

South Asian ethnicity and risk of childhood accidents: an ecological study at enumeration district level in Leicester

M. D. Tobin, J. Milligan, R. Shukla, B. Crump and P. R. Burton

Abstract

Background Surveys of 'self-reported' accidents suggest that South Asian children in the United Kingdom may have lower rates of childhood accidents, but little is known about their susceptibility to severe accidents compared with white children.

Methods We conducted an ecological study at the level of Census enumeration districts to compare hospital utilization as a result of childhood accidents according to White, South Asian, Black or 'Other' ethnic grouping and Townsend deprivation score in Leicester. Enumeration districts were assigned to postcoded data for fracture clinic attendances between 1997 and 1999 and in-patient admissions and in-patient stays of longer than 3 days as a result of accidents between 1995 and 1999 in children under 16 years.

Results South Asian children were less likely than white children to attend fracture clinic, be admitted or to have a prolonged stay as a result of an accident. Having adjusted for deprivation score, for a 10 per cent increase in the proportion of South Asian residents in an enumeration district, the odds ratio for an in-patient stay of longer than 3 days was 0.95 (95 per cent confidence interval (CI) 0.91–1.00, $p = 0.035$), for an accident admission the odds ratio was 0.93 (95 per cent CI 0.92–0.94, $p < 0.001$) and for attendance at fracture clinic the odds ratio was 0.94 (95 per cent CI 0.92–0.96, $p < 0.001$). For a district with 70 per cent of its children from South Asian groups (as observed in one-fifth of Leicester's enumeration districts), this represents a 40 per cent lower rate of accident admissions.

Conclusions South Asian children were significantly less likely to utilize hospital services as a result of an accident. This may well be explained by differential exposure to accident hazards across ethnic groups, rather than by different thresholds of hospital attendance, given that hospital utilization was also lower for serious accidents in South Asian children.

Keywords: accidents, ethnic, Asian

Introduction

Childhood accidents (unintentional injuries and poisonings), as common and preventable causes of childhood morbidity and mortality associated with marked health inequalities, are of major public health concern.¹ In England and Wales, over a

quarter of all children aged 2–15 years attend their general practitioner or hospital following an accident in any given year.² Over 100 000 children are admitted as a result of an accident each year, 10 000 of whom will require an in-patient stay of more than 3 days ('serious accidental injury').³ Childhood accidents also cause permanent disability, although the prevalence of such problems is less well documented.¹ In England and Wales in 1995, 590 children aged 1 month to 15 years died as a result of injury or poisoning, accounting for 18 per cent of total deaths in this age group.⁴ Effective, appropriately targeted public health action can reduce accident rates. For example, transport accidents, which accounted for 51 per cent of accidental childhood deaths in England and Wales in 1998, can be prevented by targeted speed reduction and road engineering programmes.⁵

Understanding variations in health service utilization as a result of childhood accidents according to ethnicity and socio-economic characteristics is of great interest to epidemiologists and policy-makers. Not only does it allow workload to be predicted to inform the planning of services that manage injuries and poisonings, but it also informs the targeting of preventive interventions. Differences between groups may give vital clues about aetiological factors.

Studies in the United Kingdom have shown socio-economic deprivation to be a risk factor for hospital admissions owing to

M. D. Tobin,¹ MRC Clinical Research Fellow

J. Milligan,² Information Analysis and Governance Manager

R. Shukla,³ Director of Public Health

B. Crump,⁴ Chief Executive

P. R. Burton,¹ Professor of Genetic Epidemiology

¹Department of Epidemiology and Public Health, University of Leicester, 22–28 Princess Road West, Leicester LE1 6TP.

²Leicester Health Informatics Service, Charnwood and Northwest Leicestershire Primary Care Trust, Gwendolen Road, Leicester LE5 4QF.

³Eastern Leicester Primary Care Trust, 1st Floor, Mansion House, 41 Guildhall Lane, Leicester LE1 5FR.

⁴Shropshire and Staffordshire Health Authority, Mellor House, Corporation Street, Stafford ST16 3SR.

Address correspondence to M. D. Tobin.
E-mail: mt47@leicester.ac.uk

childhood accidents.⁶ However, United Kingdom studies investigating variations in hospital utilization as a result of childhood accidents according to ethnic group have so far focused on self- (or parental-) reporting of accidents, as hospitals have not, until recently, started to record the ethnicity of patients. The *Health survey for England '99* showed marked differences in self-reported accident rates between ethnic groups, with lower rates in South Asian children.⁷ However, these differences could have been accounted for by differences in reporting practices for accidents between ethnic groups.

As we could find no United Kingdom studies that examined the relationship between ethnicity and the risk of hospital utilization owing to childhood accidents, and no international studies that were generalizable to the United Kingdom population, we undertook a study to investigate the relationship between ethnicity and hospital utilization owing to childhood accidents in the residents of Leicester. As data on the ethnicity of individuals attending hospital were not routinely available, and as data on ethnicity and on deprivation were available by Census enumeration district, we adopted an ecological approach at the level of enumeration districts,⁸ which was the smallest level (less than 500 total population) at which United Kingdom Census data on ethnicity were available.

Methods

Leicester is a city in the East Midlands of England, with a population of 293 000, which is ethnically diverse and relatively young. Forty per cent of Leicester's children under 15 years are from minority ethnic groups. South Asian children account for one-third of the City's children under 15 years. Overall Leicester City is relatively deprived. The mean Townsend score⁹ for Leicester's 601 Census enumeration districts is 5.1 (range -7 (relatively affluent) to 23 (severely deprived)), standardized to the Townsend score for Leicestershire health district.

We obtained data on admissions to the Leicester Royal Infirmary as a result of accidents in Leicester residents under 16 years between April 1995 and March 1999. This hospital is the only provider of accident and emergency, fracture clinic and children's in-patient services for Leicester's population. Admissions as a result of accidents had a primary International Standard Classification of Diseases (ICD-10) code indicating an injury or poisoning (S00 to T98X) and an ICD-10 external cause code indicating an accidental cause (V01-X59, Y40-Y84).¹⁰ 'Serious accidental injuries' carried the same code, but related to in-patient admissions of longer than 3 days (the United Kingdom Government definition of serious accidental injury).³ Data on new out-patient attendances at the Leicester Royal Infirmary fracture clinic were obtained for the period April 1997-March 1999. ICD codes were not available for fracture clinic attendances and these data therefore related to all diagnoses.

We used MapInfo Professional v5.5 to apply Census enumeration districts to hospital data with postcodes.¹¹ Thirty-four enumeration districts (5.7 per cent) were excluded from the

analysis: data from the Office for National Statistics on ethnicity were not available for enumeration districts with fewer than 50 residents (20 enumeration districts); we also chose to exclude enumeration districts with fewer than 10 0-15-year-olds (14 enumeration districts). Hospital utilization rates were calculated using the Family Health Services Register population as the denominator. Census data were used to measure deprivation using the Townsend score,⁸ adjusted to the mean Townsend score for Leicestershire. Census population estimates were used to estimate the number and proportion of each ethnic group by enumeration district. Office for National Statistics ethnic classifications⁸ were combined as follows: South Asian (Indian, Pakistani or Bangladeshi); Black (Black-Caribbean, Black-African, Black-Other including Black-Mixed); 'Other' (Chinese, Other-Asian, Other-Mixed); and White (White).

Statistical analysis was undertaken using generalized estimating equations,¹² with the statistical software STATA 6.0. The use of generalized estimating equations allowed confounding variables to be adjusted for and allowed correlation in accident rates between enumeration districts within the same ward to be quantified and adjusted for. Furthermore, by using robust ('Huberized') standard errors, statistical inferences based upon the regression coefficients in the model were rendered robust to misspecification of the correlation structure.¹²

Results

A total of 567 enumeration districts were included in the analysis. Of the 62 572 residents of these enumeration districts under 16 years, 37 580 (60.1 per cent) were White, 20 135 (32.2 per cent) were South Asian, 2239 (3.6 per cent) were Black, and 2618 (4.2 per cent) were in other ethnic groups. There were 1608 new out-patient attendances at the Leicester Royal Infirmary fracture clinic in children under 16 between April 1997 and March 1999. Of the 3082 hospital admissions as a result of accidents in children aged 0-15 years between April 1995 and March 1999, 264 resulted in stays of longer than 3 days - 'serious accidental injury'.³

Before any adjustment, the correlation in childhood accident admissions between enumeration districts in the same ward was 12.6 per cent; after adjustment for ethnicity and Townsend score the correlation fell to 0.5 per cent.

Tables 1-3 show the odds ratios for in-patient stays of more than 3 days as a result of accidents, admissions owing to accidents and new attendances at fracture clinic, respectively, according to ethnic group. Odds ratios (ORs) are shown adjusted for other ethnic groups only, and adjusted for other ethnic groups and the Townsend score. The odds ratios for ethnicity are interpreted as follows: given two otherwise equivalent enumeration districts, from this heterogeneous sample of enumeration districts, if one enumeration district has a 10 per cent higher proportion of South Asian residents than the other, that enumeration district will, on average, exhibit an odds of accidental injury that is 'OR' times that in the other enumera-

tion district. Formally, this is called a 'marginal' interpretation of the odds ratio.¹²

Before adjusting for the Townsend score, a 10 per cent increase in the proportion of South Asian children was associated with a significantly lower risk of an in-patient stay of longer than 3 days (OR 0.96 (95 per cent confidence interval, CI, 0.92–1.00), $p = 0.038$), a significantly lower odds ratio of admission owing to an accident (OR 0.93 (95 per cent CI 0.92–0.94),

$p < 0.001$), and a significantly lower odds ratio of new attendance at fracture clinic (OR 0.94 (95 per cent CI 0.93–0.96), $p < 0.001$). For a district with 70 per cent of its children from South Asian groups (as observed in one-fifth of enumeration districts), this represents a 40 per cent lower rate of accident admissions.

Adjustment for the Townsend score had the effect of marginally increasing the protective effect of South Asian ethnicity on risk of in-patient admission for longer than 3 days (OR 0.95

Table 1 Odds ratios (ORs) for in-patient stays of longer than 3 days at the Leicester Royal Infirmary as a result of accidents in Leicester residents under 16 years between April 1995 and March 1999, according to ethnicity and the Townsend score

Characteristic	OR adjusted for other ethnic groups (95% CI); p	OR adjusted for Townsend score and other ethnic groups (95% CI); p
South Asian	0.96 (0.92–1.00); 0.038	0.95 (0.91–1.00); 0.035
Black	0.98 (0.81–1.19); 0.88	0.86 (0.65–1.13); 0.28
Other ethnic group	1.02 (0.74–1.40); 0.91	0.98 (0.72–1.34); 0.91
Townsend10		1.28 (0.94–1.76); 0.12

Odds ratios for ethnic groups shown are those for a 10 per cent increase in the proportion of residents from a South Asian, Black or Other ethnic group. 'Townsend10' is odds ratio for a 10 point increase in the Townsend score. 'OR adjusted for Townsend score' is the odds ratio adjusted for the quadratic term for a 10 point increase in the Townsend score.

Table 2 Odds ratios (ORs) for admissions to the Leicester Royal Infirmary as a result of accidents in Leicester residents under 16 years between April 1995 and March 1999 according to ethnicity and the Townsend score

Characteristic	OR adjusted for other ethnic groups (95% CI); p	OR adjusted for Townsend score and other ethnic groups (95% CI); p
South Asian	0.93 (0.92–0.94); <0.001	0.93 (0.92–0.94); <0.001
Black	1.02 (0.89–1.17); 0.80	0.94 (0.82–1.09); 0.434
Other ethnic group	0.95 (0.85–1.07); 0.41	0.95 (0.85–1.06); 0.339
Townsend10		1.25 (1.14–1.37); <0.001
Townsend10 squared		0.90 (0.83–0.98); 0.018

Odds ratios for ethnic groups shown are those for a 10 per cent increase in the proportion of residents from a South Asian, Black or Other ethnic group. 'Townsend10' is odds ratio for a 10 point increase in the Townsend score. 'OR adjusted for Townsend score' is the odds ratio adjusted for the quadratic term for a 10 point increase in the Townsend score.

Table 3 Odds ratios (ORs) for new attendances at Leicester Royal Infirmary fracture clinic by Leicester residents under 16 years between April 1997–March 1999 according to ethnicity and the Townsend score

Characteristic	OR adjusted for other ethnic groups (95% CI); p	OR adjusted for Townsend score and other ethnic groups (95% CI); p
South Asian	0.94 (0.93–0.96); <0.001	0.94 (0.92–0.96); <0.001
Black	0.94 (0.79–1.12); 0.50	0.94 (0.78–1.14); 0.52
Other ethnic group	0.88 (0.74–1.05); 0.16	0.89 (0.75–1.05); 0.16
Townsend10		1.10 (0.99–1.23); 0.073
Townsend10 squared		0.82 (0.71–0.94); 0.006

Odds ratios for ethnic groups shown are those for a 10 per cent increase in the proportion of residents from a South Asian, Black or Other ethnic group. 'Townsend10' is odds ratio for a 10 point increase in the Townsend score. 'OR adjusted for Townsend score' is the odds ratio adjusted for the quadratic term for a 10 point increase in the Townsend score.

(95 per cent CI 0.91–1.00), $p = 0.035$), and had little or no effect on risk of admission (OR 0.93 (95 per cent CI 0.92–0.94), $p < 0.001$) or fracture clinic attendance (OR 0.94 (95 per cent CI 0.92–0.96), $p < 0.001$). The lower risk observed in South Asian groups could not therefore be accounted for by differences in deprivation levels.

Before adjusting for the Townsend score, a 10 per cent increase in the proportion of children from Black ethnic groups was associated with a non-significantly lower risk of an in-patient stay of longer than 3 days (OR 0.98 (95 per cent CI 0.81–1.19), $p = 0.88$), a non-significantly higher risk of admission owing to an accident (OR 1.02 (95 per cent CI 0.89–1.17), $p = 0.80$), and a lower risk of fracture clinic attendance (OR 0.94 (95 per cent CI 0.79–1.12), $p = 0.50$). After adjusting for the Townsend score, Black ethnicity was associated with a non-significant reduction in the risk of all three measures of hospital utilization. Before adjusting for the Townsend score, a 10 per cent increase in the proportion of children from Other ethnic groups was associated with a non-significantly higher risk of an in-patient stay of longer than 3 days (OR 1.02 (95 per cent CI 0.74–1.40), $p = 0.91$), a non-significantly lower risk of admission owing to an accident (OR 0.95 (95 per cent CI 0.85–1.07), $p = 0.41$), and a lower risk of fracture clinic attendance (OR 0.88 (95 per cent CI 0.74–1.05), $p = 0.16$). However, after adjusting for the Townsend score, 'Other' (i.e. Chinese, Other-Asian, Other-Mixed) ethnicity was associated with a non-significant reduction in the risk of all three measures of hospital utilization.

Discussion

Our ecological study indicates that South Asian children are at substantially lower risk of accidents requiring hospital in-patient and out-patient care than white children. This is the first epidemiological study that we are aware of to investigate the relationship between ethnicity and hospital admissions owing to accidents and serious accidental injury in the United Kingdom. Access to health care in the United Kingdom does not depend on health insurance coverage, and therefore ethnic differences in access to care could more easily depend on cultural and language barriers. However, given our observation that South Asian children are at a significantly lower risk of serious accidental injury (defined as an in-patient stay of longer than 3 days),³ it is unlikely that ethnic differences in thresholds for accessing care could primarily account for lower hospital utilization rates for childhood accidents in South Asians. We did not attempt to compare specific accident types by ethnic group (in view of the small numbers involved). However, future research should attempt to explore the reasons underlying the ethnic variations in hospital utilization as a result of childhood accidents we have shown. This could be achieved by (1) adequately powered quantitative comparison of accident types, preferably at the individual level and (2) in-depth qualitative research to explore ethnic variations in accident hazard exposure and hospital utilization.

Surveys of children in the United Kingdom have shown that South Asian children self-report (or their parents report) fewer accidents resulting in any contact with a health professional.^{7,13} The data from our study are consistent with the findings of these surveys, and indicate that reporting differences between ethnic groups are unlikely to account for the ethnic differences previously reported using such methods.^{7,13}

We used broad ethnic classifications, to ensure that our study was adequately powered. Ninety-three per cent of Leicester's South Asian children are Indian, 5 per cent Pakistani and 2 per cent Bangladeshi. Although there will be heterogeneity between and within these groups, the *Health survey for England '99* showed that self-reported accident rates were significantly lower in Indian, Pakistani and Bangladeshi children than in the general population.⁷

Although we found no significant variations in risk of hospital utilization as a result of accidents in Black or 'Other' ethnic groups, this study had limited power to detect such variations in small populations.

The data from our study provide further insights into the relationship between small area deprivation score and childhood accidents. Having adjusted for ethnicity, the relationship between deprivation and accident admissions was represented by an 'n'-shaped curve, the highest odds ratio being observed for enumeration districts with a Townsend score of 11 (modest deprivation). The relationship between deprivation and fracture clinic attendances was similarly represented by an 'n'-shaped curve, with a peak in risk at modest levels of deprivation. However, we found a linear increase in the risk of in-patient stays of longer than 3 days as a result of an accident with an increase in the Townsend score. Higher thresholds for hospital utilization in the most deprived communities may explain these findings. Alternatively, children from the most deprived backgrounds may be at greater risk of serious injuries, such as motor vehicle accidents, but at lower risk of minor accidents, such as those sustained during organized sports activities.

It is possible that the reduced risk of hospital utilization as a result of accidents in South Asian children we showed at enumeration district level may not exist at the individual level (the 'ecological fallacy').¹⁴ Instead of our ecological approach, we could have analysed the data at the individual level if we used a computerized algorithm to assign ethnicity on the basis of surname. The SANGRA algorithm, for example, might have been expected to identify around 90 per cent of South Asian names in Leicester.¹⁵ However, misclassification of ethnic group would have remained a problem. Furthermore, deprivation data were available at community level rather than individual level. Although an ecological approach can be justified in this instance, we must exercise appropriate caution when making inferences about the relationship between South Asian ethnicity and accident risk at the individual level. It will be necessary to test our findings at the individual level using directly collected ethnic data from routine hospital information when this becomes available.

Accident prevention interventions, such as road engineering and other environmental improvements, frequently need to target areas rather than individuals.¹⁶ The planning of such interventions can be assisted by understanding the relationship at community level between accidents and small area characteristics, such as ethnicity and deprivation score, provided that such relationships are also meaningful at the individual level.¹⁴ The *Health survey for England* has already demonstrated the relationship between ethnicity and self-reported accidents at the level of individuals,⁷ and it will soon be possible to confirm whether the same is true for accidents resulting in hospital utilization.

We were unable to exclude the small proportion of non-accidental fractures from fracture clinic attendances, as these attendances were not coded. However, fracture attendances have been shown to give an unbiased estimate of the incidence of fractures, unlike hospital accident and emergency department attendances, for which attendance is strongly correlated with distance from the department.¹⁷

The Townsend score is derived from Census data on unemployment, home ownership, overcrowding, and car ownership.⁹ It has been widely used as a measure of small area deprivation, but does not reflect some aspects of environmental deprivation. We therefore also analysed the data using the Index of Local Deprivation,¹⁸ with equivalent findings.

The approach we adopted for the analysis of data not only allowed ethnicity groups and the Townsend score to be adjusted for, but also allowed the correlation in hospital utilization rates within the same ward to be quantified and adjusted for. Furthermore, using robust ('Huberized') standard errors, statistical inferences based upon the regression coefficients in the model were rendered robust to misspecification of the correlation structure. This was important, because we used an 'exchangeable' correlation structure, which implied equal correlation between all enumeration districts in a ward, whereas in reality it is likely that the correlation between adjacent enumeration districts in a ward will be higher than that between two enumeration districts that are further apart in the same ward. In addition, adjacent enumeration districts that span a ward boundary will be expected to be correlated but will be treated as uncorrelated by the model. The use of robust standard errors means that these problems in specifying the structure are rendered of little consequence.¹²

Our finding of a lower risk of hospital utilization as a result of childhood accidents in South Asians has important implications for public health practice – to predict workload, target prevention and understand aetiology. We cannot infer that South Asian communities are 'less needy'. The lower risk of accidents observed in South Asian children in Leicester may well result from lower participation in physical activities. The *Health survey for England – the health of minority ethnic groups*, showed that Indian and Pakistani children participated less in all types of physical activity, including walking, active play and sports.⁷ This is of particular concern in view of the vulnerability of this population to diabetes and coronary heart disease.¹⁹

Community-based interventions encompassing both environmental modification and health education have been shown to be effective in preventing childhood accidents.^{20,21} Interpretation of our results in the context of the findings of the *Health survey for England*⁷ should not only suggest to policy-makers the need to target these interventions to communities with high accident rates, but perhaps also target exercise promotion in South Asian communities. Paradoxically, successful exercise promotion could increase accident rates in South Asian children. A case could therefore be made for combining accident prevention and exercise promotion in such communities.

Acknowledgements

We are grateful to Professor Michael Clarke and Dr Jennifer Kurinczuk, Department of Epidemiology and Public Health, University of Leicester, and also to anonymous reviewers for their comments on earlier drafts of this work, and to Miss Helen Reeve, Information Analyst, Health Informatics Service, Leicester, for her advice.

References

- 1 Roberts I, Diguseppi C, Ward H. Childhood injuries: extent of the problem, epidemiological trends, and costs. *Injury Prev* 1998; **4**: S10–S16.
- 2 Office for National Statistics. *Health survey for England 1996*. London: Office for National Statistics, 1998.
- 3 Department of Health. *Saving lives: our healthier nation*. London: The Stationery Office, 1999.
- 4 Office for National Statistics. *Mortality statistics 1995: childhood infant and perinatal: DH3, no. 28*. London: Office for National Statistics, 1997.
- 5 Ward H, Norrie J, Allsop R, Sang A. *Urban safety project: the Bristol scheme*. London: Transport and Road Research Laboratory, 1989.
- 6 Kendrick D, Marsh P. How useful are sociodemographic characteristics in identifying children at risk of unintentional injury? *Public Hlth* 2001; **115**: 103–107.
- 7 Errens B, Primatesta P, Prior G. *Health survey for England – the health of ethnic minority groups '99*. London: The Stationery Office, 2001.
- 8 Office of Population Censuses and Surveys. *1991 Census definitions. Great Britain*. London: HMSO, 1992.
- 9 Townsend P, Phillimore P, Beattie A. *Health and deprivation: inequality and the north*. London: Croom Helm, 1988.
- 10 World Health Organization. *International standard classification of diseases and related health problems – tenth revision (ICD-10)*. Geneva: WHO, 1992.
- 11 MapInfo Corporation. *MapInfo Professional v5.5*. New York: MapInfo Corporation, 2000.
- 12 Burton P, Gurrin L, Sly P. Tutorial in biostatistics. Extending the simple linear regression model to account for correlated responses: an introduction to generalized estimating equations and multi-level mixed modelling. *Statist Med* 1998; **17**: 1261–1291.
- 13 Williams R, Shams M. Generational continuity and change in British Asian health and health behaviour. *J Epidemiol Commun Hlth* 1998; **52**(9): 558–563.

- 14 Greenland S, Robins J. Invited commentary: ecologic studies – biases, misconceptions, and counterexamples. *Am J Epidemiol* 1994; **139**: 747–760.
- 15 Nanchahal K, Mangtani O, Alston M, dos Santos Silva I. Development and validation of a computerized South Asian Names and Group Recognition Algorithm (SANGRA) for use in British health-related studies. *J Publ Hlth Med* 2001; **23**(4): 278–285.
- 16 Towner E, Ward H. Prevention of injuries to children and young people: the way ahead for the UK. *Injury Prev* 1998; **4**: S17–S25.
- 17 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**: 173–176.
- 18 Department of the Environment, Transport and the Regions. 1998 *index of local deprivation (regeneration research summary no. 15)*. London: DETR, 1998.
- 19 Adler AI, Neil AW, Stratton IM, *et al.* Ethnicity and cardiovascular disease: the incidence of myocardial infarction in white, south Asian, and Afro-Caribbean patients with type 2 diabetes (U.K. prospective diabetes study 32). *Diabetes Care* 1998; **21**(8): 1271–1277.
- 20 Guyer B, Gallagher SS, Chang BH, *et al.* Prevention of childhood injuries: evaluation of the Statewide Childhood Injury Prevention Program (SCIPP). *Am J Publ Hlth* 1989; **79**: 1521–1527.
- 21 Svanstrom L, Ekman R, Schelp L, Lindstrom A. The Lidköping accident prevention programme: a community approach to preventing childhood injuries in Sweden. *Injury Prev* 1995; **1**: 169–172.

Accepted on 28 June 2002