Trent Region for 1992-7

Cause of injury	No (%) of admissions	% of admissions with valid ICD codes
Children aged 0-4 years		
Falls	7 758 (36.1)	39.3
Pedal cycle injuries	258 (1.2)	1.3
Pedestrian injuries	293 (1.4)	1.5
Other transport injuries*	324 (1.5)	1.6
Burns and scalds	1 445 (6.7)	7.3
Poisoning and chemical injuries	4 271 (19.9)	21.6
All other injury mechanisms	5 413 (25.2)	27.4
Missing ICD codes	1 719 (8.0)	
Total admissions	21 481 (100)	
Children aged 5-14 years		
Falls	15 669 (44.9)	48.9
Pedal cycle injuries	3 152 (9.0)	9.8
Pedestrian injuries	1 678 (4.8)	5.2
Other transport injuries*	1 446 (4.1)	4.5
Burns and scalds	446 (1.3)	1.4
Poisoning and chemical injuries	1 081 (3.1)	3.4
All other injury mechanisms	8 547 (24.5)	26.7
Missing ICD codes	2 869 (8.2)	
Total admissions	34 888 (100)	

*Excluding pedal cycle and pedestrian injuries.

Socioeconomic gradients for injury severity

We found a significant gradient for all admissions in children aged 0-4 by Townsend score (table 1). We also found a socioeconomic gradient for the three types of admissions in children aged 5-14 years, although the gradients were less marked than for children aged 0-4.

Socioeconomic gradients for injury mechanism

The commonest external cause of injury in both age groups was falls (table 2). The second most common causes were poisonings in children aged 0-4 and pedal cycle injuries in older children.

We found increasing admission rates with increasing deprivation for all mechanisms of injury except for other transport injuries (which excluded pedestrian and cycle injuries) (table 3). The steepest socioeconomic gradient was for pedestrian injuries, where the most deprived fifth of wards had almost four times the admission rate than the most affluent fifth (adjusted rate ratio 3.65 (2.94 to 4.54)). Similarly, rates of admission for burns and scalds and poisoning injures were three times higher in the most deprived fifth of wards compared with the most affluent fifth.

Discussion

We found a steep socioeconomic gradient for all hospital admissions for injuries in childhood, including those of greater severity. These gradients were steepest for children aged under 5. There were also steep socioeconomic gradients according to the external cause of injury. The steepest gradients were for pedestrian injuries, burns and scalds, and poisoning.

Limitations and merits of study

This study is based on routinely collected data on NHS hospital admissions, which we have not been able to validate. However, a recent systematic review showed a

Table 3 Rates of hospital admission for different causes of injury for children aged <15 years in Trent Region for 1992-7 by Townsend deprivation score. (Values are median rates (interquartile range) per 10 000 children)

	Townsend score*				
Cause of injury	**Lowest fifth**	**2nd**	**3rd**	**4th**	**Highest**
Falls	205.8 (124.4 to 267.3)	182.7 (122.2 to 253.9)	234.9 (162.3 to 301.0)	267.3 (195.9 to 315.0)	329.4 (268.9 to 409.0)
Pedal cycle injuries	25.6 (0.0 to 48.0)	28.8 (12.5 to 46.1)	28.9 (0.0 to 43.5)	36.8 (19.9 to 60.5)	46.0 (22.2 to 66.1)
Pedestrian injuries	0.0 (0.0 to 14.5)	0.0 (0.0 to 21.4)	7.5 (0.0 to 26.0)	16.6 (0.0 to 32.5)	34.4 (20.4 to 49.1)
Other transport injuries†	17.2 (0.0 to 34.2)	15.0 (0.0 to 32.5)	14.1 (0.0 to 33.2)	16.1 (0.0 to 30.0)	20.8 (12.1 to 29.0)
Poisoning and chemical injuries	25.2 (0.0 to 48.0)	29.8 (0.0 to 51.3)	44.4 (16.6 to 74.2)	52.2 (31.7 to 84.7)	81.4 (51.9 to 114.3)
Burns and scalds	0.0 (0.0 to 13.1)	0.0 (0.0 to 15.9)	4.9 (0.0 to 21.6)	16.0 (0.0 to 32.7)	29.9 (17.6 to 45.7)

*Townsend scores divided by quintiles, with the highest fifth representing the most deprived electoral wards. †Excluding pedestrian and pedal cycle injuries.

median accuracy of 91% for diagnostic codes and 70% for procedure codes.[4] Indeed, the role of routine NHS data in monitoring and promoting equity in primary care has been advocated,[5] as has a role in identifying areas of concern needing further study.[6]

Data were not available for private admissions, although we expect that the vast majority of patients are admitted to NHS hospitals. Finally, our use of routinely collected data limited us to an area, rather than an individual, measure of deprivation. As with all ecological studies, caution must be exercised in drawing conclusions concerning individual deprivation and injury morbidity.

The strengths of our study are that we have incorporated the possible confounding effects of proximity to hospital, ethnicity, and rurality.[7 8] Our study is the largest study in the subject and one of the most robust since it is less subject to local variations in a single area or hospital unit. Our sample is more than 20 times the size of that in a recent study that showed no socioeconomic gradient for the incidence of fractures in children, which the authors themselves found surprising.[9] Given recent reports on the important lack of injury morbidity data, particularly in relation to social inequalities,[10] and the importance of injuries as a national priority,[11] we believe our finding are worth reporting with due caution.

Implications of our findings

We found a steep socioeconomic gradient for all injury admissions for children under 5 years. This is unlikely to be explained by thresholds for admission that differ by social group, as the gradient persists for long bone fractures requiring an operative procedure, where we would expect virtually all cases to be admitted irrespective of social group.[12]

The socioeconomic gradient for all injury admissions for children aged 5-14 was also significant, although less steep for long bone fracture requiring an operative procedure. This suggests factors other than injury severity may play a part in the decision to admit children in this age group.

Why might the gradient in injury morbidity be steeper for younger children? This may partly be explained by the changes in injury mechanism with age. After falls, the leading cause of injury related admissions is poisoning in younger children and transport related injuries in older children. Younger children also spend more time at home, and the Townsend score, which includes non-owner occupation and overcrowding, may better reflect the quality of the home environment than that of the environment in schools, play areas, or leisure facilities where older children spend more of their time.

This study implies that targeting deprived areas with interventions that are known to be effective for these injury mechanisms—such as traffic calming and smoke alarms—may reduce these inequalities. If primary care organisations are to undertake injury prevention in line with national priorities, then their budgets need to reflect local levels of injury morbidity.

What is already known on this topic?

There is a steep socioeconomic gradient for injury related mortality

There is conflicting evidence regarding the socioeconomic gradient for injury morbidity, particularly with respect to different injury severity and injury mechanisms

What this study adds

A socioeconomic gradient for injury morbidity exists in children aged <15 years, particularly in those aged <5, which persists for different measures of injury severity

The socioeconomic gradient for injury mechanisms is steepest for pedestrian injuries, burns and scalds, and poisoning, which has implications for targeting injury prevention strategies

We thank Andy Nicholson and Howard Chapman from Trent NHS Executive for their help with extracting hospital admissions data and Maura Bell and April McCambridge for helping process ethical approval.

Contributors: see bmj.com

Funding: Grant from Trent NHS Executive Trent.

Competing interests: None declared.

1 Roberts I, Power C. Does the decline in child injury mortality vary by social class? A comparison of class specific mortality in 1981 and 1991. *BMJ* 1996;313:784-6.
2 Roberts I. Cause specific social class mortality differentials for child injury and poisoning in England and Wales. *J Epidemiol Community Health* 1997;51:334-5.
3 Townsend P, Davidson N. *The Black report*. London: Penguin, 1982.
4 Campbell S, Campbell M, Grimshaw J, Walker A. A systematic review of coding accuracy. *J Public Health Med* 2001;23:205-11.
5 Majeed FA, Chaturvedi N, Reading R, Ben-Shlomo Y. Monitoring and promoting equity in primary and secondary care. *BMJ* 1994;308:1426-9.
6 McKee M. Routine data: a resource for clinical audit. *Qual Health Care* 1993;2:104-11.
7 Lyons RA, Lo SV, Heaven M, Littlepage BNC. Injury surveillance in children—usefulness of a centralised database of accident and emergency attendances. *Injury Prev* 1995;1:173-6.
8 McKee CM, Gleadhill DNS, Watson JD. Accident and emergency attendance rates: variation among patients from different general practices. *Br J Gen Pract* 1990;40:150-3.
9 Lyons R, Delahunty A, McCabe M, Allen H, Nash P. Incidence of childhood fractures in affluent and deprived areas: population based study. *BMJ* 2000;320:149.
10 British Medical Association. *Injury prevention*. London: BMA, 2001.
11 Department of Health. *Saving lives: our healthier nation*. London: Stationery Office, 1999.
12 Cryer PC, Jarvis SN, Edwards P, Langley JD. Why the government was right to change the 'Our Healthier Nation' accidental injury target. *Public Health* 2000;114:232-7.

(Accepted 15 April 2002)