EPIDEMIOLOGY OF INJURIES IN PRIMARY SCHOOL-AGED CHILDREN

Part 1 of 2: Thesis

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ABSTRACT

Background

Injuries remain one of the leading causes of death and disability for children over the age of one year in the UK and socioeconomic differences persist in injury occurrence. Policy makers need to understand the distribution of injuries and their associated risk factors to address the issue. This thesis aims to summarise the evidence from cohort studies of injury occurrence and risk factors for injury in school aged children, to describe the injuries occurring to primary school aged children in an area of England, and to explore the relationship between secondary care attended injuries in those children and risk factors in the child, their family, their home and their neighbourhood.

Methods

A systematic literature review of cohort studies reporting injuries in school-aged children was undertaken. Data on injuries and risk factors was used from the Avon Longitudinal Study of Parents and Children (ALSPAC). Parent reported injury data collected four times between the ages of five and 11 years were coded and described. Multivariable logistic regression analyses of risk factors for secondary care attended injury were undertaken on the observed data and repeated on a dataset where missing values had been imputed.

Results

The review identified 44 papers from 18 cohort studies. Risk factors for injury were identified, and equivalent variables from ALSPAC included in analyses where possible. The distribution of 12,421 injury events in 5752 children in ALSPAC illustrated trends in injuries by type of injury, age and sex. Child factors such as male sex, having a previous injury treated in secondary care and behavioural problems were associated with increased risk of injury. Mothers with many life events and children living in privately rented accommodation had increased risks of injury. Children with two or more younger siblings had reduced risks of injury.

Conclusions

Few cohort studies have reported trends in child injury with age, collected information on the child's environment or reported associations between the environment and injury. This study addressed these issues. Limited evidence of environmental predictors for child injury were found, but factors in the child, their family and their home may usefully inform prevention initiatives.

ACKNOWLEDGEMENTS

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I am very grateful to Dr Jon Heron (University of Bristol), who, as my ALSPAC ‘data buddy’ provided advice on the structure of the dataset, cleaning data, and applying codes, helped to create a measure of geographic socioeconomic disadvantage, converted the data files from Microsoft Access to SPSS to STATA, and provided support to help me write STATA commands and interpret the outputs.

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ABBREVIATIONS

Abbreviation	Explanation
A&E	Accident and Emergency (Emergency department)
AIS	Abbreviated Injury Severity (scale)
ALSPAC	Avon Longitudinal Study of Parents and Children
CHES	Child Health and Education Study
CI	Confidence Interval
DCD	Developmental Coordination Disorder
DMCDS	Dunedin Multidisciplinary Child Development Study
FMI	Fraction of missing information
GP	General Practitioner
HIC	High Income Country
ICECI	International Classification of External Causes of Injury
IDB	Injury Database (injury classification system)
IMD	Index of Multiple Deprivation
LMIC	Low and Middle Income Country
LR	Likelihood Ratio
MAR	Missing at random
MCAR	Missing completely at random
MNAR	Missing not at random
NCDS	National Child Development Study
NEC	Not elsewhere classified
NHS	National Health Service
NOMESCO	Nordic Medico-Statistical Committee (injury classification system)
ONS	Office for National Statistics
OR	Odds Ratio
RR	Relative Risk
SES	Socioeconomic Status
UK	United Kingdom
USA	United States of America

CHAPTER 1: INTRODUCTION

This research study describes the epidemiology of injuries in children aged 5-11 years as recorded in a British cohort study and explores risk factors associated with the injuries reported. The purpose of this chapter is to describe the scale of child injuries, the justification for the research and to state the aims and objectives of the study.

1.1 CURRENT UNDERSTANDING OF THE EPIDEMIOLOGY OF CHILDHOOD INJURY

1.1.1 Global overview

Children enable the development and growth of society. They are the building blocks of families, communities and populations; they grow to become the parents, the workforce and the leaders of future communities. Until they develop and mature into self-sufficient, self-caring individuals they are dependent on the actions of adults to provide for them and keep them safe. Our society does not keep all children safe. Every day around the world an estimated 2274 children lose their lives to an unintentional injury.[1] For every child that dies, many more receive injuries resulting in disability, discomfort and distress. Non-fatal injuries are estimated to affect the lives of 10-30 million children and adolescents each year. The majority of such injury occurs to those children living in the most disadvantaged circumstances and countries. Reducing this substantial burden requires the coordinated efforts of multiple agencies and practitioners to translate research into policy and evidence based interventions into practice, so that parents, carers and families are enabled to help keep children safe.

1.1.1.1 The burden of child injury

Assessment of the global burden of childhood unintentional injury is challenging as many countries have no or limited means of recording trends in injury occurrence. The World Report on Child Injury Prevention, published by the World Health Organisation in 2008[1] is a comprehensive attempt to collate and interpret information from all countries. Injury related causes account for three of the top 15 killers of children aged 1-4 years (in order; drowning, road traffic injury and fire-related deaths) and four of the top 15 killers for children aged 5-14 years (Road traffic injuries, drowning, fire-related deaths and falls). Non-fatal road traffic injuries and falls are two of the top 15 causes of disability-adjusted life years (DALY's) in children aged 0-14 years. The total burden of all injury deaths under the age of 18 years (including both intentional and unintentional) is estimated to be 950,000 per year. The commonest types of injury deaths are those related to road traffic injuries, drowning, and fire-related burns (Table 1).

Table 1: Proportion of 950,000 global child injury deaths by cause, 0-17y, World, 2004

Intent	Type of injury	Proportion (%)
Unintentional	Road traffic injury	22.3
	Drowning	16.8
	Fire-related burns	9.1
	Falls	4.2
	Poisoning	3.9
	Other*	31.1
	Total	**87.4**
Intentional	Homicide	5.8
	Self-inflicted	4.4
	War	2.3
	Total	**12.5**

Table adapted from World Report on Child Injury Prevention [1]
*Other includes smothering, asphyxiation, choking, animal bites, hypothermia, hyperthermia and injuries secondary to natural disasters

The burden of child injury falls almost entirely on the poorest countries, with 95% of the 875,000 unintentional injury deaths in children under 18 years each year occurring in low and middle income countries (LMIC). Injury surveillance in these countries has been limited partly because injury is perceived as a less significant issue compared to communicable disease and nutritional issues.[2;3] This has the consequence that estimates of injury occurrence are likely to be underreported, although new efforts to assess injury burden are being undertaken.[4] In contrast, high income countries (HIC) such as the UK have had mechanisms for recording unintentional injuries in children for many years and are able to demonstrate reduced rates of child injury in recent decades. The annual child injury mortality rate in LMICs (41.7/100,000/yr) is almost 3 ½ times that in high income countries (12.2/100,000/yr). There is a significant inequity in rates of injuries between countries both by type of injury (Table 2) and by age of child (Table 3). The rate ratio between LMICs and HICs is greatest for fire deaths and drowning, reflecting the differing environmental exposures that children experience between different countries.

Table 2: Unintentional injury death rates per 100,000 children (under 20 years) by cause and country income level, World, 2004

	Type of unintentional injury						
	Road Traffic	Drowning	Fire burns	Falls	Poisons	Other*	Total
HIC	7.0	1.2	0.4	0.4	0.5	2.6	12.2
LMIC	11.1	7.8	4.3	2.1	2.0	14.4	41.7
LMIC/HIC ratio	1.59	6.50	10.75	5.25	4.00	5.54	3.42
World	10.7	7.2	3.9	1.9	1.8	13.3	38.8

Table adapted from World report on child injury prevention[1]
Other* includes smothering, asphyxiation, choking, animal bites, hypothermia, hyperthermia and injuries secondary to natural disasters

Table 3 illustrates that the risk of unintentional injury death is greatest for those under the age of one year, and for older adolescents. The difference in rate ratios between high and low / middle income countries however, is greatest for children aged 1-4 years and those aged 5-9 years. The mortality rate ratio for older adolescents (15-19 years) reflects the importance of road traffic mortality in this age group across the world. There is a gender difference in injury occurrence, with boys generally sustaining more injuries than girls. In most regions of the world the gender gap for fatal injuries increases with age. At a global level the gap is small for children under the age of four years but it increases throughout the school age period. The gender gap also exists for all injury types except for fire-related burns, where girls sustain more burn deaths than boys. This is thought to reflect girls' increased exposure to fires through cooking in the home.

Table 3: Unintentional injury death rates per 100,000 children (under 20 years) by age and country income level, World, 2004

	Age (in years)					
	Under 1	1-4	5-9	10-14	15-19	Under 20
HIC	28.0	8.5	5.6	6.1	23.9	12.2
LMIC	102.9	49.6	37.6	25.8	42.6	41.7
LMIC/HIC ratio	3.68	5.84	6.71	4.23	1.78	3.42
World	96.1	45.8	34.4	23.8	40.6	38.8

Table adapted from World report on Child Injury Prevention[1]

The inequity in both fatal and non-fatal childhood injuries seen between HICs and LMICs can also be seen at the WHO regional level and within individual countries, with the greatest burden of injuries falling to those populations most disadvantaged.

1.1.1.2 The injury iceberg

The epidemiology of child injury is frequently described as a pyramid or an iceberg, to illustrate the fact that for every child who dies as a result of an injury a greater number are admitted to hospital, a greater number again are treated in hospital but not admitted, and a greater number still are treated in community settings or treated at home. The European Report on Child Injury Prevention[5] estimated the pyramid for Europe using data from studies in the Netherlands,[6] the UK[7] and Sweden[8] (Figure 1), showing that for every child death there were 129 hospital admissions and over 1600 attendances at emergency departments.

Figure 1: Clinical pyramid for child injuries in the Netherlands, UK and Sweden

Source: European Report on Child Injury Prevention[5]

The relative proportions of the layers of the pyramid and the slope of the pyramid will vary depending on the proportion of children who have severe injuries. This will vary between countries, age groups and types of injury included.

1.1.1.3 Consequences of injury

The consequences of childhood injury are not well reported and depend on a number of factors including the type of injury, the age of the child, the access to healthcare and the type and quality of the care provided. A recent survey of emergency department attendances for unintentional injury in children under the age of 12 years in four LMICs (Bangladesh, Columbia, Egypt and Pakistan) reported 1552 injury events, of which 2% resulted in a permanent disability, 11% resulted in a disability lasting ≥6 weeks, 36% in a disability lasting <6weeks and 51% in no disability.[4] This study suggested that childhood injuries were resulting in a considerable burden of disability. Such disability is important as it may result in children being unable to complete their education, to find employment or to become independent from their families until well into adulthood.

1.1.1.4 Reducing the child injury burden

Sweden has one of the lowest child injury death rates in the world.[8;9] It has achieved marked decreases in child injury mortality over the last 30 years; child injury deaths per 100,000 children per year fell from 24 (1969[1]) to 10 (2001[8]) for boys and from 11 (1969[1]) to 4 (2001[8]) for girls. The reasons for this success are considered to be due to a national perception of child injury as a public health problem that should be tackled by society as a whole. Consequently, a range of multi-sectoral measures are thought to have contributed to the successful reduction in injury mortality rates including; reduced road traffic injuries and drowning events due to changes in the environment, increased awareness of home safety measures through home visits by health professionals, safer product design and improved healthcare for injured children. Despite these efforts, within-country inequality in Swedish injury rates persist,[8] however, it has been estimated that if all countries across the WHO European Region could reduce their child injury mortality rates to the same level as Sweden, 15,000 lives could be saved each year across the region.

1.1.2 UK overview

1.1.2.1 The scale of the problem

In recent years fewer than 300 children aged 0-14 years per annum have died from injuries and poisonings in England and Wales. Table 4 shows mortality data for 2008 indicating that deaths are more frequent in boys compared to girls and that there are two peaks in occurrence, one in the mobile pre-school child (aged 1-4 years) and the second in the older child (10-14 years).

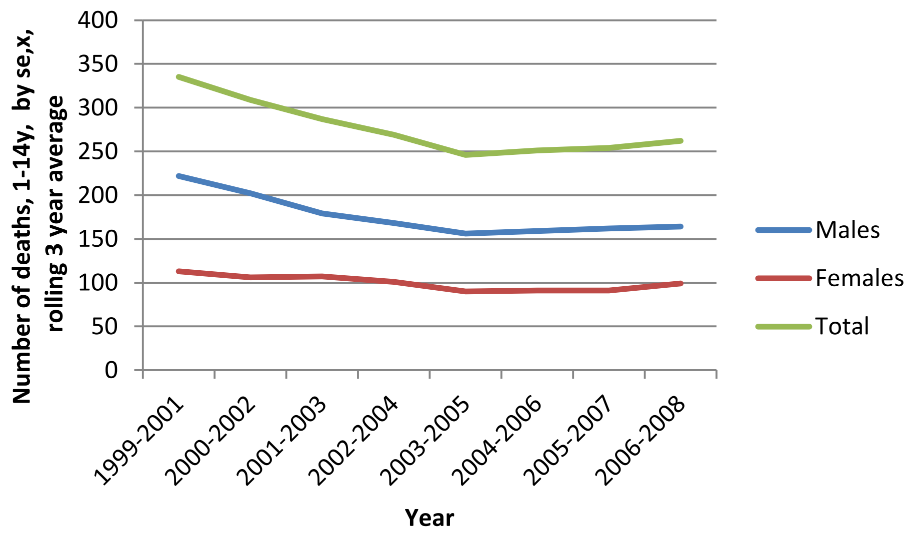
Table 4: Child mortality from injury and poisoning, 2008, England and Wales

	Age in years				
	Under 1	**1-4**	**5-9**	**10-14**	**0-14**
Males	27	51	29	65	172
Females	19	41	18	40	118
Total	46	92	47	105	290

Source: Office for National Statistics (ONS) Mortality Statistics 2008 Series DH4 [Injury and poisoning]

Unintentional injury kills three children per 100,000 population, a rate similar to cancer.[10] Child mortality in England and Wales has fallen with time. Figure 2 shows that the trend in child mortality from 1999 has been falling to about 2004, since when the frequency of deaths has plateaued. As numbers of deaths are relatively low, three year rolling averages have been presented to smooth year on year variation in cases.

Figure 2: Child mortality due to external causes of injury and poisoning, 1-14 years, by sex, rolling 3 year average, 1999-2008, England and Wales

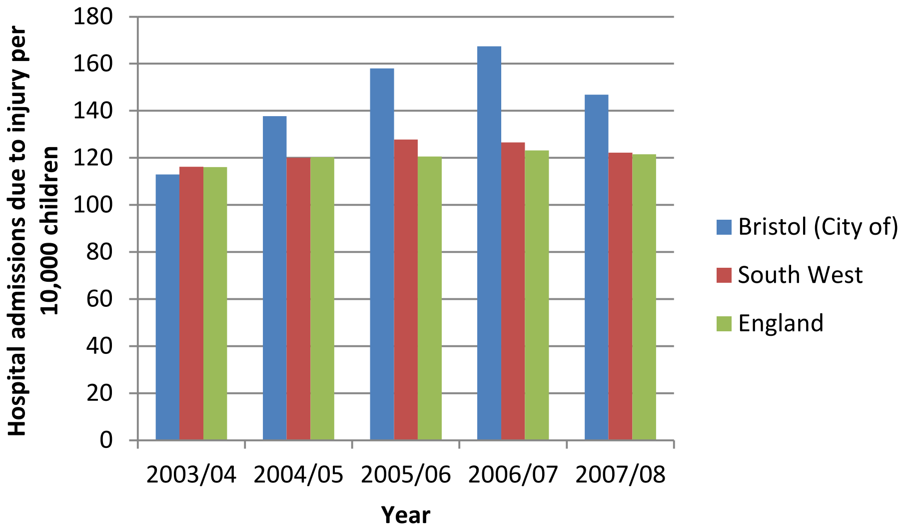


Source: ONS Mortality Statistics (1999-2005 Series DH2 [causes of death], 2006-2008 Series DH4 [Injury and poisoning])
Note: 1999-2000 estimates use ICD9 codes E800-999, 2001-2008 estimates use ICD10 codes S00-T98

Unintentional injuries are the leading cause of death for people aged 1-14 in the UK, with the main causes from injury being due to fire, falls, poisoning, drowning and road traffic incidents. Road traffic incidents have contributed to injury morbidity for many years; Pless reported that 4.1% of boys and 2.1% of girls aged 8-11 years in the 1958 British Birth cohort sustained road traffic injuries during the period 1966-1969. [11] More recently, road traffic incidents accounted for 76 road deaths in children 0-14 years in 2007, 46% of all accidental deaths during that period.[12]

In England in 2007/08 there were 134,000 hospital admissions due to injury in children aged 0-17 years old, a rate of 122 admissions / 10,000 children,[13] although the figure locally (Bristol) was higher for the same period at 147/10,000 children (n=1157 children) based on nationally collected data. The trend in admissions has been stable in this age group for England, but admissions in Bristol have been higher than the regional or national figures, and increasing in recent years. (Figure 3)

Figure 3: Hospital admissions due to injury, 0-17 year olds, local (Bristol), regional and England data, 2003/04 to 2007/08



Source: Hospital Episode Statistics, (National Indicator 70)
Note: includes unintentional and intentional injuries

Non-fatal injuries are the reason for many hospital attendances. Forty nine percent of boys and 34.8% girls in the 1970 British Birth Cohort sustained an injury requiring medical attention aged 5-10 years during the period 1975 -1980.[14] In 2007 it was estimated that such injuries resulted in two million visits to A&E departments in England each year, costing the National Health Service (NHS) an estimated £146 million pounds.[10] In addition, there are costs to the NHS related to injuries that are treated in primary care settings, and in hospital following admission.

1.1.2.2 Social inequalities

Inequalities in child injury seen around the world are also present in the UK. A study in Scotland using death registration data between 1982 and 2006 found that boys had more fatal injuries than girls at all ages between 0-14 years, with a male excess for all injury types except fire deaths.[15] The inequalities associated with demographic and economic differences between families and communities are more complex and more difficult to interpret, partly because of the multiple methods used to define disadvantage.

Roberts and Power compared injury death rates in children aged 0-15 years between 1979-1983 and 1989-1992, by social class.[16] Despite a trend in reduction in incidence of fatal injuries in the UK with time, the gap between social classes widened from 3.5 times higher for social class V (unskilled) compared to social class I (professional) in 1979-1983 to 5.0 times higher in 1989-1992. The inequality was particularly strong for fire and pedestrian deaths.

Although child injury rates continued to fall between 1981 and 2001 in children aged 0-15 years in England and Wales, children of parents who had never worked or were long term unemployed were found to have an injury death rate 13.1 times that of children with parents from higher managerial or professional occupations.[17] This inequality was more marked for specific types of injury; 20.6 times higher for child pedestrian deaths, 27.5 times higher for child cyclist deaths and 37.7 times higher for deaths due to fires.

Mulvaney reported changes in fire related fatalities in children aged 0-14 years, finding a 6% reduction in incidence per year between 1995 and 2004, but no reduction in the gap between the most and least disadvantaged quartiles as determined by the Index of Multiple Deprivation 2004 over the same period.[18] Williamson identified similar findings for head injury fatalities in Scotland with a reduced incidence with time but mortality differences between the most and least deprivation categories persisted for children aged 0-9 years and increased for children age 10-14 years. Pedestrian incidents were the leading cause of fatal head injuries.[19] Child cycling deaths and pedestrian deaths decreased in incidence between 1985 and 2003 but when exposure to mode of travel is considered, rates of cycling deaths were 50 times greater and pedestrian deaths 30 times greater than car occupant deaths in 2003, emphasising the need to protect children in the road environment. [20]

A socioeconomic gradient is also evident for non-fatal child injuries that require admission to hospital. Petrou et al demonstrated a statistically significant increasing gradient in admissions for injury and poisoning in children born in Oxford from 1979 to 1988 between social class I and those in social class V, over their first 10 years of life.[21] Similarly, both an increase in hospital admissions for 0-14 year olds and admissions for greater severity injuries were seen with increasing socioeconomic deprivation in the Trent region between 1992-1997.[22] In Wales, between 1997 and 1999, there was an increasing rate of hospital admissions with increasing deprivation of area of residence, both for all injuries and for a range of unintentional injury subtypes (falls, road traffic accidents, burns and poisonings).[23] Using hospital admission data for the whole of England, Edwards was able to show that, for a range of serious injuries between 1999 and 2004, socioeconomic inequalities existed across England, particularly for child pedestrians, where the rate for the most deprived areas was 4.1 times that of the least deprived areas (95% confidence interval (95% CI); 2.8-6.0).[24] Less evidence exists for injuries treated in primary care, but Kendrick et al were able to demonstrate that having two unemployed parents and living in rented accommodation were associated with increased risk of primary care attended injuries in pre-school children in Nottingham.[25]

A number of factors have been associated with an increased risk of unintentional injury in childhood.[14;26;27] These can be grouped as child factors (e.g. male sex, previous injury, behaviour), family factors (e.g. larger family size, young maternal age at child's birth, maternal education), and environmental factors (e.g. socioeconomic deprivation). The environment in which a child grows up will influence the injury risks to which they are exposed, yet in high income countries such as the UK we do not yet have a clear understanding of why environment influences a child's risk of unintentional injury.[28] Whilst the burden of injury in school-aged children in the UK has fallen in recent years, there remain preventable child deaths, admissions and attendances for medical attention. The inequity of these injuries within the UK remains significant.

1.2 JUSTIFICATION FOR RESEARCH

This introduction has explored the scale and inequitable distribution of child injury occurrence and risk. To address these challenges there needs to be an increase in the knowledge base of the extent and outcome of injury, and of the risk factors that should guide universal and targeted injury prevention interventions.[29] The recent Priority Review of accident prevention among children and young people[30] found that data collection systems based on hospital admission represent only the 'tip of the iceberg' in child injury occurrence in the UK, and that the links between injury and other health, social and environmental issues needed to be explored. The review identified gaps in the research including the role of parental supervision in injury prevention and risks related to leisure and play. Research exploring childhood injury using non-hospital admissions data appears warranted. Child and family risk factors for childhood injury have been shown to have an association with injury risk, but associations with environmental factors are less clear. During the pre-school period children spend the majority of their time within the family home. Once children start attending school there is a change in their environment and their exposure to injury risks. The factors associated with unintentional injury risk in children attending school are less well understood than those in pre-school children.

Cohort studies have the potential to inform injury prevention policy and practice. One of the recent sources of non-hospital population level data for injury prevention research in the UK has been the 1970 British Birth Cohort study, also known as the Child Health and Education Study. This longitudinal cohort recruited families of children born during one week in 1970. Although not designed for injury epidemiological research it has provided useful understanding of the distribution of injuries and risk factors associated with injuries in this cohort.[14;27;31-33] The study described in this thesis will use data from a more recent longitudinal cohort study, the Avon Longitudinal Study of Parents and Children (ALSPAC).[34] This cohort forms the most comprehensive set of longitudinal child, family and environmental data available in the UK today. Information provided by parents on injuries sustained to children in the cohort between the ages of 5 and 11 years will form a dataset to contribute to current understanding of the distribution of injuries in school-aged children in the UK and factors associated with those injuries.

1.3 AIMS AND OBJECTIVES

1.3.1 Aim of this study

To contribute to our understanding of the distribution of injuries occurring in children aged 5-11 years living in the UK and the relative contribution of factors in the individual child, their family, and their environment that are associated with the risk of injury occurrence, and explore the degree to which that contribution is hierarchical.

To address this aim the study will undertake a systematic review of the literature arising from child cohort studies and analyse data collected during the Avon Longitudinal Study of Parents and Children. The study will test whether factors in the child's environment (specifically, within their home or their neighbourhood) contribute to injury risk independently of the risk associated with factors in the individual child or their family. The null hypothesis will be that there is no additional, independent risk of injury from home and neighbourhood factors over and above that from factors in the child or their family.

1.3.2 Objectives of the study

The study will achieve its aim through the following four objectives:

1) To conduct a systematic review of the literature from child cohort studies to determine
    a. the breadth, strengths and gaps in the descriptive epidemiology of injuries occurring to school-aged children
    b. the associations between individual, family and environmental factors and injury risk in those children

2) Using the ALSPAC dataset, to identify and obtain the appropriate variables to study, and to clean and prepare the data for analysis

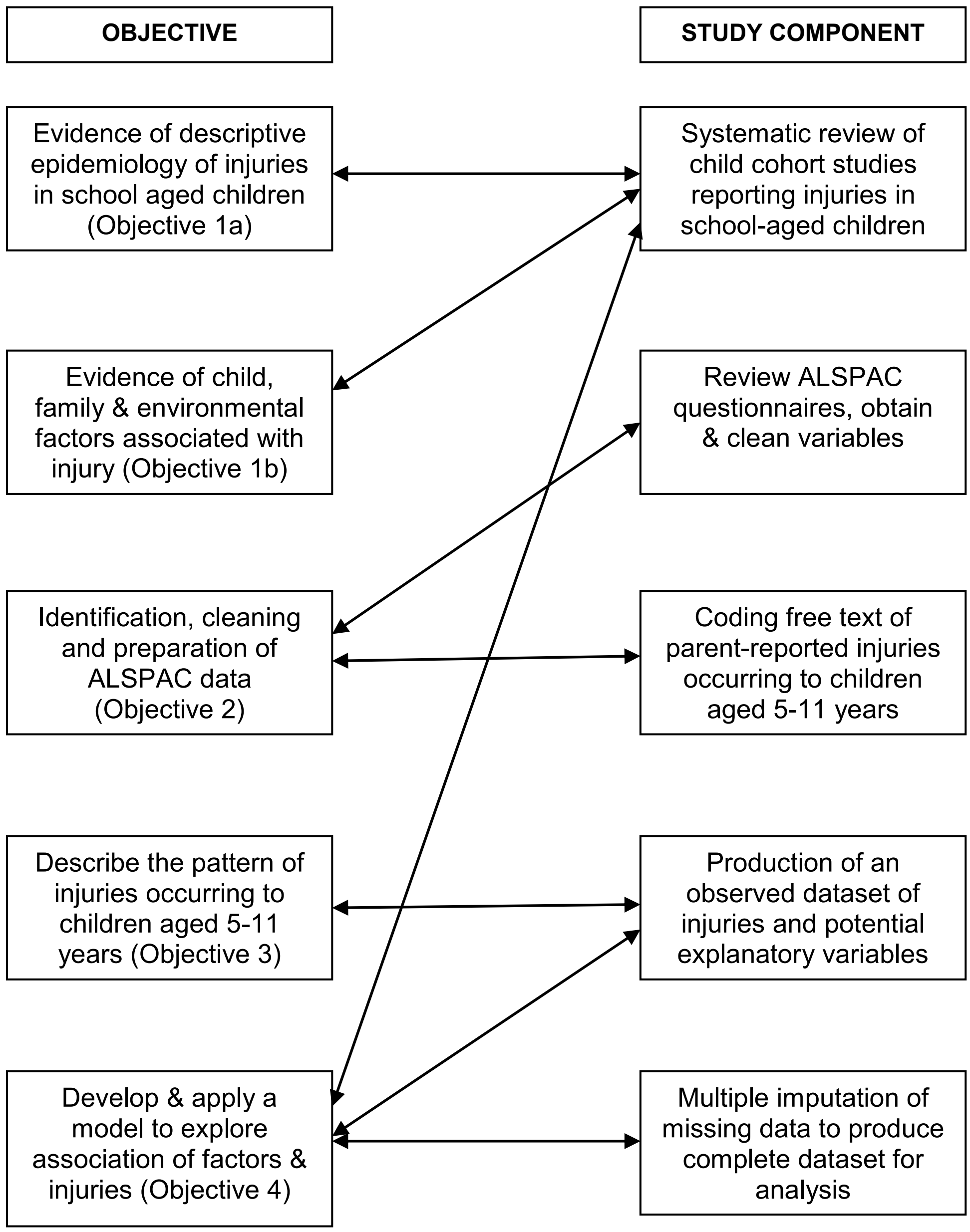
3) To describe the patterns of injuries occurring to children aged 5-11 years as recorded in the ALSPAC data

4) To use a hierarchical framework to explore the relative contribution of child family and environmental factors with the risk of parent reported injuries and within that framework to develop a multivariable regression model using data from ALSPAC to explore associations between risk factors and injury.

The objectives will be met through a series of study components illustrated in Figure 4.

The thesis will provide a background to child injury (Chapter 2) and to the methodological issues that affect all research studying child injury (Chapter 3). A systematic review of cohort studies reporting child injury will be provided in Chapter 4, followed by a description of ALSPAC in Chapter 5. Chapter 6 will describe the methods used to conduct the analysis of the ALSPAC data. Results will be split into the descriptive reporting of childhood injuries (Chapter 7) and the results of analyses of the associations between injury and a range of risk factors (Chapter 8). A discussion of the strengths and weaknesses of the study and an interpretation of the study results will be provided in Chapter 9, with a conclusion in Chapter 10.

Figure 4: Mapping the objectives against the contributions provided by components of the study



CHAPTER 2: BACKGROUND

The purpose of this chapter is to provide a background to the subject of childhood injury; to describe theories of injury causation, consider frameworks for the prevention of injuries and describe how such frameworks have been translated into policy, both globally and within the UK.

2.1 WHY DO CHILD INJURIES HAPPEN? CONTRIBUTIONS TO UNDERSTANDING CAUSATION

Many factors are involved in the causation of injuries in children. Specific risk factors are explored in the systematic review (Chapter 4). Concepts that contribute towards our understanding of why child injuries happen are described here.

2.1.1 The play of chance

Historically, there has been a low level of public, professional and political advocacy for child injury prevention and one of the barriers has been a perception that little could be done to prevent accidents. A common perception has been that an 'accident' is mainly due to a play of fate, or random chance or that 'he was in the wrong place at the wrong time' or 'it was just one of those things'. Such beliefs suggest that injuries are not amenable to prevention.[35;36] There has been a belief that injury is a natural part of growing up and that children will learn through the mistakes that lead to injury. However, it can be clearly shown that the number and nature of injury varies by age, sex, socioeconomic status and a range of other factors indicating that injuries are not random events. The recognition that certain types of injury frequently follow a similar chain of events or are consequent upon a particular set of circumstances has resulted in patterns of prediction for some injuries.

A simple example of this idea concerns childhood scalds. The scalds occur most frequently in pre-school children.[37;38] Frequently the cause of the scald is hot tea or coffee,[39]with the child reaching for a mug on a table or in the hand of an adult and pulling the contents over themselves. We can therefore advise parents that they should not drink a cup of hot tea or coffee with a child sitting on their lap.

Not all children exhibiting particular risk behaviours will have the same risk of injury, or the same severity of injury should an injury event occur. The child who runs out into the road may demonstrate risk behaviours such as hyperactivity or impulsiveness, but the risk of sustaining an injury from being hit by a vehicle, and the severity of that injury, will depend on a number of other factors, including, but not limited to, traffic load on the street, speed limit for that road, driver adherence to speed restriction, reaction time of the driver etc. More advanced analysis of such patterns of injury entail the use of statistical tools such as multivariable analysis which can determine the independent contribution of one or a number of factors when other factors are taken into account.

Such patterns of prediction enable hypotheses of causality to be generated, and prevention interventions to be developed. The recognition that accidents do not happen by chance means that injury prevention researchers prefer to use the term 'unintentional injury' rather than 'accident', although the term accident is still in common use (for example the 'Accident and Emergency Department' or the Royal Society for the Prevention of Accidents).[40] 'Injury' is neutral with respect to causation, intent or predictability. The term 'Injury prevention' therefore includes all measures that are taken, knowing that an accident may happen, to minimise or eliminate the potential for injury, whilst 'injury control' is used to encompass both 'injury prevention' and also the follow up and rehabilitation of the injured person to minimise the consequences of the injury.[41]

2.1.2 Vulnerability of children

Children are vulnerable to injury for a number of reasons. Young children naturally explore their environment and their own abilities. Awareness of the consequences of their actions and of the capacity to understand and respond to risk are developmental milestones that occur as children grow. For example, the ability to judge the speed and distance of an approaching car is limited below the age of eight years.[42] Even when the ability to assess environmental risks has developed, other factors such as the tendency to experimentation and risk taking during the adolescent period, means that young people remain vulnerable to injury risk. Therefore children need supervision and action from adults until such time as they are able to protect themselves independently.[3]

Both anatomically and physiologically children are at increased risk of injury and the consequences of injury compared to adults. Children are smaller than adults and therefore less visible in the road environment, increasing their vulnerability to road traffic. Their small airway gives an increased risk of choking following ingestion of objects, and ingestion of a quantity of a poison will have a greater effect in a smaller body with less capacity and maturity of systems for metabolism. Children's skin is burned more rapidly and deeply when exposed to heat than adults and their relatively large surface area compared to their volume means that they are more susceptible to fluid loss following burns and scalds.[43] Falls resulting in fractures through a joint will disrupt the growth plate in young bones with increased risk of permanent deformity unless facilities exist to treat this. The smaller mass of children means that when they are struck by an object the transmission of energy is more likely to result in serious injuries than in an adult, both as a direct action of the impact (e.g. smaller, thinner bones are more likely to break) and as an indirect action of the consequences of the impact (e.g. being thrown further after being struck by a vehicle).

Children live in a world where they have no political voice. Even in democratic nations their ability to influence their own wellbeing is limited until they reach the voting age of that country. They are therefore dependent on the advocacy of adults for their health and wellbeing. The United Nations Convention on the Rights of the Child seeks to promote the welfare of children through the recognition of nations of their responsibility to advocate for children living in that country.[44] Two of the articles in the UN Convention directly relate to injury prevention:

- Article 19: that appropriate legislative, administrative, social and educational measures should be used to protect children from all forms of physical or mental violence, injury or abuse
- Article 24: that parties shall take appropriate measures to diminish infant and child mortality

The physical and social environment in which a child grows up is primarily designed for the adults that use it and not for the child. Children's exposure to factors that may increase injury risk varies between countries depending on the legislation passed by adults in those countries; for example the legal age for drinking alcohol or for driving a vehicle on a public road can vary considerably between countries.

2.1.3 Laws of accident causation

Using statistical probability, Elvik has proposed four 'laws of accident causation' relating to the occurrence of road traffic incidents.[45] Risk factors known to have a statistical association with road traffic incidents, i.e. those shown to increase the probability of an incident occurring, are used to explore the underlying mechanisms of road traffic incidents. The four laws are:

- **The universal law of learning**; that the ability to detect and control traffic hazards improves continuously as the amount of travel increases, i.e. the accident rate per unit of exposure will decline as the amount of exposure increases.
- **The law of rare events**; that the more rarely a risk factor is encountered the greater its effect on accident rate
- **The law of complexity**; the more units of information per unit time a road user must attend to, the higher the probability that an error will be made
- **The law of cognitive capacity**; the more cognitive capacity approaches its limits, the higher the accident rate

These laws obviously interact; otherwise the law of learning would suggest that older drivers are safer drivers as they have had greater driving experience. In practice we know that elderly drivers have an increased risk of road traffic incidents,[46] suggesting that the law of cognitive capacity interacts with that of universal learning.

Whilst the laws have been developed as applied to road traffic injury there is the potential to apply or adapt the laws to other areas of injury occurrence. Falls are one of the commonest mechanisms of child injury and the laws can be applied to this issue. The law of learning would predict that as children grow they would fall less; pre-school children who have recently learnt to walk fall frequently, whilst those at school and in adolescence fall less frequently. A child's development means that they learn the skill of walking and develop an understanding of the limits of their gross motor abilities (law of cognitive capacity), although new experiences e.g. stairs (law of rare events) and complex situations e.g. learning gymnastics (law of complexity) may result in an increased risk of falling and subsequent injury.

2.1.4 The impact of a changing world

The epidemiology of global childhood injury is changing as features of our world and the way we live in it change.[1;3;47] Four issues have been identified as having an impact on child injury burden:

2.1.4.1 Globalisation

Globalisation is the socioeconomic, cultural, political and environmental processes that intensify the connections between people, businesses and countries.[48] The effect of globalisation on health outcomes is increasingly reported.[49] For childhood injury, globalisation can have the advantage of more rapid dissemination of injury prevention knowledge, advocacy and interventions, and increased population wealth can lead to improved standards of living and infrastructure. However, these benefits are balanced by disadvantages related to increased exposure to injury risks. Increased movement of capital between nations has led to increased trade using road transport and therefore traffic related injuries,[50] and increased numbers of children in employment, thereby increasing the risks of occupational injuries.[1] The availability of cheap goods may mean that safer traditional alternatives are no longer used, for example the use of open plastic buckets for water storage has been associated with child drowning which would not have been possible with traditional narrow necked water vessels.[1]

2.1.4.2 Urbanisation

A greater proportion of the world's population live in urban settings than ever before, and the rate of change from rural to urban living is greatest in LMICs.[51] Whilst urban living may result in the improved access to healthcare, rapid urban expansion in LMICs may result in large numbers of families living in slum or inadequate housing with its associated injury risks; open cooking fires and heaters, unguarded high rooms and buildings, unsecured storage for chemicals, uncleared waste, and a lack of safe play areas.[3;47] Urban settings increase the likelihood of child labour and exposure to the high volumes of motor traffic.

2.1.4.3 Motorisation

Motorisation has a significant independent association with injury that disproportionately affects the most vulnerable.[52] Globally, road traffic injuries are one of the top causes of mortality from unintentional injury in children over the age of 1 year.[1] Child pedestrians may be struck by moving vehicles, whilst older children may be injured as cyclists, and adolescents as vehicle drivers.[50] A recent analysis[53] of data from the 2004 Global Burden of Disease study[54] found that traffic incidents were the largest single cause of mortality in young people between the ages of 10-24 years, accounting for 14% of male deaths and 5% of female deaths. The frequency of road traffic injuries is greatest in urban areas, however, the more severe injuries tend to occur on rural roads where traffic travels at higher speeds.[55] Economic development may result in a rapid expansion of road networks without pedestrian safety infrastructure such as pavements, mechanisms to separate road users or street lighting. Globally, deaths and injuries from road traffic collisions are estimated to rise by 67% between 1990 and 2020.[55]

2.1.4.4 Climate change

Rising carbon dioxide levels and secondary temperature increases will affect all populations, and are predicted to increase the risk of some types of injury.[56] One predicted effect is the increased likelihood of inland and coastal flooding with its associated risk of drowning and injury in mudslides. Extreme heat and drought will be associated with increased risk of wild fires.[57] Extreme weather events lead to displacement of populations, who set up temporary or makeshift towns with inherent injury risks such as open fires.

2.2 FRAMEWORKS FOR CHILD INJURY PREVENTION

Three basic principles have been proposed for the prevention of child injuries;[58] the first, that injuries are acknowledged as a significant health problem (due to the burden of ill health consequent to the injury and the health care that is expended to respond to the injury) and therefore prevention efforts should be led by health agencies. Secondly, that research into the occurrence and risk factors for injury need to be followed through into action to prevent child injury, for example through the development and evaluation of interventions, in both experimental and real world settings, and that effective interventions should then be mainstreamed. Thirdly, that governments should recognise and provide leadership for child injury prevention activities in their countries.

2.2.1 Public health approach to injury prevention

The use of a public health approach towards injury prevention was promoted by Gordon in 1949, demonstrating that, just like infectious disease, the description of injuries by time, place and person could lead to greater understanding and stimulate preventative action.[59] Today, a public health approach promotes action towards primary, secondary and tertiary prevention of injuries.

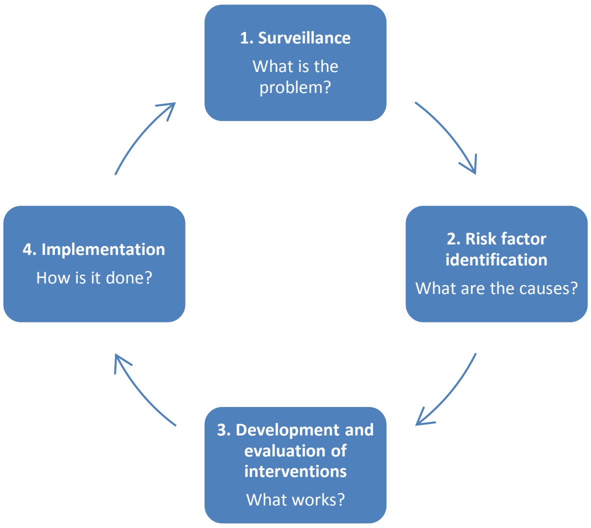
Primary prevention involves the removal or reduction of the injury hazard such that the injury event does not occur. This could be combined with other activities to improve the environment of the family, for example the removal of open fires in makeshift settlements and the provision of off-the-floor cooking facilities will both significantly reduce the likelihood of burns and scalds associated with cooking on open fires, and improve the quality of the indoor air (thereby reducing likelihood of respiratory illness such as infection or asthma).[60]

Secondary prevention does not seek to prevent the injury event from occurring but to limit the severity of the injury sustained during the injury event. For example, the installation and use of child seats, seat belts and air bags in cars means that in the event of that vehicle being involved in a road traffic collision the seat belt and air bags will automatically deploy, preventing or limiting the injuries that the occupants would have sustained had they been unrestrained and thrown within the vehicle following a rapid deceleration.

Tertiary prevention requires the optimal delivery of evidence-based interventions and care for injured children to reduce the risk of disfigurement, disability or death following an injury. This requires high quality evaluations of interventions to treat injuries. In addition, high quality pre-hospital and hospital care for those with the most severe injuries is required and the appropriate triage and referral or treatment of those presenting to primary or community care services.

The complexity of the factors involved in injury occurrence and the need for complex interventions requires coordination of action into a cycle of injury control (Figure 5). The process starts with the monitoring of injury occurrence and interpretation of data to identify a problem. Secondly, understanding of the risk factors involved in that problem is deepened, using routine data where available and data specifically for understanding of the problem where required. Interventions to prevent the injury are then developed and evaluated for effectiveness and cost effectiveness (stage 3) and then implemented / mainstreamed. Ongoing monitoring using surveillance systems is then required to determine whether the intervention has had the desired preventative effect.

Figure 5: The public health approach to child injury prevention



Source: The World report on child injury prevention[1]

Injury prevention interventions may be provided to a large population or community (known as universal interventions) or to specific populations or groups (known as targeted interventions). Whilst it may seem appropriate to target interventions to those populations at greatest risk of specific types of injury (for example those living in the most deprived areas), this may not be the most effective and cost-effective method of reducing the total number of injuries since it may fail to protect the majority of the population who do not live in the most disadvantaged areas, but who may collectively have the larger number of injuries.[61;62] Targeted interventions may not have the expected effects if the population who has been targeted do not perceive the risk to be serious or their exposure to it to be frequent[62] and it may be difficult to identify those populations most at risk.[61] One unintended consequence of providing only universal interventions is that they may have a greater beneficial effect in low risk populations than in high risk groups (e.g. greater use of safety equipment amongst more affluent populations able to afford them), thereby widening the inequalities gap between groups.[63;64] From a cost effectiveness viewpoint, if the low risk majority are more likely to take up an intervention, then a small reduction in injury across a large population may be more effective overall than a larger reduction in injury in a targeted minority population. There is a risk that because the least disadvantaged are also those who have the greatest political voice, such approaches make the safe safer whilst those most disadvantaged remain at risk. Coordinated universal and targeted services are required together.

2.2.2 The Haddon matrix

Just as in communicable disease control, injury control requires an understanding of factors related to the individual at risk, the agent causing the harm and the environment in which that harm occurs. Haddon brought this ‘host, agent, environment’ triad to the injury field in his work on the prevention of road traffic accidents in the 1970’s.[65;66] Just as we now discuss primary, secondary and tertiary prevention, Haddon described the potential for intervention in three phases; pre-crash, crash and post-crash, which later became pre-event, event and post-event so that the framework could be applied to any injury event. The Haddon matrix provides a number of ‘cells’ where injury prevention activity can occur and effective interventions in any individual cell have the potential to improve outcomes for an individual (Table 5).[67]

Table 5: Haddon matrix completed for the prevention of injuries to car drivers and occupants

	Host	Agent	Environment
Pre-event	Driver training, licensing and testing of eyesight	Car road worthiness Speed limiters	Road planning and signage Traffic calming Speed limits & cameras
Event	Driver does not speed Car occupant use of seatbelts Driver avoidance of drink, drugs and use of mobile phone	Age appropriate car seats and use of seatbelts Air bags Impact bars Antilock brakes	Crash barriers Soft verges Gravel traps
Post-event	Evidence based trauma care	Response of emergency services	Access for emergency services

In addition to the matrix, Haddon described ten measures to prevent ‘energy damage’ to persons or property.[68] These have been interpreted for child injury prevention in the World Report on Child Injury Prevention (Table 6).[1] They can be used to identify activities and approaches to injury prevention that can then systematically contribute to all the cells within the Haddon matrix.[69] It may be noted that these are more likely to be activities that afford universal protection without the need for change in an individual's behaviour (e.g. separating pedestrians from other road users) rather than behavioural interventions that rely on the individual adopting the safety behaviour.

Table 6: Haddon's countermeasures to injury and examples from child injury prevention[1]

	Haddon's countermeasure	Child injury prevention example
1	Prevent the creation of the hazard in the first place	Banning the production and sale of unsafe products and toys
2	Reduce the amount of energy contained in the hazard	Speed reduction of traffic
3	Prevent the release of the energy	Child resistant containers for medicines and chemicals
4	Modify the rate or spatial distribution of the hazard from its source	Use of seat belts and child restraints
5	Separate people in time and space from the hazard and its release	Separate bicycles and pedestrians from other road users
6	Separate people from the hazard by interposing a material barrier	Window bars, pool fencing, well covers
7	Modify the relevant basic qualities of the hazard	Softer playground surfaces, thermostatic mixing valves
8	Make the person more resistant to damage	Good nutrition and health
9	Counter the damage already done by the hazard	First aid treatment for burns – cooling the burn
10	Stabilise, repair and rehabilitate the injured person	Burn grafting, reconstructive surgery and rehabilitation

A further development of Haddon's matrix has been proposed by Runyan to facilitate prioritisation of decision making between potential interventions identified in Haddon's matrix.[70] Runyan proposes a third dimension to the grid of factors (host, agent, and environment) and phases (pre-event, event, post-event). The components of the third dimension are values that help determine which of a range of potential interventions should be prioritised; effectiveness, cost, freedom, equity, stigmatisation, preferences and feasibility.

2.2.3 The three E's

For a number of years injury prevention interventions have been categorised into the three E's; Education, Engineering and Enforcement. Effective child injury prevention programmes will usually be multi-component and contain elements from each of these three areas.

2.2.3.1 Education

Providing parents and carers with the knowledge and skills to keep children safe is one of the first steps in child injury prevention. The information provided is intended to enable carers to understand the changing risks associated with their child's stage of development, and the need for age-appropriate supervision. Education may include the promotion of safety devices (such as car seats, helmets, safety gates and fireguards). This may be delivered through supportive home visiting programmes and can lead to changes in the home environment.[71;72] Educational interventions for children and adolescents have been shown to be effective for a range of risks including crossing the road[73], pedestrian road use[74] and dog bites.[75] However, it is recognised that health education alone is likely to result in limited or short term behaviour change only. Therefore educational components are usually delivered as part of an intervention together with environmental and or enforcement change and provides the information that underpins the other components. Education also needs to extend beyond the carer to include professionals and policy makers. Advocacy and action to raise the awareness and profile of child injury are forms of education.

2.2.3.2 Environment

Changes to the environment have significant potential to reduce injury risk, for both adults and children. Area wide environmental changes have made significant improvements to road traffic injuries in high income countries such as the UK, e.g. methods to slow traffic speeds in residential areas (e.g. speed bumps, chicanes, pinch points) or use of speed cameras, and the separation of different types of road user (e.g. pedestrians, cyclists, vehicles and public transport) have the potential to improve the safety of all road users. Most of the evidence of effectiveness comes from high income countries and the interventions shown to be effective may be too expensive for low and middle income countries.

There is currently a lack of evidence of effectiveness for reduction of injuries due to modification of the home environment. A systematic review of home modification for reduction in home injuries, including studies providing home safety equipment, identified five randomised controlled trials reporting outcomes in children, but results reported minimal or no reductions in injuries in intervention homes compared to control homes.[76] There is very little evidence of the effectiveness of environmental change from low and middle income countries although initiatives such as covering wells will reduce exposure to injury risk even if not formally evaluated. Within many homes in LMICs cooking is undertaken using open fires at floor level in a communal living space and presents a significant burn and scald risk to children, especially those less than five years old. A project in rural Guatemala to replace open floor level fires with elevated stoves for cooking has shown reductions in burns in children.[77]

Modification to products within the home can result in reduced child injury risk. The introduction of child resistant closures has led to a reduction in deaths from ingestions of medicines[78;79] and relatively minor changes to products have the potential to reduce the severity or consequences of an injury should it occur, for example the modification of the lids of pens to allow the passage of air should they be aspirated.[80] The introduction of new products can reduce injury, as shown by the effectiveness of bicycle helmets in the reduction of head and facial injuries.[81]

2.2.3.3 Enforcement

The introduction of legislation and the enforcement of that legislation can lead to reductions in risk of injury for adults and children. Such universal measures have the potential to result in significant benefit. Examples include the requirement to use protective equipment such as seatbelts in vehicles[82], helmets for bicyclists[83], fitting of smoke alarms in buildings[84], and fencing around swimming pools.[85] Regulation around manufactured products (such as the use of the British Standards Institution 'Kite Mark' in the UK) and standards for play equipment (such as standards for the lead content of paint) can reduce risk. Legislation alone cannot fulfil the potential of reducing child injury without the enforcement of that legislation. An example of how legislation for injury prevention that is poorly enforced results in limited reduction in risk would be the low levels of adoption of legislation to ban the use of mobile phones whilst driving in the UK.[86] The introduction of legislation or changes to existing legislation may take a long time to achieve. For low and middle income countries legislation for safety may be difficult to get prioritised over other needs and enforcement is likely to be more difficult than in high income countries due to capacity and other priorities.

Therefore, in summary, effective injury prevention requires:

- Surveillance to monitor trends in injury occurrence in time, place and person, and to use this information to inform research and practice
- Research to determine patterns of injury, to identify risk factors for injury occurrence, and evaluation of both interventions to prevent injury and the effectiveness of care for injured children.
- Prioritisation of injury prevention in health policy and coordination across government departments to enable prevention activities
- Awareness of the extent and preventability of unintentional injury amongst the public, professionals and policymakers
- Interventions using both universal and targeted approaches
- Advocacy for injury prevention from professionals and policy makers
- A workforce to support injury prevention interventions and research
- Legislative support for process and practice to reduce injury risk and enforcement of that legislation

2.3 INJURY PREVENTION POLICY

2.3.1 Global policy

A number of global initiatives and policies relating to child health and the prevention of child injury apply to England:

The United Nation Convention on the Rights of the Child (1989) states that all countries signed up to the convention have a responsibility to protect children up to the age of 18 years. Children have the right to health and the right to a safe environment free from injury and violence.[44] The convention was ratified by the United Kingdom in 1992.

The eight Millennium Development Goals (MDG) were adopted in 2000 at the General Assembly of the United Nations. The fourth MDG on child health aims to reduce by two thirds the child mortality rate for children under the age of five years, between 1990 and 2015.[87] Many deaths in the first year of life are due to congenital or perinatal causes, but of those after the age of 1 year, about 6% are due to injury. The MDG therefore support action to reduce injury deaths in this age group. One consequence of the focus on reducing mortality of the under 5s to achieve the MDG 4 is the risk of diverting attention away from children aged 5-18 years where injuries constitute a greater proportion of mortality.[60]

At a special session of the United Nations General Assembly in 2002, 180 countries adopted the document '*A World Fit for Children*'[88] which includes 21 goals for the subsequent decade and supported the Millennium Development Goals and the standards set in the UN Convention on the Rights of the Child. It includes statements on providing children with a safe environment and protecting children from harm.

The governing body of the World Health Organisation, the World Health Assembly, has responded to WHO reports on Violence and Health[89] and on Road Traffic Injury[55] to produce resolutions on violence and health (Resolution WHA 56.24) in 2003 and road safety and health (Resolution WHA 57.10[90]) in 2004. Children are specified as a target group for interventions in these resolutions.[1]

The Children's Environment and Health Action Plan for Europe (CEHAPE) was adopted by European Ministers in 2004 at the Fourth Conference on Environment and Health.[91] It commits to four Regional Priority Goals for countries within the WHO European Region. The second of these goals is to ensure protection from injuries and adequate physical activity.

The World Report on Child Injury Prevention makes seven recommendations to Governments around the world.[1] These are:

1. Integrate child injury prevention into a comprehensive approach to child health and development
2. Develop and implement a child injury prevention policy and plan of action
3. Implement specific actions to prevent and control child injuries
4. Strengthen health systems to address child injuries

5. Enhance the quality and the quantity of data for child injury prevention
6. Define priorities for research and support research on the causes, consequences, costs and prevention of child injuries
7. Raise awareness of and target investments towards child injury prevention.

2.3.2 UK policy

Child injury prevention has had varying prominence in government policy in England over the last two decades. This section will summarise the key government policies that have created opportunities for action to prevent unintentional injuries in children and young people.

The '*Health of the Nation*' white paper (1992) formed the central health policy in England between 1992 and 1997.[92] It was the first attempt by a government in England to strategically improve the health of the population. Reduction in accidental injury was identified as one of five national targets for health improvement.

The subsequent white paper *Saving Lives: Our Healthier Nation* (1999) was the New Labour health policy that included accidental injury as one of its four key targets for public health.[93] It included the target to reduce the death rates from accidents by at least one fifth and to reduce the rate of serious injury from accidents by at least one tenth by 2010. It recognised that injury was a leading cause for childhood admissions to hospital and that England compared poorly to other European countries for child pedestrian deaths.

The Accidental Injury Task Force published a report for the Chief Medical Officer in 2002 to identify steps that would have the greatest impact on injury prevention.[94] One working group focused on child injury. Recommendations included cross-governmental coordination of initiatives, data collection and integration, workforce for delivery and leadership and research and dissemination of evidence.

The Every Child Matters (ECM) policy arose with the Children Act 2004, and provides the current framework for child health policy in England today. There are five outcomes that the policy seeks to achieve for all children, the second of which is 'Stay safe' and includes safety from unintentional injury.[95] The *Staying Safe Action*

Plan was launched in 2008, sets out the government's priorities for the period 2008-2011.[96] These include a National Home Safety Equipment Scheme '*Safe at Home'* (administered by RoSPA and focused on 141 areas with the highest rates of hospital admissions following home injury), a new Child Safety Education Coalition (including the publication of guidance on the relationship between accidents and child development[97]) and a *Priority Review of Accident prevention amongst children and young people* to review existing practice, and make recommendations.[30] The government has set a Public Service Agreement target (PSA 13) to improve children and young people's safety that includes four indicators, one of which has relevance to this thesis, namely, the reduction in hospital admissions caused by unintentional and deliberate harm.

The National Institute for Health and Clinical Excellence (NICE) is currently developing a series of guidance on the prevention of unintentional injuries in children under the age of 15, due for publication in late 2010.[98] This guidance will provide a review of the evidence of effectiveness of interventions in the home, road and leisure environments and evidence of regulatory, legislative and policy practice for injury prevention.

A number of government departments other than health have produced policy that contributes to reductions in child injury. Important examples include firstly; the *2004/5 Fire and Rescue National Framework*[99] which sets the target to reduce the number of accidental fire-related deaths in the home by 20% between 1999 and 2010, and includes financial support to deliver fire prevention interventions through the fire and rescue service, and secondly; the Department for Transport's road safety strategy, *'Tomorrow's Roads: Safer for everyone'*[100] that sets targets for the reduction in road casualties by 2010, including a 50% reduction in the number of children killed or seriously injured, compared with the average for 1994-98.

2.4 SUMMARY OF CHAPTER

This chapter has provided a background to the subject of childhood injury. It has described some theories of why injuries happen to children and young people, stated the commonly used frameworks for the prevention of such injuries and described how those frameworks have been translated into policy at a global and a UK level. In doing so it has provided the context against which the findings of the systematic review and data analysis of this thesis will be set.

CHAPTER 3: METHODOLOGICAL ISSUES IN CHILD INJURY RESEARCH

This chapter will explore methodological issues that need to be considered when researching the epidemiology of child injury and explain some of the methodological decisions made for this study.

3.1 RESEARCH EVIDENCE FOR EPIDEMIOLOGY

The quantitative evidence informing our understanding of the epidemiology of childhood injury can arise either from descriptive data such as population registry datasets or from observational studies such as cross-sectional, case-control, or cohort studies.[101] Observational studies enable analysis of hypotheses, particularly the exploration of whether one or more factors are associated with an increase or decrease the risk of injury. The researcher does not have control over which subjects are exposed to factors of interest and which are not, so determines exposure by report or assessment. An observational study cannot determine causality, but only whether there is an association between an exposure and an outcome. Confounding factors are those that are related to both the exposure of interest and the outcome of interest but are not part of the causal pathway between exposure and outcome. In any observational study, confounding factors need to be identified and controlled so that they do not bias any association between the exposure of interest and the outcome studied.

3.1.1 Cohort studies

Cohort studies identify a group of people, determine which are, and are not, exposed to particular factors of interest and then follow the groups until a specific time point or outcome has occurred. [102;103] The clarity of the temporal relationship between exposure and outcome is one of the main advantages of cohort studies over case-control or cross-sectional designs. Cohort studies can provide the incidence of the outcome of interest in a population and the consequences of exposure to a range of different factors in the form of risk estimates with confidence intervals. Cohort studies are able to identify associations between various exposures and the outcome of interest, but are unable to determine whether the relationship is causal. The disadvantages of cohort studies are that there may be bias in the selection of participants in the cohort and loss to follow up results in the participants being unable to be followed to determine whether or not they suffer the outcome of interest. This is particularly troublesome if participants that are lost are not evenly distributed between those exposed and those not exposed to the factor of interest. Cohort studies may not be useful for particularly rare outcomes unless the study is very large and the cohort is followed for a very long period of time. The Avon Longitudinal Study of Parents and Children used in this research is a prospective cohort study and subject to the advantages and disadvantages outlined above.

3.2 DEFINITION OF 'CHILDREN'

Children and young people can be grouped and named in a variety of different ways (e.g. babies, infants, toddlers, child, adolescent, teenager, young person etc). Differences in the categories used by different authors, and the age bands of such groups, can make it difficult to compare the outcomes of different research studies, especially if the data cannot be disaggregated into individual year groups. Some degree of aggregation is often necessary, especially for injury prevention research in high income countries where the incidence of injury, especially severe or fatal injury, is relatively low.

For the purposes of this research project the children studied are those aged five to 11 years inclusive. This age group was chosen as it maps to the English school system. Five years of age is the legal age of starting education. The majority of children who go to state schools enter a primary school at the age of five years (often having been at nursery school prior to the age of five years, or in a reception class from the age of four years) and stay in that school until the age of 11 years when they move to a secondary school where they remain until the age of 16 years.

3.3 DEFINITION OF INJURY

A clear definition of the outcome of interest is necessary in any study. Unlike other disease processes where the outcome is defined by the presence or absence of a particular disease (e.g. cancer), injuries need to be defined by both the causative event (e.g. a road traffic accident) and by the subsequent pathology (e.g. a fractured skull).[104] Theoretical definitions of injury often describe the consequences of energy transfer, for example, *'injury is the transfer of one of the forms of physical energy* *(mechanical, chemical, thermal etc) in amounts or at rates that exceed the threshold of human tolerance'*.[105] Whilst scientifically correct, such definitions do not capture events and outcomes that are commonly considered to constitute injuries such as lack of essential energy (e.g. lack of oxygen during asphyxiation or drowning, or lack of heat during hypothermia), or common childhood injuries such as ingestion, insertion or inhalation of foreign bodies (e.g. coins or small toys), or adverse psychological outcomes. It therefore falls to the researcher to be transparent when reporting the definitions of injury used so that readers may know how to interpret studies and whether different studies are reporting comparable outcomes.[106]

In this study the definition of injury used is that defined by the parents of the children in the Avon Longitudinal Study of Parents and Children. If, when questioned about injuries in their child, the parents reported an event or outcome, then that information had the potential to be included in the injury outcome data. Parents reported a range of injury events (e.g. a blow to the head) as well as injury outcomes (e.g. a fracture or a wound). Parentally-reported injuries were not validated against other data sources. The method used to categorise parentally-reported outcomes is considered below in the section on classification of injuries, and in detail in Chapter 6 where the coding of parentally-reported injuries is described.

3.4 INTENTIONAL AND UNINTENTIONAL INJURIES

Historically, practitioners and researchers have dichotomised injury events into intentional and unintentional. This decision has important implications for whether or not the injury is treated in a blame free manner, with input from healthcare staff only, or whether social care, child protection, the police and the courts are involved with the family following the injury event. In practice, the decision on intentionality is usually made by the paediatrician at the time of the initial presentation on the basis of the history given by the caregiver and the injuries sustained by the child. It has been increasingly recognised that this dichotomy is both unhelpful in identifying children in need and in determining the epidemiology of different types of injury.[107] Childhood injury may be better considered as a spectrum between an injury that could not have been anticipated or prevented to one where another person intended to cause harm to a child. Between these extremes are injuries that could have been anticipated and avoided, but the likelihood of preventing the injury is determined by a range of factors such as the vulnerability of the child, the perception of the hazard by the caregiver, the perceived severity of any potential injury, and the attention and proximity of the adult to the child at the time of the injury. An adult may be considered implicit in the occurrence of an injury if they failed to adequately supervise and keep the child safe; such 'neglect' may be considered a child protection issue, particularly for the younger child.[108] For child injury researchers this presents a challenge since classifications of injuries as intentional or unintentional are likely to be inaccurate. Asking a parent whether an injury was intentional is likely to result in incomplete data due to parental fear that the injury will lead to a child protection investigation.

3.5 RISK OF INJURY

The 'risk of injury' is the statistical probability of an injury occurring in a given set of circumstances. It is usually expressed as an injury rate relative to a unit of a given population over time.[62] Such a measure has the potential to be objective and comparable with similar measures both temporally and geographically, assuming that measurements of the components are consistently applied, accurate and complete. Such comparisons may be described as relative risks. It is necessary to consider whether exposures in populations or settings are truly comparable or whether other factors (referred to as confounding or mediating factors) are affecting those comparisons. For example, in a study by Ward of pedestrian activity and injury risk, women were shown to have a lower risk of pedestrian injury than men.[109] It could be assumed that this result was because women were less likely to be pedestrians than men, but in fact women have been shown to be more likely to walk and to cross more roads than men. If their exposure to the road environment was higher than that of men, but their rate of pedestrian injury was lower, then further factors must have exerted an influence. In this example pedestrian behaviour influenced the result and indicated that women were more likely to adopt safer behaviours in the pedestrian environment than men.

There may be a mismatch between reported risk and observed risk if a perceived risk results in a change in behaviour. For example, a community may report that a dual carriageway that separates their residential area from their local shops and facilities is dangerous and at high risk of leading to pedestrian injuries. The observed data may fail to demonstrate any increase in pedestrian injuries on this stretch of road compared to other areas of the community if the perceived risk leads to avoidance of crossing the road on foot and a preference for using public or private transport to travel the distance from the residential area to the shops.

3.6 CLASSIFICATION OF INJURIES

A classification system should enable information to be entered into categories according to criteria, which result in consistency of application and interpretation. An injury classification system needs to include information on the circumstances of the injury event (activity, mechanism, and location at the time of injury), part of the body injured, nature of the injury, cause of the injury and intentionality of the injury.[110] The most commonly used classification scheme for coding deaths and morbid conditions is the International Classification of Disease (ICD), currently in its 10th revision. As with any classification system there may be concerns that it fails to meet the needs of all circumstances[111], and incomplete or inaccurate application reduces the quality of the coded data.[112;113] Inconsistencies in the application of the ICD-10 system have resulted in difficulties when comparing coded datasets; not all countries transferred from ICD-9 to ICD-10 at the same time and some countries (e.g. Australia and the USA) have made modifications to the system for use in their countries.[110] In addition, alternative classification systems exist (e.g. that used by NOMESCO, the Nordic Medico-Statistical Committee). The International Classification of the External Causes of Injury (ICECI) system has been developed by the World Health Organisation to be supplementary to the data coded by ICD-10 and provide an internationally accepted modular hierarchical system of classification of the external causes of injuries.[114]

In this study the injuries reported by the parents of children enrolled in ALSPAC were coded using the ICECI classification system. Further detail on the rationale and detail of the coding are provided in Chapter 6 and in Appendix 6.

3.7 ASSESSMENT OF INJURY SEVERITY

Many different methods exist to categorise the severity of the injury sustained. Fatal or non-fatal injury is the only objective and consistently applied system for establishing severity but it is too limited for general use. As fatal childhood injury is a relatively rare occurrence in high income countries such as the UK, there needs to be a method to identify which of the non-fatal injuries are the more serious and which can provide big enough sample sizes to be useful for hypothesis generation and testing.

Objective measures include a range of injury scoring methods, many of which have developed from the Abbreviated Injury Scale (AIS) score produced in 1971. Based on consensus expert opinion of the anatomical damage sustained during the injury event, the AIS score has been criticised for its poor correlation between severity and survival (partly due to the inability to combine the impacts in cases of multiple injuries), scoring not being comparable across body parts, and not providing a graduated interval scale of progressive severity.[115] A range of alternative trauma related scales have been developed;[116] for example the Injury Severity Score (ISS) and the Revised Trauma Score (RTS), but all tend to have their limitations and are dependent on the need to have accurate information recorded to apply the code, and the training and capacity to apply the codes accurately.

For these reasons proxy measures for injury severity are frequently used in injury research. Such measures include ‘hospital admission’ or ‘attendance at an emergency department’ for injuries requiring treatment in secondary care settings or ‘medical attendance’ to also include injuries treated in community or primary care settings. These categories are assumed to be representative of decreasing severity, but such a system does not take into consideration factors known to influence hospital or medical attendance such as proximity to the hospital, perceived severity of the injury and self-efficacy to treat. Nor does it consider changes in medical practice which may enable more children to remain at home with their families rather than be admitted to hospital or variable facilities available at the hospital.[117]

Further pragmatic alternatives include disruption of activities of daily living, such as time off school, with the assumption that the more severe the injury the greater the number of days of school absence. Such proxy measures of severity may be of particular use in low and middle income countries where access to medical care may be limited. The choice of which system to use for categorising severity of injury is important because variation in the method used to select a ‘case’ can influence whether risk factors are considered to be associated with injuries or not. In a study by Stewart-Brown et al, cases defined by hospital admission had different risk factors to those defined by parental report.[118]

In this study a pragmatic decision was made to use parentally-reported injury as our indicator of severity. Information was collected in the questionnaires on whether medical attention was sought and this information was coded to allow comparison of injury frequency by whether the injury was parent-treated, treated in a primary care setting, a secondary care setting or required admission to hospital. For analyses of risk factors the dependent variable was treatment in a secondary care setting or admission to hospital. Further information is provided in Chapter 6.

3.8 PARENTAL RECALL OF INJURIES

Information on the injuries sustained by children is often sought from their parents, whilst older children may be able to self-report. Parents will vary in their ability to recall past injury events. Recall may depend upon a number of factors; the severity of the injury, whether medical treatment or admission to hospital was necessary, whether there were consequences to the injury (e.g. a plaster cast, a scar, time off school etc), the people present and places associated with the injury event (e.g. a holiday or a family gathering) and the period of recall. In addition, the honesty of the parent may be relevant if there is concern whether or not the injury was intentional. In a survey of the accuracy of parental recall Agass et al validated parent report against general practice records. Parental recall of injuries was found to be incomplete, but where recalled, the quality of the information relating to the circumstances and location of the injury event were better than in the general practice record.[119] Pless et al found that parental recall for the previous year was more accurate than recall of accidents ‘ever’ when comparing parental recall with hospital physician records, but found that parents often reported injury events not known to the physician (for example if treated in an emergency department and the physician not notified afterwards).[120] Generally younger mothers and those with fewer children appeared to recall more accurately than older mothers or those with more children. In an analysis of data from a longitudinal study of children in New Zealand, Langley et al found that parents who under-reported unintentional injuries in their children did not differ significantly from those who did not under-report for a variety of family, behavioural or developmental factors.[121] Parent report appears to be a reliable method for obtaining information on injuries in children, but the risk of under-reporting, especially of more minor injuries should be considered, and validation against a number of other sources would be preferable.

For three of the four questionnaires used in this study parents were asked to recall injuries in their child that had occurred during the previous year. In the fourth questionnaire the recall period was much longer (an average of 2½ years). The methods used to adjust for this difference and the implications of the different recall periods are further considered in Chapter 6. The ethical framework of ALSPAC does not allow researchers to link information in the questionnaires to NHS or educational records. Therefore the anonymity of the data held in the Avon Longitudinal Study of Parents and Children did not allow validation of parental reports of injury against emergency department, hospital or general practitioner records.

3.9 THE CHALLENGE OF MAKING INTERNATIONAL COMPARISONS

The resources and infrastructure to study the epidemiology of child injury are often better in high income countries that have lower rates of injury, whilst the burden of injuries occurs in low and middle income countries without such resources. The value of making international comparisons, even between countries with similar social, economic and political progress, is challenged by a number of factors. A national mortality rate, even a low rate such as that in the UK, will mask inequality within injury types, or for population groups or areas within countries. For example, England and Wales has a relatively low rate of motor vehicle deaths compared to New Zealand, Australia or the USA, but the child pedestrian death rate in England and Wales (a component of the motor vehicle death rate) is higher in England and Wales than either Australia or the USA.[122]

A further issue concerns the quality of the data available, particularly the completeness and accuracy of the data. Unless countries have robust surveillance systems in place it may be difficult to know whether data are comparable. In the European Report on Child Injury Prevention average standardised mortality rates for unintentional injuries in children aged 0-19 years between 2003 and 2005 are reported to be lower in countries such as Georgia or the former Yugoslav Republic of Macedonia than countries such as Sweden, generally considered to have the lowest child injury rates in Europe.[5] The reason for such findings is almost certainly that the figures for Georgia and the former Yugoslav Republic of Macedonia are incomplete due to lack of infrastructure to report quality data.

Other factors that need to be considered when making international comparisons are person-time exposure to hazards (e.g. drowning will be more frequent in countries with large expanses of open water), the safety infrastructure available in that country (e.g. whether countries routinely separate pedestrians from other road users with barriers or pavements) and the enforcement regulations in those countries (e.g. different speed limits or illegal alcohol levels for drivers and enforcement of those regulations). Therefore, where similar surveillance, classifications and quality of data are available international comparisons of data on child injuries can be made and may provide useful benchmarking.[123] However, where such criteria cannot be demonstrated international comparisons should be made with caution.

In the systematic review undertaken as part of this study, data reported from cohort studies anywhere in the world have been identified and collated. Due to the heterogeneity of the data collection systems statistical pooling has not been attempted and a narrative review is provided. Further detail on the methods used is available in Chapter 4.

3.10 SUMMARY OF CHAPTER

This chapter has summarised the main methodological issues that exist for researchers undertaking studies in child injury, and has commented on how those issues have influenced the decision making for this study. Directions to further information in other chapters have been provided.

The chapter has demonstrated that most of the issues raised are either due to, or compounded by, the variety of methodologies currently in use by injury researchers. The existence of multiple methodologies does not necessarily mean that the issue is complex, more that there has not been one best way identified. Consensus on some issues, such as classification of injuries, has improved. The methodological decisions made for this study are based upon best practice where possible and a pragmatic method to manage the data available where best practice has yet to be determined. The findings of the data analysis in this thesis will be interpreted in the context of the methodological issues presented.

CHAPTER 4: SYSTEMATIC REVIEW OF COHORT STUDIES REPORTING INJURY IN SCHOOL-AGED CHILDREN

4.1 BACKGROUND

To inform the analysis and interpretation of the ALSPAC dataset it was necessary to understand current knowledge of the occurrence and circumstances of injuries occurring to school-aged children and the risk factors for those injuries. Published reports of injury data are derived from a variety of study designs including case control studies, cohort studies and population registry follow up studies. As stated in Chapter 3, the primary advantage that cohort studies have over the other types of study design is the collection of exposures and lifestyle data prior to the occurrence of injury. The temporal nature of this data collection reduces recall bias which threatens the validity of case control study findings, and is often absent from population registry follow up studies. The findings of cohort studies reporting injury in school-aged children are therefore more likely to be valid than other study designs.

Traditional methods of reviewing literature such as expert reviews or snowballing articles for reviews are prone to a number of biases, including the increased likelihood that an article will be published if it is written in English, if it has identified statistically significant findings and if those findings are in a positive rather than negative direction. Selective reporting of published papers has the potential to produce a review that supports the personal opinion of the author. As a cohort study was to be used as the primary source of data in this study, and in order to avoid the issues occurring in traditional literature reviews, a systematic review of cohort studies reporting injury in school-aged children was undertaken, with the aim of providing an objective and transparent appraisal of current knowledge from this study design, of the occurrence and risk factors for unintentional injury in children of this age group.

4.2 AIM AND OBJECTIVES OF THE SYSTEMATIC REVIEW

Aim:

To clarify current understanding of childhood injury using data from child cohort studies

Objectives:

1) To describe the type and range of injuries recorded from cohorts of school aged children

2) To establish which variables (risk or protective factors) have been explored with respect to injury occurrence in this age group

3) To identify which variables (risk or protective factors) have been shown to be associated with injury and the nature of that association

4) To identify the extent to which the consequences of injury have been studied through cohorts of school-aged children

A preliminary review of the evidence indicated a number of published reports from cohort studies that included children of any age between 5 and 18 years. The data in ALSPAC specifically relates to children of UK primary school age (5-11 years). In order not to exclude studies that included children beyond this age range it was decided to include children of any age who were attending school, up to 18 years.

4.3 CRITERIA FOR STUDIES IN THIS REVIEW

4.3.1 Inclusion criteria

Studies were included in the review if they met all of the following criteria:

Types of studies

- The study design was a cohort, a longitudinal or a follow up study
- The study was prospective in nature
- The study involved active recruitment of participants to the cohort

Types of participants

- The participants were children aged less than or equal to 18 years and were healthy at recruitment to the study

Types of outcome measures

- Outcomes included unintentional physical injuries that were sustained during the age period of 5 to 18 years

4.3.2 Exclusion criteria

Studies were excluded from the review if they met any of the following criteria:

- Studies where children were selectively recruited to the study because of a specific illness, disease, diagnosis, disability or injury
- Studies that were retrospective in nature or case series
- Population based cohorts or record based cohorts where no active recruitment to the study occurred
- The study only collected outcomes related to psychological or psychiatric injury
- Studies where children were selectively recruited to the study because of an activity they undertook that placed them at increased risk of injury, e.g. participation in a team sports league or sports competition (added at title and abstract screening stage – see section 4.5.1 below for details)

4.4 SEARCH STRATEGY FOR IDENTIFICATION OF STUDIES

To identify studies for inclusion in the review a search strategy was developed that included both the searching of electronic databases and a review of grey literature sources of information.

4.4.1 Electronic database searching

Electronic databases were searched using free text and thesaurus terms to explore three concepts;

- children and young people
- injuries
- cohort studies

To develop the search history search terms for each concept area were combined with published search filters designed to balance sensitivity (the identification of as many relevant studies as possible) with specificity (increased likelihood of the study being relevant) and thereby improve the detection of appropriate research.[124] An internet search identified appropriate filters for the concept of children and young people[125] and that of cohort studies,[124;126] but neither the internet nor the Cochrane Injuries Group were able to identify a filter to support finding studies reporting injuries. The search history was developed in an iterative manner using Medline and then adapted as required for each database searched. No language or date restrictions were applied. The initial search history (maximal sensitivity) retrieved over 40,000 references including much that was not relevant, so the history was made more specific by considering each search term and reviewing its contribution to the number of 'hits'. Author's key words published in citations meeting the inclusion criteria were used to refine the search history, which was discussed with Professor Elizabeth Towner and Jason Briddon (UWE Librarian).

The finalised search history (Table 7) was used to search Ovid Medline (1966 to January Week 3 2006)

Table 7: Medline search history

No.	Search terms
1	(cohort adj1 stud$).mp. [mp=title, original title, abstract, name of substance word, subject heading word]
2	(longitudinal adj1 stud$).mp. [mp=title, original title, abstract, name of substance word, subject heading word]
3	exp Cohort Studies/
4	1 or 2 or 3
5	exp Adolescent, Hospitalized/ or exp Adolescent/ or exp Adolescent Institutionalized/
6	exp Child/ or exp Child, Hospitalized/ or exp Child, Institutionalized
7	exp Pediatrics/
8	exp Disabled Children/
9	youth$.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
10	teen.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
11	5 or 6 or 7 or 8 or 9 or 10
12	exp accident prevention/ or exp accidental falls/ or exp accidents, home/ or exp accidents, traffic/ or exp drowning/
13	exp "Wounds and Injuries"/ep [Epidemiology]
14	12 or 13
15	4 and 11 and 14

The search history was adapted for a range of electronic databases (Table 8) known to cover medical and social science journals that may report injury outcomes.

Table 8: Electronic databases included in review

Date of search	Search No.	Database	Publications identified
29.01.06	1	Medline (1966 to January Week 3 2006)	3295
	2	Old Medline (1950 to 1965)	0
	3	Embase (1980 to Week 4 2006)	1005
30.1.06	4	Cinahl (1982 to Dec Wk 2 2005)	508
	5	BNI (British Nursing Index) (1985 to Jan 2006)	92
31.01.06	6	HMIC (Health Management Information Consortium) (January 2006)	187
	7	AMED (Allied and Alternative Medicine Database) (1985 to Jan 2006)	118
	8	SportDiscus (1830 to Jan 2006)	168
01.02.06	9	ChildData (1989 to 2006)	16
	10	Index to Theses (1716 to 17.01.06)	253
02.02.06	11	ISI Proceedings (1990 to 27.01.06)	65
	12	Zetoc (1993 to 2.2.06)	674
	13	NRR (National Research Register) (2000 to 02.02.06)	62
	14	ReFeR (Research Findings Electronic Register) (02.02.06)	290
	15	Cochrane Library (2006 Issue 1)	123
07.02.06	16	PsycINFO (1806 to Wk 5 Jan 2006)	49
Total			6905

The results of searches 1 to 8 and 16 were exported into RefWorks reference management software (RefWorks Classic, 2006. www.refworks.com), whilst the results of searches 9 to 15 did not allow this facility and were reviewed on screen.

4.4.2 Grey literature sources

The main sources of grey literature used in the review were

1. Reviewing the bibliography lists of included studies
2. Contacting the authors of included studies to request details of further published and unpublished work, internal reports or additional data

3. Contacting authors of studies where eligibility was uncertain firstly to confirm eligibility and secondly to identify further published or unpublished work that met inclusion criteria
4. Performing a Medline search (1966 to 2006) on publications by the lead author of included studies
5. Conducting an Internet search for websites relating to known child cohorts to identify contacts and search publication lists for papers and reports of injury outcomes
6. Attendance at the 1st International Conference on Child Cohort Studies, Oxford, 12-14th September 2006

4.5 METHODS OF THE REVIEW

4.5.1 Management of citations

Using RefWorks software, duplicated references were excluded where appropriate using the 'close match' identification tool. A review of the title, abstract and key words of imported studies allowed ineligible studies to be excluded based on their design, recruitment, population, or study outcomes (if specified in sufficient detail). The full texts of remaining references were obtained and further ineligible studies excluded using the same criteria. The references identified by electronic databases that did not allow references to be imported into RefWorks were reviewed on screen using the same criteria, at the time the search was undertaken. Studies meeting the inclusion criteria but identified through grey literature sources were added manually into RefWorks.

During the process of reviewing the citations retrieved by the Medline search a large number of cohort studies were identified that reported injuries occurring to children taking part in formal competitive sports. This finding was discussed with the supervision team. As this group of children were exposed to an increased risk of injury due to their sporting activities and the injuries themselves differed from those sustained by children not engaged in competitive sporting activities, the inclusion criteria for the review were modified to exclude such cohorts.

4.5.2 Data extraction and assessment of study quality

A data extraction form was developed and piloted by three users (the author, Professor Elizabeth Towner and Dr Mariana Brussoni) on five papers, modified and then produced in both Microsoft Word (Appendix 1) and Microsoft Excel formats. Data were extracted on the number and description of study participants, the study design, methods and the outcomes evaluated. Two reviewers; the author and either Professor Elizabeth Towner or Dr Mariana Brussoni, extracted data from all included studies. Reviewers were not blinded to the names of journals, the authors, or institutions, or the results when extracting data on study methods. Data from both reviewers were entered into a series of Excel worksheets to allow comparison and confirmation of correctly extracted data. Differences in data extraction were resolved through discussion.

To assess study quality, data were extracted on study methodology, participant recruitment and retention, analysis and reporting, using 11 questions adapted from CASP quality criteria[124] (Table 9 and Appendix 1). Following appraisal of each paper using these criteria a quality rating of A, B or C was assigned, where A = Good (i.e. sound methodology and clear reporting, no concerns), B = Adequate (i.e. minor methodological or reporting concerns but not to the extent that the validity of the reported results was questioned) or C = Poor (i.e. significant methodological or reporting concerns such that serious doubt was placed on the validity of the published results). Classification with a poor quality rating indicated a paper not suitable for inclusion in the synthesis stage of the review. After rating all the papers that met the inclusion criteria, those given a poor quality rating were discussed with Professor Towner to confirm that the poor rating had been appropriately applied, and these papers were excluded from synthesis in the review.

Table 9: CASP Quality criteria used to assess studies in the review

Criteria number	Quality criteria question
1	Does the study address a clearly focused issue?
2	Is the cohort representative of a defined population?
3	Were outcomes appropriately measured to minimise bias?
4	Was duration of follow up of subjects long enough to answer the research question posed?
5	Was the loss to follow up clearly stated?
6	Have the authors identified potential confounding factors?
7	If there was an analysis did the authors account for potential confounding factors?
8	If there was an analysis did the authors account for missing data?
9	If there was an analysis are the results reported with precision estimates where appropriate?
10	Is the nature of the cohort study being exploited to its full potential?
11	Are the results believable?

Note: Full details of the CASP criteria, including their sub-questions, are included at the end of the data extraction form (Appendix 1)

4.5.3 Analysis

Unlike the synthesis of randomised controlled trials through meta-analysis, the methodology used to combine the findings from observational studies such as cohort studies is less well established, and concerns exist regarding the risk of false conclusions resulting from statistical pooling.[127-129] Cohort studies are observational, so the results are at risk of unidentified confounding factors and selection bias in the children recruited and retained in the cohort. The most disadvantaged families are the least likely to be recruited or retained in cohort studies. ALSPAC is known to have greater loss to follow up of more disadvantaged families. For these reasons a meta-analysis of the findings of the cohort studies identified during this systematic review was not appropriate, and a narrative synthesis was used.

The methodology for narrative synthesis was developed from published guidance.[130] Although unable to provide a numerical estimate of risk, such a synthesis was more likely to provide a realistic and potentially valid understanding of those risks. The methodology used had 3 stages:

1) **Tabulation** - of the methods, analysis, results, conclusions and quality of the cohort studies identified in the review (hereafter referred to as 'studies'), and of the individual citations reporting findings from those studies (hereafter referred to as 'papers').
2) **Within-Study analysis** – a narrative review of each study to determine the contribution of that study to the research field, and to report consistency of findings between papers reporting that study
3) **Between-Study analysis** – a thematic narrative to summarise the findings across different studies, to identify any differences between studies and possible reasons for those differences, and to identify gaps in the knowledge base.

Subgroups specified *a priori* included

a. **Age of the child**, i.e. 'primary school-age children' (5-11 years) versus 'post-primary school-age children' (12-18 years) (or their international equivalent)
b. **Economic status of country** of study, i.e. higher income countries versus low and middle income countries (as defined by the World Bank[131])
c. **Date of study**, i.e. older (those recruited up to 1980) versus newer studies (those recruited since 1980)

Papers reporting different ages of children were reported separately at the Within-Study analysis stage, and during the Between-Study analyses. Papers reporting findings in different countries and with very different dates were reported separately during the Between-Study analyses.

Studies reporting descriptive injury outcomes only were synthesised separately to those reporting injury outcomes where an analysis of the effect of risk factors and protective variables had also been conducted.

4.6 RESULTS

4.6.1 Identification of included studies

6905 citations were identified from searching electronic databases. 149 were excluded as duplicates and a further 6581 were excluded following a review of the titles and abstracts on screen, leaving 175 citations requiring a review of the full text. Two citations (one written in Chinese and one thesis from USA) were required in full text to confirm eligibility, but could not be provided by the British Library. From the remaining 173 citations 18 papers meeting the eligibility criteria were identified (Figure 6). A further 26 papers were identified from grey literature sources (Table 10). A total of 18 different child cohort studies were identified reported in 44 papers. No unpublished studies or papers were identified.

Figure 6: Flowchart of identified eligible studies

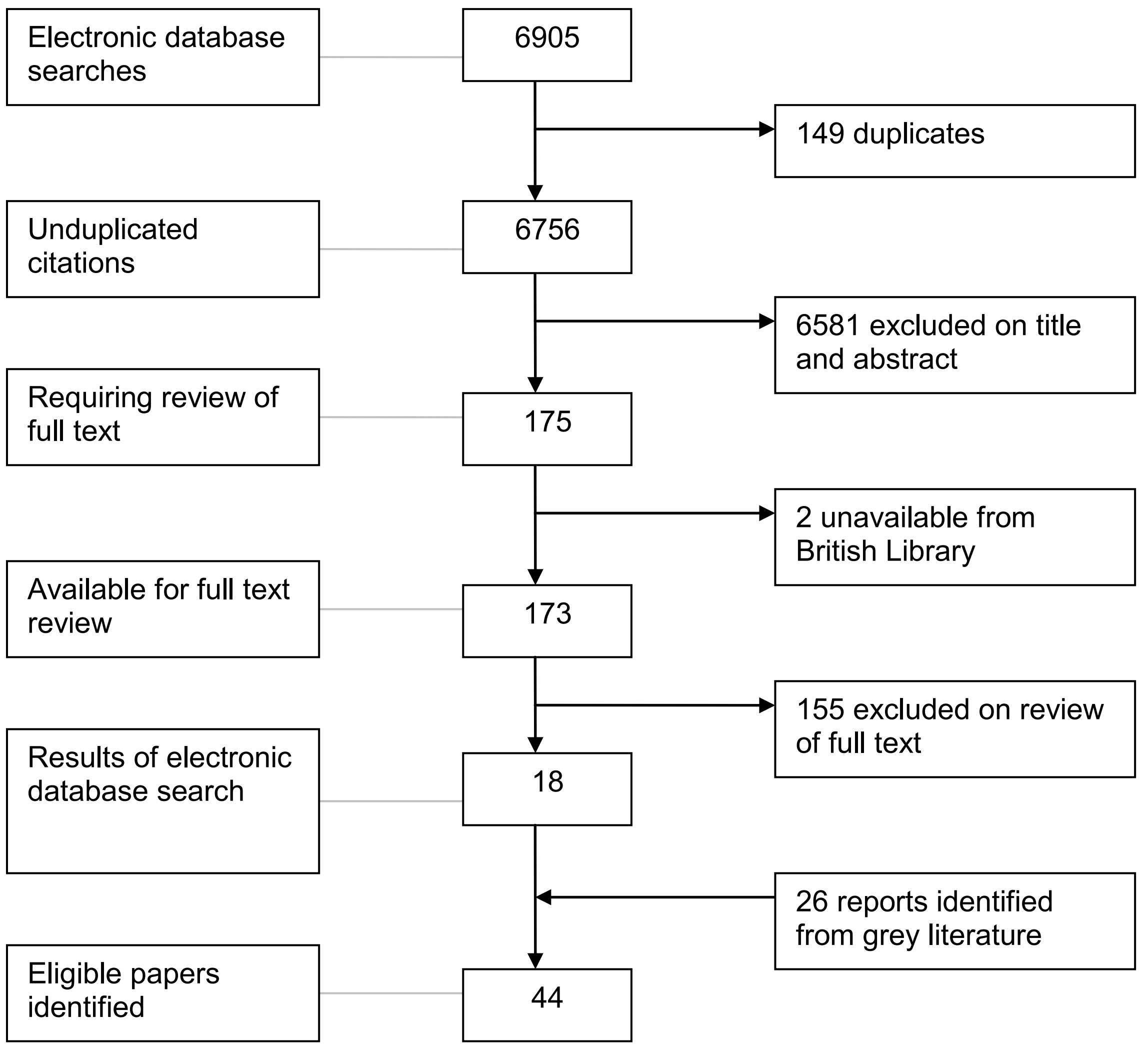


Table 10: Sources of papers identified from the grey literature

Grey literature source of included studies	Number of papers identified
Medline search for other papers written by lead author	11
Bibliography list of an included paper	7
Bibliography list of a background paper	4
Email contact with author of included paper	2
Publication list on a cohort study website	1
Expert contact	1
Total	**26**

Attempts were made to contact by email the 28 different lead authors or corresponding authors of the 44 papers. For eight papers, an attempt was made to identify the programme director of the cohort study rather than the author, for four papers no email was identified and one author had died. Six authors were traced but did not respond to the email sent. Six lead authors,[132-137] and two corresponding authors[138;139] responded to email contact and provided additional information, clarification of eligibility or further references. A further lead author responded and provided additional injury data.[140]

In addition to the 44 papers, a further eight papers[141-148] were identified that met the inclusion criteria in all respects except for the fact that they either included results for children outside the specified age range (i.e. <5 years or >18 years) and the data could not be separated, or data were incompletely reported. Furthermore, two additional papers[149;150] contained cohorts of children nested within case control studies. As these two papers were so different in their methodology to the majority of studies in the review (e.g. the children were recruited as matched controls to injured children), and results were not generalisable to a specific population or geographical area it was not considered appropriate to include them in the review. These 10 papers were excluded from the synthesis of results (Table 11).

Table 11: Papers excluded from systematic review

Author, Year of paper, Country of cohort (Name of cohort)	Reason for exclusion
Junger, 1999, Canada (Cohort in Montreal)	Injury data for range Kindergarten to 14 years, not available for school-aged period separately
Tremblay, 1995, Canada (Cohort in Montreal)	Reported collecting injury data at 14-15 years but no data reported and not available from author
Essen, 1982, UK (1958 British Birth Cohort)	Injury data for range 0-16 years, not available for school-aged period separately
Thanh, 2003, Vietnam (Fila Bavi Cohort)	Injury data for range 0-15 years, not available for school-aged period separately
Thanh, 2005, Vietnam (Fila Bavi Cohort)	Reported an injury rate for children aged 5-14 years but denominator not reported or available
Sathiyasekaran, 1996, India	Injury data for range 0-14 years, not available for school-aged period separately
Westaby, 2003, USA	Injury data for range 12-21 years, not available for school-aged period separately
Bijur, 1996, UK (1970 Child Health and Education Study)	Injury data for range 0-10 years, not available for school-aged period separately
Goulding, 2000, New Zealand	Cohort of healthy girls matched to cases with distal forearm fractures
Schwebel, 2002, USA	Cohort of healthy boys matched to cases with disruptive behaviour

In addition to the 18 cohort studies included in the review, two further cohort studies were identified that have collected data on injury occurrence in school-aged children: The 1990 Birth to Twenty Study, Johannesburg, South Africa (also known as 'Mandela's children' study, http://web.wits.ac.za/academic/health/Research/BirthTo20/) and the Jamaican Birth Cohort Study.[151] Neither of these cohorts have published their injury findings to date (confirmed by personal communication with directors of the studies).

4.6.2 Description of included studies and papers

Eighteen of the included papers were identified from electronic database searches[11;33;136-140;152-162] and 26 papers were identified from searches and sources conducted after the initial database searches.[14;27;31;32;132-135;163-180] The 18 cohort studies and the papers reporting injury outcomes from them are tabulated in Table 12. Five cohorts recruited infants at birth and the remaining 13 studies recruited children once they were in school. The majority (n=14) of the studies were from high income countries (UK, New Zealand, USA and Canada) but four were from middle income countries (Thailand, Taiwan and China).[139;162;177;178] Four cohorts used a nationally representative sampling method, while the remainder sampled particular geographical areas (often urban). The oldest cohort study was recruited in 1947[163] and the most recent in 2002.[139] The five oldest cohort studies identified were all commenced in the UK, with recruitment occurring prior to 1973. Middle income countries have been reporting injury in recruited cohorts since 1991. The three most recent cohorts identified were all from middle income countries. No cohorts were identified from countries designated low-income.

Table 12: Cohort studies included in systematic review

Name of cohort study, Country*, First year of recruitment	Location†*	Aim and selection criteria of primary study, Age at recruitment to primary study	Number recruited / number eligible (%)‡	Author, year, [Quality rating]§	Aim of paper and selection criteria (Number of children studied). Duration of follow up from recruitment Percentage of those recruited followed up
Cohort from Baise, China [M], 2002	Baise City, Guangxi Zhuang Autonomous Region [U]	**Aim**: To describe patterns of nonfatal unintentional injuries. **Selection**: Adolescents from 36 randomly selected classes in 9 randomly selected schools **Age at recruitment**: 11 to 18 years	1840/1855 (99)	Chen, 2005a[139] [A] Chen, 2005b [178][A]	**Aim**: as primary study. **Selection**: Children aged 11-18 years (n=1840). **Follow up**: 1 year (99.2%) **Aim**: as primary study plus investigation of the association of psychological symptoms with injury. **Selection**: Children aged 13-18 years (n=1474). **Follow up**: 1 year (95.2%)
Cohort from Maanshan, China [M], 2001	Maanshan city [U]	**Aim**: To study the incidence of injuries and the relationship with behaviour problems. **Selection**: Cluster sampling from Years 1-5 in 3 primary schools. **Age at recruitment**: 6 to 12 years	2005/NS (nk)	Peng, 2003[162] [B]	**Aim**: as primary study. **Selection**: as primary study (n=1983). **Follow up**: 1 year (98.9%)
Cohort from Kaohsiung, Taiwan [M], 1995	Kaohsiung city [U]	**Aim**: To study the incidence of nonfatal school-related injuries over one academic year. **Selection**: Adolescents aged 13-15 years (Grades 7, 8 and 9) attending 6 randomly selected schools. **Age at recruitment**: 13 to 15 years	13335/NS (nk)	Yang, 1998[177] [B]	**Aim**: as primary study. **Selection**: as primary study (n=13335). **Follow up**: 1 academic year (nk)
West of Scotland 11-16 Study, UK [H], 1994	Central Clydeside [U]	**Aim**: To study teenage health and the factors which influence it. **Selection**: Pupils entering 43 randomly selected post primary schools from randomly selected classes in 135 primary schools. **Age at recruitment**: 11 years	2586/2793 (93)	West P, 2004[140] [A]	**Aim**: To test the hypothesis of equalisation in health between childhood and adolescence. **Selection**: Participants who were surveyed at recruitment (age 11), 13 and 15 years. (n=2196). **Follow up**: 5 years (11 years 93%, 13 years 84.9%, 15 years 78.6%)
National Longitudinal Survey of Children & Youth,	Nationwide [M]	**Aim**: To follow the development and well-being of children from birth to early adulthood. **Selection**: A random probability sample of residential households with children aged 0-11years.	22831/NS (nk)	Soubhi, 2004a[137] [B]	**Aim**: To study the relationship between child, family and neighbourhood characteristics on medically attended injuries. **Selection**: Children aged 4-11 years living in 10261 households responding to cycle 2 of the study (n=5357). **Follow up**: 1 year (63.3%)

Canada [H], 1994		**Age at recruitment**: 0 to 11 years		Soubhi, 2004b[161] [B]	**Aim**: To study the relationships between injury, behaviour, parenting, family functioning and neighbourhood characteristics. **Selection**: Children aged 4-11 years living in 10261 households responding to cycle 2 of the study (n=5357). **Follow up**: 1 year (63.3%)
Add Health Study, USA [H], 1994.	Nationwide [M]	**Aim**: To study a nationally representative sample of public and private school students. **Selection**: Clustered sampling of 145 middle junior and high schools **Age at recruitment**: 11/12 to 17/18 years	90118/ e118576 (76)	Hammig, 2001[136] [B]	**Aim**: To identify behaviours associated with injuries among boys who fight. **Selection**: Boys involved in fights in past 12 months (n=1314) from a random sample of cohort participants. **Follow up**: 1 academic year (100%)
Cohort from Kamphaeng Phet Province Vaccination Study, Thailand [M], 1991	Kamphaeng Phet Province [R]	**Aim**: To study the efficacy of an inactivated hepatitis A vaccine. **Selection**: Children attending 148 largest community primary schools in the study province. **Age at recruitment**: school entry to 16 years	40119/130000 (31)	Kozik, 1999[138] [B]	**Aim**: To describe mortality and self reported injury morbidity in a cohort of schoolchildren. **Selection**: a randomly selected subset of 20% of the cohort, chosen for sequential serological tests as part of the vaccine trial (n=6378). **Follow up**: 2 years (81.0%)
Adolescent Injury Control Study, USA [H], 1990	Allegheny County, Pittsburgh, Pennsylvania [U]	**Aim**: To investigate the incidence and risk factors for adolescent injuries. **Selection**: 7th to 9th grade students in one school district. **Age at recruitment**: 12 to 16 years	1245/1400 (89)	Anderson, 1994[160] [A]	**Aim**: To examine the patterns of socio-economic status and injury morbidity. **Selection**: as primary study (n=1245). **Follow up**: 2 years (89.0%)
Cohort from Eastern Shore, Maryland, USA [H], 1986	3 counties on Eastern Shore, Maryland, Baltimore [M]	**Aim**: To investigate factors associated with use of tobacco, drugs and alcohol, and early unprotected sexual intercourse among rural youth. **Selection**: All 8th grade students in three counties. **Age at recruitment**: 12 to 14 years	758/1930 (39.3)	Alexander, 1992[159] [B]	**Aim**: To study behavioural risk factors for medically attended injuries. **Selection**: as primary study + having completed data from both parent and child (n=632). **Follow up**: 2 years (72.0%)
Carolina Longitudinal Study, USA [H], 1981	Carolina [M]	**Aim**: To study social development. **Selection**: Students in two bi-racial school districts in either the 4th grade (9-10 yrs) or 7th grade (12-13 yrs). **Age at recruitment**: 9/10 and 12/13 years	695/e993 (70)	Cobb, 1995[158] [B]	**Aim**: To study the relationships between child factors, & socio-economic status and injury / "close calls" (near accidents). **Selection**: Sub-sample of students responding to questions on injury and 'close calls' during interviews (n=271). **Follow up**: to 12th Grade (~2-7 years) (39.0%)
Christchurch Child Development	Christchurch [U]	**Aim**: To examine the social, environmental and other risk factors related to child morbidity and explore factors related to health service use,	1265/1310 (96.4)	Horwood, 1989[135] [B]	**Aim**: To describe participant's medical history between 5-10 years. **Selection**: All children traceable, with data up to 10 years (n=1079). **Follow up**: 10 years (84.3%)

Study, New Zealand [H], 1977		family functioning and well-being. **Selection**: All hospital births in the urban region of Christchurch, New Zealand between period 15 April 1977 and 5 August 1977. **Age at recruitment**: Birth		Fergusson, 1995[175] [B]	**Aim**: To study relationship between antisocial behaviour in adolescence and injury. **Selection**: Respondents from cohort with complete data (n=954). **Follow up**: 16 years (75.4%)
				McKinley, 2002[176] [B]	**Aim**: To study the effect of mild head injury prior to age 10 on children in mid to late childhood. **Selection**: Respondents from cohort with data available. (n=939). **Follow up**: 13 years (74.2%)
Cohort from Seattle, USA [H], 1975	Seattle, Washington, [nk]	**Aim**: To study the relationship between injury and risk taking behaviour or stressful life events. **Selection**: All seventh grade boys enrolled in physical education at one Middle School **Age at recruitment**: 12 to 13 years	138/150 (92)	Padilla, 1976[179] [C]	**Aim**: As primary study. **Selection**: As primary study. **Follow up**: 5 months (68.7%)
Dunedin Multidisciplinary Child Development Study, New Zealand [H], 1975	Dunedin metropolitan area, Otago [U]	**Aim**: To study the health and development of children and adolescents, the influences and events contributing to morbidity & health behaviour. **Selection**: All surviving infants born at Dunedin's maternity hospital between 1st April 1972 and 31st March 1973, whose mothers resided in the metropolitan area during pregnancy and were still living in the province of Otago when children were age 3 **Age at recruitment**: 3 years	1037/1139 (91)	Langley, 1981[134] [B]	**Aim**: To describe injuries experienced by children aged 6-7 years. **Selection**: All traceable seven year olds from original cohort plus those eligible and added to the cohort (n=1072). **Follow up**: 4 years (92.4%)
				Langley, 1985[168] [B]	**Aim**: To describe injuries experienced by children aged 8-9 years. **Selection**: All nine year olds from the original cohort assessed at the research centre. (n=818). **Follow up**: 6 years (78.9%)
				Langley, 1987a[169] [B]	**Aim**: To describe injuries experienced by children aged 10-11 years. **Selection**: All traceable 11 year olds from the original cohort who agreed to take part (n=925). **Follow up**: 8 years (89.2%)
				Langley, 1987b[155] [A]	**Aim**: To study the relationship between child and family variables to childhood injuries. **Selection**: All traceable children with data for the period 7-11 yrs (n=781). **Follow up**: 8 years (75.3%)
				Chalmers, 1989[170] [B]	**Aim**: To describe injuries experienced by children aged 12-13 years. **Selection**: All traceable children completing questionnaires at the research centre (n=738). **Follow up**: 10 years (71.2%)
				Lodge, 1990[171] [B]	**Aim**: To describe injuries experienced by children aged 14-15 years. **Selection**: All traceable children completing questionnaires at the research centre (n=849). **Follow up**: 12 years (81.9%)

				Begg, 1990[172] [B]	**Aim**: To describe the road crash experiences of children aged 14-15 years. **Selection**: All traceable children completing questionnaires at the research centre (n=848). **Follow up**: 12 years (81.8%)
				Begg, 1991[173] [B]	**Aim**: To study injuries sustained in bicycle crashes in children aged 14-15 years. **Selection**: All traceable children completing questionnaires at the research centre (n=848). **Follow up**: 12 years (81.8%)
				Begg, 1992[174] [B]	**Aim**: To study injuries sustained in motor vehicle crashes in children aged 14-15 years. **Selection**: All traceable children completing questionnaires at the research centre (n=848). **Follow up**: 12 years (81.8%)
				Jones, 2002[156] [B]	**Aim**: To describe the proportion of children remaining fracture-free up to the age of 18 years. **Selection**: All children providing injury information at each stage of follow up (n=variable, 739 to 984). **Follow up**: 15 years (71.3-84.5%)
				Jones, 2004[157] [B]	**Aim**: To study child risk factors for fractures in cohort members. **Selection**: Poorly specified. (n=675-853). **Follow up**: 15 years (65.1-82.3%)
Cohort from South Wales, UK [H], 1972	Two 'industrial towns' South Wales, [U]	**Aim**: To study the effects of milk supplementation on child growth to 5 years. **Selection**: Consecutive births in two community hospitals. Twins, premature infants, and those receiving supplements excluded. **Age at recruitment**: Birth	1163/1288 (90.3)	Davidson, 1987[167] [B]	**Aim**: To study the relationship between maternal personality and injury in children. **Selection**: Participants of original cohort with complete data. (n=831). **Follow up**: 8 years (71.5%)
				Davidson, 1988[133] [B for injury reporting, C for analysis]	**Aim**: To study the relationship between child behaviour and injury. **Selection**: All children remaining in the study at 5 years of age (n=951). **Follow up**: 8 years (81.8%)
Child Health & Education Study (CHES), UK [H]. 1970.	Nationwide (England, Scotland, Wales and Northern Ireland) [M]	**Aim**: To study the circumstances, health, education and social development of children through to adulthood. **Selection** All children born between 5-11 April 1970, alive and living in England, Wales or Scotland in 1975. **Age at recruitment**: Birth	CHES: 16004/NS (nk). BCS70: 17196/NS (~95)	Bijur, 1988a[31] [A]	**Aim**: To study the relationship between behaviour and injury. **Selection**: Children with data at both 5 and 10 years, who were singleton births, had an English speaking mother of British ancestry, no suspicion of child abuse as the cause of the injuries (or in care), and mother present at the 5 year old interview (n=10394). **Follow up**: 10 years (64.9%)
				Bijur, 1988b[27] [B]	**Aim**: To study the relationship between pre-school injuries and injuries in the school-aged period. **Selection**: as Bijur 88a (n=10394). **Follow up**: 10 years (64.9%)

				Bijur, 1988c[14] [B]	**Aim**: To study the relationship between family and child factors and injury. **Selection**: as Bijur 88a (n=10394). **Follow up**: 10 years (64.9%)
				Bijur, 1990[32] [B]	**Aim**: To study the sequelae of mild head injury in children. **Selection**: as Bijur 88a (n=10394). **Follow up**: 10 years (nk)
				Beattie, 1999[33] [B]	**Aim**: To describe injuries requiring medical attention in Scottish teenagers. **Selection**: All teenagers in the cohort traced as resident in Scotland in 1986/7 (n=958). **Follow up**: 16 years (68.0%)
Cambridge Study of Delinquent Development, England, UK [H], 1961	London [U]	**Aim**: To study offending and antisocial behaviour in London males. **Selection:** All boys aged 8-9 years (born 1951-4), on the registers of 6 state primary schools and one special school, within a one mile radius of the research office in a working class area of South London **Age at recruitment**: 8 to 9 years	411/411 (100)	West, 1977[180] [B]	**Aim**: To describe the life styles of youths at age 18. **Selection**: all traceable from primary study (n=389). **Follow up**: 10 years (94.6%)
				Shepherd, 2002[166] [A]	**Aim**: To study the relationship between offending, health and injury. **Selection**: all traceable from primary study (n=387). **Follow up**: 10 years (94.2%)
				Shepherd, 2004[132] [B]	**Aim**: To study the relationship between childhood characteristics, teenage delinquency, injury and illness at 16-18. **Selection**: all traceable from primary study (n=378). **Follow up**: 26 years (94.6%)
National Child Development Study (NCDS), UK [H], 1958.	Nationwide (England, Scotland and Wales), [M]	**Aim**: To monitor the social, economic, educational and health circumstances of all children in England, Scotland and Wales. **Selection**: All children living in England Scotland and Wales who were born in the week 3-9 March 1958 **Age at recruitment**: Birth	17418/e17957 (97)	Peckham, 1973[164] [B]	**Aim**: To describe the preliminary findings at age 11 years. **Selection**: All children from the cohort alive and living in England, Scotland or Wales (n='more than 15000'). **Follow up**: 11 years (nk)
				Peckham, 1976 [165][B]	**Aim**: To describe development, illnesses, school absence, social conditions and educational progress at age 16 years. **Selection**: All children from the cohort traced through educational authority school registers in 1974, and agreeing to participate (n=15245). **Follow up**: 16 years (87.5%)
				Pless, 1989[11] [B]	**Aim**: To study factors that may affect the risk of having a traffic injury. **Selection**: All children from the cohort alive and living in England, Scotland or Wales. (n=13653 at 11yrs, n=11507 at 16yrs). **Follow up**: 16 years (78.4% at 11 years, 66.1% at 16 years)
				Bijur, 1991[152] [B]	**Aim**: To study the relationship between parent-adolescent conflict and injury. **Selection**: Children from cohort whose British, English speaking mother responded to questionnaire, with >50% data complete and had data on injury episode at age 16 and 23 years (n=8231). **Follow up**: 23 years (47.3%)
				Cumberland, 2004[153] [B]	**Aim**: To study the relationship between colour vision deficiency, education and injury. **Selection**: Unclear. Assumed to be participants from the original birth cohort that had colour vision assessed at age 11 years using the Ishihara test (n=12534). **Follow up**: 33 years (72.0%)

				Rahi, 2006[154] [B]	**Aim**: To study the relationship between amblyopia and educational, health and social outcomes. **Selection**: Participants from cohort at age 16, excluding those with bilateral visual loss, unilateral visual loss inconsistent with amblyopia or known eye disease (n=8861). **Follow up**: 33 years (50.9%)
Newcastle Thousand Families Study, UK [H], 1947	Newcastle upon Tyne, England, [U]	**Aim**: To describe disease and disablement in a representative sample of the city's children. **Selection**: Infants born to mothers resident in Newcastle from 1 May to 30 June 1947. **Age at recruitment**: Birth	1142/NS (nk)	Miller, 1974[163] [B]	**Aim**: To describe growth, injury, disease, social adaptation and educational attainment of children in relationship to family life and the environment of Newcastle families. **Selection**: All members of the cohort still enrolled between the ages of 5-15 years (n=763). **Follow up**: 15 years (66.8%)

*Country [High, Middle or Low income economic country]. †Location [Urban, Rural, Mixed setting], ‡e=estimated, NS=Not specified, nk=not known, §Quality rating [A, B or C – see Methods]

The injury outcomes, descriptive reporting of injuries sustained, analyses of risk factors and critical appraisals of the 44 papers are tabulated in Appendix 2. Fifteen papers reported injury in primary school-aged children (~5-11 years inclusive),[14;27;31;32;133-135;155;162;164;167-169;176;177] and 19 papers reported injuries in post-primary school-aged children (~12-18 years inclusive).[33;136;138-140;152-154;158-160;170-175;178;179] Ten papers reported injuries in children across both these age periods.[132;137;156;157;161;163;165;166;180] The quality of the included papers was generally good. Seven papers were given an A quality rating,[31;139;140;155;160;166;178] 35 were given a B quality rating and only two were given a C rating.[133;179] Considering papers given a C rating, critical appraisal of the paper by Davidson[133] identified that an unvalidated method of assessment of two behavioural measures was used, and some analyses had been conducted on very small numbers of children. Following discussion with Professor Towner the analysis section of this paper was given a C rating and not used in the synthesis of findings, whilst the descriptive reporting of injuries in this cohort was not subject to these concerns, given a B rating, and included in the synthesis. The findings of the second low quality paper[179] were selectively reported, with analyses conducted on only a portion of the cohort, rather than the whole cohort. Following discussion, this paper was excluded from the synthesis. Of the 28 papers reporting any analysis of risk factors for injury only three[31;152;156] adequately reported and managed the missing data in their dataset.

4.6.3 Within-Study narrative review of cohorts

A description and commentary of each of the 18 cohort studies are reported in reverse date order (i.e. most recently recruited cohort first).

1) Cohort from Baise City, China

1840 adolescents (11-18 years) from 36 randomly selected classes across nine randomly selected middle and high schools in one region of China were followed up for one year and non-fatal unintentional injuries were reported.

Thirty two percent of the children sustained any injury during the 12 months of follow up, with 10% having more than one injury.[139] The commonest mechanism of injury was falling (33%), followed by being struck by an object or person (20%), lacerations or wounds from sharp objects (14%), motor vehicle or transportation injuries (5%), burns or scalds (4%), bites and stings (3%), choking or airway problem (2%), poisoning (<1%) or 'other' (includes drowning, fire crackers, electrocution) (18%).

Severity of injury was assessed by two proxy measures; care received post injury (None (10%), Parent or teacher (48%), School medical staff (12%), Outpatient care (27%) or Hospitalisation (4%)) and by time missed from school (<1day (35%), 1-3 days missed (51%), 4-6 days missed (7%), ≥7 days missed (7%)). Injuries occurred at home (32%), school (35%), on the road (10%), or elsewhere (23%). More girls than boys were injured at home, whilst more boys than girls were injured during sport.

The rate of injuries was greater in boys than girls, and there was a trend of fewer injuries with increasing age (from 41% of 11 year olds injured to 20% of 18 year olds). Injury was more common in minority ethnic groups compared to the two majority ethnic groups (p=0.02). Children without siblings had higher rates of injury than those with siblings (p<0.01), as did children who lived with parents compared to those with divorced parents or who lived with grandparents (p=0.03). Injury risk was higher in families with lower parental educational level (p<0.01), and in families with lower family income (p<0.01). After controlling for gender, age, ethnicity and mothers education, children whose family had the middle income band had increased risk of injury compared with those in lowest band. In a subsequent paper by the same author[178] psychological symptoms in adolescents aged 13 to 18 years (obsessive-compulsiveness, somatisation, anxiety, depression, interpersonal-sensitivity and psychosis) showed statistically significant positive associations with injury risk after controlling for gender, age and ethnicity

Both papers by Chen scored well during quality appraisal. The authors acknowledged the risks of underreporting of injuries when using self report measures without validation from secondary sources. The psychological assessment tool was only used at baseline, so the persistence of psychological difficulties throughout follow up was unknown.

2) Cohort from Maanshan City, China

The cohort reported injuries in 1983 primary school-aged children and the relationship between injury and behaviour problems. Children aged 7-13 years were recruited through a cluster sampling technique from three schools in Maanshan city. For each class selected, half of the children were invited to participate.[162]

98.9% children were followed up for one year, with 31% sustaining any injury (32% of boys and 29% of girls), and 9% having more than one injury. The five commonest mechanisms of injury (in decreasing order) were falls, blunt object injuries, choking, sharp objects and hot / cold or caustic objects. Injuries were distributed evenly by age. The risk of injury of any mechanism was greater for boys and for children with behaviour problems, except injuries due to animal bites and drowning. Antisocial behaviour, neurotic behaviour, mixed behaviour problems, having a young mother, a mother with a high educational level, a difficult pregnancy and low use of injury prevention interventions by the family were all associated with increased risk of injury greater than chance. Injury risk was significantly reduced if the parent accompanied the child to school. The rationale for including some of these variables in the analysis was not clear from the text. The authors concluded that some people were fundamentally more prone to injury and that some injuries were inevitable.

3) Cohort from Kaohsiung City, Taiwan

This cohort reported the incidence of non-fatal school-related injuries in children aged 13-15 years, occurring over one academic year (9 months). Children (n=13335) were recruited from grades 7-9 from six randomly selected junior high schools in Kaohsiung.[177]

Twenty seven percent of children sustained any injury during follow up, and 2% sustained more than one injury. The three commonest categories of injury were bruising/contusions, cuts/wounds and concussion/foreign bodies/burns. The part of the body most likely to be injured was the upper limb, followed by lower limb and head/face. Injuries occurred more frequently in school than at leisure (before or after school). Thirty six percent of injuries involved other students of which 9% were considered intentional. Boys had more injuries than girls at all ages. A statistically significant increased relative risk for injury was found; for injuries not involving other students (Relative Risk (RR)=2.64, 95%CI: 2.42 to 2.86), for injuries involving other students where intent was involved (RR=4.53, 95%CI: 4.19 to 4.96) and when injuries were unintentional (RR=3.06, 95% CI: 2.81 to 3.32).

The classification of injury type and circumstances made it difficult to compare results of this study to others in the review. The author used a robust randomised sampling method to identify a representative sample of children for the cohort. In addition the authors attempted to estimate the proportion of time that students were supervised and unsupervised whilst in school.

4) West of Scotland 11-16 Study, UK

Children (n=2586) from randomly selected classes in 135 primary schools in Central Clydeside were followed up for five years and surveyed at 11, 13 and 15 years of age. The study aimed to test the hypothesis of an equalisation in health between late childhood and mid adolescence, such that the trend for more injuries occurring to children from lower socio-economic groups was attenuated as children age. The authors provided additional, unpublished data.[140]

At 13 years of age 34% of teenagers reported injuries sustained during the previous 12 months (39% of boys and 28% of girls). By 15 years the number of children injured in the previous year had increased to 49% (58% of boys and 40% of girls). Only selected injuries were reported, and these differed at the three time points making assessment of trend across the follow up period difficult. Boys were more likely to be injured than girls at both follow up periods. West reported evidence of equalisation for pedestrian road traffic accidents in both sexes, and for burns/scalds and sports injuries in females, but not males. In contrast a marked socio-economic gradient existed for violence related injuries in 15 year old males. Both occupational and non-occupational measures of socio-economic status yielded similar results.

5) National Longitudinal Survey of Children and Youth, Canada

This ongoing national survey follows the development and wellbeing of Canadian children from birth to early adulthood. A random probability sample of residential households with children aged 0-11 years were recruited to the study periodically. In two papers Soubhi et al examined the relationships between child, family and neighbourhood characteristics on medically attended injuries occurring to 5357 children aged 4-11 years recruited during survey cycle one and followed up two years later in cycle two.[137;161]

Twelve percent of the children studied sustained an injury during the previous 12 months. The author did not report details of the type of injuries sustained, the body part injured or outcome of injury stating that small numbers did not allow breakdown into categories. This was surprising considering the number of cases reported (n=632). After controlling for family socio-economic circumstances, number of persons in the household, physical and mental health of the primary caregiver, and a past history of injuries multivariable regression indicated that boys had more injuries than girl. Below average consistency of parenting was associated with increased risk of injury (Odds Ratio (OR) = 1.43, 95%CI: 1.22 to 1.68, $p<0.001$), and enumeration areas with high percentages of low income families were reported to be significantly associated with injuries although the 95% confidence interval includes 1.00 (adjusted OR = 1.02, 95%CI: 1.00 to 1.03, $p<0.01$). Both papers appear to report the same data and results.

6) Add Health (National Longitudinal Study of Adolescent Health), USA

This study recruited a representative sample (n=90,118) of students aged 11-18 from public and private middle junior and high schools across the USA. Using a random sample of the boys who reported fighting in the previous 12 months (n=1314), Hammig et al explored injuries associated with violent behaviour during a 12 month follow up. 18% of the boys reported being injured in a fight, and 47% reported injuring someone else in a fight. Details of the injuries sustained were not reported.[136]

Multivariable regression showed that the factors independently associated with being injured in a fight included group fighting three or more times and fighting with strangers. Variables associated with injuring someone else in a fight included group fighting 1-2 times or more, fighting with strangers and carrying a weapon. The authors did not comment on the validity of the self reporting of injuries in self and others. It could be speculated that injuries to self sustained during fighting would be selectively under-reported, whilst those occurring to those being fought would be selectively over-reported.

7) Cohort from Kamphaeng Phet Province Vaccination Study, Thailand

40,119 children were recruited to a study of the effectiveness of an inactivated hepatitis A vaccine from the 148 largest community primary schools in the Kamphaeng Phet Province of Northern Thailand. Kozik et al reported the mortality and self-reported injury morbidity in a randomly selected subset of 20% (n=6378) of the original cohort chosen for sequential serological testing in the vaccine trial.[138] Although the authors report that the children in the cohort were aged between 2 and 16 years, this study was included in the review because the usual age of primary school children in Thailand is between 6 and 12 years, and this study specifically recruited from primary schools. It is thought that the number of children less than 5 years and greater than 11 years must have been small.

Sixty six percent of the children (71% of boys and 60% of girls) sustained an injury over the one year of follow up, and 33% (38% boys and 27% of girls) sustained more than one injury. The commonest injuries were wounds (42%), burns and scalds (18%), near drowning (12%) and ingestions (2%). Commonest mechanisms of injury reported included bites and stings (21%), sharp objects (20%), hot / cold / caustic agents (18%), water (12%), falls (12%), motor vehicle occupant (6%), blunt objects (5%), motor vehicle pedestrian (4%), ingestions (2%) and landslides (0.2%).

Twenty (0.05%) children died from injuries during the one year follow up. Boys experienced more injuries than girls in all age groups and categories except landslides, poison ingestion and burns. Motor vehicle injuries were discussed in some depth. Forty six percent of the pedestrian injuries occurred as the child walked beside the road and 46% whilst crossing the road. Seventy seven percent of the pedestrian injuries were due to the child being hit by a motorcycle.

Few studies identified in the review had such large cohorts. Having young children self report injuries over the previous year could underestimate injuries due to recall bias, if the injuries were not substantiated through other sources. The types of injuries sustained and number of deaths reflect the increased risks children are exposed to in middle income countries, and the potential for injury prevention.

8) Adolescent Injury Control Study, USA

This study from Pennsylvania, USA investigated the incidence, socioeconomic distribution and risk factors for adolescent injuries in 1245 seventh to ninth grade students in one school district (~12-16 years); 89% of the eligible students were recruited in 1990 and followed for two years.[160]

Approximately 40% of the students sustained injuries during the 24 months of follow up, and 55% of those injuries were sports related. Social differences in injury occurrence were investigated using income of the township of residence (high, middle or low), parent education and the number of adults living in the household as indicators of socio-economic status. No statistically significant differences in time to first injury, home versus school injuries or sport-related versus non-sport related injuries were identified. The reportedly consistent findings across these different indicators of socioeconomic status add weight to the opinion that social patterning of injury is reduced in adolescents compared to younger children. The authors used time to first injury to get over the problem that some children will have only one injury whilst others may have several. This does however reduce the information available on children who have multiple injuries and can lead to difficulty in interpretation of published confidence intervals.

9) Cohort from Eastern Shore, Maryland, USA

Eighth grade students (~13-14 years old, n=632) from three counties from the Eastern Shore of Maryland, USA were recruited to investigate factors associated with the use of tobacco, drugs, alcohol, and early unprotected sexual intercourse in rural youth. The study recruited 39.3% of the eligible population in 1986 and

Alexander et al reported the association between risk taking behaviours and medically attended injuries during two years of follow up.[159]

Forty seven percent of children sustained injuries during the first year of follow up, and 34% during the second year. Description of the injuries was not reported. Multivariable logistic regression (adjusted for sex, race and parent education) indicated that lifetime marijuana use of 1-5 times, or working for more than 11 hours/week were associated with increased risk of injury reported during 9th Grade (~14-15 years) greater than chance. Alcohol use in last 1-2 days, and playing 1-3 team sports were both associated with increased risk of injury in 10th Grade (~15-16 years).

The large numbers of children who were not recruited to the study despite being eligible threaten the generalisability of these findings, though the authors report that those recruited did not differ from those not recruited, by sex or ethnic group. Self-report of injury occurrence could result in underreporting of injuries. There was inconsistency of data between two of the published tables, the cause of which could not be identified from the text of the report.

10) Carolina Longitudinal Study, USA

This study of students' social development recruited children in two bi-racial school districts in either the 4th Grade (~9-10 years) or in the 7th Grade (~12-13 years) during 1981. Approximately 70% of eligible students were recruited. Cobb et al reported the relationship between gender, race, socio-economic status, aggression, and risk taking behaviour with the incidence of adolescent injury and 'close calls' (near accidents).[158] Thirty nine percent of the recruited cohort were available for follow up and responded to questions on injury and close calls during the 9th, 10th and 11th Grades.

131 of the 695 recruited students (19%) reported any injury or close call during follow up to 14-18 years. The commonest injuries were from motor vehicle accidents (36%) and sports injuries (24%). Firearms accounted for 2% of injuries, and ingestions for 1%. Sixty seven percent of injuries were reported as minor or very minor (e.g. scratches, bruises or sprains), 26% were reported as major (e.g. fractures), 2% were serious (e.g. head injury) and 5% (n=6) were fatal. Injuries occurred mostly on the road (36%), whilst at leisure / sports (24%) or whilst at work (5%). Injuries occurring in the home were not reported. Males, those with aggressive

behaviour, and those with risk taking behaviour were all statistically more likely to have injuries than females or those without such behaviour ($p=<0.05$).

Despite having such a high number of fatal incidents in such a small subsample (n=6; three motor vehicle fatalities, two firearm deaths and one ingestion death), this fact was not discussed by the author. It has been assumed that these deaths were not included in the numerators, although this is not clear from the text. The author used a denominator of n=271 for his description of injuries, but this review has recalculated the proportion of injured children using the eligible cohort as the denominator (n=695). Socio-economic status was reported to be not associated with injury, but the method of assessment of socioeconomic status was not reported, making interpretation difficult.

11) Christchurch Child Development Study, New Zealand

This 1977 birth cohort study from New Zealand examined the social, environmental and other risk factors for child morbidity. Ninety six percent of the eligible cohort were recruited (n=1265). Eighty six percent of the recruited cohort were of European descent, and 14% were Maori or Pacific Islanders.

Two papers reported injuries that occurred during the period 5-11 years and had presented to the GP, A&E, or been hospitalised.[135;176] Horwood reported that between the ages of five and 10 years, 8% of all GP consultations, 32.2% of all hospital outpatient appointments and 12.1% of all hospital admissions were due to injuries.[135] The rate of GP consultations for injury increased steadily from 15.5/100 children aged 5-6 years to 24.8/100 children aged 9-10 years even though overall rates of GP consultations/year fell between the same period. Similarly, rates of accidents requiring attendance at outpatients fluctuated markedly over the period, with a maximum rate of 188.6/1000 children at age 7-8 years, whilst rates of hospital outpatient attendance overall fell between five years and 10 years. Fractures requiring outpatient attendance occurred throughout the age period 5-10 years without any apparent trend, compared with burns and scalds which peaked at 7-8 years (10.1/1000) and accidental poisoning which fell rapidly from a peak of 14.3/1000 at age 5-6 years. Hospital admissions due to accidents peaked at 14.6/1000 for children aged 7-8 years. Fractures requiring admission were highest at this age, compared with admissions for burns / scalds and poisoning which were rare after 5-6 years. Horwood reported rates and proportions only, and provided no confidence intervals or p values to support his findings.

McKinley reported head injuries occurring to children in the cohort.[176] Mild head injury was defined as having a parent-reported head injury for which medical attention was sought , with loss of consciousness of 20 minutes or less + hospitalisation of 2 days or less and no evidence of skull fracture. Four percent of children in the cohort experienced head injuries meeting this definition between six and 10 years of age; 70% were boys, and 30% girls. Neither author reported an analysis of risk factors for the injuries reported.

Fergusson reported unintentional injuries in two groups of 14-16 year olds; those with antisocial behaviour problems and those without.[175] Seventy five percent (n=954) of the original recruited cohort were followed up and had data on both behaviour and injuries. Descriptive reporting of the injuries sustained was not provided. Fergusson compared the mean number of unintentional injuries, the mean number of injuries requiring medical attention and the mean number of injuries requiring hospital treatment for those identified as having conduct / oppositional defiant disorder at 15-16 years, being recurrent (10+) offenders, or being classified as a multiple problem teenager, or not being identified with these three antisocial behaviours. Mean numbers of injuries were greater for all three injury categories in the antisocial disorder groups than those without the antisocial disorders, but only reached statistical significance for mean number of unintentional injuries in children with conduct/oppositional defiant disorder (n=153, mean injuries=3.1) compared to those without (n=801, mean injuries=2.3), p<0.001. The only significant predictor of accident risk was male sex.

12) Cohort from Seattle, USA

One hundred and three 7th Grade boys (~12-13 years old) enrolled in one school in Seattle, Washington, USA were followed up for five months and asked to self report injuries.[179] The study was designed to explore the relationship between injury and two variables; risk taking behaviour and readjustment following stressful life events. Risk taking behaviour was assessed using trained observers during four physical education classes and categorised into high, medium or low risk taking behaviour. Response to stressful life events was assessed using a rating scale.

Results were only reported for the 56 boys who fell into the categories of either the lowest or the highest 27% on the readjustment rating scale. Absence of any descriptive reporting of injury on the whole cohort, and such selective reporting of analyses of risk factors for injury meant that a ‘C’ or poor quality rating was given to this paper and it was not considered further during the synthesis of studies

13) Dunedin Multidisciplinary Child Development Study (DMCDS), New Zealand

Children were recruited to this cohort if they had been born in the Dunedin maternity hospital over one year from 1st April 1972, and still lived in the Dunedin metropolitan area in 1975 when the children were aged three years. The cohort recruited 91% (n=1037) of those eligible who were predominantly Europeans (97%) with an unrepresentative recruitment of Maori and Pacific Islanders (3%).

The injuries sustained by children in this cohort between the ages of 5 and 11 years were described in three papers.[134;168;169] All three papers describe maternally reported injuries occurring during the previous two years. Data were collected at age 7, 9 and 11. The proportions of different injuries are not directly comparable between papers due to differences in the denominators used. Parental reports of injuries were validated using hospital and GP records at nine and 11 years. The proportion of children sustaining any, or multiple, injuries increased with increasing age. Trends for specific injuries varied; fractures, bruising and strains increased whilst injuries common in the pre-school period, such as cuts, crushes and burns decreased. This may partly be explained by the increasing tendency for injuries to occur whilst the children are engaged in active play when outside the home environment, either in the garden / yard, on the school playground, on the road or during leisure / sport. Langley et al analysed the risk and protective factors for injury between the ages of seven and 11 years.[155] Only male sex and a personal adversity score (comprising a behaviour rating, IQ score, and measures of gross and fine motor coordination) were significant predictors of injury. There were no significant associations identified for a number of individual variables (parent or teacher rated behaviour, intelligence, reading ability, language skills, and motor skills) or family / environment variables (changes of residence, family size, change of caregiver, socioeconomic status, maternal mental health, family relationships or a family adversity index).

Three authors report injuries occurring to the DMCDS cohort between the ages of 12 and 15 years, in five papers.[170-174] The proportion of children reporting any injury during the two years up to age 13 (51%) was identical to that during the two years up to age 15. The proportion reporting more than one injury over the same periods was similar (17% and 19% respectively). With increasing age the types of injuries were more likely to be fractures, dislocations or sprains than cuts or bruises, which probably reflects the increasing tendency for injuries to be related to leisure / sport participation. The majority of injuries across both periods were minor (AIS-1), were treated by A&E or the GP, and resulted in any disability lasting less than one week. In both time periods 1% of children sustained injuries considered permanent. Begg et al reported 58 road traffic injuries occurring during the two years aged 14 and 15 years.[172-174] 39 were sustained during bicycle crashes, 10 during motor vehicle crashes, five whilst a pedestrian, and four whilst on a motorbike. In addition, one cohort member had died during a road traffic crash shortly before the data collection period. The majority of road traffic crash injuries were minor and treated not hospitalised. The only variable identified as significantly associated with increased risk of injury was male sex. No other analyses of risk factors for injury were reported.

Fifty one percent of the cohort sustained any fracture between 5-18 years with the fracture occurrence almost trebling through primary school age (from 4.7% of 5-6 year olds to 13.9% of 11-12 year olds), to reach a maximum of 16.7% of 13-14 year olds.[156;157] More boys than girls suffered fractures at all ages. The peak age for fractures in girls (11-13 years, 12.9% fractured) was earlier than for boys (13-15 years, 21.6% fractured). Fingers, hands, wrists and forearms were the commonest sites for boys and girls, plus foot / toes for girls. Male sex, lower SES of family, heavier weight between 5-18 years (RR = 1.15 (95% CI 1.03-1.28)), and taller height between 5-18 years (RR = 1.13 (95% CI 1.02-1.24)) were associated with increased risk of injury. Birth length (RR = 1.28 (95% CI 1.04-1.58)) and BMI between 5-18 years (RR = 1.24 (95% CI 1.02-1.52)) were associated with increased risk of pre-pubertal fractures (<11 years for boys and <9 years for girls). For teenagers daily smoking increased fracture risk (RR = 1.43 (95% CI 1.05-1.95)). Maternal smoking, participant occasional smoking, breastfeeding, and sports participation had no significant effect on fracture risk.

14) Cohort from South Wales, UK

This cohort of consecutive births in two industrial Welsh towns in 1972 was established to study the effects of milk supplementation to age five. The cohort was followed for a further three years to age eight to identify injuries attending the local casualty department in those children still traceable. Davidson[133;167] reported injuries in 951 children between the ages of five and eight years. Thirty two percent sustained one or more injuries during the period of follow up, with more boys than girls having either one, or more than one, injury during this period. Only selective types of injuries were reported; lacerations (35.3%), head injuries (15.3%), fractures (14.1%), sprains (9.8%), bruising / abrasions (5.7%), foreign bodies (3.5%), burns and scalds (1.0%), or nerve/vascular/tendon injury (0.2%). The author reported that male sex, having a soiling problem, moderate or high maternal neuroticism, maternal problems managing the child, children being fearful and having more than two children in the family were associated with increased risk of injury.

The risk of under-reporting of injuries treated at home or at an alternative casualty department was not commented on. Concerns relating to the selective reporting of results, data in the tables not reflecting data in the text, failure to use validated questionnaires to assess behaviour problems, and conducting analyses of very small numbers of children (<10) resulted in one paper[133] being given a C rating for quality appraisal and data were not included in the synthesis of risk factors.

15) Child Health and Education Study 1970 (CHES) / 1970 Birth Cohort Study, UK

The Child Health and Education Study was established in 1975 to follow up all the children born in one week in April 1970 who were still alive and living in England, Wales or Scotland. The vast majority of these children were in families recruited during the 1970 British Birth Cohort Study, which was originally established to report obstetric care and neonatal morbidity. Three papers reporting injuries requiring medical advice or treatment between 5-10 years of age were published by Bijur et al.[14;27;31] A fourth paper reported injury findings in the Scottish teenagers that formed a subsample of the original cohort.[33]

Bijur reported data on a subsample (n=10394, 65%) of the original national cohort where the child was a singleton birth, had an English speaking mother present at the age five interview, where there was no suspicion of child abuse, the child was not in care, and for whom there was data at five and 10 years. The subsample was not therefore representative of the original eligible cohort. The number of children reported to have sustained any injury varied across the three papers (42.1%-46.3%). Four percent of children were reported to have injuries requiring hospitalisation,[31] 12.9% were reported to have more than one injury[27] and 3.9% were reported to have had more than three injury events.[14] Boys were more likely to be injured than girls. Seventy one percent of injuries were reported to be 'mild' (e.g. sprains, strains, contusions and lacerations), 15% were fractures, 10% head injuries, 3% burns/scalds and <1% were 'severe' (e.g. amputations, spinal cord injury, near drowning or ingestions).[31] Living in a household with four or more children significantly increased the risk of hospitalised accidents after adjustment for a range of social, maternal and child factors, but that having 1-3 siblings did not increase risk.[14;31] Having a pre-school injury, male sex, high child aggression scores, a young mother (aged 20-24 years) or fewer younger siblings significantly increased the risk of injury between five and 10 years of age.[27] Parents were asked to recall injuries over a very long period (five years) which is likely to have resulted in under-reporting of less severe injuries. Factors likely to influence the likelihood of seeking medical advice or treatment (e.g. proximity to healthcare services or confidence to provide first aid) were not discussed.

Beattie et al reported injuries occurring in 1416 children from the cohort who were living in Scotland at age 16.[33] Forty three percent of children sustained one or more injuries between the ages of 10 and 16 years (52% of boys and 33% of girls). Types of injuries were not reported other than 26.6% were fractures. Mechanisms of injury included falls 34%, collisions 23%, cycle/pedestrian road accidents 9%, motor vehicle road accidents 5%, assaults 3%, and 'other' 26%. Eleven percent of all injuries were due to sport. The part of the body injured was upper limb/hand 36.4%, lower limb/foot 28.7%, head/face 23.0%, neck/spine 2.8%, trunk/body 1.2% and unspecified 7.9%. The severity of injury was assessed using the Abbreviated Injury Severity Score: Minor = 70.3%, moderate = 29.7%, severe = 0%. Location and consequences of injury were not reported. Male sex was identified as a predictor for injury, but no difference was found by social class or by Scottish Health Board region of residence. This was hypothesised as being due to equalisation of injury risk between childhood and adolescence. However, Scottish Health Board regions are large and could mask areas of inequity in injury, and the long recall period (six years) risked underreporting of injuries due to recall bias.

16) Cambridge Study of Delinquent Development, UK

This longitudinal study of offending and antisocial behaviour was commenced in London in 1961 with 411 boys aged 8-9 years, and reported their lifestyles and health in to adulthood. The sample was predominantly White (90.4%) with small numbers of Afro Caribbean boys (2.9%). Follow up to 18 years was high (94.6%). Three papers reported injuries occurring between the ages of 16-18 years[132;166;180]although they are inconsistent in both the number of injuries reported and the number of boys in which the injuries arose; The number of boys reporting injury between 16 and 18 years varied between 195 and 211 (50-55%) across the three papers . Injuries occurred at home (10.9 - 21.8%), at school or work (37 – 38.4%), on the road (10.9 – 18.0%), or at sport or leisure (18 – 21.8%). Mechanism of injury was not recorded other than that due to assault (13.7 – 17%).

Any injury and severe injuries (requiring hospital treatment) were statistically associated with delinquency and recidivism[180] whilst those injured during sporting activities were least likely to be delinquent. The odds of any injury were statistically greater for boys who were antisocial (OR=1.39) and of being injured in an assault were greater if the boys had troublesome (OR=4.36) or daring (OR=3.2) behaviour, a low IQ (3.62), or if they lived in a large family (OR=2.89) or a family with a low income (3.09).[166]

17) National Child Development Study (NCDS) / 1958 British Birth Cohort, UK

The NCDS utilised the birth cohort recruited for the Perinatal Mortality Study of 1958 across England, Wales and Scotland. The original recruitment was highly representative of the eligible population with 97% of infants born during the week 3-9th March 1958 recruited. Although six papers have been identified that report injury outcomes from this cohort, injury was not pre-specified as an outcome of interest, and therefore there are limited risk factors for injury reported.

Three papers reported injury outcomes in the primary school-aged period.[11;154;164] Peckham et al reported that 29% boys and 23% girls between 7-11 years sustained one or more accidents resulting in either a burn, a laceration requiring 10 or more stitches or a head injury causing loss of consciousness.[164] The low rate of injuries reported is likely to be due to the long recall period and the definition of injuries used, which was intended to select severe injuries. Other injuries reported included near drowning (3% children) and ingestions (2% children). Two percent of all hospital admissions for the cohort were due to accidental injuries. The reporting of location of injury was incomplete; 17% of injuries occurred in the home, 3% in school and 2% on the road. Pless et al reported 3% of children aged 8-11 years in the cohort sustained a road traffic injury, 2% of the cohort were hospitalised because of their road traffic injury and boys were twice as likely to be hospitalised as girls.[11] Manual social groups were reported to have higher rates of any injury but this statement was not supported by data.[164] An increased risk of road traffic injury between seven and 11 years was reported for boys if appearing ‘scruffy and underfed’, having a sensory deficit, fidgety, sensitive, living in homes lacking basic amenities, not living with natural mother or having ever been taken into care of local authority. For girls the risk was increased if they had poor gross motor control, had family problems, or were considered maladjusted.[11] The major risk factors for road traffic injury were considered to be not those associated with personal or family characteristics, and that interventions focused on the environment or changing driver behaviour were more likely to be effective than those aimed at altering personal or family characteristics. However, the evidence reported did not support this conclusion. Sensory deficit due to amblyopia was not associated with injury at any age between 7-16 years. Compared with children with normal vision, those with resolved amblyopia had statistically fewer accidents requiring hospital care between 7-11 years.[154]

For post-primary school-aged children 4% of children aged 16 years had an injury causing one week or more to be missed from school during the previous year, and that 20% had attended a hospital casualty department in the previous year.[165] Between the ages of 12 – 16 years 1% of the children in the cohort were hospitalised for road traffic injury and 4% injured but not hospitalised.[11] Boys were over three times as likely as girls to have two or more accidents during this period,[152] twice as likely to have injuries requiring outpatient treatment and three times as likely to have injuries requiring hospitalisation. Cumberland et al reported that the rate of injuries requiring outpatient treatment in children aged 11-16 with normal vision was lower (24%) than those with colour vision deficiency (30%) but that this was not a significant risk.[153] Increased risk of injury aged 15-17 years was statistically associated with male sex, antisocial behaviour, overactivity, high conflict scale score, and multiple home moves.[152] After controlling for alcohol consumption, occupation of father, number of home moves and quality of housing, the rate of hospitalised injuries in the boys with high conflict scores was 2.3 times that of the low conflict group, and for females 2.4 times, but non-significant for outpatient treated injuries.

18) Newcastle Thousand Families Cohort, UK

This birth cohort of 1142 children commenced in 1947 across Newcastle upon Tyne to measure the frequency and extent of disease and disablement in a representative sample of the city's children. The findings of the study were reported in a series of three books. The third book in the series reported the school age period, 5-15 years.[163] The proportion of the city's eligible children that were recruited to the study is not reported, nor is the representativeness of the final cohort at age 15 years. By school entry at age five, 847/1142 (74.2%) of the cohort were still enrolled in the study, reducing to 763/1142 (66.8%) at school leaving age (15 years).

The reporting of injuries sustained by the cohort was listed as an aim of the study. 48% of the cohort sustained any injury between five and 15 years. The frequency of injuries decreased with increasing age, and boys sustained more injuries than girls at all ages, with the gap widening with increasing age. The reporting of injuries is selective and sometimes incomplete, e.g. it is reported that 16% of injuries were fractures, 8% cuts and 5% burns but other types of injuries are not given. The commonest mechanisms of injury were falls, fighting and injuries on the road. The road was the commonest location of injury (37%) followed by the home (26%), school (19%) and outside play (18%). Fifty nine percent of injuries resulted in hospital attendance, and 6% in hospital admission. Children with low intelligence, lack of initiative, poor concentration, and poor agility, social classes 3, 4 and 5, poorly coping mothers and mothers who were poor at supervising their children were all reported to be associated with higher incidence of injury but no data were provided to support this finding.

4.6.4 Between - Study thematic review of cohorts

The studies identified in the review were heterogeneous with respect to setting, participants, method of data collection, recall and follow up, classification systems used, and methods for description of injuries and analyses of risk factors. Statistical pooling through meta-analysis was not appropriate due to the risk of unrecognised confounding. The studies were therefore narratively reviewed, through examination of themes running across the studies. Due to the heterogeneity of studies even this level of synthesis could be considered inappropriate, however, findings that are consistent in different settings, among different participants and conducted at different times are more likely to be valid and potentially transferable to other settings. Subgroup analyses by age (‘primary school age’ (~5-11 years) versus ‘post-primary school age’ (~12-18 years), country income (high income countries versus low and middle income countries), and year of recruitment to the cohort (pre-1980 versus post-1980) have been undertaken where possible and appropriate.

4.6.4.1 Descriptive reporting of injuries

Sixteen papers reported only descriptions of injuries sustained by children in the cohorts[33;134;135;138;163-165;168-174;177;180] and the remaining 28 papers reported risk factor analyses for injury in addition to descriptions of the injuries. The breadth of descriptive reporting of injuries is shown in Table 13.

Table 13: Summary of descriptive reporting of injuries from included papers

Primary study name, Country, Year of recruitment	Author, year	Any injury	Repeat injuries	Type of injury	Mechanism of injury	Part of body injured	Severity of injury	Consequences	Location of injury event
Cohort from Baise City, China, 2002	Chen, 2005a	✓	✓	✓	✓	✓	✓		✓
	Chen, 2005b	✓							
Cohort from Maanshan City, China, 2001	Peng, 2003	✓	✓		✓				
Cohort from Kaohsiung, Taiwan, 1995	Yang, 1998	✓	✓	✓		✓			✓
West of Scotland 11-16 Study, UK, 1994	West P, 2004	✓		✓	✓				✓
National Longitudinal Survey of Children & Youth, Canada, 1994	Soubhi, 2004a	✓							
	Soubhi, 2004b								
Add Health Study (aka National Longitudinal Study of Adolescent Health), USA, 1994	Hammig, 2001				✓				
Cohort from Kamphaeng Phet Province Vaccination Study, Thailand, 1991	Kozik, 1999	✓	✓	✓	✓		✓		
Adolescent Injury Control Study, USA, 1990	Anderson, 1994	✓							✓
Cohort from Eastern Shore Maryland, USA, 1986	Alexander, 1992	✓							
Carolina Longitudinal Study, USA, 1981	Cobb, 1995	✓			✓		✓		✓
Christchurch Child Development Study, New Zealand, 1977	Horwood, 1989			✓			✓		
	Fergusson, 1995						✓		
	McKinlay, 2002	✓	✓	✓		✓			
Cohort from Seattle, USA, 1975	Padilla, 1976								
Dunedin Multidisciplinary Child Development Study, New Zealand, 1975	Langley, 1981	✓	✓	✓	✓	✓	✓	✓	✓
	Langley, 1985	✓	✓	✓	✓	✓	✓		✓
	Langley, 1987a	✓	✓	✓	✓		✓		✓
	Langley, 1987b	✓							
	Chalmers, 1989	✓	✓	✓	✓	✓	✓	✓	✓
	Lodge, 1990	✓	✓	✓	✓	✓	✓	✓	✓
	Begg, 1990	✓			✓		✓		✓
	Begg, 1991	✓		✓	✓	✓	✓		✓
	Begg, 1992	✓					✓		
	Jones, 2002	✓		✓					
	Jones, 2004	✓							
Cohort from South Wales, UK, 1972	Davidson, 1987	✓							
	Davidson, 1988	✓	✓	✓			✓		
Child Health & Education Study (aka British Births Study 1970), UK, 1970	Bijur, 1988a	✓	✓	✓			✓		
	Bijur, 1988b	✓	✓	✓					
	Bijur, 1988c	✓	✓				✓		
	Bijur, 1990			✓		✓	✓		
	Beattie, 1999	✓		✓	✓	✓	✓		
Cambridge Study of Delinquent Development, UK, 1961	West, 1977	✓					✓		✓
	Shepherd, 2002	✓			✓				✓
	Shepherd, 2004	✓							✓
National Child Development Study (aka 1958 British Birth Cohort Study), UK, 1958	Peckham, 1973	✓		✓					✓
	Peckham, 1976	✓					✓		
	Pless, 1989	✓			✓		✓		✓
	Bijur, 1991	✓	✓				✓		
	Cumberland, 2004	✓					✓		
	Rahi, 2006								
Newcastle Thousand Families Study, UK, 1947	Miller, 1974	✓		✓	✓		✓	✓	✓

Note: Padilla 1976 did not report descriptive data for the whole study cohort. Soubhi 2004b and Rahi 2006 reported only analysis of risk factors for injury and did not report descriptive injury data

The average proportion of the cohort sustaining both any injury and multiple injuries varied markedly, largely because of differences in injury and outcome definitions, and duration of follow up. All papers reporting any injury or multiple injuries by gender found that injuries were more common in boys than girls, with the difference appearing to widen in the post-primary school age group (Table 14).

Table 14: Proportion of boys and girls sustaining any injury or multiple injuries during follow-up

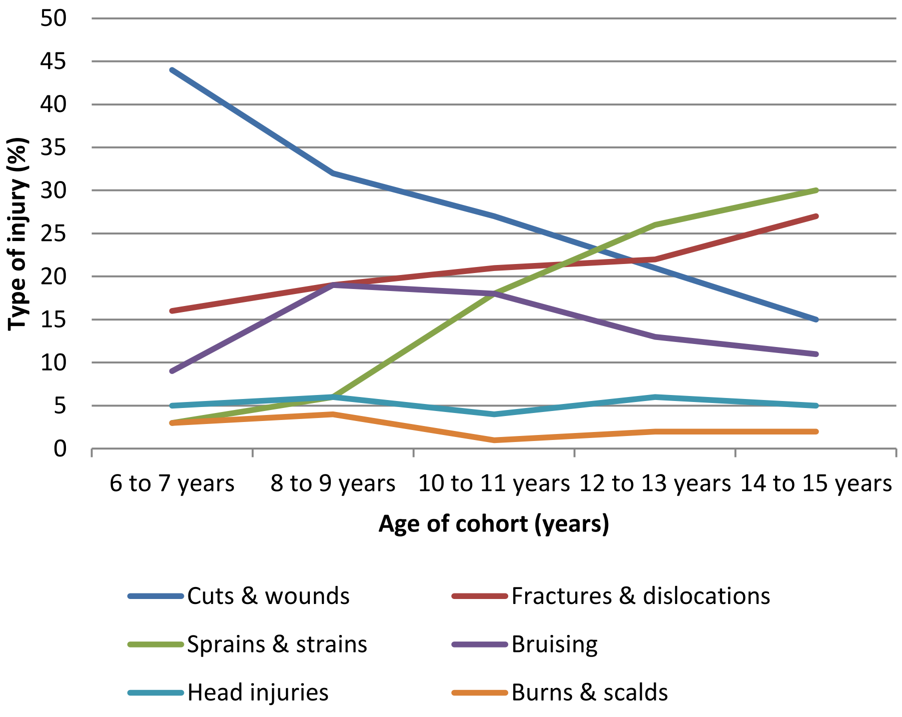
Cohort, Country (Period of data collection)	Age of child (years)	Proportion (%) of cohort sustaining injury			
		Any injury		More than one injury	
		Boys	Girls	Boys	Girls
Primary school age					
Cohort from south Wales, UK (1977-1980)	5-8[133]	37.2	26.3	12.5	7.1
1970 British Birth Cohort Study, UK (1975-1980)	5-10[14]	49	34.8	43.9	31.4
1958 British Birth Cohort, UK (1966-1969)	8-11[11]	4.1	2.1		
Post primary school age					
Cohort from Baise City, China (2002-2003)	11-18[139]	34.8	30.3	12.2	8.3
	13-18[178]	32.6	27.4		
West of Scotland 11-16 study, UK (1994-1998)	13[140]	39.2	28.1		
	15[140]	58.0	40.1		
Carolina Longitudinal Study, USA (1981-1986)	14-18[158]	53.1	39.0		
1970 British Birth Cohort Study, UK (1980-1986)	10-16[33]	52	33		
1958 British Birth Cohort, UK (1969-1974)	12-16[11]	6.6	3.5		
	12-16[152]	25.3	11.4	5.3	1.5
	11-16[153]	30.6	17.3		
Combined primary and post-primary school age					
Cohort from Kampaeng Phet Province Vaccination Study, Thailand (1991-1993)	School entry-16[138]	70.8	60.2	37.9	27.2
Cohort from Maanshan, China (2001-2002)	7-13[162]	32.1	29.1	9.7	8.4

Note: 1958 British Birth Cohort Study paper by Pless[11] reported road traffic injuries only

Type and mechanism of injury

The New Zealand Dunedin Multidisciplinary Child Development Study (DMCDS) described injuries occurring between the ages of six and 15 years in greater detail than any other study.[134;168-171] The changing pattern of injuries with age suggests that cuts/wounds become less common, and fractures and sprains/strains become more common (Figure 7). These findings were consistent with those from four papers from older UK cohorts[31;33;133;163] with respect to fractures and by a paper from a middle-income country with respect to lacerations and sprains/strains.[138] The latter paper reported 12% of injuries were near-drowning. Only two other cohorts reported near-drowning cases; both were older UK studies with rates of ≤3%.[31;164]

Figure 7: Percentage of types of injury sustained between 6 and 15 years in the DMCDS cohort



Note: data compiled from five papers[134;168-171]

Four papers from three cohorts (UK, New Zealand and China) reported the proportion of injuries affecting different parts of the body.[33;139;170;171] Upper limbs were affected in 32-36% of injury events reported, lower limbs in 29-39% of injury events and the head or face in 19-23% of injury events. One Taiwanese cohort found that rates of upper limb injuries were double those affecting the lower limb.[177] Falls were the most common mechanism of injury, followed by injuries involving sharp and blunt objects, although the proportions of the latter two categories vary considerably between papers because of different definitions (Table 15). Injuries sustained during sports participation were rarely specified.

Table 15: Percentage of injuries by different mechanisms of occurrence, by age

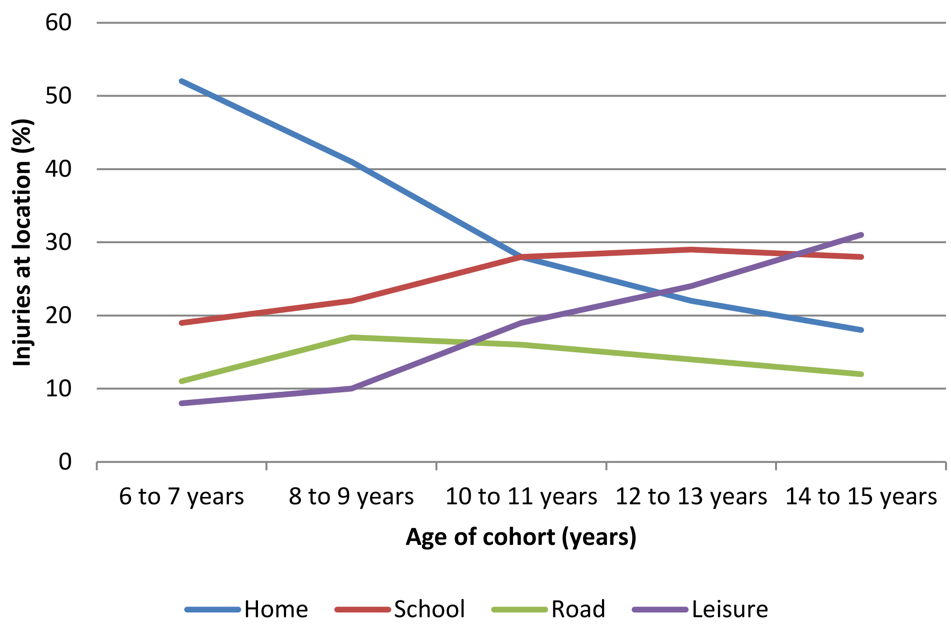
Cohort	Age of child (inclusive years)	Falls %	Sharp objects %	Blunt object %	Motor vehicle RTI %	Non - MV RTI %	Heat / cold %	Airway %	Other %
Dunedin Multidisciplinary Child Development Study	6-7[134]	44	18	10	4	4	2	2	16
	8-9[168]	45	10	25	14				6
	10-11[169]	54	17		9	13			7
	12-13[170]	54	69		3	1			
	14-15[171]	39	71			7	2		17
1970 British Cohort Study	10-16[33]	34		26	5	9			26
Cambridge Study of Delinquent Development	16-18[132;166;180]			14-17					
Baise City Cohort	11-18[139]	33	14	20	5		4	2	22
Newcastle Thousand Families Study	5-15[163]	>50							
Carolina Longitudinal Survey	14-18[158]			7	36				57
Kamphaeng Phet Province Vaccination Study	School entry -16[138]	12	20	5	6	4	18	12	23

Note: RTI = Road traffic injury, Non-MV = Non motor vehicle road traffic injury (includes pedestrian, cycle and skateboard injuries). Airway includes suffocation, submersion, airway trauma or foreign body. Percentages may not total 100 due to rounding, partial data reporting and because categories are not used exclusively by all authors.

Location of injury event

The location of the reported injury event changed as the children aged. The home became less important as more injuries occurred in school and leisure areas. This is shown clearly in the DMCDS cohort[134;168-171] (Figure 8). Even at home, injuries became increasingly likely to occur outside, e.g. in the garden, yard, driveway or path.[168;170;171] Injuries on the road peaked at 8-9 years in the DMCDS, but never formed a large proportion of injury locations. Two UK cohorts[132;140;166;180] and one from China[139] reported similar locations for children of post-primary school age, despite varying in geographical setting and date of recruitment (1969-2005). One older UK cohort[163] and one cohort from the USA[158] both found a greater proportion of injuries occurring in the road environment (Table 16).

Figure 8: Change in location of injury event in the DMCDS cohort



Note: Compiled from data from five papers.

Table 16: Percentage of injuries occurring in different locations, by age of children injured

Cohort	Age of child (inclusive years)	Home %	Road %	Leisure, Play, or Sports %	School %	Work %
Primary school-aged children						
Dunedin Multidisciplinary Child Development Study	6-7[134]	52	11	8	19	
	8-9[168]	41	17	10	22	
	10-11[169]	28	16	19	28	
Post-primary school-aged children						
West of Scotland study	11-16[140]			32		
Dunedin Multidisciplinary Child Development Study	12-13[170]	22	14	24	29	
	14-15[171]	18	12	31	28	
Cambridge Study of Delinquent Development	16-18[132;166;180]	11	18	22	38	
Baise City Cohort	11-18[139]	32	10	23	35	
Combined primary and post-primary school-aged children						
Newcastle Thousand Families Study	5-15[163]	26	37	18	19	
Carolina Longitudinal Survey	9-18[158]		36	24		5

Note: Percentages may not total 100 due to rounding and partial data reporting.

Severity and consequences of injury

Comparison of severity of reported injuries was difficult because of the number of methods used to categorise severity of injuries. Seven papers reporting healthcare service use as a proxy for severity tended to define an injury as one requiring medical attention. Reported injuries were more likely to have required primary care (7-33%) or outpatient / emergency room care (13-65%) than hospital admission (<10%)[134;135;163;168-171] (Table 17). Only one cohort stated the proportion of the reported injuries receiving care outside of health service settings, with 70% of injuries being managed by the child or their carer, 27% managed by a primary care doctor and 4% admitted to hospital.[139;178] The Abbreviated Injury Scale score was used in five papers[33;168-171] from two cohorts (New Zealand and UK) and suggested that, as children became older, the injuries they sustained were likely to be less severe (Table 18). Two cohorts used duration of time away from school as a proxy for injury severity and suggested that between 4%[165] and 7.2%[139] of children missed more than a week from school as a consequence of their injury.

Table 17: Percentage of injuries requiring different forms of healthcare service use, by age of child

Cohort	Age of child (years)	Admitted to hospital (%)	Seen in hospital emergency room or outpatient setting (%)	Seen by primary care doctor (%)
Primary school age children				
Dunedin Multidisciplinary Child Development Study, New Zealand[134;168;169]	6-7	9		
	8-9	2	24	
	10-11	2	38	7
Christchurch Child Development Study, New Zealand[135]	5-6	1	18	16
	6-7	1	13	16
	7-8	2	19	20
	8-9	1	13	23
	9-10	1	16	25
Post-primary school-aged children				
Dunedin Multidisciplinary Child Development Study, New Zealand[170;171]	12-13	4	61	27
	14-15	5	65	33
Combined primary and post-primary school-aged children				
Newcastle Thousand Families Study, UK[163]	5-15	6	53	

Note: Percentages may not total 100 across papers where only partial health service use was reported, and because health care providers are not used exclusively (e.g. a child may be taken to their GP and then attend a hospital). Percentages have been rounded to whole integers.

Table 18: Percentage of injuries in different categories of severity, using the Abbreviated Injury Scale score, by age of child

		Abbreviated Injury Scale score		
Cohort	**Age of child (years)**	**AIS 1 (minor)**	**AIS 2 (moderate)**	**AIS 3 (severe)**
Primary school-aged children				
Dunedin Multidisciplinary Child Development Study, New Zealand	8-9[168]	65	24	5
	10-11[169]	72	19	3
Post-primary school-aged children				
Dunedin Multidisciplinary Child Development Study, New Zealand	12-13[170]	74	23	1
	14-15[171]	83	15	2
1970 British Cohort Study, UK	10-16[33]	70	30	0

Note: Percentages may not total 100 across papers where incomplete data are reported. Percentages have been rounded to whole integers.

Three cohorts reported fatal injuries. In the New Zealand DMCDS cohort[169;174] and a US cohort[158], unintentional fatal injuries were due to road traffic incidents. In the cohort from Thailand[138], 0.05% of the cohort (n=20) died from unintentional injury over two years of follow up; 13 (65%) due to road traffic crashes, and six (30%) due to drowning. Only two cohorts reported any short term or long term consequences of the injuries sustained. In one UK study[163], 0.5% (n=3) received severe disabilities. In the New Zealand DMCDS, 70% of the injuries reported at 12-13 years resulted in some limitation of activities from the day after the injury.[170] Most were of short duration, but 20% lasted longer than one month and 1% (n=8) resulted in a permanent disability. Similar findings emerged two years later when this assessment was repeated.[171]

4.6.4.2 Analysis of injury risk

Twenty seven papers from 15 cohorts reported some analysis of risk factors for injury. The breadth of child, family and environmental factors are shown in Table 19 and Table 20. A summary of all the risk factors is shown in Table 21.

Table 19: Child factors reported in included papers

Primary study name, Country, Year of recruitment	Author, year	Child factors: Gender, age, ethnic group	Past history of injury	Growth	Sensory deficit	Motor skills & physical ability	Cognition & learning ability	Concent-ration & attention difficulties	Psycholog - ical difficulties	Behaviour-al difficulties	Personal risk taking
Cohort from Baise City, China, 2002	Chen, 2005a	✓									
	Chen, 2005b								✓		
Cohort from Maanshan City, China, 2001	Peng, 2003	✓								✓	
West of Scotland 11-16 Study, UK, 1994	West P, 2004	✓									
National Longitudinal Survey of Children & Youth, Canada, 1994	Soubhi, 2004a	✓						✓		✓	
	Soubhi, 2004b	✓						✓		✓	
Add Health Study (aka National Longitudinal Study of Adolescent Health), USA, 1994	Hammig, 2001	✓								✓	
Adolescent Injury Control Study, USA, 1990	Anderson, 1994	✓									
Cohort from Eastern Shore Maryland, USA, 1986	Alexander, 1992	✓								✓	✓
Carolina Longitudinal Study, USA, 1981	Cobb, 1995	✓								✓	
Christchurch Child Development Study, New Zealand, 1977	Fergusson, 1995	✓								✓	
Cohort from Seattle, USA, 1975	Padilla, 1976								✓	✓	
Dunedin Multidisciplinary Child Development Study, New Zealand, 1975	Langley, 1987b	✓				✓	✓			✓	
	Jones, 2002	✓									
	Jones, 2004			✓							
Cohort from South Wales, UK, 1972	Davidson, 1987	✓						✓	✓	✓	
	Davidson, 1988	✓						✓	✓	✓	
Child Health & Education Study (aka British Births Study 1970), UK, 1970	Bijur, 1988a	✓						✓		✓	
	Bijur, 1988b	✓	✓							✓	
	Bijur, 1988c	✓						✓		✓	
Cambridge Study of Delinquent Development, UK, 1961	Shepherd, 2002					✓	✓			✓	✓
	Shepherd, 2004					✓					
National Child Development Study (aka 1958 British Birth Cohort Study), UK, 1958	Pless, 1989	✓		✓	✓	✓	✓		✓	✓	
	Bijur, 1991	✓								✓	
	Cumberland, 2004	✓			✓						
	Rahi, 2006				✓						

Note: Padilla 1976 did not report data for whole cohort for factors analysed, and McKinlay 2002 and Bijur 1990 both analysed head injury as a risk factor for specific outcomes, but did not analyse risk factors for head injury

Table 20: Family and environmental factors reported in included papers

		Family factors						Environmental factors
Primary study name, Country, Year of recruitment	**Author, year**	**Family size & composition**	**SES of family**	**Maternal mental health**	**Parenting ability & activity**	**Physical home environment**	**Family dysfunction**	**Neighbourhood**
Cohort from Baise City, China, 2002	Chen, 2005a	✓	✓					
	Chen, 2005b							
Cohort from Maanshan City, China, 2001	Peng, 2003	✓	✓	✓	✓			
West of Scotland 11-16 Study, UK, 1994	West P, 2004		✓					
National Longitudinal Survey of Children & Youth, Canada, 1994	Soubhi, 2004a				✓		✓	✓
	Soubhi, 2004b				✓		✓	✓
Add Health Study (aka National Longitudinal Study of Adolescent Health), USA, 1994	Hammig, 2001		✓					
Adolescent Injury Control Study, USA, 1990	Anderson, 1994							✓
Cohort from Eastern Shore Maryland, USA, 1986	Alexander, 1992		✓		✓			
Carolina Longitudinal Study, USA, 1981	Cobb, 1995							
Christchurch Child Development Study, New Zealand, 1977	Fergusson, 1995						✓	
Cohort from Seattle, USA, 1975	Padilla, 1976							
Dunedin Multidisciplinary Child Development Study, New Zealand, 1975	Langley, 1987b	✓	✓	✓			✓	
	Jones, 2002		✓					
	Jones, 2004		✓					
Cohort from South Wales, UK, 1972	Davidson, 1987			✓				
	Davidson, 1988							
Child Health & Education Study (aka British Births Study 1970), UK, 1970	Bijur, 1988a	✓	✓	✓		✓		
	Bijur, 1988b	✓						
	Bijur, 1988c	✓	✓	✓		✓		
Cambridge Study of Delinquent Development, UK, 1961	Shepherd, 2002	✓	✓					
	Shepherd, 2004							
National Child Development Study (aka 1958 British Birth Cohort Study), UK, 1958	Pless, 1989	✓				✓	✓	
	Bijur, 1991	✓	✓				✓	
	Cumberland, 2004							
	Rahi, 2006							

Note: Padilla 1976 did not report data for whole cohort for factors analysed, and McKinlay 2002 and Bijur 1990 both analysed head injury as a risk factor for specific outcomes, but did not analyse risk factors for head injury

Table 21: Summary of variables reported across included papers

Individual variables
Activity levels (hyperactivity, hyperactive behaviour, overactivity, fidgetiness, inability to keep still) Age Aggressive behaviour (physical aggression, violent behaviour, getting into fights, starts fights, fights where, fights whom, fights in groups, weapon carrying in last 30/7, weapon use, weapon threats) Alcohol (“heavy drinking”, "abuse", consumption at age 16, use in last 30/7) Appearance (teacher: 'scruffy', 'underfed') Birth length Birth weight Body Mass Index (BMI, lean mass, fat mass, total body bone mass density) Bone age Breastfed Concentration ability (inattention, lacks concentration) Conduct problems (Antisocial behaviour, Conduct/oppositional disorder, ODD with ADHD, ODD without ADHD, discipline problems, management disorder, troublesome, hostility, school discipline problems e.g. sent to head teacher or detention) Emotional development difficulties (Attachment difficulties, dependent behaviour, sensitive, reluctance to attend school, interpersonal sensitivity, relationship skills) Employment (no of hours of paid employment/wk, unstable job record) Ethnic group (ethnicity, race) Health - general (Experience of illness, medical history, number of hospitalisations for other than injury) Hearing impairment Height (appears small or very small - teacher report) Learning ability (teacher ratings of oral, reading ability, comprehension, verbal-cognitive ability, mathematics, IQ (WISC-R), general abilities, School certificates, learning disability, mental handicap) Low heart rate (aged 16-18) Motor skills development (Fine motor coordination, hand control, gross motor coordination, walking alone by 18 months, physical handicap, clumsy, awkward) Offending (frequent 10+, part of antisocial behaviour, police contact, anti establishment attitudes - negative to police, school, bosses) Physical activity (participation in physical activities > hour per week, no of teams in which they played, physical fitness, exercise hrs per week, leisure time physical activity) Prosocial behaviour Psychological / psychiatric difficulties (anxiety, depression, eating problems, fears, moods, mood disorders, neurotic behaviour, obsessive compulsiveness, paranoid ideation, phobias, psychoticism, sleeping problems, somatisation, tantrums, tempers, worries) Pubertal staging Risk-taking behaviour not recorded elsewhere (daring, cruising in cars) SES Sex (Gender) Sexual activity (early onset, unprotected) Smoking (“heavy smoking”, in last 30/7, at age 15, at age 18) Soiling problems/encopresis Speech impairment (language development) Substance misuse (substance misuse disorder, cannabis use, marijuana use ever) Vision impairment (amblyopia, colour vision defects) Weight

Family variables
Adverse family events (family disruption, family stability) Change in primary carer (change in parent figure in last 4 years, between 7-11 years, ever been in care of local authority, who child lives with if parents divorced, parental attachment) Child rearing practices and difficulties (behaviour control) Family conflict (domestic tension) Family injury prevention practices (e.g., access to pesticides, dangerous goods, thermos flask, sharp toys, needles, scissors) Family relationships (roles, communication, involvement, responsiveness, family problem solving) Family size (number of persons in household, number of children in family, number of living children, number of children <16 years, "large" (5+ children) family size) Father present (natural father present, stepfather present, other male head of household present, family structure) Fathers education (Number of years) Fathers occupation (unemployment) Financial difficulties (Family living standards, family monthly income, income "low", ownership of car / telephone / television / refrigerator, poverty) House moves (number of household moves between 12 and 16 years, b/w 1970 & 1975, b/w birth and 5 years, b/w 7-11 years "frequent' house moves) Housing difficulties (measure of 'family problems') Mother had difficult pregnancy (e.g., combination of symptom, mixture of symptom, depression) Mother smoked during pregnancy Mother's age (age at child's birth, younger than 22 at child's birth) Mother's education (mothers education at child's birth, number of years of education) Mother's marital status Mother-child interaction (mother child conflict, mothers emotional responsiveness, Parenting (praise, punishment, rule creation and enforcement, general interaction), mother-child supervision) Mother's employment outside the home (mothers full time employment, mothers occupation if no father figure) Mother's mental health (depression, psychological well-being or distress) Mother's personality (extraversion, neuroticism, tendency to lie, punitiveness) Mother's physical health (restriction of activity of person most knowledgeable) Parent previously convicted (parental offending) Parental substance abuse (part of Family adversity score) Parental supervision (going to shops, going to playground/park, playing in street, going on local buses, going to school, choice of friends, "poor" parental supervision, rules for homework, weekday or weekend curfews) Socioeconomic status Siblings (number of siblings, number of older and younger siblings) Upbringing of natural parents
Environmental variables
Health visitor rating of neighbourhood Health visitor rating of tidiness and quality of furniture by HV Household amenities (indoor WC, availability of yard or garden, sole use of kitchen facilities, kitchen used as living area) Mean household income (reverse coded) Neighbourhood cohesion (parental report) Neighbourhood problems (parental report) Number of rooms Overcrowding (>2 persons per room) Ownership of accommodation (tenure of housing) Socio-economic status of neighbourhood (% families with less than $20000 income, % population over 15 yrs with a university degree (reverse coded), % population over 15 yrs without a secondary school certificate, % of single-female headed households in neighbourhood, % total neighbourhood income from government transfer payments, % unemployed aged 15 years and over, % population below poverty level) Type of accommodation e.g. house, flat, etc (part of index of housing quality)

A synthesis of child, family and environmental factors is reported below. Detailed results of risk factor analyses from individual papers are provided in Appendix 3 (effect estimates reported as odds ratios or relative risk) and Appendix 4 (effect estimates reported as p values).

Child factors

Male sex was a significant risk factor for injury across a range of geographical settings (China, USA, New Zealand, UK and Canada) and periods of time (1958-2002).[133;137-139;159] In contrast with the descriptive data reported, two papers that analysed injury risk by age of the child found either no difference greater than chance[136] or more injuries in younger children.[139] Four US cohorts[136;158-160] reported no statistically significant differences in injury occurrence between different ethnic groups, in contrast to one study from China[139] that found more injuries in minority ethnic groups. Only one paper reported a history of injury as a risk factor for future injury, finding increased risk greater than expected by chance.[27]

Risk factors related to the physical development of the child were not consistently found to be associated with injury, although cohorts rarely analysed identical factors. Being taller and heavier than peers was an independent factor for fractures in children from New Zealand,[157] while post-primary school UK boys were more likely to sustain road traffic injuries if of short stature.[11] The latter study also reported increased risk of traffic injuries with sensory deficit (unspecified), in contrast with papers reporting no increased risk of any injury associated with colour vision deficit[153] or amblyopia.[154] Studies exploring the impact of poor coordination or motor development found little evidence of independent increased risk in cohorts from both the UK[11] and New Zealand.[155]

Learning ability was not associated with risk of injury in the two studies reporting this variable.[11;155] Children with psychological difficulties were consistently found to have increased risks across both geographical setting (UK and China) and time (1958, 2001 and 2002).[11;139;162] Hyperactivity was an independent risk factor in two UK cohorts,[11;152] but not in a Canadian study.[137] Behavioural difficulties (such as antisocial or aggressive behaviours) were reported in 10 different cohorts, with authors reporting increased risk in both primary school-aged children[27;31;162;167] and post-primary school-aged children,[136;152;158;166;180] and across time and place. A smaller number of papers did not report increased risk of injury with behavioural difficulties.[137;155;159;175] Risk-taking behaviour was consistently associated with injury greater than expected by chance generally[158;166] and for specific risk behaviours including daily smoking,[157] lifetime marijuana use[159] and recent alcohol use.[152;159]

Family factors

Living in a family with many siblings was associated with increased risk of injury greater than chance in three UK cohorts,[14;27;31;166;167] in contrast with a New Zealand cohort of primary school-aged children[155] and an adolescent cohort from China.[139;178] A relatively young mother at the time of the child's birth was independently associated with injury risk in cohorts from both the UK (where 'young' was defined as 20-24 years)[27] and China (where 'young' was defined as under 22 years).[162] Living without either one or both of the natural parents varied from increasing injury risk,[11] to decreasing the risk[139] to making no difference.[155;178]

None of the measures of socioeconomic status (SES) of the child's family were consistent in associations with injury risk. Cohorts from UK and New Zealand showed no significant differences in injury rates between families of different social class as determined by parental occupation.[33;155;156] When income was used as an indicator of SES, higher rates of injury were associated with either lower incomes,[166] or middle band incomes,[139] or no association with poverty was found,[136] and increased risk of injury was reported in families with lower[139] or higher[162] parental education, or was not associated with parental education.[159] The West of Scotland cohort study[140] examined adolescent injury risk using four measures of SES. Unpublished data indicated no significant association with injury for burn injuries or road traffic injuries, but a significant trend for assault injuries in boys (increased injuries in lower SES groups) and a reverse gradient for sports injuries in girls (increased injuries in higher SES groups).

Poor maternal mental health was associated with increased risk of injuries in primary school-aged children in two UK cohorts,[163;167] but not in New Zealand.[155] Consistent parenting (defined using the McMaster Family Assessment Device)[137] and parental injury-prevention measures (such as the safe keeping of poisons and sharp or hot objects)[162] reduced injuries greater than by chance, while the effect of parental supervision was inconclusive.[159;163] Indicators of poor family functioning were associated with traffic injuries in one UK cohort,[11] but no association between family relationships, family adversity or family dysfunction and child injury were identified in two cohorts from New Zealand.[155;175]

Environmental factors

Only one cohort reported the influence of a poor physical home environment, with increased risk of traffic injuries in boys living in homes lacking basic amenities.[11] Frequent house moves in adolescence were associated with injury in a UK cohort[152] but not in primary school children from New Zealand.[155] Three cohorts studied the wider environment; a Canadian study[137] explored neighbourhood disadvantage using an index of factors, while one UK study[33] and one US cohort[160] explored measures of regional disadvantage. None were able to identify an independent association greater than could have occurred by chance.

4.7 DISCUSSION

4.7.1 Principal findings

The pattern and circumstances of injuries change as children progress from five to 18 years; in general, there is a widening of the difference in rates of injury occurrence between boys and girls, an increase in the frequency of injuries with an apparent reduction in the severity of injuries, and a tendency for injuries to occur in sports and leisure locations. Falls are consistently the primary mechanism of injury, but the type of injury changes with age from cuts and lacerations to sprains and fractures. The review did not reveal patterns relating to the consequences of injury due to very limited reporting.

Most analyses of risk factors were at the individual (child) level (23/27 papers), a smaller number explored family factors (19/27), and very few considered the wider environment (6/27). Male gender, relative high weight or height, psychological difficulties, behavioural problems, risk taking behaviour, having a large number of siblings, having older siblings and having a younger mother were all associated with an increased risk of subsequent injury across more than one cohort and setting. The risk factors related to the individual child often reflected the child increasing their exposure to injury risk situations, or may have resulted in injury due to the child placing themselves in injury risk situations where they lacked the developmental or judgement skills to prevent injury. Having older siblings may be a risk factor because carers perceive that older siblings will supervise younger children, when in practice the younger children try to copy their older brothers and sisters. Younger mothers, compared with average age or older mothers may be less aware of the risks a child will encounter as they develop and grow. Understanding such factors helps to indicate groups and situations where interventions should be considered and the effectiveness of such interventions assessed. Factors infrequently explored or inconsistently associated with injury risk included a past history of injury, having a sensory deficit, poor learning ability, poor attention, parental health, parenting ability, family dysfunction, socio-economic status and the wider environment of the child. It was noted that the majority of studies assessed risk factors for injury and few studied factors related to resilience to injury.

4.7.2 Methodological issues

The review focused on evidence from prospective cohort studies, enabling a wide range of injury events of variable severity to be reported. A consequence of this decision was that very few child deaths due to injury were included in the risk factor analysis. Collating data from case-control studies where cases were children who had died from injury, might have yielded different results and gained further insight in to preventing these severest of injuries.

More papers were identified through grey literature searching than from electronic databases, which was often due to the absence of an indexing term relating to the study design. Randomised controlled trials frequently have their study design indexed by electronic databases, but this review found that other study designs, such as cohort studies, were not routinely indexed. Systematic review methodology increasingly considers the inclusion of non-trial and observational evidence to support the development of policy and the implementation of interventions. Hence all study designs require adequate indexing to allow identification. All the included papers were in English, except for one in Mandarin.[162] No unpublished papers were identified, although one author did provide additional unpublished data.[140] The predominance of papers in English was not unexpected, since the expense and infrastructure required to conduct cohort studies was likely to have limited them to high income countries. In this review four studies were identified from low and middle income countries, and three of these reported in English. There was frequent positive reporting bias within papers, where authors stated they collected or analysed data but only published selected results, and this risked overestimating the effects of the reported factors. A further eight papers were identified[141-148] that met the inclusion criteria except that they reported data for children younger or older than the 5-18 age group. Despite attempts to contact authors, data limited to the age period of interest were not available, and these papers were excluded. Absence of these data may have influenced the findings and conclusions drawn.

Heterogeneity existed between included studies with respect to date of study, setting, participants, methodology, and classification systems for measuring risk factors or assessing injury severity. The variety of methods used to classify injury severity reflects the previous lack of widely accepted classification systems. Authors used different definitions of 'an injury' although most defined an injury as that requiring medical attention. Older studies tended to record only the more severe (e.g. hospitalised) injuries. One of the difficulties arising from differing reporting styles was the determination of the denominator used in each paper and in each study. For each study in the review, it would have been preferable to use the number of children or babies eligible as the denominator (as this is the number the sample is attempting to represent). In practice, the studies tended to use the number of children recruited as the denominator, and sometimes the number eligible could not be determined. Frequently the authors did not indicate whether the children not recruited differed from those recruited. In an ideal publication the number of children recruited would reduce at each follow up by the number of children that had died and the number that had permanently withdrawn from the study, but this level of detail was rarely reported. There is an assumption that authors will follow up everyone who was recruited, whilst in practice some authors only follow up those children that have completed all previous assessments or report selected sub-samples of participants. To complicate matters further the denominator can go up during follow-up as eligible children enter the study (e.g. due to immigration). An attempt was made to be consistent during reporting and to use the number eligible as the denominator where this is reported, and the number recruited where number eligible was not reported. In studies with multiple papers, the denominator reported in each paper was used rather than to try to use one denominator across different papers reporting the same cohort.

Study quality was assessed using a modified version of the CASP (Critical Appraisal Study Programme) tool for cohort studies[124] and found that the quality of the included papers was generally satisfactory. Only one paper[179] was completely excluded from the synthesis owing to selective reporting and inability to obtain complete data. However, authors rarely reported comparisons of recruited and non-recruited children, or those lost to follow up compared with those retained. Loss to follow up was reported in 71% of papers, and varied between 0.8% [139] and 52.7%.[152] Modal period of follow up was 1-2 years but varied between nine months[177] and 15 years.[163] It is acknowledged that alternative methods could have been used to assess the quality of the papers identified in this review, such as the

STROBE tool[181] or the Newcastle-Ottawa assessment tool.[182] The CASP tool was chosen for its familiarity and ease of application to the task.

Methods for synthesising data from observational studies are still being developed but the risks of unrecognised confounding when calculating statistical estimates of effect are well reported.[127-129] The narrative synthesis used in this review attempted to be a transparent and objective method to summarise the literature identified. The detailed inclusion of cohort studies that were reported in multiple publications (e.g. the DMCDS cohort and the National Child Development Study) risked over-weighting their findings, but not including all publications would have lost valuable data. The DMCDS was the only cohort providing in depth sequential reporting of type and circumstances of injury in an increasingly ageing cohort, thereby illustrating changing patterns of risk. It is acknowledged that this study was relatively small (~1000 children), whilst some of the national studies from the UK or USA, or some of the descriptive reporting from middle income countries, was based upon a much greater number of children, and could therefore be considered more representative of the experience of all children in that country, and therefore more valid. Individuals within clusters are more similar than individuals between clusters, limiting the ability to generalise findings outside of the cluster. Only four of the 18 cohorts identified children used a nationwide sampling frame. The remainder were based in geographical areas that would have had some element of clustering effects. The majority of studies came from high income countries where risk factors may differ from those in middle and low income countries. It is possible that further studies from low and middle income countries may have been identified if additional non-English databases had been included in the search strategy.

An attempt was made to be robust in the methodology used in the review and to be transparent in the reporting, so that an unbiased overview of the evidence could be produced. Even so, methodological decisions made along the way were based on judgement and opinion, and are therefore not immune to criticism. In addition, the findings of this review need to be considered in the context of epidemiological reports of injury in school-aged children that have arisen from other study designs, and the changing social contexts and experiences of children and adolescents. Children engaged in competitive sport were excluded from this review, yet their risks of injury are well recognised. Understanding of these risks and the effectiveness of interventions to prevent such injuries was beyond the scope of the review.

4.8 CONCLUSIONS

The review attempted to summarise the knowledge of unintentional injury in school-aged children available from cohort studies. It showed broad and consistent patterns of injury across time and geographical location, and identified a limited number of factors consistently associated with the increased risk of injury in this age group. The use of repeated measures over time within cohort studies had rarely been used to monitor the changing patterns of injury with age, and follow up was often limited to two years or less. Individual child factors cannot account for all inter-country variation in injury occurrence and therefore further research to explore environmental and societal factors associated with increased injury risk is warranted. The review demonstrated the value of cohort studies as a methodology to describe injury occurrence and to assess risk factors for injury. Such factors are important for the generation of hypotheses of injury causation and to inform the development of new interventions.

4.8.1 Implications of the review for this research

This review demonstrated the role of cohort studies to describe the pattern of injuries in children and identify risk factors for injury. The last national birth cohort study occurred in the UK in 1970. The circumstances and experiences of children growing up in the 1970s and early 1980s are very different to those of children today. There has been one UK study since the 1970 Birth cohort, that of the West of Scotland 11-16 study, which recruited children in 1994. However these children were recruited at age 11, so this study provides no information on injury experience and risk factors for the primary school-aged period. The Avon Longitudinal Study of Parents and Children presents an opportunity to provide a more contemporary description of injuries occurring to primary school-aged children than that previously available and also contains data on a number of family and environment variables that may contribute to our understanding of the role of factors outside the child that influence the risk of injury. The findings of the review have identified the variables to be included in the request for data from ALSPAC.

CHAPTER 5: ALSPAC

The purpose of this chapter is to describe the Avon Longitudinal Study of Parents and Children, the data collected during the primary school years, and the choice of data for inclusion in this study.

5.1 DESCRIPTION OF THE STUDY

ALSPAC (the Avon Longitudinal Study of Parents and Children) is a longitudinal prospective cohort study that began in September 1990. Pregnant women with an estimated date of delivery between 1st April 1991 and 31st December 1992, living within the former area of Avon in the South West of England, were eligible for participation in the study. 14,541 women were recruited, resulting in 14,062 live births, of which 13,998 were still alive at 12 months of age and form the basis of the cohort that has been followed to the present day (Figure 9). Of the 14,541 core pregnancies, there were 195 twin pregnancies, three triplet pregnancies and one quadruple pregnancy. The 13 infants who were triplets or quads were excluded from the final dataset for confidentiality reasons, whilst the 195 twin pregnancies were included as individual children.

Data were collected from early pregnancy using self completed questionnaires sent to the mother, her partner and, after the age of five years, to the children themselves. In addition, biological samples were taken from parents and children, environmental samples taken from the children's homes, and physical, psychological and behavioural measures completed by parents and children.

Figure 9: Numbers of women recruited and children followed to age 5 in ALSPAC

5.1.1 Strengths of ALSPAC

ALSPAC was designed to be of a size to provide sufficient power to study common disorders and traits and the role played by common environmental exposures. For binary outcomes, with 10,000 subjects the study had the power to be 80% sure of identifying as statistically significant a true relative risk of 1.41 or more, to an exposure of prevalence 5%.[34]

At the planning stage of ALSPAC, the children living in the Avon area were shown to be representative of Great Britain as a whole through a comparison of the data collected during Child Health and Education Study, a longitudinal follow up of all children born in Great Britain during a single week in April 1970.[34] The enrolled cohort was found to be broadly representative of Great Britain as a whole when compared on demographic characteristics in the 1991 census.

The breadth and quality of the data collected are two further strengths of ALSPAC. Information on factors relating to the individual child, their family, their community and their environment have been collected involving academic and practitioner perspectives at the questionnaire planning stage to enable a huge potential for analyses of the impact of factors on the whole spectrum of child health. The study has been embraced by the local population, such that recruitment of the eligible population to the study was high (estimated at 80%) and attrition from the study was low, especially between the end of the first year of life and five years.

5.1.2 Limitations of ALSPAC

Although the enrolled cohort was found to be demographically similar to the UK average in the 1991 census, since 1992 the demographics of the population of the former Avon area have changed with significant inward migration of populations from outside the UK. Of 7841 children that attended an assessment in 1998-9, at the age of seven years, 4.1% were of non-White ethnic groups. The retained cohort is no longer representative of the population of the Avon area, particularly within the city of Bristol, where 17% of the population were from black and minority ethnic groups in 2009.

As with any longitudinal study, participants have withdrawn and dropped out of the study with time. Families from lower socioeconomic groups are less likely to remain within longitudinal studies than those from higher socioeconomic groups. These two factors result in reduced ability to generalise the findings of analyses using the ALSPAC dataset to the UK population as a whole. The current cohort still contains respondents from a wide range of social backgrounds, urban and rural, and retains children from more deprived groups.

Much of the data collected in ALSPAC has been dependent on parentally-reported information through questionnaires, with only limited validation of information through other sources such as medical records. Since the age of seven a sample of children in the study have been invited to participate in visits to the ALSPAC research centre where objective measurements and assessments of health and development have been undertaken. The collection of unvalidated parentally-reported information carries the risk of selective reporting and recall bias. This is particularly relevant for the subject of this study; injury. Parents may underreport injuries sustained for fear of being perceived as a ‘bad parent’ for failing to keep their child safe, or that the injury may have been perceived as intentional. The study asked the parents to report ‘any injury’ and did not specify whether the injury was intentional or unintentional. This was a decision taken by the ALSPAC team when the questionnaires were designed. It was considered that including questions on intentional injuries would risk non-response, and where responses were given, injuries would be significantly underreported. As an alternative, a series of questions on injuries 'due to the action of another person' were included.

All information collected during the study is anonymised such that individual responses cannot be linked back to participants by individual researchers. This attempts to reassure parents that the information they provide is treated confidentially, and helps reduce the risk of selection bias in reporting. However, reassurance relies on the trust the parent's have in the anonymity arrangements.

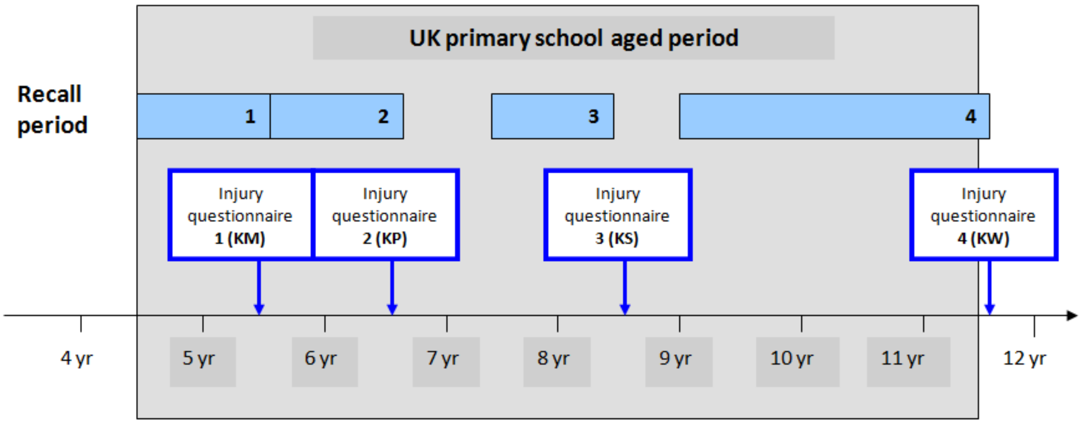
5.2 INJURY AND PREDICTOR VARIABLES COLLECTED IN ALSPAC

The injury and predictor variables used in this thesis come from a variety of questionnaires completed by mothers and collected during pregnancy, at birth and at any point up to the time the child was 11 years of age. The outcome data are the parentally reported injuries collected in four questionnaires administered during the period in England when children attend primary school; the child entering school during the year after their 4th birthday and leaving primary school during the year after their 11th birthday. These questionnaires were:

1) KM questionnaire: *My five year old son / daughter* - administered when the children were 65 months of age (5½ years)
2) KP questionnaire: *My son / daughter growing up* - administered when the children were 78 months of age (6½ years)
3) KS questionnaire: *My son / daughter's health* - administered when the children were 103 months of age (8½ years)
4) KW questionnaire: *Being a girl / boy* - administered when the children were 140 months of age (11½ years)

Administration of these questionnaires is illustrated in Figure 10 and the questions are reproduced in Appendix 5. In these four questionnaires, mothers (or the primary caregiver where this was not the mother) were asked to report injuries of any severity that their child had received during a specified recall period; for the KM questionnaire this was since the child was 4½ years old for all injury types, for KP and KS questionnaires this was the previous 12 months for the majority of injury types, and for the KW questionnaire this was injuries since the 9th birthday (up to 2½ years) for all injury types.

Figure 10: diagrammatic representation of the timing of the four questionnaires that collected injury outcome data, and their respective recall periods



The specific injuries being assessed varied in the four questionnaires but all questionnaires contained questions on burns and scalds, ingestions and 'other' injuries. Table 22 contains information on the different types of injuries that were collected in the four questionnaires.

Table 22: Questions on different types of injuries included in the four questionnaires

Questionnaire (Age)	Burns & scalds	Falls	Ingest substance or object	Sports injuries	Traffic injuries	Action of another person	Other injuries
1 (5½ years)	✓	✓	✓	×	×	×	✓
2 (6½ years)	✓	×	✓	✓	✓	✓	✓
3 (8½ years)	✓	×	✓	✓	✓	✓	✓
4 (11½ years)	✓	×	✓	✓	✓	✓	✓

(✓ = included, ×= excluded)

For the KP and KS questionnaires the recall period for the questions on 'has your child been injured by the actions of another person' was 'ever' rather than the 12 month recall period used for the other injury types.

Most information collected in the questionnaires was captured in a manner that allowed direct computer entry (through the use of responses recorded in tick boxes that were numerically coded). However, for questions relating to injuries, in addition to numerically coded data, mothers were asked to describe the circumstances of a range of different types of injury using free text. Information on the circumstances of the injury event was requested including:

- Location of the injury event
- How the injury happened
- Month/year of the injury
- Type of injury sustained
- Part of the body injured
- Who was with the child at the time of injury
- What did that person do with the child after the injury
- What treatment was given for the injury
- What was the object causing the injury (only for burns/scalds or ingestions)

These detailed injury event descriptions could be provided for up to three injuries of each type within the questionnaire form, and could be continued on separate paper if the mother had more than three injuries of that type to report.

Response rates, recall periods and numbers of injuries reported in the four questionnaires are summarised in Table 23. Over 10,000 questionnaires were sent out at each data collection point and high response rates were achieved for each questionnaire.

Table 23: Response rates, recall period and injuries reported in the four questionnaires

Questionnaire (age)	Questionnaires sent out (n)	Questionnaires returned n(%)	Recall period (months)
1 (5½ years)	11549	9013 (78.0)	12
2 (6½ years)	10908	8578 (78.6)	12*
3 (8½ years)	10981	7996 (72.8)	12*
4 (11½ years)	10311	7165 (69.5)	30

* = 12 month recall period used for all injury types except ‘injuries due to the action of another person’ where the recall period was ‘ever’

CHAPTER 6: METHODS

The purpose of this chapter is to describe how the data were prepared for analysis and the methods used to undertake the descriptive epidemiology of injury and risk factor analyses.

6.1 PREPARATION OF THE DESCRIPTIVE INJURY DATA

Any free text information completed on ALSPAC questionnaires was keyed in full onto a Microsoft Access (MS Access) database by administrative staff supervised by the ALSPAC data management team shortly after the questionnaire was returned to the ALSPAC office. MS Access databases containing data fields of relevance to specific research projects can then be made available to individual researchers with a child identifier unique to each researcher (this prevents individual researchers pooling datasets). Four MS Access datasets containing free text injury data from each of the four questionnaires containing injury questions were provided for this study. Each questionnaire dataset required cleaning prior to combination with the other questionnaire datasets and then coding of the combined dataset.

6.1.1 Cleaning of the free text data

6.1.1.1 Stage 1: number of injuries

Each questionnaire had asked mothers or carers to report up to three injuries (or more on separate sheets) for each injury type within the recall period. For example, at age 5½ years the mother could record three different burn/scald events, three different falls, three different 'other' injuries etc. Therefore each burn/scald event was coded with an 'accident number' 1, 2 or 3. Where an injury event had no accident number allocated or the accident number was unclear, the accident number had been allocated a 99 code by the ALSPAC administrative staff. Cleaning of the data in the four questionnaire datasets therefore first required a review of the 'accident code = 99' results to compare the text provided for that child with other text provided for other accidents occurring to the same child. If it was apparent that the text related to a specific injury event (for example it related to a fall and there was only one other fall recorded for that child at that age, then 'accident number = 99' was changed to the appropriate accident number for the identified injury event, in this case, fall number 2). If there was no obvious injury event to which the 99 code could be changed then the text was deleted. This latter circumstance was relatively common as parents would quite frequently have written a general comment on the questionnaire form such as “lots of minor grazes” or “none thank God” which were not related to specific injury events but had been coded 99 by the administrative staff. Table 24 summarises the recoding / deletion of ‘accident number = 99’ codes. The coding of free text in the KW questionnaire at 140 months had the greatest number of ‘accident number = 99’ codes. There were no ‘accident number = 99’ codes in the KS questionnaire.

Table 24: Data cleaning of ‘accident number = 99’ codes, by questionnaire

Questionnaire (age in months)	‘accident number = 99’ (n)	Number of instances where 99 was recoded to ‘accident number = 1,2, or 3’ (n)	Number of instances where data deleted (n)
KM (65 months)	46	0	46
KP (78 months)	40	36	4
KS (103 months)	0	0	0
KW (140 months)	275	242	33

6.1.1.2 Stage 2: duplicate entries

The next stage of cleaning required the identification of duplicate entries. Data entry by the ALSPAC administrators had resulted in a number of typographical errors that had resulted in two apparently duplicate entries and occasions when the same free text data had been entered twice. Queries were run using the MS Access ‘Query’ tool, to identify duplicates in each of the four questionnaire datasets. Where typographical errors were identified (e.g. the text described a burn/scald but the question number indicated it was a fall, the question number was changed to that for a burn/scald), the appropriate change was made to the data entry. Where two sets of identical text were identified (indicating duplicate data entry) one of them was deleted. Table 25 indicates the duplicates corrected and deleted in each dataset.

Table 25: Data cleaning for duplicate entries, by questionnaire

Questionnaire (age in months)	Number of duplicates identified (n)	Number of instances where typographical error corrected (n)	Number of instances where one copy of double data entry deleted (n)
KM (65 months)	82	41	0
KP (78 months)	154	58	19
KS (103 months)	736	94	274
KW (140 months)	304	125	27

The four MS Access datasets relating to each of the four questionnaires were then combined into a single dataset by one of the ALSPAC statisticians, so that each injury event had a single row within the dataset, and each piece of information relating to that injury event (e.g. the place it occurred, the object that caused the injury etc) was recorded in a separate column. The number of injury events in this dataset was 13,840.

6.1.2 Coding the free text data

The free text information required coding to enable analysis and interpretation. Similar free text information had been collected in ALSPAC for parentally-reported injuries during the pre-school period (0-4½years). The pre-school free text injury data had been coded using a pragmatic and evolving system of codes, developed by the ALSPAC team that was studying pre-school injuries at the time. This coding system was reviewed to establish if it was suitable for use with the primary school-aged free text data. Two key problems were identified;

1) The coding was too limited for coding the school-aged injury data. New codes needed to be created to record emerging injury types and circumstances as the children grew, developed and were exposed to new injury risks. In addition, a number of the codes were redundant as they related to injuries sustained at very early stages of child development that would not be applicable to a primary school-aged child.
2) A number of inconsistencies in the coding system risked errors being made during application of the coding framework.

It was therefore determined that a new coding framework would need to be identified or developed to meet the requirements of the proposed analysis.

6.1.2.1 Development of the new coding framework

An internet search for existing coding frameworks for injury identified three main classification systems;

1) The International Classification of External Causes of Injury (ICECI) - a related classification in the World Health Organisation Family of International Classifications[183]
2) The Injury Database (IDB) Coding Manual - developed for the recording of information of injuries at emergency departments across the European Union, developed using ICECI and designed as a tool to enable effective injury surveillance systems to be established[184]
3) The Nordic Medico-Statistical Committee Classification of External Injury Codes (NOMESCO) - developed to facilitate injury prevention and control[185]

The intended purpose, coding structure and method of application of these three systems were compared. Their strengths and weaknesses are summarised in Table 26.

The WHO International Classification of External Causes of Injury (ICECI) was identified as the most appropriate system to use for the coding of injury data in the ALSPAC database. This was because of its ability to code the richness of the information available through ALSPAC, and its establishment as a global classification system which would allow the comparison of ALSPAC data with other datasets coded to the same system from around the world.

Table 26: Comparison of three injury classification systems; IDB, ICECI, NOMESCO

Aim	Development	Strengths	Weaknesses
European Union (EU) Injury Database (IDB)			
A database of all injuries attending selected emergency departments in EU countries to provide ongoing injury surveillance. IDB is the only data source in the EU that contains sufficient detail for developing preventative action against accidental injury in Europe. Should be regarded as a derivative of ICECI with additional elements.	Originally only monitoring non-fatal home, leisure and sports accidents, it was developed from the EHLASS Programme (European Home and Leisure Accident Surveillance System). The IDB coding manual was developed using ICECI (primary guideline), the Home & leisure accident V2000 coding manual and the Minimum Datasets on Injuries developed for use in the EU. Coding rules follow ICD rules particularly for direct cause and underlying cause	The IDB provides information about external causes and circumstances of accidents, the mechanism of the accident, the activity of the victim, of occurrence and related products. These details can be analysed in relation to type and severity of the actual injury for each record Hierarchical coding tree allows aggregation if necessary	The IDB was not originally designed as a classification system for all injuries (though has been adapted to be so). IDB data is collected at Emergency departments of selected hospitals around the EU (may therefore be more appropriate for more severe injuries, and less appropriate for GP or home treated injuries). Does not routinely code type of transport event (e.g. Land or water), indoor / outdoor, type of home, type of school, rural /urban, injury prevention measures (e.g. use of helmet) – but not an issue as this data is not in the free text
ICECI			
A classification to enable systematic description of how injuries occur, designed to assist injury prevention. Originally for routine injury data collection sites e.g. A&Es. Designed to enable researchers to define the injuries they are studying, detail circumstances of injury occurrence and provide information on specific types of injuries (e.g. RTAs)	Designed to map to a table of aggregated categories to which data coded to ICD9 and ICD10 (Chapter XX) can be mapped. It is multi-axial (factors can be coded independent of other factors), modular (e.g. core versus sports) and hierarchical (up to 3 levels of detail, level used can differ between modules). Developed from ICD system originally intended for mortality statistics & patients admitted to hospital.	ICECI is related to the External causes chapter of ICD and accepted by the WHO as a member of the WHO family of international classifications Has been used to record risk factor exposure of children in a cohort study (reference not stated) Can be used in modular and hierarchical form to select codes of use to individual requirements Has a look up index which may be helpful	Great depth of coding detail possible therefore would need to be selective in choosing which areas to code and the hierarchical level to code to. Within ICECI do not have a *Type of injury* coding section – ICECI refers back to ICD-10, so would have to use Chapter XIX or create own coding
NOMESCO			
The aim of the classification is to be a practical tool for injury epidemiology, which will lead to prevention of unnecessary deaths, non-fatal injuries and the long term consequences of injury. It aims to capture the sequence of events precipitating the moment of injury. Aim to provide information demanded by sectors involved in injury prevention	First published 1984 (i.e. precedes IDB or ICECI). Developed from existing classifications after the 1982 WHO meeting proposing a multi-axial classification following initial development work in Denmark that should feed into the development of ICD-10. It has a multi-axial, modular and hierarchical structure. Designed for use in A&E settings	Very simple coding system of 2 or 4 digits. Easy from manual to identify code to use. Can code place, mechanism, activity and product code.	The injury itself must be coded with ICD-10 Chapter XIX or equivalent as with ICECI Place of occurrence combines e.g. living room, bedroom and hallway – loss of existing 65m coding detail.

Information taken from the coding manuals of EU Injury Database, ICECI and NOMESCO downloaded from the Internet on 11th April 2007.

The ICECI system is divided into modules and items. Each module covers a certain specific area of enquiry. There are seven core modules and a further five additional modules which provide a greater level of detail for certain core modules. The core modules are numbered C1 to C7 and are summarised in Table 27.

Table 27: Core and additional modules in the ICECI system

Core module	Core module name	Additional modules within Core module
C1	Intent	Violence
C2	Mechanism	Transport
C3	Object / substance	
C4	Place	Place (further detail)
C5	Activity	(i) Sports (ii) Occupational
C6	Alcohol use	
C7	Drug use	

Within each module there is a hierarchical list of items, each of which has a designated code, plus specific inclusion and exclusion criteria for that item. ICECI has been designed so that certain elements of ICECI can be used as required by the data collection system to which it is being applied.

For the coding of the school-aged ALSPAC injury data the Mechanism module (C2), Object / substance module (C3) and Place module (C4) were used. The level of detail of coding available through ICECI was greater than that needed to code the ALSPAC data, so an appropriate level of coding was identified for the information available.

ICECI did not provide codes for information such as the person(s) with the child at the time of injury, the treatment provided to the child, the part of the body injured or the type of injury resulting from the injury event. For these areas of data the original ALSPAC coding frameworks were updated, errors corrected and the potential for inconsistent application reduced through the writing of definitions and application guidance.

The resulting coding framework was produced as a coding manual for ALSPAC injuries. Each module in the manual provided a definition of the module, a guide to how codes in that module should be applied (with examples where appropriate), the format of codes for that module, and the source of the codes for that module. The coding manual has been included in Appendix 6.

6.1.2.2 Application of the new coding framework

The coding system developed and recorded in the coding manual was then applied to the free text within the MS Access dataset. All coding was undertaken by the author. The majority of coding was undertaken using the 'update query' facility in MS Access. For example, a query was run to identify all 'place' entries where the free text response was 'kitchen'. 274 records were retrieved. The first screen of results was scanned by eye to ensure it had retrieved appropriate records and then an update query was run such that all 274 'kitchen' place records retrieved were allocated a code of "1.02". The free text of all 274 records was then scanned by eye to ensure that the code was appropriate for the free text. When no further locations suitable for coding by this method were identified, a query was run to identify any remaining free text relating to place for which no code had been applied. These injury events had the place of occurrence coded individually. If an injury event had no text recording the place of occurrence, then a 'not known' code was applied.

This coding technique was used to code free text relating to place of injury occurrence, object causing a burn or scald, substance / object ingested, supervision of the child at the time of injury event, outcome of the injury event, treatment given, part of the body injured, and mechanism of injury.

'Treatment given' was used as a proxy for severity of injury, since it was assumed that more severe injuries were more likely to require treatment by primary or secondary care minor injuries. This is likely to be true for injuries such as fractures of which almost all will be seen in secondary care, but is less accurate for injuries such as lacerations and sprains where the confidence of the parent to manage the injury and the ease of access to primary or secondary care are likely to determine whether or not the injury is managed at home or whether health professional opinion is sought.

The 'mechanism of injury' was recorded in two ways; both the underlying mechanism and the direct mechanism. The difference between underlying and direct mechanisms is best explained by example; if a girl trips over a toy and falls, cutting her head on the corner of a table, then tripping over the toy is the underlying mechanism (coded as a fall), whilst cutting her head on the table is the direct mechanism (coded as ‘blunt force: contact with object’). In comparison, if a boy cuts his finger with a knife then cutting his finger (coded as ‘penetrating force: cutting’) is both the underlying and the direct mechanism.

During the free text coding process a number of further data entry errors were identified and corrected, and records were deleted where near duplicates (not picked up on the previous exact duplicates search) were identified, or non-injuries had been recorded (e.g. ‘allergic reaction’, ‘burst appendix’, ‘earring trapped in ear’, ‘in-growing toenail’ etc).

A total of 99,717 items of free text were coded by this process (Table 28). Cleaning and coding the dataset was undertaken over ~5½ months.

Table 28: Number of free text items coded, by category

Category of free text data	**Number of items in dataset coded**
Object causing injury (burn/scald or ingestion)	2837
Supervision at time of injury event	13840
Outcome of injury event	13840
Treatment given	13840
Part of the body injured	13840
Place of injury event occurrence	13840
Underlying mechanism of injury	13840
Direct mechanism of injury	13840
Total	**99717**

6.1.3 Restructuring of the dataset

The fully coded Microsoft Access dataset was converted into an SPSS dataset (SPSS 13.0 for Windows) by one of the ALSPAC statisticians. The conversion included re-structuring of the dataset from having one injury event per row, to a dataset with one child per row. Any child that had multiple injury events had additional columns added to the width of the dataset.

6.1.4 Adjustment of recall periods

A further stage of preparation required a review of the data relating to injuries caused ‘by the action of another person’ collected in the KP (6½ years) and KS (8½ years) questionnaires. These questions asked if the child had been injured due to the actions of another person ‘ever’. In order to make the recall period equivalent to that used for the other injury types within these questionnaires (i.e. ‘within the last 12 months’) those injuries that had been reported as occurring *before* the 12 month recall period needed to be excluded. This cleaning was possible because the date of the injury event and the date that the questionnaire had been returned to the ALSPAC office were available for the majority of cases. This analysis was undertaken with one of the ALSPAC statisticians and used a conservative cut off of 13 months prior to the questionnaire being returned to the ALSPAC office rather than a 12 month cut off. The cut off at 13 months was used because the date of the injury was only recorded as month and year. Because it was not known whether the injury occurred at the beginning or end of the month, a decision was taken to use the cut off as prior to 13 months so that eligible injury events were not excluded. Those injuries caused by the action of another person that occurred more than 13 months prior to the return of the questionnaire or where the date of the injury event was not recorded were deleted.

6.1.5 Measure of socioeconomic disadvantage

In order to explore inequality in distribution of injuries it was necessary to identify a measure of socioeconomic disadvantage to use in analyses. The Index of Multiple Deprivation 2000 (IMD) was used. These data were not routinely available as part of the ALSPAC dataset and had to be created and added to the dataset. The IMD 2000 score for the postcode of residence when the child was aged five years was allocated to each child in the dataset. This allocation was undertaken by the ALSPAC statisticians as postcode data is not made available to individual researchers for reasons of confidentiality. An IMD 2000 score for the postcode of residence of the child was available for 13369 ALSPAC children. Postcode at age 5 years was chosen as this was the residence at the time of commencement of primary school. It was acknowledged that a proportion of children would move home within the following four years but a pragmatic decision to use the IMD at a single time point was taken. The IMD scores of the children were ranked and then divided into five quintiles for analysis where quintile 1 was the least disadvantaged and quintile 5 the most disadvantaged. As the cohort retained to primary school age is more affluent than the general population of the UK (as the least affluent are more likely to be lost to follow up) this resulted in quintiles that are not directly comparable to quintiles of deprivation for England as a whole.

6.2 PREPARATION OF DATA FOR RISK FACTOR ANALYSES

6.2.1 Injury variable

It was necessary to establish the number of injuries sustained by the children in the cohort to be used as the 'outcome' or dependent variable in multiple regression analyses of risk factors for injury. In each questionnaire, and within each set of questions on a specific injury type, parents were asked to write the number of injuries of that type their child sustained during the period of recall. The questionnaire therefore provided a number of injuries of different types available from the parents. However, there was no means to validate this information.

It was therefore decided to use the information on the 0, 1, 2, or 3 injuries recorded in detail through free text to determine the number of injuries sustained per child for any one injury type. Although there was no external validation of this number of injuries either, the detailed questioning asked of the parents when providing free text did provide some degree of confidence of the robustness of the recall of the injury event. It is acknowledged that the recall of injuries sustained over a period of 12 months or more will underestimate the true number of injuries sustained and will bias the results towards the more severe and more recent injuries as these are more likely to be remembered.

The coding of the descriptive injury data included coding the location of where the injuries were treated; at home, in a primary care setting or in a secondary care setting. No measure of injury severity had been collected, therefore the treatment location was used as a proxy measure for severity, since more severe injuries were more likely to present to hospital or secondary care for treatment.

Children of different ages are known to sustain different types of injuries and therefore different explanatory variables may act as risk or protective factors for injury at different ages. A stratification of the injury variable was therefore made by splitting the outcome into those who were of England Infants School age (i.e. 5-7 years, or 'early primary') and those who were of England Junior School age (i.e. 8-11 years, or 'late primary') at the time of completion of the questionnaire. The Infants school age analyses contained data from two of the questionnaires (KM and KP questionnaires that collected data at 65 and 78 months respectively) and is hereafter referred to as 'Early primary'. The Junior school age analyses contained data from remaining two questionnaires (KS and KW questionnaires that collected data at 103 and 140 months respectively) and is hereafter referred to as 'Late primary'.

6.2.2 Variables considered as potential risk factors

A range of potential risk factors for injury in primary school-aged children were identified for use as explanatory (or independent) variables in the multiple regression analyses. Rather than set out to test a specific injury risk hypothesis, this study intended to be exploratory, and to use the breadth of data within the ALSPAC dataset to identify risk factors for injury in primary school aged children. There were two sources of information from which to decide on the explanatory variables to include:

1) The systematic review of cohort studies of injuries in primary school-aged children had identified a range of explanatory variables that had been shown in other studies to have been either risk or protective factors for injury. These factors had been grouped for synthesis into individual (i.e. child), family and environmental factors. Few environmental factors had been reported in the cohort studies identified, and where present, their influence on the risk of injury appeared less than that of family and individual factors, although it was unclear whether this was due to poor validity of the environmental measures used or a valid finding. Risk factors explored by other authors in the field were therefore explored within ALSPAC where possible.
2) Discussion with members of the supervision team and experts in the field of injury prevention to identify other factors known to have been collected in ALSPAC and that could be explored for an association with injury. Discussion focussed on factors in the child's environment since these did not appear to have been widely explored within the studies identified in the systematic review.

A decision was taken to look for potential risk and protective factors in ALSPAC that could be categorised into individual, family or environmental factors, and then to try to establish the value of environmental risk factors for predicting injuries in primary school-aged children over and above that determined by considering child and family risk factors. Using the concept of the wider determinants of health as described by Dahlgren and Whitehead,[186] it was speculated that environmental factors could either influence the risk of injury directly, or via influence on family or individual factors. A hierarchical model[187] suggesting that the majority of the influence of environmental factors was likely to be through more ‘proximal’ factors such as the family and the individual, was suggested by the ALSPAC statistician. This model was consequently chosen as the model to test through multivariable regression. The model is described in more detail in Section 6.4.5.

The questionnaires used in ALSPAC are available on line (http://www.bristol.ac.uk/alspac/sci-com/quests/). A review of all of the questionnaires listed in Table 29 was undertaken to identify variables that could potentially be used in the multiple regression analyses. Each questionnaire in ALSPAC has been summarised in one datafile. Files are referred to by letter codes, e.g. mother completed questionnaires (A, B, C etc) and child based questionnaires completed by main carer (KA, KB, KC etc). These files are either available as ‘released’ files (where basic data cleaning has been undertaken prior to making them available to researchers), or as ‘built’ files. In a ‘built’ file further analysis has been undertaken in addition to data cleaning such that a range of derived variables are also available to researchers. A derived variable is one where a number of variables from the questionnaire are combined to produce a new variable, for example, a series of responses to questions on friendships and neighbours could be combined into an overall ‘social networks’ score. In addition there are two files; MZ and KZ that contain background information on all mothers and children who were part of ALSPAC.

Each questionnaire listed was reviewed. Those questions where data could potentially contribute to the multiple regression analysis were identified and the question subject, the question number and the question code were recorded on a Microsoft Excel spreadsheet. Where similar data was collected at multiple time points the questionnaire completed closest to the four injury questionnaires was chosen. For example, questions relating to mothers educational attainment were asked on multiple occasions. Maternal educational attainment data for inclusion in the multiple regression analyses were selected at age five and age nine in preference to that at the time of the child’s birth. The data request spreadsheet was sent to the ALSPAC statistician who extracted the requested data, allocated a unique child identifier to the data and provided the data available for analysis as an SPSS dataset.

Table 29: ALSPAC questionnaires scrutinised for potential explanatory factors

ALSPAC file	Title of questionnaire	Age at administration	Status of file
Child based questionnaires (completed by carer)			
KK	My young 4 year old Boy / Girl	54 months	Built
KL	Development and health of my son / daughter	57 months	Released
KM	My five year old son / daughter	65 months	Released
KN	My school boy / girl	69 months	Released
KP	My daughter / son growing up	78 months	Released
KQ	My son / daughter at school	81 months	Built
KR	My son's / daughter's wellbeing	91 months	Built
KS	My son's / daughter's health	103 months	Released
KT	My son / daughter at home & at school	103 months	Not available
KU	Your son / daughter at 9	115 months	Released
KV	My son / daughter's health and happiness	128 months	Not available
KW	Being a girl / boy	140 months	Released
Carer questionnaires			
K	Study mothers questionnaire	61 months	Released
L	Mothers lifestyle	73 months	Released
M	Mother and home	85 months	Released
N	Mother and family	97 months	Released
P	Mother of a 9 year old	110 months	Released
Q	You and your surroundings	122 months	Released
R	Lifestyle and health of mother	134 months	Released

6.3 ANALYSIS OF DESCRIPTIVE INJURY DATA

The descriptive analysis of the injuries sustained by the children was conducted through a series of cross tabulations in SPSS where number and rate of total injuries were reported. For each type of injury (e.g. cuts/wounds, burns/scalds, fractures etc) the number and rate of injuries by age and stratified by sex were estimated, plus the number and percentage of injuries occurring by a range of different variables, and is summarised in Table 30.

Table 30: Analyses undertaken to describe injuries sustained, by type of injury

Type of injury	Place of injury event	Mechanism of injury	Supervision at time of injury	Part of body injured	Object involved	Treatment received	Quintile of deprivation
Cuts & wounds	✓	✓	✓				✓
Bruising & swelling	✓	✓	✓	✓			✓
Fractures	✓	✓		✓			✓
Burns & scalds		✓	✓	✓	✓	✓	✓
Sprains & strains	✓	✓		✓		✓	✓
Dental injuries	✓	✓	✓			✓	✓
Ingestions	✓		✓		✓		✓
Head injuries	✓	✓				✓	✓
Eye injuries	✓	✓	✓			✓	✓
Injuries in the road		✓	✓				✓
Transport injuries	✓		✓				✓

Due to the richness of the injury dataset available there were four possible levels of stratification of the data:

1) The type of injury recorded by injury question (e.g. whether the injury was a burn/scald, a sports injury, or an injury due to the action of another person etc)
2) The circumstances of injury obtained from the free text provided by parents (which was subsequently categorised into e.g. place of injury, supervision, mechanism etc)
3) The age of the child at the time of the injury (collected by age at time questionnaire completed, i.e. one of four time points)
4) The potential for multiple injury events of the same type occurring at the same age (e.g. a parent could report 3 burn/scald events in the questionnaire returned at 8½ years)

It was not possible to produce crosstab commands in SPSS that could include all levels of stratification. Therefore a series of simple stratified crosstabs were undertaken in SPSS and then the data exported to MS Excel, where it was combined and graphs and tables produced.

6.4 ANALYSIS OF RISK FACTORS FOR INJURY

This section describes the decisions taken and methods used to analyse the association between risk/protective factors and injuries requiring attention in secondary care.

6.4.1 Unit of analysis

A single child in ALSPAC could sustain multiple injuries during the period covered by the four questionnaires. For this study analyses were conducted to explore the association of risk and protective factors with *any* injury occurring to a child within the follow up period. It is acknowledged that children who sustain multiple injuries are likely to differ from those who sustain one injury or none at all. The multilevel modelling to explore clustering of injuries at the level of the child was considered to be beyond the scope of this study.

6.4.2 Selection of cases for inclusion in analyses

An ideal dataset would contain complete data for all explanatory variables and all injury variables for every child (or 'case'). In any prospective longitudinal study attrition of participants or failure to return one of a series of questionnaires is a recognised limitation. The number of families that returned at least one of the four questionnaires containing injury questions was 10,324. The number of families that returned all four questionnaires was 5752. These 5752 records were chosen to provide the main dataset for the analysis because they provided information on whether an injury was sustained at every time point. These data are hereafter referred to as the *observed data*.

The consequence of limiting the analyses to those children with complete injury data was the risk of biasing the results towards the null, i.e. the analyses would produce more conservative estimates of association between risk factors and injury outcomes than if all possible participants had been included.

6.4.3 Stratification of independent variables

The independent (or explanatory) variables were split into four groups; child, family, home and environment. The original intention had been to have three groups; child, family and environment. Following assessment of the environmental variables available it was decided to split these into ‘home’ (to explore the association of injury occurrence with the child’s immediate environment, i.e. within the home) and ‘environmental’ (to explore the association of injury occurrence with the child’s wider environment, i.e. their neighbourhood, or community). The decision to split these variables was due to the theoretical potential for the family to have greater ability to influence their home environment than the wider environment in which they lived.

6.4.4 Analyses of individual independent variables

A decision was taken to undertake all analyses of risk and protective factors and injury occurrence using STATA software (Stata/SE 9.2 for Windows, Stata Corp Ltd, Texas, 2007) as this had greater functionality to manage the planned analyses of missing data and an imputed dataset. The observed data in the SPSS dataset were therefore converted to a STATA file and all analyses were undertaken using this software.

For each independent variable, the coding, the completeness and the prevalence were reported. Variables were re-coded into binary outcomes where possible and appropriate, and kept as ordinal categorical variables where necessary. No continuous variables were used. An exploratory analysis of the association between each independent variable and the injury variables was undertaken using a X^2 analysis and p value, stratified by age of the child at the time of the injury.

Odds ratios (OR) for the association between each independent variable and the ‘any injury’ outcome variable were derived. For each binary variable logistic regression analyses were conducted, both adjusted and unadjusted within group (i.e. adjusted for other child variables within the child group, for other family variables within the family group etc.). For each ordinal categorical independent variable, univariable logistic regression analyses generated an OR for each level or category of the variable. A single estimate of effect (e.g. a trend or global p value) was required rather than separate estimates for each category. Odds ratios of trend are more powerful than separate estimates, and indicate the average change in odds per category of the variable. Within each ordinal categorical explanatory variable the odds ratios for each category were compared to identify if there appeared to be a trend of increasing or decreasing odds across the categories of that variable. Where this was found, a log likelihood ratio (LR) analysis was used to confirm whether an OR for trend was appropriate to be used. In this analysis, the log likelihood derived by using the variable in categories was compared with the log likelihood derived from using the trend across the categories. If the LR X^2 was not significant at the $p<0.05$ level it indicated that there was no statistically significant difference between analysis in categories and analysis as a trend, and it was appropriate to use the odds ratio for trend.

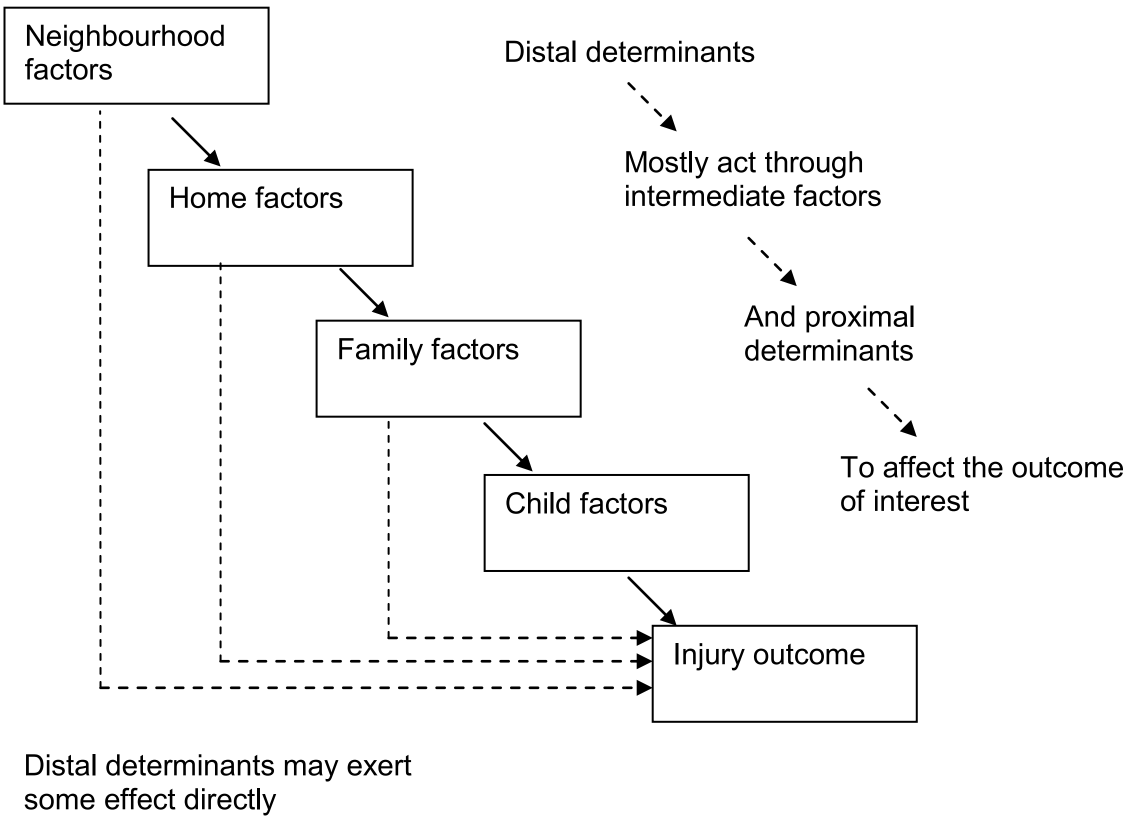
If no trend for increasing or decreasing odds was seen across the categories of the variable, it suggested that it was not appropriate to use an OR for trend. In this circumstance the log likelihood ratio estimation was used to produce a global p value for that variable. This test determined whether the odds of an injury were different across the different categories of that explanatory variable. No difference in odds is equivalent to having a constant. In practice, the comparison was of a model that included the categorical explanatory variable of interest with a model that excluded the variable. A decision was taken that if the p value for the LR X^2 test (the 'global p') was not significant at the $p<0.05$ level then the variable was less likely to contribute to future models and was therefore no longer included. If the p value for the LR X^2 test was statistically significant then the explanatory variable was retained.

6.4.5 Framework for the multivariable analysis

Multivariable analysis is a statistical technique used to understand the relative contributions of a wide variety of independent variables to an outcome of interest.[188] In the context of this project the risk of having an injury during the primary school-aged years is likely to be formed by the statistical contribution of a number of risk factors acting together. Multivariable analysis can be used to understand the association between injury and risk and protective factors in the home and wider environment of a child and compare them to the risk associated with independent variables relating to characteristics of the individual child and to their family.

To undertake the multivariable analysis a theoretical framework was required. The variables included in the multivariable analysis had a variety of inter-relationships. However, for the purposes of this exploratory analysis and to enable an estimation of the specific association between environmental variables and injury risk in primary school-aged children, a hierarchical structure was used.[187] Techniques such as stepwise logistic regression, where variables are added to the model only if they demonstrate a level of statistical significance, is widely used, but has the limitation of not allowing the consideration of variables that may have biological or social associations that struggle to meet criteria for statistical significance at a p<0.05 level. Therefore the analysis undertaken in this study used a conceptual framework that clearly states the hierarchical relationships between groups of variables. Variables that are higher up the hierarchy are considered less likely to directly affect the outcome of interest but instead exert the majority of their influence through variables more proximal to the outcome. Four levels have been used in this analysis: Neighbourhood, home, family and child (Figure 11).

Figure 11: Hierarchical conceptual framework for childhood injury



Child factors included physiological, developmental and behavioural variables of the child who may sustain an injury treated in secondary care during the period of study. Child factors such as sex, to which no intervention could be targeted, were excluded. Similarly, age of the child cannot be included in the model, as no intervention could potentially influence the age of the child. However, age has been explored through stratification of the analyses into those affecting the early primary period and those affecting the late primary period. Family factors included variables related to family composition, the mental or physical health of family members or social or fiscal family measures. Home factors included those related to the immediate environment of the child, specifically the living circumstances of the child during the period of study. Finally, environmental factors included objective or subjective measures of the wider environment of the child, specifically the neighbourhood in which the child lived.

6.4.6 Analysis of observed data

The multivariable regression analysis of the observed data used the hierarchical framework to construct a series of models reporting odds ratios of groups of independent variables with the outcome of secondary care attended injury.

The models are illustrated in Table 31 where each model considers the combination of different groups of variables. Models 1, 5, 6 and 7 are models of effect adjusted for other variables within the group only (Neighbourhood, Child, Family and Home respectively). Model 2 explored the impact of home variables, adjusted for environmental variables. Model 3 explored the impact of family variables, adjusted for home and neighbourhood variables, and Model 4 explored child variables adjusted for family, home and neighbourhood variables.

Table 31: Model framework for analysis of risk factors for injury.

	Model number						
Variable group	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Neighbourhood	✓	✓	✓	✓			
Home		✓	✓	✓			✓
Family			✓	✓		✓	
Child				✓	✓		

Note: ✓ indicates this group of variables are included in this step of the model

The results of the univariable analyses of association between individual independent variables and the outcome of secondary care attended injury were used to determine which variables should be entered into the multivariable regression models. Strict adherence to a p value cut off of 0.05 for the model entry criteria is unhelpful in an exploratory analysis such as this and therefore a more liberal cut off was required. The use of a <0.1 cut off for the p value of the odds ratio is suggested in some key texts[189] whilst others suggest that an even broader value (<0.2 or <0.25) is appropriate.[188] For this study a cut off of p<0.1 was chosen.

Results of studies reported in the systematic review indicated that risk and protective factors for injury were likely to change with increasing age of the child. To explore this within ALSPAC dataset analyses had already been split into early primary and late primary age groups. Variables with p values of <0.1 for the outcome of secondary care attended injury in either the early primary school period or the late primary school period were included in subsequent analyses.

6.4.7 Multiple imputation and analysis

6.4.7.1 Why does missing data matter?

In any study there is a risk that data intended for collection, will be missing. In a longitudinal cohort study such as ALSPAC this is a significant risk since one of the primary limitations of cohort studies is attrition of participants. Furthermore, some information may be lost accidently (e.g. questionnaire returned by the parent but lost in the post, or a failure of one page of a questionnaire to be printed), or may have been wrongly collected and therefore deleted (e.g. parent not answered the question using the options available). The missing data could relate to the outcome of interest, the independent variables, or both.

Data may be missing in a number of different ways:

1. **Missing completely at random (MCAR)** – this assumes that the probability of an item of data being missing is completely independent of any of the other observed or missing values. For example, a laboratory sample is dropped, or a page is not printed in one questionnaire due to a printing error.

2. **Missing at random (MAR)** – any difference between the observed and the missing data is explained by the observed data. For example, questionnaires may be less likely to be returned by younger mothers than older mothers because younger mothers are likely to move home more frequently. The term ‘missing at random’ is therefore confusing as this ‘missingness’ is not truly random, but predictable by the data that is available. However, convention now dictates that this is the correct terminology for this circumstance.
3. **Missing not at random (MNAR)** – even when all of the observed data are considered, the likelihood that data will be missing is related to the missing data. For example, a patient misses an appointment because they have symptoms and the condition causing the symptoms is the reason they were due to attend the appointment.

Descriptive reporting of variables, their proportion of missing data and cross tabulations of the individual variables and outcomes of interest are used to indicate patterns of ‘missingness’ within the data. Data that is MAR or MCAR is suitable for multiple imputation, whilst that which is MNAR is not.

Conducting an analysis that only includes questionnaires with complete responses for both the outcome variable and the independent variables (i.e. a truly complete case analysis), results in a number of issues:

- Estimates of effect (e.g. means, odds ratios etc) may be biased (as they are based only on the available data and the missing data may differ from the observed data)
- Standard errors may be increased and confidence intervals widened (as these estimates will be calculated on smaller numbers of participants)
- There will be a reduction in power of the study (as the sample size is reduced due to loss of data / participants)

Limiting the analysis to those parents that had returned all four questionnaires containing questions on injury (n=5752), resulted in significantly reduced quantities of missing data and produced a dataset for which the presence or absence of an injury was known for each child. However, the power of the study was reduced by reduced numbers of subjects and independent variable data could still be missing. In the multivariable regression analyses of the observed data only children that had all of the independent variables in each model, in addition to the injury outcome, were included in each analysis. This resulted in models containing different numbers of participants, varying degrees of missing data, varying degrees of bias due to that missing data, and varying degrees of power.

6.4.7.2 Simple methods for dealing with missing data

The simplest and most common method for coping with missing data is to only use those individuals where all data are complete. This is likely to significantly reduce the statistical power of the study and the results may be biased unless the missing data are missing completely at random.[190]

The alternative to the removal of individuals from the analysis is to 'impute' or generate a plausible value for the missing data, using the data that is available. Two common methods for this are to use the mean of the observed data or to replace the missing data with the last available measured value ('last number carried forward'). Both of these techniques have been criticised for lacking statistical validity and for their risk of introducing bias into the results. [191]

An improvement would be to fit a regression model to the available data and then replace the missing data with a value taken from the regression line. For example, for variables X and Y where some values of X are missing, a scatter plot and line of best fit can be plotted for those cases where both X and Y values are available and then the missing X values can be replaced by the value suggested by the line of best fit.

However, any method that creates only a single alternative imputed value for the missing data can lead to standard errors (and hence confidence intervals) that are too small since they fail to consider the uncertainty about the value of the missing data. Hence a method is needed that can incorporate this uncertainty, and result in standard errors of an appropriate size.

6.4.7.3 The method of multiple imputation

The underlying principle of multiple imputation is to use the observed data that is available to understand the relationships between the variables in that dataset. The steps in the method are:

1. An imputed regression model is fitted to the observed data but random noise is added to the estimated values to take uncertainty into consideration. Thus the first imputed dataset has been created.

2. The second step is to repeat this process *m* times to produce *m* imputed datasets. Creating multiple datasets also helps express the uncertainty about the missing data.
3. Each imputed dataset is then individually analysed using the method used for the observed data to give the original quantity of interest, Q. Thus a range of values for Q have been generated (Q_1,....,Q_m) which differ because of the random variation introduced during the imputation process.
4. The estimates for Q are then pooled (averaged) to give an overall estimated association. The standard errors are calculated using a set of rules (Rubin's rules)[192] that take into account the variability in results between the imputed datasets.

It is necessary to include a wide range of variables when imputing missing data. In addition to all the variables in the substantive analysis, both the outcome of interest and independent variables that will not form part of the final analysis are appropriate to include in the imputation process since they help determine the relationship between the variables and therefore improve the prediction of the missing values. Failure to include this breadth of variables may mean that the missing at random (MAR) assumption is not plausible.[193]

The multiple imputation technique requires the assumption that the missing data are MAR or MCAR. Under this assumption, the multiply imputed data will give unbiased estimates of effect and standard errors. It is therefore a useful tool for maintaining power and dealing with large datasets with potentially complex relationships between variables.

The recommended number of imputations of the data that should be run has increased with experience and use of the multiple imputation technique. Initially, three to five imputations (m=3 or m=5) were considered adequate. However, statisticians have theorised that another researcher running an imputation model on the same data could produce a set of imputed values of Q that have markedly differing confidence intervals and p values, because of the variation in random noise added during the imputation process. It is therefore recommended that five imputations should only be used if the fraction of missing information (FMI) is small, i.e. <5% of values are missing. In multivariate analyses where the FMI is likely to be greater than 5%, then >5 imputations should be undertaken. Fifty or more imputations are currently considered good practice.

Several standard statistical software packages are now able to perform multiple imputation greatly increasing its availability to researchers.

6.4.7.4 Multiple imputation used in this analysis

The technique of multiple imputation by chained equations (MICE) was first described by van Burren in 1999[194] and is based upon the principles described above. Since then, developments in statistical software packages have enabled the method to be increasingly accessible, including in STATA.[195-197] In STATA, `ice` is the command used to generate the multiple imputation and `m(#)` is the command to indicate the number of multiply imputed datasets required (where # = an integer). Once the multiply imputed datasets have been created, the substantive analysis is run, as in the analysis of the observed data, this time prefixed by the `mim` command, which fits the analysis model and applies Rubin's rules to combine estimates and derive standard errors.

The criteria that were applied to identify the variables used to generate the multiply imputed dataset included;

- Variables that were the strongest confounders associated with the outcome of interest (injury at age 8-11 years)
- Variables that predicted 'missingness' in the strongest confounders of injury at 8-11 years
- Variables included in the observed data logistic regression model for injury

The variables used to generate the multiply imputed datasets are listed in Table 32.

Table 32: Variables included in command to generate the multiply imputed dataset

Level	**Data variable**	**Variable code**
Outcome	Any secondary care attended injury aged 8-11	Anysci81
Child	Gender	Kz021b
	Hearing impairment at age 5	km2071b
	Visual impairment at age 7	f7vs010b2
	Gross motor skills at age 4	gmotor42b
	Total behaviour problems at age 6	total6Cat
	Total behaviour problems at age 9	total9Cat
	Learning difficulties at age 6	kp1220b
	Learning difficulties at age 8	learndiff8b

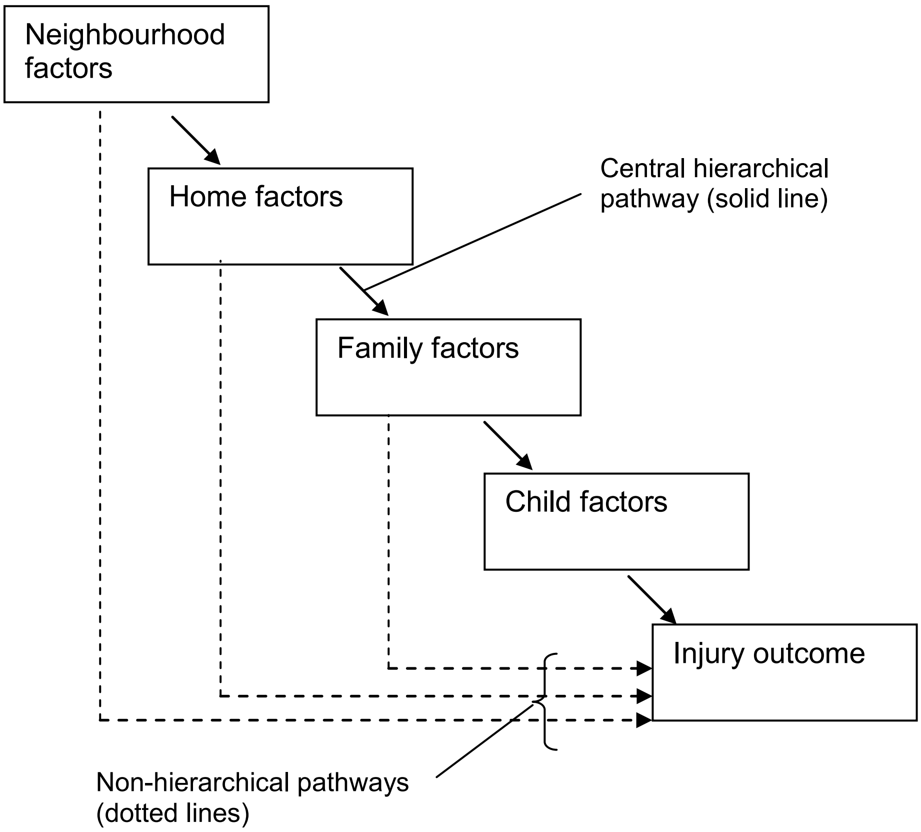
	Any secondary care attended injury aged 5-6	anysci56
	Any secondary care attended injury aged 3-4	anysci34
Family	Maternal age at child's birth	mz028bbin
	Mothers marital status at child age 7	Mmarital7
	Paternal social class	socclasscat
	Maternal highest educational level at child age 5	edqual5bin
	Maternal highest educational level at child age 9	edqual9bin
	Maternal general health at child age 6	mhealth6
	Maternal general health at child age 9	mhealth9
	Maternal self reported depression at child age 9	depr9
	Maternal life events score at child age 6	life6cat
	Maternal life events score at child age 9	life9cat
	Number of younger siblings at child age 6	sibsYCat
	Number of younger siblings at child age 9	sibsYCat2
	Number of older siblings at child age 6	sibsOCat
	Number of older siblings at child age 9	sibsOCat2
Home	Living in private rented accommodation at child age 5	rent5
	Living in private rented accommodation at child age 7	rent7
	Maternal satisfaction with the home at child age 5	Home5
	Maternal satisfaction with the home at child age 7	Home7
	Reported problems with the home at child aged 5	hprobs5bin
	Reported problems with the home at child aged 7	hprobs7bin
	Number of house moves at child aged 5	moves5b
	Number of house moves at child aged 7	moves7b
	Crowding in the home at child aged 7	crowd7cat
	Crowding in the home at child aged 10	crowd10cat
Neighbourhood	Quintile of deprivation of area of residence at child age 5	Qimd
	Neighbourhood problems score at child aged 7	nbprobs7b
	Mothers social networks score at child aged 5	socnet5bin
	Mothers social networks score at child aged 9	socnet9bin
	Neighbour cares for children at child aged 5	ncares5
	Neighbour visits house at child aged 5	nvisits5b
	Neighbour visits house at child aged 7	nvisits7b
	Mothers social support score at child age 5	socsup5b
	Mothers social support score at child age 9	socsup9b

One hundred imputed datasets were generated (m=100), yielding a 220MB dataset containing 500,000+ observations. This imputed dataset was used to re-run the multiple regression analysis previously used on the observed data.

6.4.7.5 Independent effect of home and neighbourhood variables on injury risk

To assess the impact of the home and the wider environment on injury risk for children, over and above that due to family and child factors, a series of analyses using likelihood ratios was conducted. These analyses identified whether groups of variables were exerting an influence on injury outcomes independently of the hierarchical pathway (Figure 12).

Figure 12: Likelihood ratio analysis of non-hierarchical contribution to childhood injury



The analysis using likelihood ratio tests identified whether any of the three non-hierarchical pathways (dotted line arrows in Figure 12) were independently contributing to the injury outcomes, over and above that occurring through the central hierarchical pathway (solid line arrows). The likelihood ratio test compared the log likelihoods of a model containing one group of variables alone to a model that contained all the other groups of variables. For example, to assess the contribution of home variables independently, the first model would calculate the log likelihood for home variables alone, and the second model would compare the log likelihood for neighbourhood, family and child variables. A p value of <0.05 for the likelihood ratio test comparing these two models would suggest that the two models had a greater difference than would have occurred by chance, and that the single group of variables was contributing to injury outcomes independently.

6.5 ETHICAL CONSIDERATIONS

This study has used data already collected by the ALSPAC team, under the approval of the ethical committees in place at that time (Bristol and Weston Health Authority District Ethics Committee, Frenchay Health Authority Ethical Committee and Southmead Health Authority Ethical Committee). The ethical framework for ALSPAC is that all the information collected on the children is anonymised, such that none of the findings on any individual child can or will be taken back to that child or family. It is therefore not possible to validate parent-reported information against primary or secondary care records. Each researcher using data from ALSPAC is given a unique identification number for each child, so that researchers cannot pool data.

The PhD proposal was submitted to the ALSPAC Scientific Committee and to the ALSPAC Ethical Advisory Committee and granted approval. All the data has been anonymised by the ALSPAC team such that no child can be identified from the data by the researcher. Advice at the start of the period of study confirmed that further approval from NHS ethical committees was not required as no direct contact with the children or their families would be undertaken during this course of study. The Chair of the Faculty of Health and Social Care Ethics Committee at the University of the West of England, Bristol, confirmed that a submission to the Faculty Ethics Committee was not required. All data has been kept securely and the project subject to standard research governance processes at the University of the West of England, Bristol.

6.6 SUMMARY OF CHAPTER

This chapter has stated the methods used to prepare the data provided by the parents and carers of primary school-aged children in ALSPAC, reported how the epidemiology of the injuries sustained by the children will be described, and provided an explanation and rationale for the methods of analysis used to explore the risk and protective factors for secondary care attended injuries in these children. The detail provided has been at a level that, it is hoped, will provide transparency of the methods used. This was felt to be particularly important for the section on the coding framework, as this framework has the potential to be applied to the preschool injury data and to injury data collected when the children were aged 13 years and 16 years. A range of different methods exist to create multivariable regression models. The decision to use a hierarchical model, split into four levels will have an impact on the associations found and the interpretation of those findings. Consistency of associations using different methods of regression would lend weight to their validity but will be beyond the scope of this thesis.

CHAPTER 7: RESULTS OF DESCRIPTIVE ANALYSIS OF INJURIES

This chapter will describe the injuries that have been reported by the parents of the children in ALSPAC, in the four questionnaires administered between five and 11 years of age. An overview of the descriptive injury data will be followed by analysis of nine different types of injury by a range of measures including location and mechanism of the injury event, the supervision of the child at the time of the event, the treatment required for the injury and the distribution of that injury type by quintile of deprivation. As transport accidents are the greatest single cause of traumatic deaths in children aged 5-14 years in England the final section will describe injuries occurring in the road environment.

This study considers only non-fatal injuries. One child in ALSPAC died between the ages of five and 11 years as a result of an injury. Further details of the injury have been withheld by the ALSPAC Team in order to preserve the anonymity of the child.

7.1 OVERVIEW OF INJURY DATA

The response rate to the questionnaires containing questions on injuries was >69% and has already been described in Chapter 5, Table 23. The number of children with any parent-reported injury and the proportion of children sustaining any injury for each questionnaire are shown in Table 33. The proportion of respondents sustaining any injury increased with time. The extended period of recall for the questionnaire collected at 11½ years will have contributed to the increased proportion seen in this questionnaire.

Table 33: The reporting period, number and percentage of respondents injured in each injury questionnaire

Age at completion of questionnaire	Reporting Period	Number of children with any injury reported	Number of respondents to questionnaire	Percentage of respondents sustaining any injury
5½ years	'Since age 4½ yrs' (~12m)	1603	9003	17.8
6½ years	'In the past 12 months'	1991	8568	23.2
8½ years	'In the past 12 months'	2211	7988	27.7
11½ years	'Since 9th Birthday' (~30m)	2698	7157	37.7

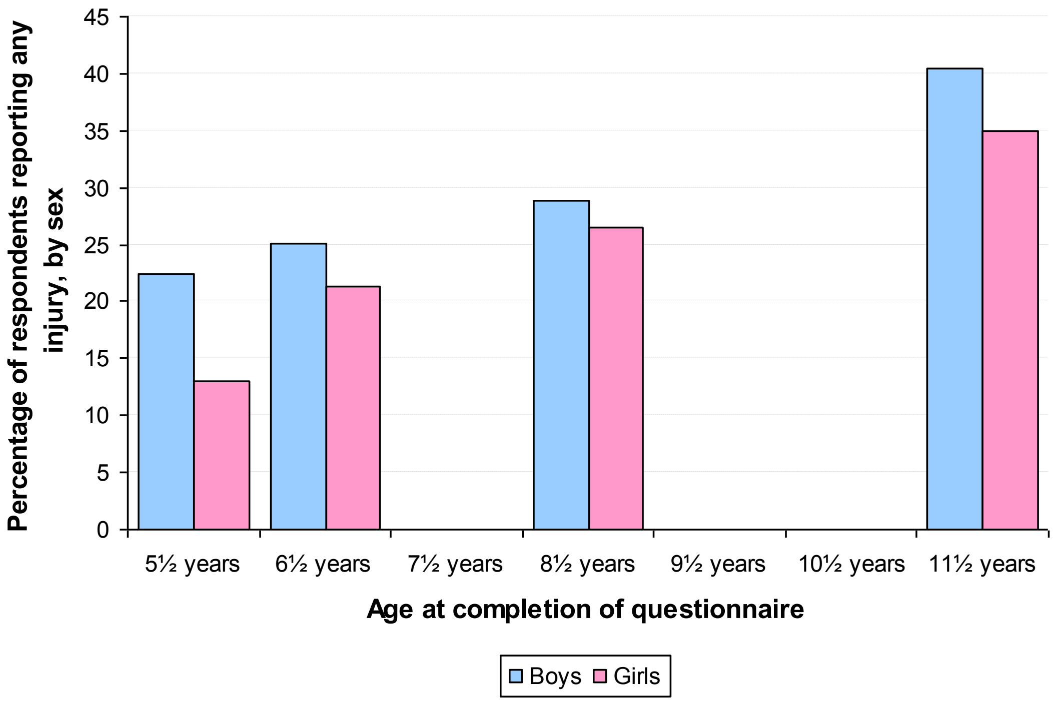
Note: m = months

A total of 5498 children were reported to have sustained any injury between 4½ and 11½ years of age; 2965 (53.9%) were boys, and 2533 (46.1%) were girls. The percentage of boys and girls reporting any injury increased in each reporting period, and on each occasion the percentage of boys sustaining any injury was greater than the percentage of girls sustaining any injury (Table 34, Figure 13). The difference was greatest at age 5½ (9.38%), then narrowed, to widen again at 11½ years.

Table 34: Number and percentage of boys and girls sustaining any injury in each reporting period

Age at completion of questionnaire	Sex	Number of children with any injury reported	Number of respondents to questionnaire	Percentage of respondents sustaining any injury
5½ years	Boys	1037	4640	22.35
	Girls	566	4363	12.97
6½ years	Boys	1107	4410	25.10
	Girls	884	4158	21.26
8½ years	Boys	1177	4085	28.81
	Girls	1033	3903	26.47
11½ years	Boys	1451	3588	40.44
	Girls	1247	3569	34.94

Figure 13: Percentage of boys and girls reporting any injury at each reporting period



Any child could have sustained several different injuries across multiple injury events reported on each injury questionnaire. A total of 12,421 injury events were reported in the four injury questionnaires (Table 35).

Table 35: Number of injury events reported through injury questionnaires

Age at completion of questionnaire	Questionnaires returned	Number of injury events reported
5½ years	9003	2046
6½ years	8568	2820
8½ years	7988	3347
11½ years	7157	4208
Total	32716	12421

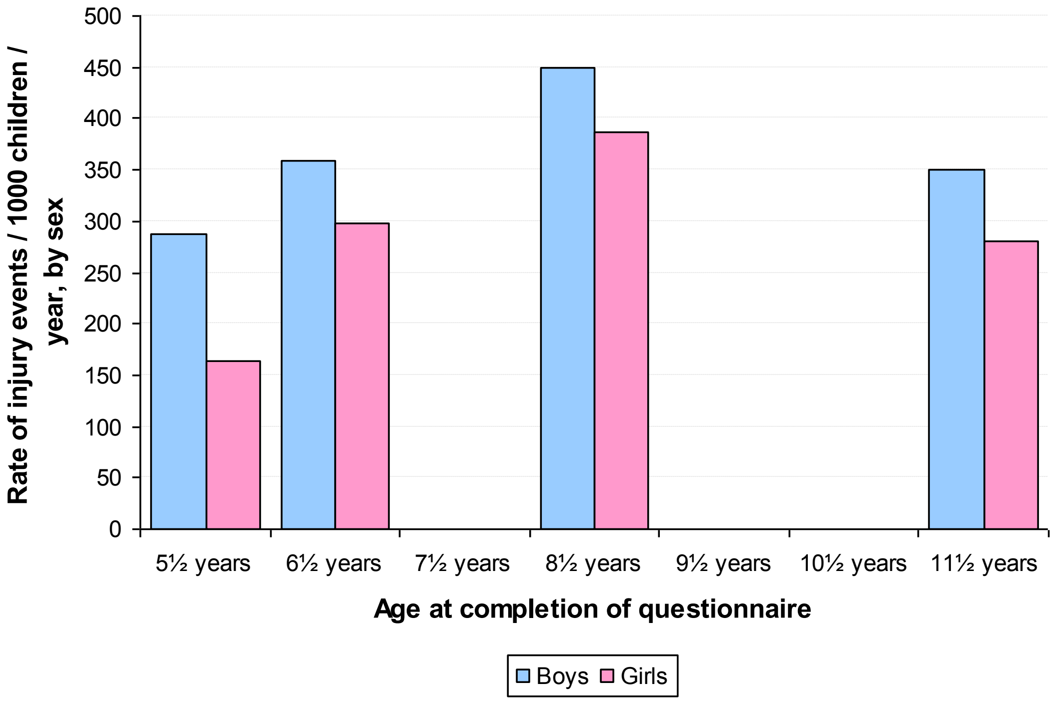
The recall period for the questionnaire at age 11½ years was longer than the other questionnaires. To calculate the rate of injury events reported in each questionnaire, the number of injuries reported during the 12 months prior to completion of the questionnaire was required. For the questionnaire at age 11½ years this was calculated using the date of return of the questionnaire and the date of the injury event. A total of 10,467 injury events were reported in the 12 month periods prior to the four questionnaires. This denominator has been used to estimate all rates reported in this chapter. The rate of injury events per year is shown in Table 36.

Table 36: Rate of injury events per 1000 children per year, by age and sex

Age at completion of questionnaire	Sex	Total number of injury events reported in previous 12m	Number of respondents to questionnaire	Rate of injury events per 1000 children per year	Rate Ratio (Boys:Girls)
5½ years	Boys	1332	4640	287.07	1.75
	Girls	714	4363	163.65	
6½ years	Boys	1579	4410	358.05	1.20
	Girls	1241	4158	298.46	
8½ years	Boys	1837	4085	449.69	1.16
	Girls	1510	3903	386.88	
11½ years	Boys	1255	3588	349.78	1.25
	Girls	999	3569	279.91	
Total		10467	32716		

The rate of injury events for boys and girls increases from age 5½ years to 8½ years, and then falls at 11½ years. The rate of injury events is greater for boys than girls at all ages (Figure 14). The ratio of the rate of injury events in boys to the rate in girls is greatest at 5½ years (1.75) and then falls to a constant level (~1.2) from age 6½ to 11½ years.

Figure 14: Rate of injury events per 1000 children per year by age and sex

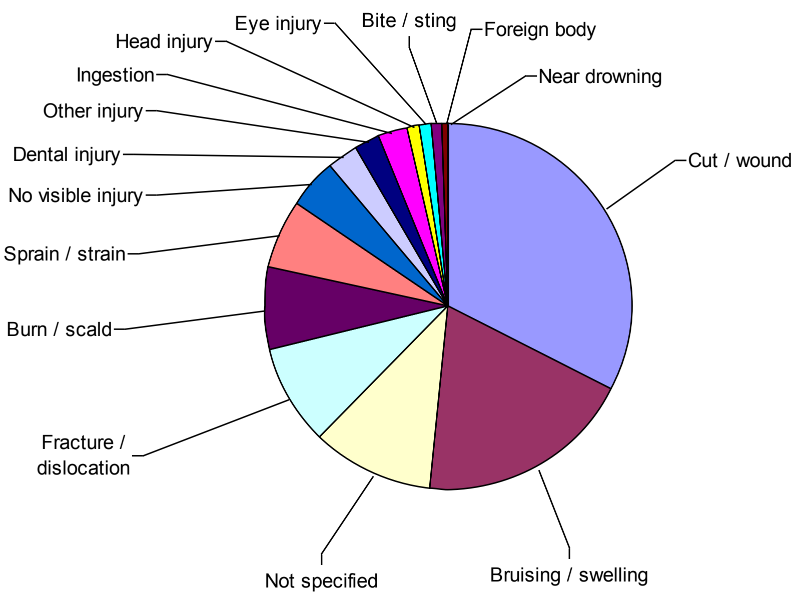


The commonest type of injuries reported were cuts and wounds, followed by bruising / swelling injuries, fractures and dislocations, burns and scalds and sprains and strains. (Table 37, Figure 15). Boys had more of each type of injury than girls except for burns and scalds and sprain / strain injuries (Figure 16)

Table 37: Number and percentage of different types of injuries reported in the 12 months prior to each questionnaire

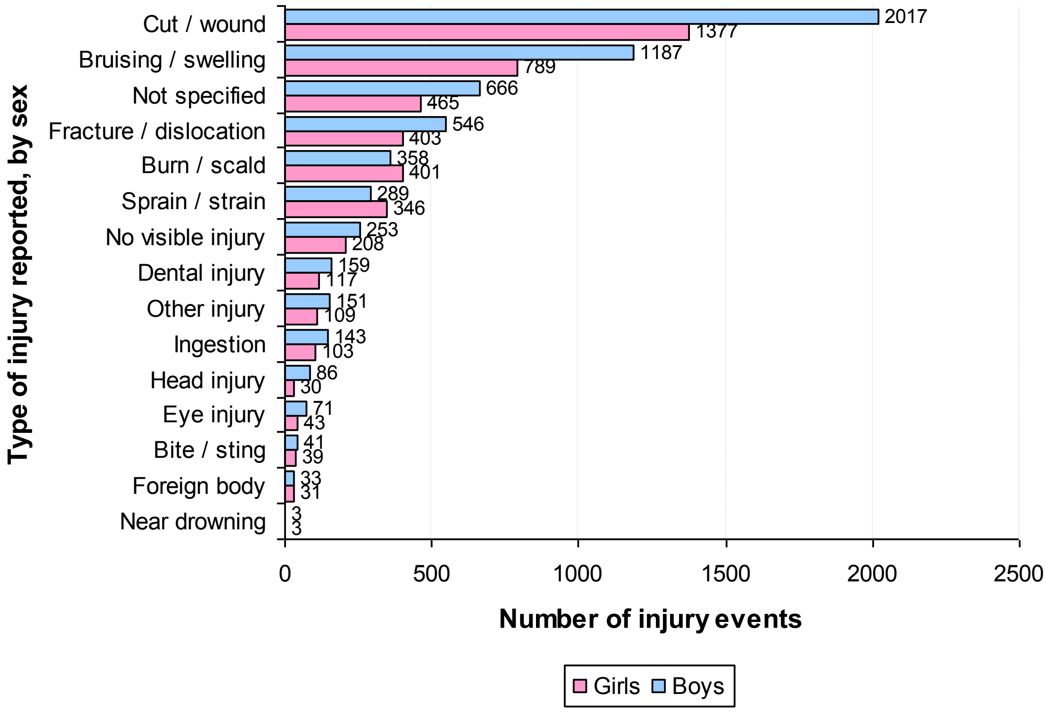
Type of injury	Number of events reported	Percentage of all injury events
Cut / wound	3394	32.43
Bruising / swelling	1976	18.88
Not specified	1131	10.81
Fracture / dislocation	949	9.07
Burn / scald	759	7.25
Sprain / strain	635	6.07
No visible injury	461	4.40
Dental injury	276	2.64
Other injury	260	2.48
Ingestion	246	2.35
Head injury	116	1.11
Eye injury	114	1.09
Bite / sting	80	0.76
Foreign body	64	0.61
Near drowning	6	0.06
Total	**10467**	**100.00**

Figure 15: Pie chart of injuries in the 12 months prior to each questionnaire, by type of injury



Note: n=10467

Figure 16: Bar chart of reported injury events in the 12 months prior to each questionnaire, by type of injury and sex



Note: n=10467

7.2 CUTS AND WOUNDS

The category ‘cuts and wounds’ included all injury events that resulted in damage to the continuity of the skin surface. The category therefore included lacerations, grazes, gashes and ‘scrages’ (a West Country expression denoting a combined scrape and graze). Injuries were also considered to comprise a cut / wound if the outcome was not clearly stated but the treatment suggested that the injury must have fallen into this category (e.g. the treatment included stitches or gluing, or if plasters or dressings were applied). The category did not include bites and stings, or burns and scalds, as these were coded separately.

7.2.1 Number and rate of cut / wound injuries

Cuts, wounds and lacerations were the commonest type of injury at all ages. A total of 3798 cuts and wounds were reported, comprising 30.6% (3798/12421) of all injury events. Boys had more cuts and wounds than girls in total (59.4%, 2258/3798) and in each data collection period (Table 38).

Table 38: Frequency of cuts and wounds by age and sex

Age (years)	Reporting period	Number of injuries		
		Boys	Girls	Total
5½	4½ to 5½	555	265	820
6½	5½ to 6½	601	460	1061
8½	7½ to 8½	593	485	1078
11½	9 to 11½	509	330	839
Total		2258	1540	3798

Note: n=3798

In all, 3395/3798 (89.4%) of these cut / wound injuries were reported in the 12 months prior to each questionnaire (Table 39, Figure 17). The rate of reported cuts and wounds increases in boys and girls to age 8½ years and then fell. The fall in rate at 11½ years may be partly due to under-reporting of cuts and wounds as children grow older.

Table 39: Rate of cuts and wounds per 1000 children per year, by age and sex

Age (years)	Reporting period	Rate of injuries / 1000 children / year	
		Boys	Girls
5½	12 months	119.61	60.74
6½	12 months	136.28	110.63
8½	12 months	145.17	124.26
11½	12 months	74.97	46.79

Note: n=3395

Figure 17: Rate of cuts and wounds per 1000 children per year, by age and sex

Note: n=3395

7.2.2 Place where the cut / wound event occurred

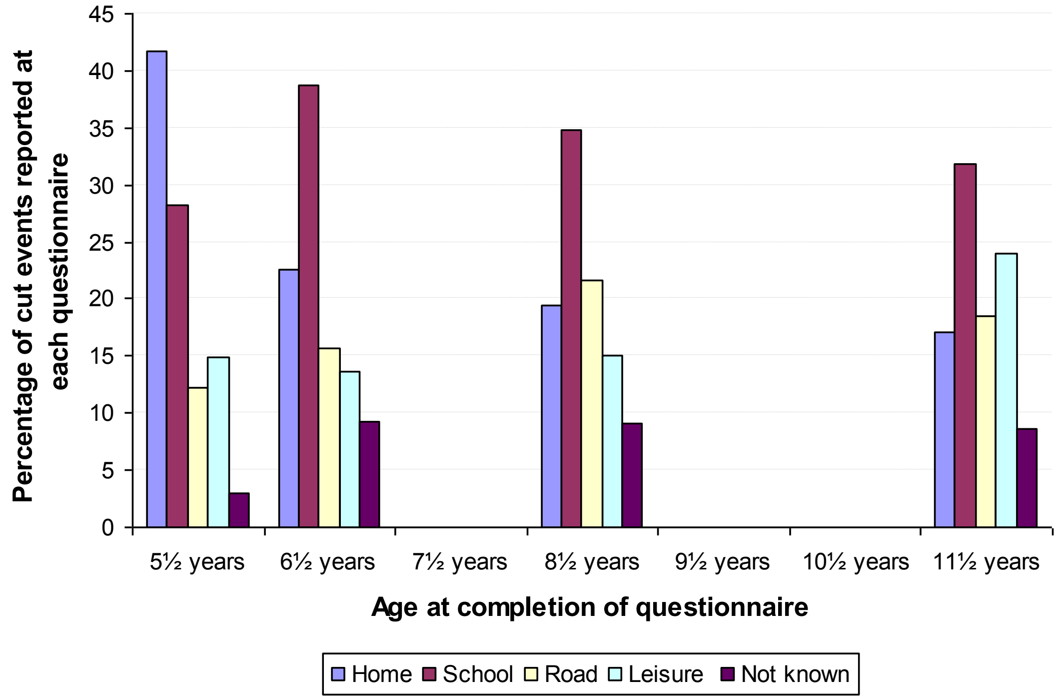
Data was available on the location of the cut / wound injury event on 3505/3798 (92.3%) of occasions. The school was the commonest location for cuts and wounds (1285/3505, 36.7%) (Table 40). Of these, 566 (44.0%) were known to have occurred in the playground. The second commonest site overall was in the home, and this was the commonest location for children aged 5½ years. Of 935 cuts and wounds in the home, 431 (46.1%) were reported to have occurred in the garden or yard. The road and the leisure environment become increasing important locations of cuts and wounds as children grew older (Figure 18).

Table 40: Location of cut and wound injuries, by age

Location	Cut / wound injuries (number and percentage)									
	5½ years		6½ years		8½ years		11½ years		Total	
	N	%	N	%	N	%	N	%	N	%
Home	342	41.71	240	22.62	210	19.48	143	17.04	935	24.62
School	232	28.29	411	38.74	375	34.79	267	31.82	1285	33.83
Road	100	12.20	167	15.74	233	21.61	155	18.47	655	17.25
Leisure	122	14.88	145	13.67	162	15.03	201	23.96	630	16.59
Not known	24	2.93	98	9.24	98	9.09	73	8.70	293	7.71
Total	820	100.00	1061	100.00	1078	100.00	839	100.00	3798	100.00

Note: n=3798

Figure 18: Change in the proportion of cuts and wounds occurring in different locations, by age



Note: n=3798

7.2.3 How the cut / wound injury occurred

The commonest underlying mechanism of the cut / wound injuries was blunt trauma, especially falling, tripping, stumbling or jumping (3419/3798, 90.0%). Penetrating injuries caused by sharp objects became more common with age but was never more than 10.7% (90/839) of the cause at any questionnaire reporting period (Table 41).

Table 41: Underlying mechanism of cut / wound injuries, by age

Mechanism of injury	Cut / wound injuries (number)				
	5½ years	6½ years	8½ years	11½ years	Total
Blunt force: Transport injury	5	10	5	11	31
Other blunt force	777	970	953	719	3419
Penetrating force	30	59	81	90	260
Other mechanism	0	1	2	1	4
Not known	8	21	37	18	84
Total	820	1061	1078	839	3798

Note: n=3798

7.2.4 Who was with the child at the time of the injury and treatment of the cut / wound sustained

Who was with the child at the time of the cut / wound injury was known for 2787 events (73.4%) (Table 42). On more than two thirds of occasions the child cut or wounded themselves whilst in the care of their parents or another adult (1956/2787, 70.2%). Children were seldom cut / wounded whilst playing alone (65/2787, 2.3%).

The treatment received for the cut / wound can be used as a proxy for the severity of the injury. The treatment received was known for 3744 (98.6%) of the cut / wound injuries. The majority of these injuries were either so minor that no treatment was necessary (244/3744, 6.5%) or the cuts / wounds were able to be managed with first aid by the parents or carers of the child (1975/3744, 52.8%). However, 1525 cuts / wounds (40.7%) required treatment from medical or dental professionals. Treatment in primary care settings were likely to be through the doctor or nurse at the local general practice or surgery. Dental care would most likely have been provided by a local dental surgeon or could have been provided at the Dental hospital in Bristol. Secondary care would include being seen in an emergency department, in outpatients, or being admitted to hospital for treatment of the injury. The number of cuts / wounds requiring secondary care was 1055/3744 (28.2%), of which only one required admission for treatment.

Table 42: Who was with the child at the time of the cut / wound, by treatment received for the injury sustained

Who was with the child	Treatment received for cut / wound injury (number)						
	No treatment required	First aid only by parent or carer	Primary care doctor or nurse	Treated by dentist	Secondary care doctor or nurse	Not known	Total
Child alone	3	30	6	0	21	5	65
Parent(s)	34	437	106	8	304	4	893
Other children	86	414	92	5	161	8	766
Other adult(s)	73	653	126	2	199	10	1063
Not known	48	441	123	2	370	27	1011
Total	244	1975	453	17	1055	54	3798

Note: n=3798

7.2.5 Cut / wound injuries and deprivation of area of residence of the child

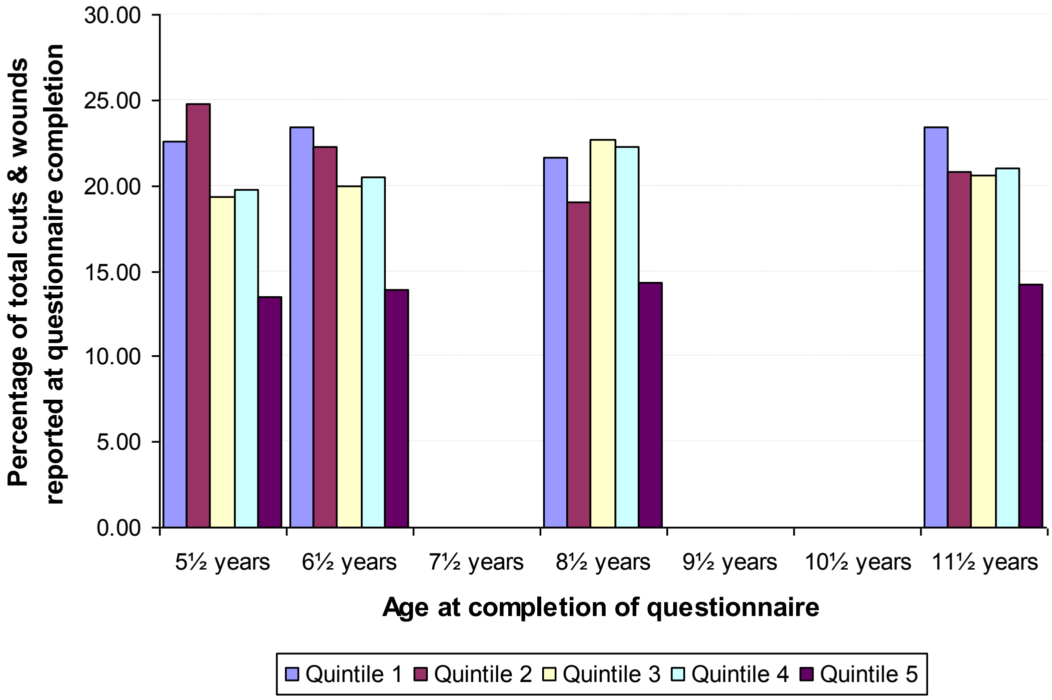
Children experiencing 3568 of the 3798 cut / wound events had an IMD 2000 quintile available. Considering all cut / wound injuries reported at each questionnaire completion, children with cuts/ wounds were less likely to be in quintile 5 than any of the other quintiles at any age (Table 43, Figure 19).

Table 43: Cut / wound injuries by quintile of deprivation and age at completion of questionnaire

IMD	Cut / wound injuries (number and percentage)								
	5½ years		6½ years		8½ years		11½ years		Total
	N	%	N	%	N	%	N	%	N
Quintile 1	175	22.61	235	23.43	217	21.61	184	23.38	811
Quintile 2	192	24.81	223	22.23	191	19.02	164	20.84	770
Quintile 3	150	19.38	200	19.94	228	22.71	162	20.58	740
Quintile 4	153	19.77	206	20.54	224	22.31	165	20.97	748
Quintile 5	104	13.44	139	13.86	144	14.34	112	14.23	499
Total	774	100.00	1003	100.00	1004	100.00	787	100.00	3568

Note: n=3568

Figure 19: Percentage of cut / wound injuries by quintile of deprivation and age



Note: n=3568

7.3 BRUISING AND SWELLING INJURIES

The category of bruising or swelling refers to injury events that resulted in visible trauma to the skin or soft tissues but did not result in breaking the continuity of the skin or in a bone injury. Bruising or swelling injuries include bumps, lumps and marks on the skin as a result of pressure, and include crush injuries where these did not result in skin trauma or bone injury. The category does not include over exertion or over stretching injuries (e.g. sprains and strains) as these are coded separately.

7.3.1 Number and rate of bruising and swelling injuries

Bruising or swelling is the second commonest outcome of an injury event, after cuts and wounds. A total of 2236 bruising or swelling injuries were reported. The number of injuries increased in each questionnaire. Boys were reported to have more bruising or swelling injuries than girls at all ages (Table 44).

Table 44: Frequency of bruising and swelling injuries, by age and sex

Age (years)	Reporting period (years)	Number of injuries		
		Boys	Girls	Total
5½	4½ to 5½	229	124	353
6½	5½ to 6½	314	213	527
8½	7½ to 8½	386	253	639
11½	9 to 11½	407	310	717
Total		1336	900	2236

Note: n=2236

In total, 1976/2236 (88.4%) of these bruising or swelling injuries were reported in the 12 months prior to each questionnaire. The rate of bruising or swelling injuries increased to age 8½ for both boys and girls and then decreased at age 11½ years (Table 45, Figure 20).

Table 45: Rate of bruising and swelling injuries / 1000 children / year, by age and sex

Age (years)	Reporting period	Rate of injuries / 1000 children / year	
		Boys	Girls
5½	12 months	49.35	28.42
6½	12 months	71.20	51.23
8½	12 months	94.49	64.82
11½	12 months	71.91	55.76

Note: n=1976

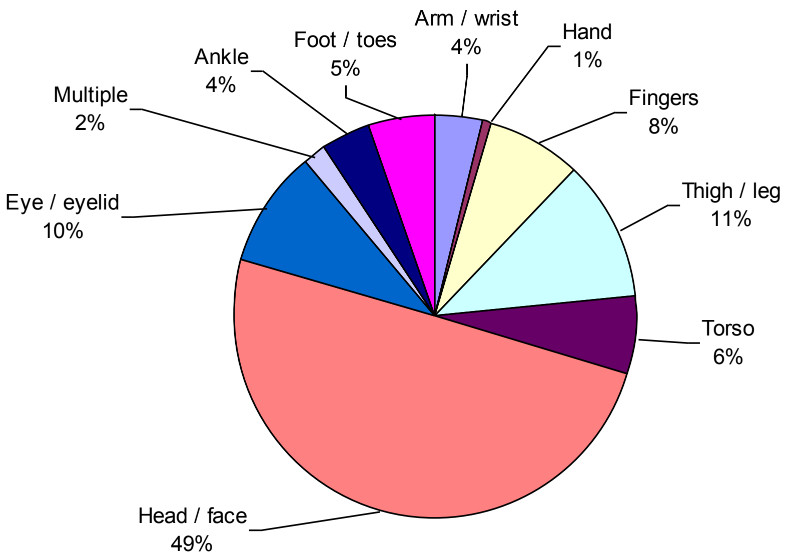
Figure 20: Rate of bruising and swelling injuries / 1000 children / year, by age and sex

Note: n=1976

7.3.2 Part of the body bruised or swollen

Information on the part of the body bruised or swollen was available for 1783/2236 (79.7%) of the injuries reported. Bruising to the face and head (including the eye, e.g. 'black eye') was the commonest type of bruising or swelling, followed by bruising to the thigh or leg (Figure 21). This presumably demonstrates under-reporting of bruising to the lower limbs, which is known to be extremely common in children of primary school age (and may therefore be perceived by carers as not worth reporting), and more complete reporting of bruising / swelling to the head and face which is perceived as more serious.

Figure 21: Part of the body bruised or swollen as a result of injury



Note: n=1783

7.3.3 Place where the bruising or swelling injury event occurred

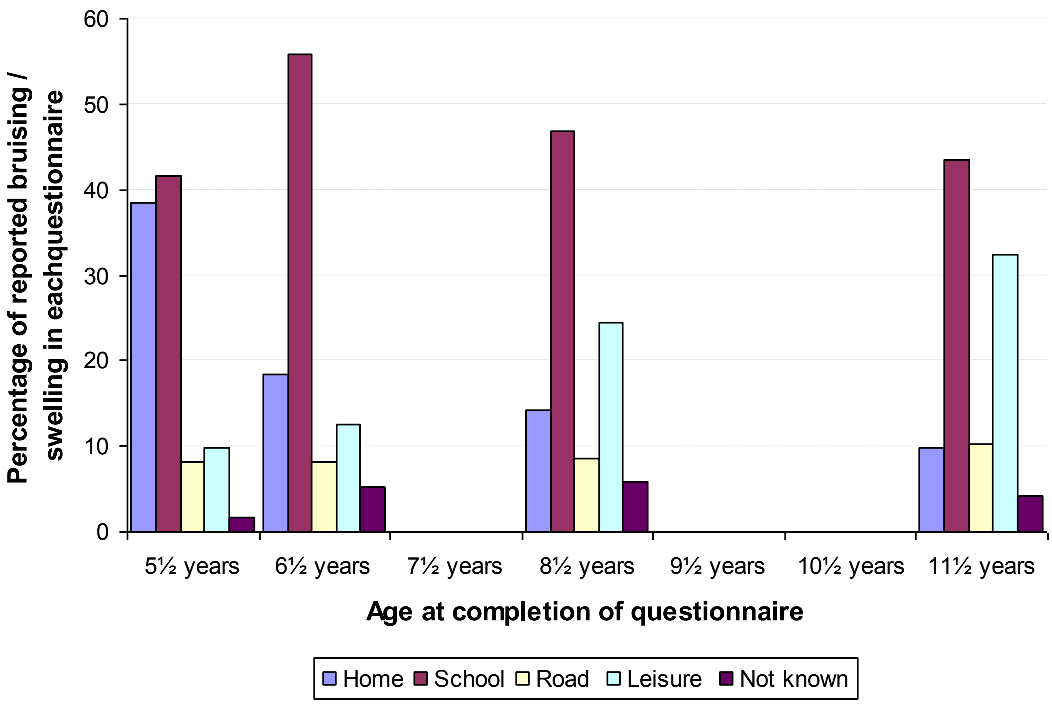
The location of the bruising / swelling injury event was reported for 2235/2236 (99.9%) of injuries. The home and school environments were common locations for bruising or swelling injuries at age 5½, but thereafter the school became the predominant location. The leisure environment became increasingly important with age, whilst the road environment was a location where a constant low proportion of bruising or swelling events occurred (Table 46, Figure 22)

Table 46: Location of bruising or swelling injury events, by age

Location	Bruising / swelling injuries (number and percentage)									
	5½ years		6½ years		8½ years		11½ years		Total	
	N	%	N	%	N	%	N	%	N	%
Home	136	38.53	97	18.41	91	14.24	70	9.78	394	17.63
School	147	41.64	294	55.79	299	46.79	311	43.44	1051	47.02
Road	29	8.22	43	8.16	55	8.61	73	10.20	200	8.95
Leisure	35	9.92	66	12.52	156	24.41	232	32.40	489	21.88
Not known	6	1.70	27	5.12	38	5.95	30	4.19	101	4.52
Total	353	100.00	527	100.00	639	100.00	716	100.00	2235	10.00

Note: n=2235

Figure 22: Change in the location of bruising or swelling injury events, by age



Note: n=2235

7.3.4 How the bruising or swelling injury occurred

The commonest mechanism leading to bruising or swelling injuries was blunt force (2048/2235, 91.6%), especially as a result of falling, tripping, stumbling or jumping and coming into contact with the ground or an object (Table 47). None of the other mechanisms of injury were responsible for a large number of bruising or swelling events.

Table 47: Underlying mechanism of bruising / swelling injuries, by age

Mechanism of injury	Bruising / swelling injuries (number)				
	5½ years	6½ years	8½ years	11½ years	Total
Blunt force: Transport injury	4	8	13	24	49
Other blunt force	333	493	575	647	2048
Penetrating force	2	1	2	3	8
Other mechanism	1	3	6	19	29
Not known	13	22	43	23	101
Total	353	527	639	716	2235

Note: n=2235

7.3.5 Who was with the child and treatment of the bruising or swelling sustained

Information on who was with the child at the time of the bruising or swelling injury was available for 1821/2235 (81.5%) children sustaining this injury (Table 48). Most events occurred when the children were with their parents or other adults (1378/1821, 75.7%). Children were less likely to be reported to sustain bruising or swelling injuries when playing alone (25/1821, 1.4%).

Information on the treatment required for the bruising or swelling injury was available for 2192/2235 injuries (98.1%). Most bruising or swelling injuries either required no treatment or were managed by first aid from the parent or carer of the child (1678/2192, 76.6%). However, 146 (6.7%) bruising or swelling injuries were seen by a doctor or nurse in primary care and 363 (16.6%) were seen in hospital. No child was admitted to hospital following a bruising or swelling injury.

Table 48: Who was with the child at the time of the bruising or swelling injury, by treatment received

Who was with the child	Treatment received for the bruising / swelling injury (number)						
	No treatment required	First aid only by parent or carer	Primary care doctor or nurse	Secondary care doctor or nurse	Care by other person*	Not known	Total
Child alone	3	8	2	7	0	5	25
Parent(s)	67	262	34	86	1	4	454
Other children	131	187	28	65	1	6	418
Other adult(s)	206	524	64	116	3	11	924
Not known	84	206	18	89	0	17	414
Total	491	1187	146	363	5	43	2235

Note: *Care by other person includes dentist, physiotherapist, chiropractor, osteopath etc.
Note: n=2235

7.3.6 Bruising and swelling injuries and deprivation of area of residence

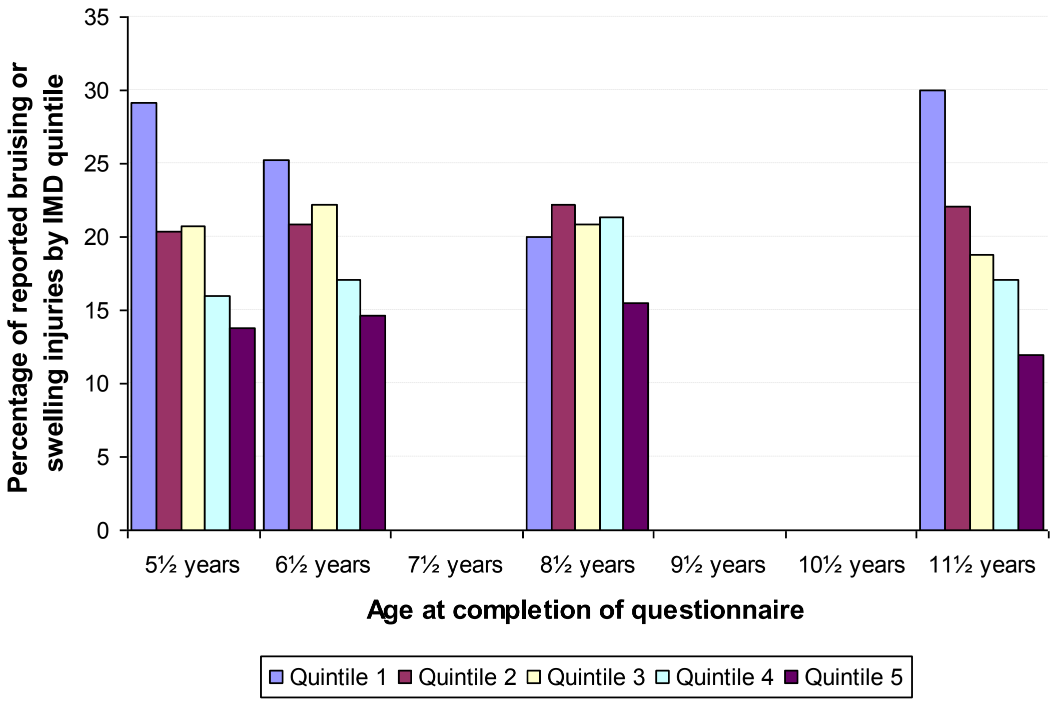
An IMD 2000 score was available for 2100/2235 (94.0%) children with a bruising or swelling injury (Table 49). The data collected at age 5½, 6½ and 11½ years suggests a trend with fewer bruising or swelling injuries in children living in greater levels of deprivation, although this pattern is not repeated in data collected at age 8½ years (Figure 23).

Table 49: Bruising / swelling injuries by quintile of deprivation and age

IMD	Bruising / swelling injuries (number and percentage)								
	5½ years		6½ years		8½ years		11½ years		Total
	N	%	N	%	N	%	N	%	N
Quintile 1	97	29.13	126	25.25	120	20.03	201	30.04	544
Quintile 2	68	20.42	104	20.84	133	22.20	148	22.12	453
Quintile 3	69	20.72	111	22.24	125	20.87	126	18.83	431
Quintile 4	53	15.92	85	17.03	128	21.37	114	17.04	380
Quintile 5	46	13.81	73	14.63	93	15.53	80	11.96	292
Total	333	100.00	499	100.00	599	100.00	669	100.00	2100

Note: n=2100

Figure 23: Percentage of bruising and swelling injuries by quintile of deprivation and age



Note: n=2100

7.4 FRACTURES

A fracture was defined as a break in any bone or damage to the surface of the bone (e.g. greenstick fracture), with or without skin trauma. Dislocations of joints were not included in this analysis of fractures.

7.4.1 Number and rate of fractures

The total number of fractures reported in the four injury questionnaires was 1290. Fractures in boys and girls increased with age and were more frequent in boys than girls at all ages (Table 50). The ratio of total fractures in boys compared to girls is 1.22 to one.

Table 50: Frequency of fractures, by age and sex

Age (years)	Reporting period (years)	Number of injuries		
		Boys	Girls	Total
5½	4½ to 5½	100	47	147
6½	5½ to 6½	107	92	199
8½	7½ to 8½	137	125	262
11½	9 to 11½	365	317	682
Total		709	581	1290

Note: n=1290

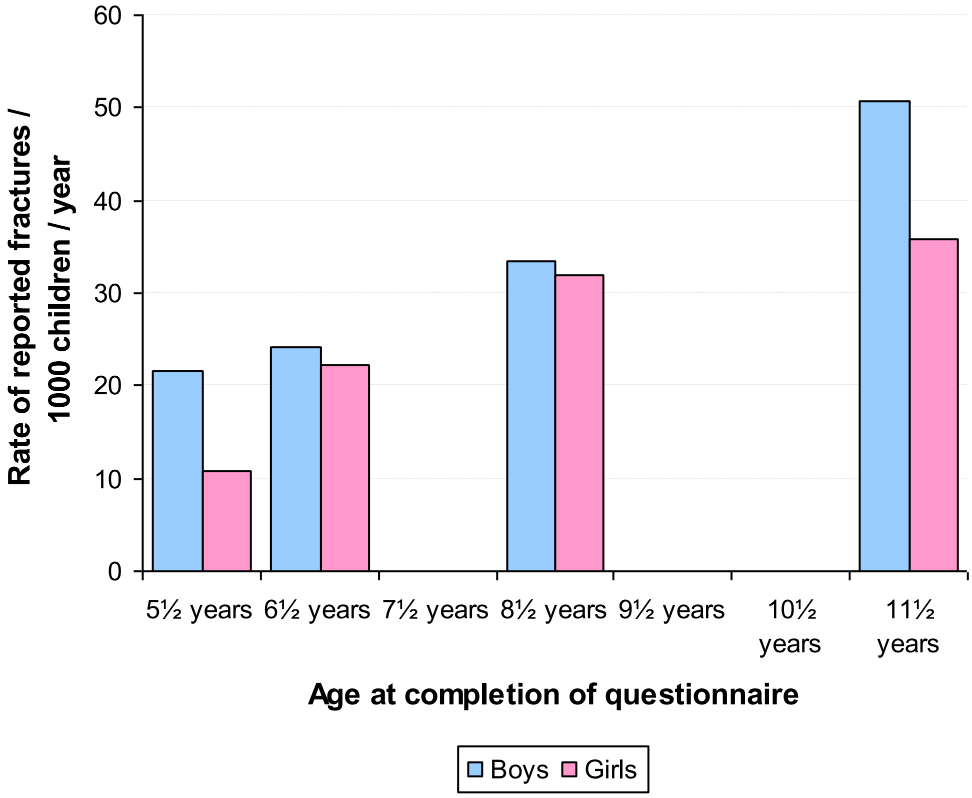
In all, 918/1290 (71.2%) of fractures were reported in the 12 months prior to each questionnaire. The rate of reported fractures increased with age. In boys this increase continues with age, whilst in girls the rate levelled from 8½ years (Table 51, Figure 24).

Table 51: Rate of fractures per 1000 children per year, by age and sex

Age (years)	Reporting period	Rate of injuries / 1000 children / year	
		Boys	Girls
5½	12 months	21.55	10.77
6½	12 months	24.26	22.13
8½	12 months	33.54	32.03
11½	12 months	50.72	35.86

Note: n=918

Figure 24: Rate of fractures per 1000 children per year, by age and sex



Note: n=918

7.4.2 Part of the body fractured

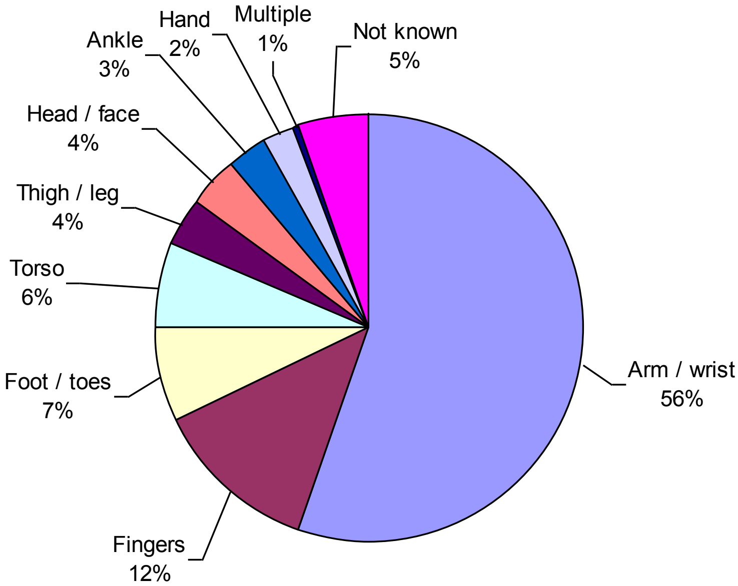
Information on the part of the body injured was available for 1282/1290 (99.4%) reported fractures. The arm / wrist was the most common part of the body to be fractured with 710 fractures, (55.4% of all fractures), followed by fingers (12.5%) and foot / toes (7.0%) (Table 52, Figure 25).

Table 52: Frequency of fractures by age and part of the body fractured

Part of body fractured	Fractures (number)				
	5½ years	6½ years	8½ years	11½ years	Total (%)
Arm / wrist	87	128	149	346	710 (55.4)
Fingers	9	10	35	106	160 (12.5)
Foot / toes	3	10	15	62	90 (7.0)
Torso	21	15	12	35	83 (6.5)
Thigh / leg	9	10	9	20	48 (3.7)
Head / face	10	7	9	21	47 (3.7)
Ankle	0	1	13	27	41 (3.2)
Hand	0	1	2	25	28 (2.2)
Multiple	4	0	1	4	9 (0.7)
Not known	4	17	13	32	66 (5.1)
Total	147	199	258	678	1282 (100.0)

Note: n=1282

Figure 25: Percentage of different parts of the body fractured



Note: n=1282

7.4.3 Place where the fracture event occurred

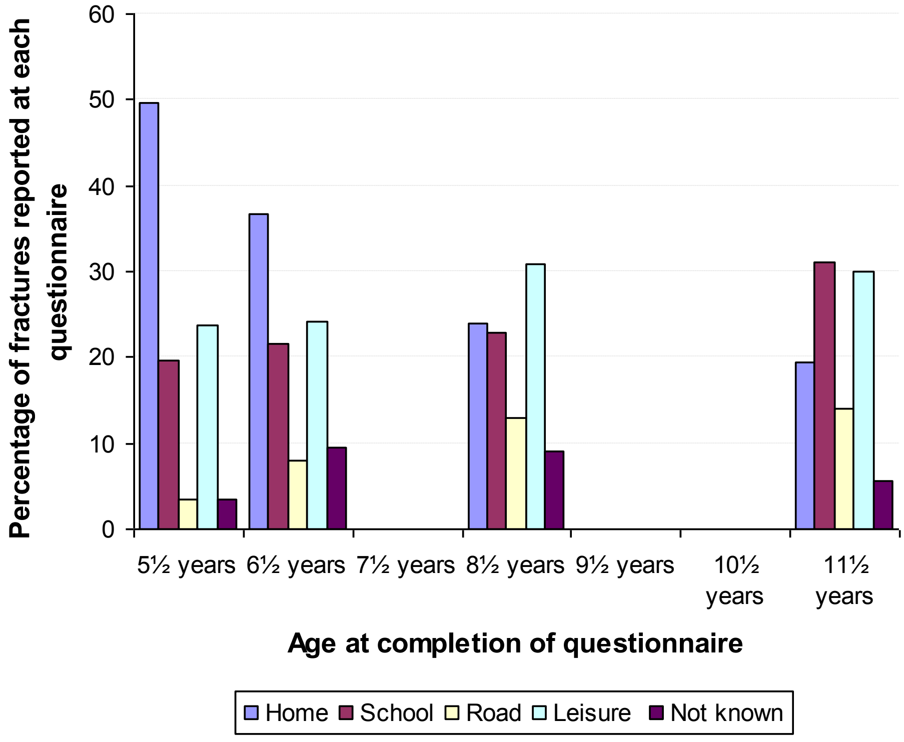
Information on the location of the fracture event was available for 1203/1290 (93.3%) fractures. Approximately equal numbers of fractures were reported occurring in the home, at school and in leisure environments overall (Table 53). With age, the home becomes a less frequent location for fractures to occur and the leisure environment and school become increasingly important. The number of fractures occurring in the road environment increases with age but remains low as a proportion of all locations (Figure 26).

Table 53: Location of fracture events, by age

Location	Fractures (number and percentage)									
	5½ years		6½ years		8½ years		11½ years		Total	
	N	%	N	%	N	%	N	%	N	%
Home	73	49.7	73	36.7	63	24.0	132	19.4	341	26.4
School	29	19.7	43	21.6	60	22.9	212	31.1	344	26.7
Road	5	3.4	16	8.0	34	13.0	95	13.9	150	11.6
Leisure	35	23.8	48	24.1	81	30.9	204	29.9	368	28.5
Not known	5	3.4	19	9.5	24	9.2	39	5.7	87	6.7
Total	147	100.0	199	99.9	262	100.0	682	100.0	1290	99.9

Note: Percentages may not total 100 due to rounding, n=1290

Figure 26: Change in location of fracture events, by age

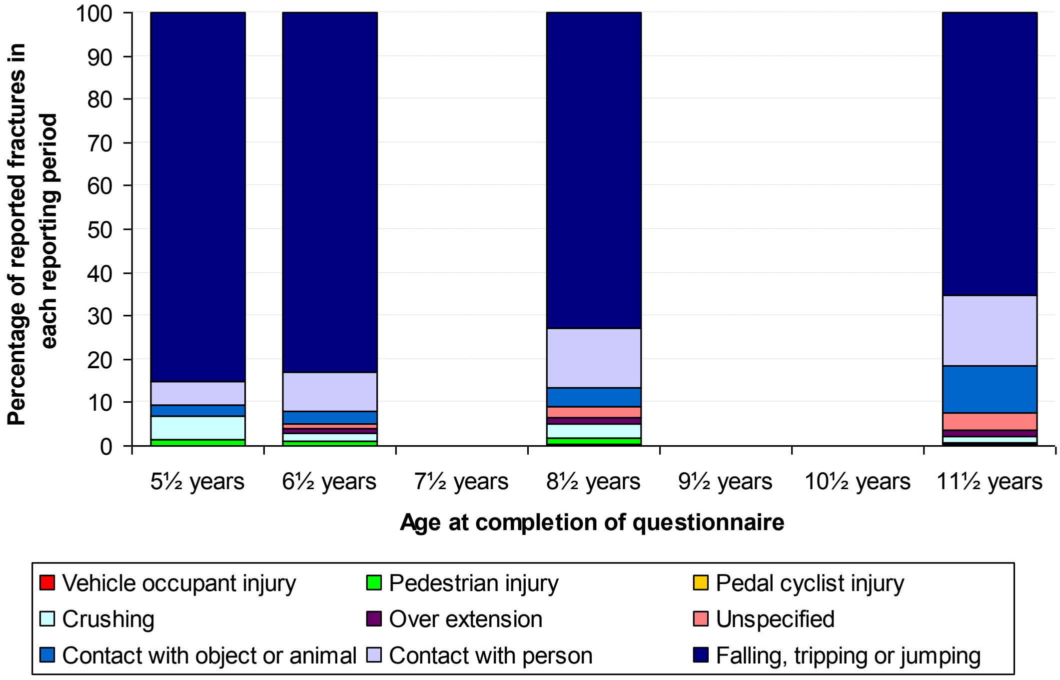


Note: n=1290

7.4.4 How the fracture occurred.

Information on the mechanism of the fracture event was reported for 1255/1290 (97.3%) injuries. The largest proportion of fractures in each reporting period were due to falling, tripping or jumping, followed by contact with persons, and contact with objects / animals, the latter categories becoming more important with age (Figure 27). Fractures occurring in the road environment (vehicle occupant injury, pedestrian injury and pedal cyclist injuries) were a very small proportion of the mechanisms of injury at each reporting period.

Figure 27: Stacked histogram of reported fractures, by mechanism of injury and age



Note: n=1290

7.4.5 Occurrence of fractures and deprivation of area of residence

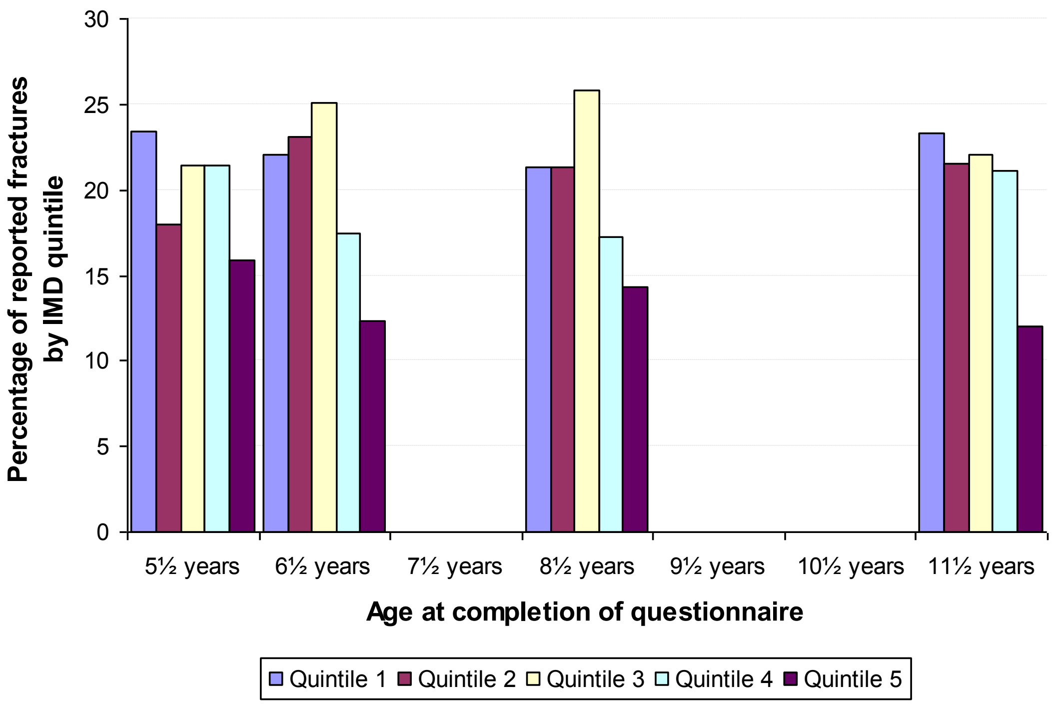
An index of multiple deprivation score was available for the postcode of residence of the child for 1224/1290 (94.9%) fractures. Analysis by age at completion of questionnaire, indicated that children in higher quintiles (i.e. less deprived) were more likely to suffer a fracture injury at each questionnaire reporting period than children in the lower (more deprived) quintiles (Table 54, Figure 28).

Table 54: Fractures by quintile of deprivation and age

IMD	Fractures (number and percentage)								
	5½ years		6½ years		8½ years		11½ years		Total
	N	%	N	%	N	%	N	%	N
Quintile 1	34	23.45	43	22.05	52	21.31	149	23.28	278
Quintile 2	26	17.93	45	23.08	52	21.31	138	21.56	261
Quintile 3	31	21.38	49	25.13	63	25.82	141	22.03	284
Quintile 4	31	21.38	34	17.44	42	17.21	135	21.09	242
Quintile 5	23	15.86	24	12.31	35	14.34	77	12.03	159
Total	145	100.00	195	100.00	244	100.00	640	100.00	1224

Note: n=1224

Figure 28: Proportion of fractures by quintile of deprivation and age



Note: n=1224

7.5 BURNS AND SCALDS

Burns and scalds were categorised on the basis of parent or carer report, whether the skin was blistered or marked, or not. All of the burns and scalds reported were due to excessive heating and none were due to cold or freezing burns.

7.5.1 Number and rate of burns and scalds

921 burn and scald injuries were reported in the four injury questionnaires (Table 55). In total, more girls were burned or scalded than boys. However, more boys were burned or scalded at 5½, boys and girls were burned equally frequently at 6½ years, and more girls than boys were burned at 8½ and 11½ years.

Table 55: Frequency of burns and scalds, by age and sex

Age (years)	Reporting period (years)	Number of injuries		
		Boys	Girls	Total
5½	4½ to 5½	100	70	170
6½	5½ to 6½	83	78	161
8½	7½ to 8½	87	121	208
11½	9 to 11½	153	229	382
Total		423	498	921

Note: n=921

In all, 589/921 (64.0%) of the burn and scald injuries were reported in the 12 months prior to each questionnaire. The rate of burns and scalds in boys varied very little over the primary school-aged period, whilst the rate for girls doubled between 5½ years and 11½ years (Table 56, Figure 29).

Table 56: Rate of burn and scald injuries per 1000 children per year, by age and sex

Age (years)	Reporting period	Rate of injuries / 1000 children / year	
		Boys	Girls
5½	12 months	21.55	16.04
6½	12 months	18.82	18.76
8½	12 months	21.30	31.00
11½	12 months	24.53	36.99

Note: n=589

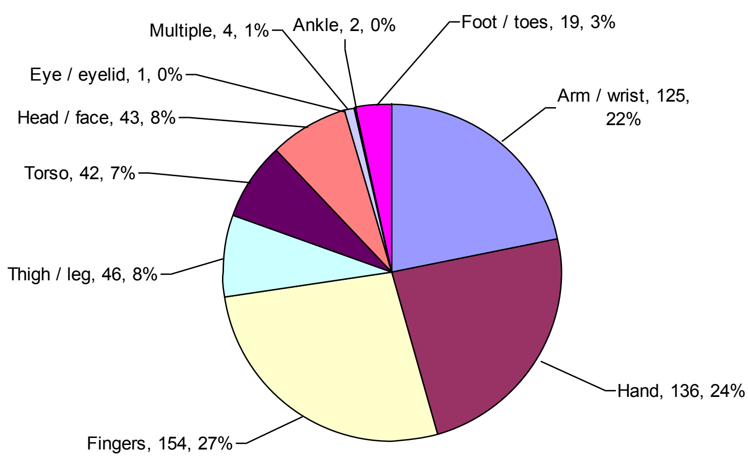
Figure 29: Rate of burn and scald injuries per 1000 children per year, by age and sex

Note: n=589

7.5.2 Part of the body burned or scalded

Information on the part of the body burned or scalded was available for 572/921 (62.1%) events. Almost three quarters of all events affected the fingers, hands or arms (415/572, 72.6%) (Figure 30). The legs, torso and head / face were the body regions next most affected.

Figure 30: Proportion of burns and scalds affecting different parts of the body



Note: n=572

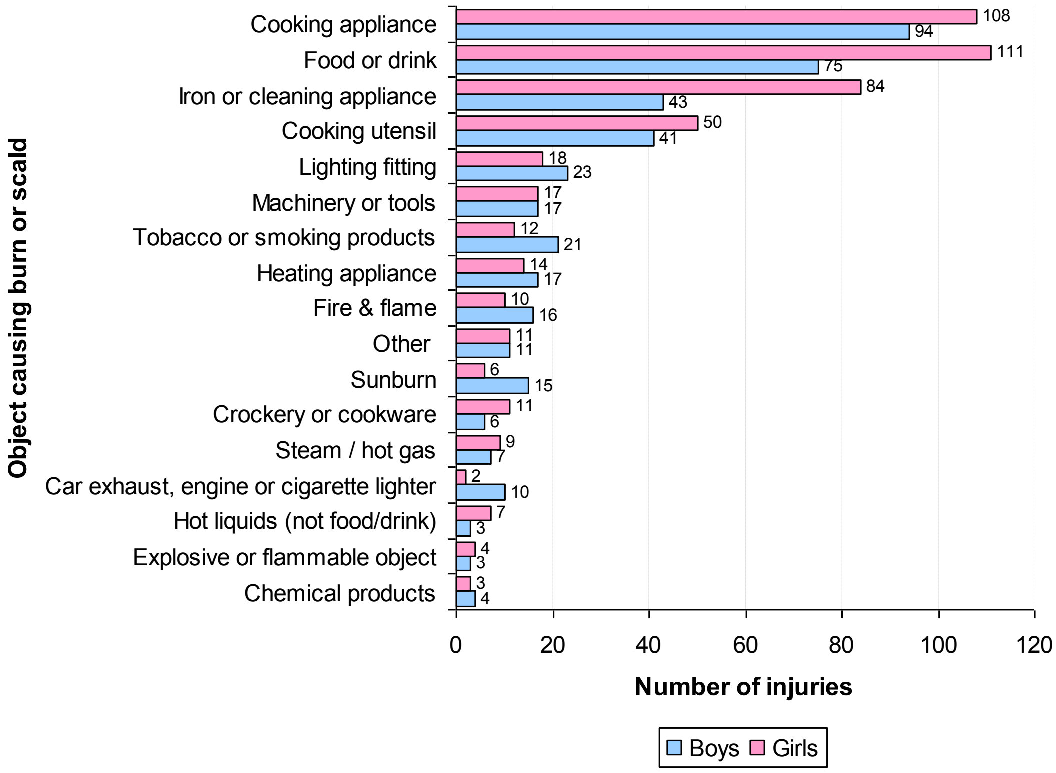
7.5.3 Object causing the burn or scald

Data on the object causing the burn was available for analysis for 883/921 (95.9%) burn and scald injuries (Figure 31). The commonest objects causing burns and scalds were those related to food and drink preparation and consumption, and those related to ironing.

Cooking appliances (n=202), cooking utensils (n=91) and crockery and cookware (n=17) accounted for over a third of all burns and scalds (310/883, 35.1%). Hot food and drink (n=186) accounted for a fifth (186/883, 21.1%) of injuries and was almost entirely due to hot drinks being spilt or dropped over children. Ironing was a common cause of burns, especially in girls (127/883, 14.4%). Although absolute numbers are smaller, boys were more likely than girls to be injured by lighting fittings e.g. hot bulbs (boys=23, girls=18), cigarettes or cigarette lighters (boys=21, girls=12), heaters and radiators (boys=17, girls=14) and open fires (boys=16, girls=10). Boys were more than twice as likely as girls to be reported as suffering sunburn (boys=15, girls=6) or burns from car engines, exhausts or cigarette lighters (boys=10, girls=2).

The type of object causing the burn or scald influenced the part of the body injured. Data was available for both object causing the burn and part of the body affected in 539/921 (58.5%) cases. Food or drink preparation objects (including cooking appliances, utensils, crockery or cookware) were most likely to cause burns on the hands or fingers, whilst the food or drink itself caused burns or scalds on any body part (Table 57). Ironing frequently caused burns to the hand or arm, as did light fittings and machinery or tools. Car injuries were most likely to affect the legs. Handling fires or flame, or coming into contact with smoking related products, were most likely to burn the hands.

Figure 31: Frequency of burn or scald injuries by object and sex



Notes: n=883
'Heating appliance' includes gas or electric fires, radiators or fires in open grates, whilst 'fire and flame' includes outdoor fires, matches, candles etc. 'Hot liquids' includes boiling water or hot oil. The category 'explosive or flammable objects' is comprised mainly of injuries caused by fireworks and sparklers. Fourteen 'friction burns' that were reported to have been sustained on either playground equipment (n=7) or carpets (n=7) were excluded from this analysis, as they were not thermal injuries.

Table 57: Part of the body burned or scalded by different objects

Object causing injury	Body part (Number of injuries)						
	Arm / wrist	Hand / fingers	Leg / thigh	Ankle / foot	Torso	Face / head	Total
Food/drink preparation object	41	113	6	2	8	16	186
Food / drink	20	45	18	12	14	9	118
Hot liquids (not food/drink)	1	0	0	1	1	0	3
Steam / hot gas	5	3	0	0	1	0	9
Iron or cleaning appliance	25	47	4	1	2	3	82
Lighting fitting	3	20	3	1	1	4	32
Sunburn	5	0	0	0	3	2	10
Machinery or tools	3	13	0	1	0	0	17
Car exhaust, engine or lighter	1	1	9	0	0	0	11
Heating appliance	7	4	1	1	4	2	19
Fire & flame	4	13	0	0	0	0	17
Explosive or flammable object	0	4	1	0	0	0	5
Tobacco or smoking product	2	20	1	0	1	1	25
Chemical products	2	0	1	0	0	2	5
Total	119	283	44	19	35	39	539

7.5.4 Treatment required for burn and scald injuries

The level of treatment required for the burn or scald can be used as a proxy for the severity of the injury. Data on the treatment required for burns and scalds were available for 902/921 (97.9%) injuries, and that on the object causing the burn or scald were available for 897/921 (97.4%) injuries. The vast majority (760/902, 84.3%) of burns and scalds reported were managed by the child's carer with first aid. Burns and scalds that required treatment in either primary care or in secondary care were mostly those caused during food or drink preparation or were caused by hot food or drink being spilt over the child (55/97, 56.7%) (Table 58). In addition 5 further scald injuries caused by non-food and drink liquids (mostly boiling water or hot oil) required treatment in secondary care. None of the burns and scalds required admission to hospital.

Table 58: Treatment required for burn and scald injuries by object causing the injury

Object causing injury	Treatment required for burn / scald (number)					
	No treatment required	First aid only by parent or carer	Primary care doctor or nurse	Secondary care doctor or nurse	Not known	Total
Food/drink preparation object	7	277	10	11	5	310
Food or drink	5	145	17	17	2	186
Hot liquids (not food/drink)	0	5	0	5	0	10
Steam / hot gas	0	16	0	0	0	16
Iron or cleaning appliance	7	115	2	2	1	127
Lighting fitting	2	37	1	1	0	41
Sunburn	2	14	3	2	0	21
Machinery or tools	2	28	2	0	2	34
Car exhaust, engine or lighter	0	8	2	2	0	12
Heating appliance	3	23	3	2	0	31
Fire & flame	6	20	0	0	0	26
Explosive or flammable object	0	7	0	0	0	7
Tobacco or smoking products	3	27	1	2	0	33
Chemical products	0	3	2	1	1	7
Other	2	17	1	1	1	22
Friction burns	3	9	0	1	1	14
Not known	3	9	2	4	6	24
Total	45	760	46	51	19	921

Note: n=921

7.5.5 Place where the burn / scald injury occurred

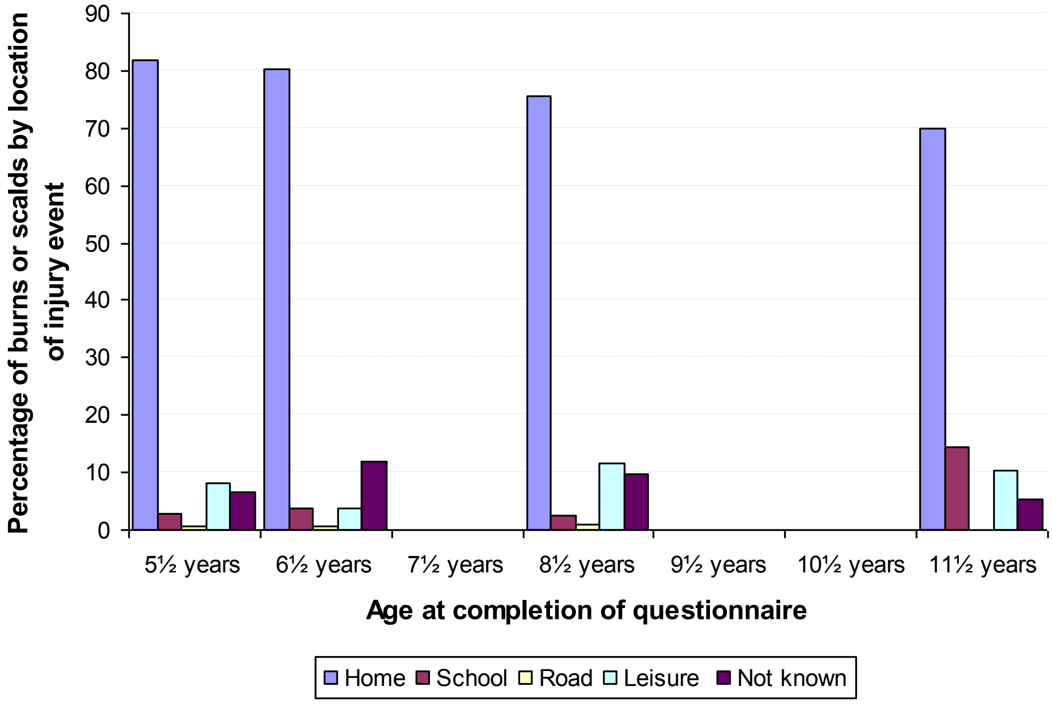
The location of the burn / scald event was known for 851/921 (92.4%) injuries (Table 59). The majority of events occurred in the child's home (692/851, 81.3%). Those occurring in school (71/851, 8.3%) tended to be in classrooms e.g. during science or cooking lessons. There was very little change in location with age (Figure 32). Almost two thirds of burns and scalds occurring in the home happened in the kitchen (444/692, 64.2%), emphasising the importance of food and drink and its preparation as a risk factor.

Table 59: Location of reported burn and scald injury events, by age

Location	Burn and scald injuries (number and percentage)									
	5½ years		6½ years		8½ years		11½ years		Total	
	N	%	N	%	N	%	N	%	N	%
Home	139	81.76	129	80.12	157	75.48	267	69.90	692	75.14
School	5	2.94	6	3.73	5	2.40	55	14.40	71	7.71
Road	1	0.59	1	0.62	2	0.96	0	0.00	4	0.43
Leisure	14	8.24	6	3.73	24	11.54	40	10.47	84	9.12
Not known	11	6.47	19	11.80	20	9.62	20	5.24	70	7.60
Total	170	100.00	161	100.00	208	100.00	382	100.00	921	100.00

Note: n=921

Figure 32: Change in the location of burn and scald injuries, by age



Note: n=921

7.5.6 Who was with the child and the treatment required for the burn or scald

Data were available on who was with the child at the time of the injury in 836/921 (90.8%) events and on the treatment of the burn / scald injury in 902/921 (97.9%) events. The majority (738/836, 88.3%) of injury events occurred when the child was with an adult, and over three quarters of these occasions this was the child's parent (572/738, 77.5%). Although infrequent, children who were burned or scalded whilst with other children (and no adults) appeared to be most at risk of having an injury that needed medical attention. The percentage of burns / scalds needing medical attention when with other children was 17.2% (10/58) compared with 7.5% (3/40) when alone, 10.5% (60/572) when with parents and 8.4% (14/166) when with other adults.

Table 60: Who was with the child at the time of the burn or scald, by treatment received

Who was with the child	Treatment required (Number of injuries)					
	No treatment	First aid by parent or carer	Primary care doctor or nurse	Secondary care doctor or nurse	Not known	Total
Alone	1	32	2	1	4	40
Parent	12	498	28	32	2	572
Other children	9	39	4	6	0	58
Other adult	14	136	8	6	2	166
Not known	9	55	4	6	11	85
Total	45	760	46	51	19	921

Note: n=921

7.5.7 Burn or scald injuries and deprivation of the area of residence of the child

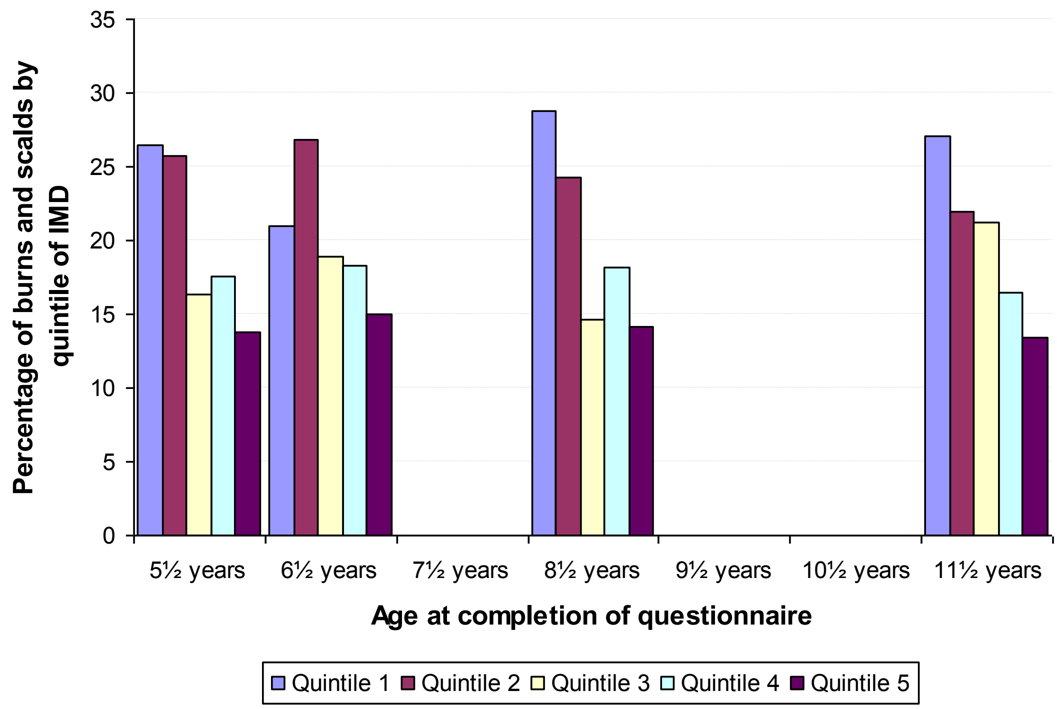
An IMD 2000 score was available for 869/921 (94.4%) children with a burn or scald injury (Table 61). There appears to be greater reporting of burns and scalds in children from quintiles 1 and 2, than the children in the more disadvantaged quintiles (quintiles 3, 4, 5) at all ages (Figure 33).

Table 61: Burn and scald injuries by quintile of deprivation and age

IMD	Burn and scald injuries (Number and percentage)								
	5½ years		6½ years		8½ years		11½ years		Total
	N	%	N	%	N	%	N	%	N
Quintile 1	42	26.42	32	20.92	57	28.79	97	27.02	228
Quintile 2	41	25.79	41	26.80	48	24.24	79	22.01	209
Quintile 3	26	16.35	29	18.95	29	14.65	76	21.17	160
Quintile 4	28	17.61	28	18.30	36	18.18	59	16.43	151
Quintile 5	22	13.84	23	15.03	28	14.14	48	13.37	121
Total	159	100.00	153	100.00	198	100.00	359	100.00	869

Note: n=869

Figure 33: Percentage of burns and scalds by quintile of deprivation and age



Note: n=869

7.6 SPRAINS AND STRAINS

The term ‘sprains and strains’ includes all over exertion or over stretching injuries to muscles, ligaments and joints. It therefore includes injuries such as ‘twisted ankles’, ‘pulled muscles’ ‘whiplash’, ‘went over on foot’ etc. Injuries were also considered to be sprains and strains if information on the injury was limited but the treatment included ‘strapping’ or ‘support bandage’ etc, where no other treatment to suggest an alternative type of injury was given.

7.6.1 Number and rate of sprain and strain injuries

A total of 840 sprains and strain injuries were reported during the primary school age period (Table 62). This type of injury was more common in older children, and more sprains and strains were reported in girls than boys. In all, 635/840 (75.6%) of sprain and strain injuries were reported in the 12 months prior to each questionnaire. (Table 63, Figure 34).The rate of sprain and strain injuries reported rises steeply after age 6½ years. The rate of sprains and strains at 6½ years and 8½ years is higher in girls, but is equal to boys at 11½ years.

Table 62: Frequency of sprains and strains, by age and sex

Age (years)	Reporting period (years)	Number of injuries		
		Boys	Girls	Total
5½	4½ to 5½	17	14	31
6½	5½ to 6½	24	49	73
8½	7½ to 8½	103	135	238
11½	9 to 11½	238	260	498
Total		382	458	840

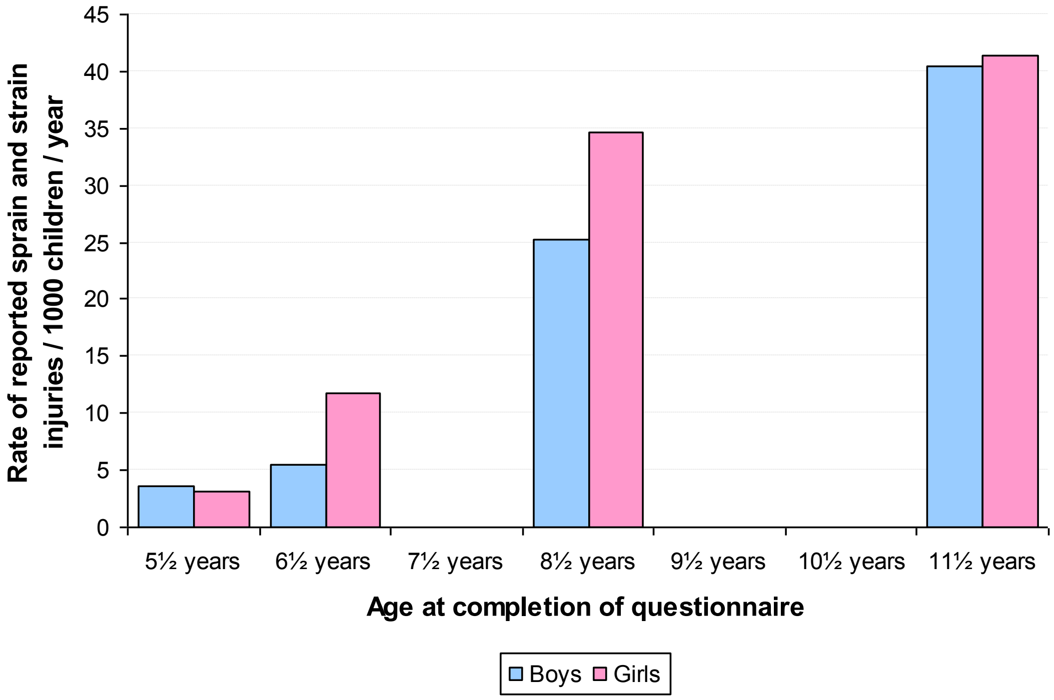
Note: n=840

Table 63: Rate of sprain and strain injuries per 1000 children per year, by age and sex

Age (years)	Reporting period	Rate of injuries / 1000 children / year	
		Boys	Girls
5½	12 months	3.66	3.21
6½	12 months	5.44	11.78
8½	12 months	25.21	34.59
11½	12 months	40.41	41.47

Note: n=635

Figure 34: Rate of sprains and strains per 1000 children per year, by age and sex

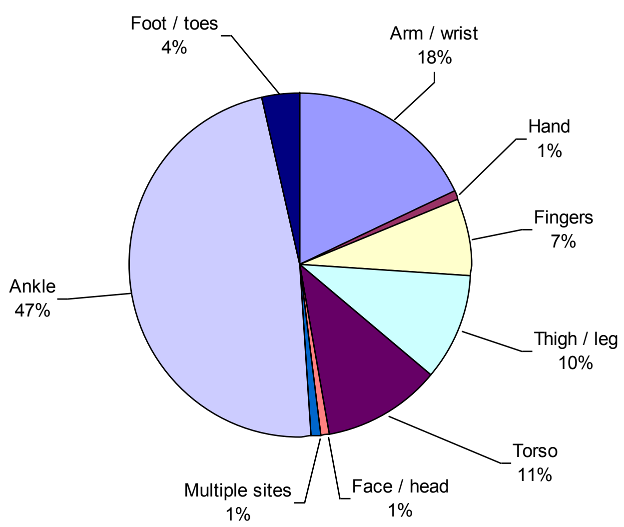


Note: n=635

7.6.2 Part of the body injured

Data were available on the part of the body suffering the sprain / strain injury in 765/840 (91.1%) cases. These injuries most commonly affected the ankle, with 47% of reported sprains and strains occurring at this site. The lower limb was more likely to be injured than the upper limb, with 61% and 26% of sprains and strains respectively (Figure 35).

Figure 35: Percentage of different parts of the body suffering sprain and strain injuries



Note: n=765

7.6.3 How the sprain / strain injury occurred

Information on the mechanism of the injury event resulting in a sprain or strain was available for 807/840 (96.1%) injuries (Table 64). The commonest cause of the sprain or strain was falling or tripping (473/807, 58.6%), followed by 'over-exertion' where no other mechanism was reported (166/807, 20.6%). It is possible that there is a degree of overlap between these two categories, since a report of 'went over on ankle' may have been reported by another parent as 'fell over on ankle'. A small number of sprain and strain injuries were the result of road traffic events when the child was a vehicle occupant (17/807, 2.1%). These are mostly whiplash injuries.

Table 64: Underlying mechanism of sprain / strain injuries, by age

Mechanism of injury	Sprain / strain injuries (number)				
	5½ years	6½ years	8½ years	11½ years	Total
Transport injury - vehicle occupant	1	2	4	10	17
Blunt force - falling or tripping	27	50	150	246	473
Blunt force - contact with person	1	4	24	78	107
Blunt force - contact with object	0	0	10	27	37
Over exertion with no reported other force	0	11	45	110	166
Other mechanism	1	2	1	3	7
Total	30	69	234	474	807

Note: n=807

7.6.4 Place where the sprain or strain injury occurred

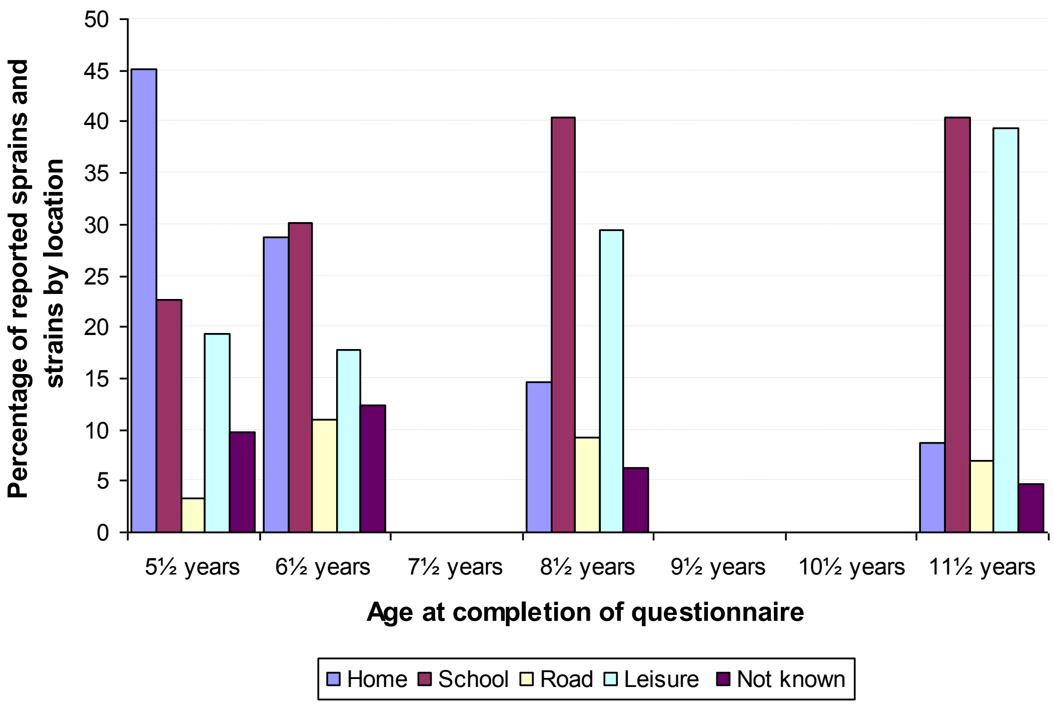
Information on the location of the sprain / strain injury event was available for 790/840 (94.0%) of injuries (Table 65). The number of sprain and strain events was highest in the school environment (326/790, 41.3%), followed by leisure settings (285/790, 36.1%). Injuries occurring in both school and leisure settings were associated with sporting activity in 332/790 (42.0%) cases. The home environment becomes increasingly less important as a location of sprain and strain injuries with age, and the school and the leisure environments become increasingly dominant locations (Figure 36).

Table 65: Location of sprain and strain injuries by age

Location	Sprain /strain injuries (number and percentage)									
	5½ years		6½ years		8½ years		11½ years		Total	
	N	%	N	%	N	%	N	%	N	%
Home	14	45.16	21	28.77	35	14.71	43	8.63	113	13.45
School	7	22.58	22	30.14	96	40.34	201	40.36	326	38.81
Road	1	3.23	8	10.96	22	9.24	35	7.03	66	7.86
Leisure	6	19.35	13	17.81	70	29.41	196	39.36	285	33.93
Not known	3	9.68	9	12.33	15	6.30	23	4.62	50	5.95
Total	31	100.00	73	100.00	238	100.00	498	100.00	840	100.00

Note: n=840

Figure 36: Change in location of sprain and strain injuries, by age



Note: n=840

7.6.5 Treatment required for sprain and strain injuries

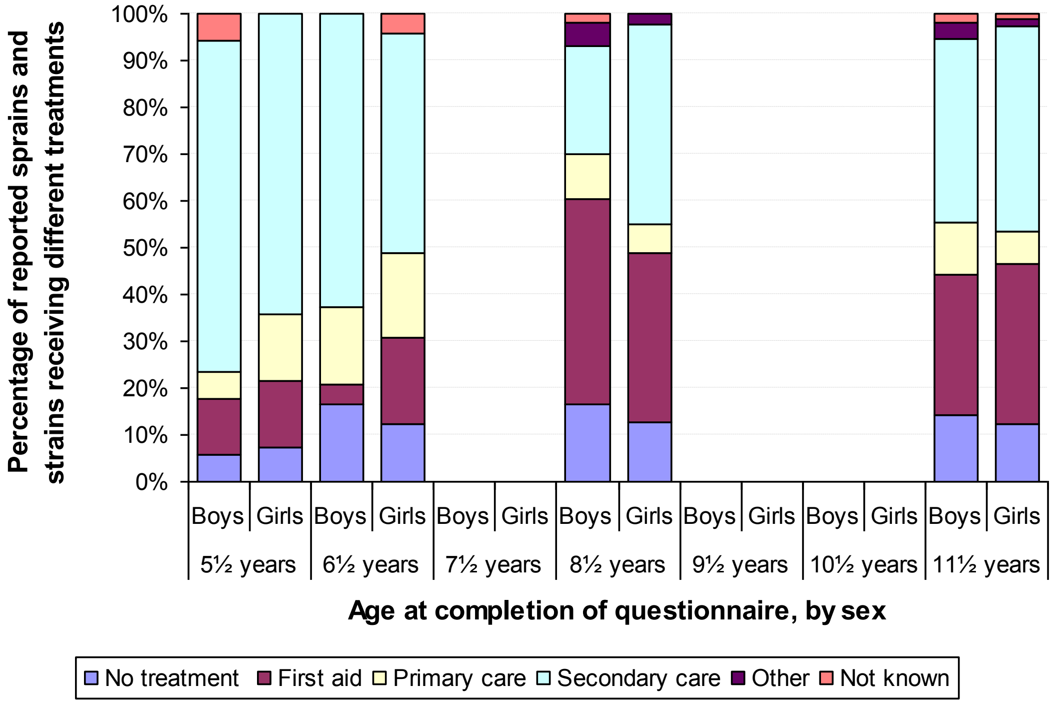
Information on the treatment of reported sprain and strain injuries was known for 827/840 (98.5%) cases (Table 66). More than half of all sprains and strains required medical attention (427/827, 51.6%), with the majority of these being seen in secondary care (348/427, 81.5%). Only one of these injuries resulted in admission to hospital. Almost a third (268/827, 32.4%) of sprains and strains were treated with first aid measures (such as rest, ice, elevation and support), and 13.5% (112/827) were reported to need no treatment. Figure 37 suggests that although fewer sprain and strain injuries were reported at age 5½ and age 6½ years, these were more likely to be treated in secondary care, compared with injuries reported in older children.

Table 66: Treatment required for sprain and strain injuries, by age and sex

Age (years)	Sex	Treatment for sprain and strain injuries (number of cases)						
		No treatment	First aid by parent or carer	Primary care doctor or nurse	Secondary care doctor or nurse	Other*	Not known	Total
5½	Boys	1	2	1	12	0	1	17
	Girls	1	2	2	9	0	0	14
6½	Boys	4	1	4	15	0	0	24
	Girls	6	9	9	23	0	2	49
8½	Boys	17	45	10	24	5	2	103
	Girls	17	49	8	58	3	0	135
11½	Boys	34	71	27	93	8	5	238
	Girls	32	89	18	114	4	3	260
Total		112	268	79	348	20	13	840

Note: Other* includes physiotherapist, osteopath etc. N=840

Figure 37: Percentage of sprain and strain injuries requiring different treatments, by age and sex



7.6.6 Sprain and strain injuries and deprivation of area of residence of the child

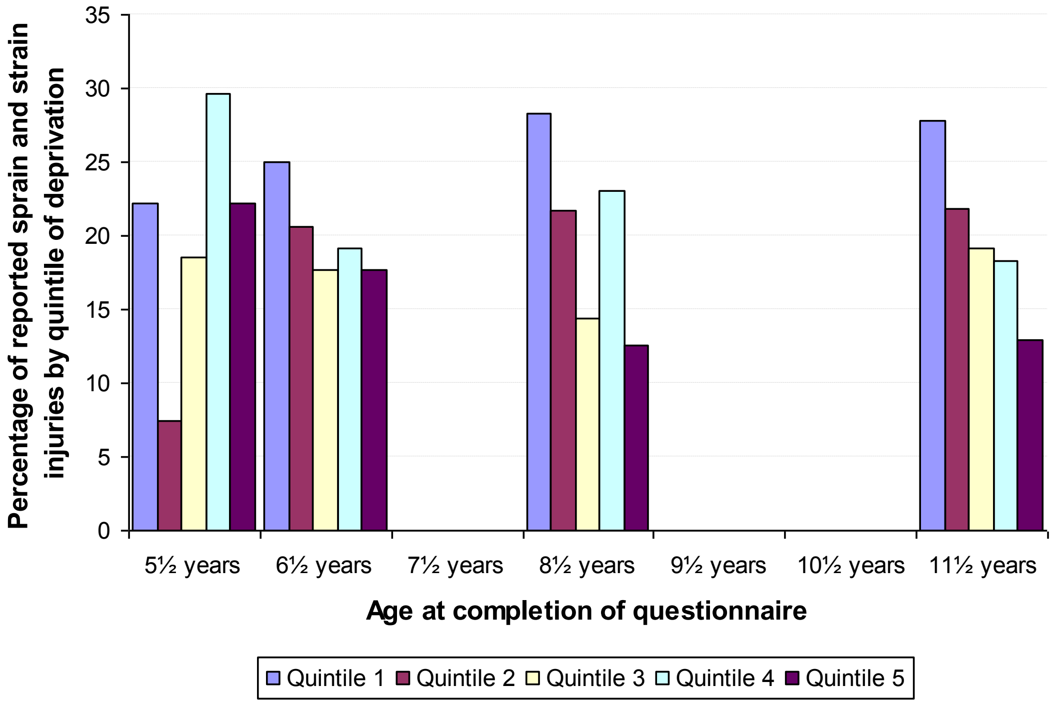
Data on the IMD 2000 score of the area of residence and sprain and strain injuries were present for 796/840 (94.8%) of injuries (Table 67). The data suggest that at 5½ years there is no pattern to sprain and strain injuries by quintile of deprivation (though absolute numbers are small), but as the children grow older a pattern emerges suggesting that children in quintile 1 (least disadvantaged) are more likely to report sprain and strain injuries than children in quintile 5 (most disadvantaged) (Figure 38).

Table 67: Sprain and strain injuries, by quintile of deprivation and age

IMD	Sprain and strain injuries (Number and percentage)								
	5½ years		6½ years		8½ years		11½ years		Total
	N	%	N	%	N	%	N	%	N
Quintile 1	6	22.22	17	25.00	65	28.26	131	27.81	219
Quintile 2	2	7.41	14	20.59	50	21.74	103	21.87	169
Quintile 3	5	18.52	12	17.65	33	14.35	90	19.11	140
Quintile 4	8	29.63	13	19.12	53	23.04	86	18.26	160
Quintile 5	6	22.22	12	17.65	29	12.61	61	12.95	108
Total	27	100.00	68	100.00	230	100.00	471	100.00	796

Note: n=796

Figure 38: Sprain and strain injuries by quintile of deprivation and age



Note: n=796

7.7 DENTAL INJURIES

Dental injuries were recorded as those where damage was sustained to a tooth or several teeth, or where damage to the gum or oral cavity required treatment by a dentist.

7.7.1 Number and rate of dental injuries

A total of 354 dental injuries were reported during the primary school-aged period (Table 68). The number of dental injuries reported in girls at each data collection point was relatively constant, but increased in boys at age 11½ years. Boys were reported to have more dental injuries than girls at all ages.

Table 68: Frequency of dental injuries, by age and sex

Age (years)	Reporting period (years)	Number of injuries		
		Boys	Girls	Total
5½	4½ to 5½	46	32	78
6½	5½ to 6½	45	42	87
8½	7½ to 8½	43	29	73
11½	9 to 11½	84	33	117
Total		218	136	354

Note: n=354

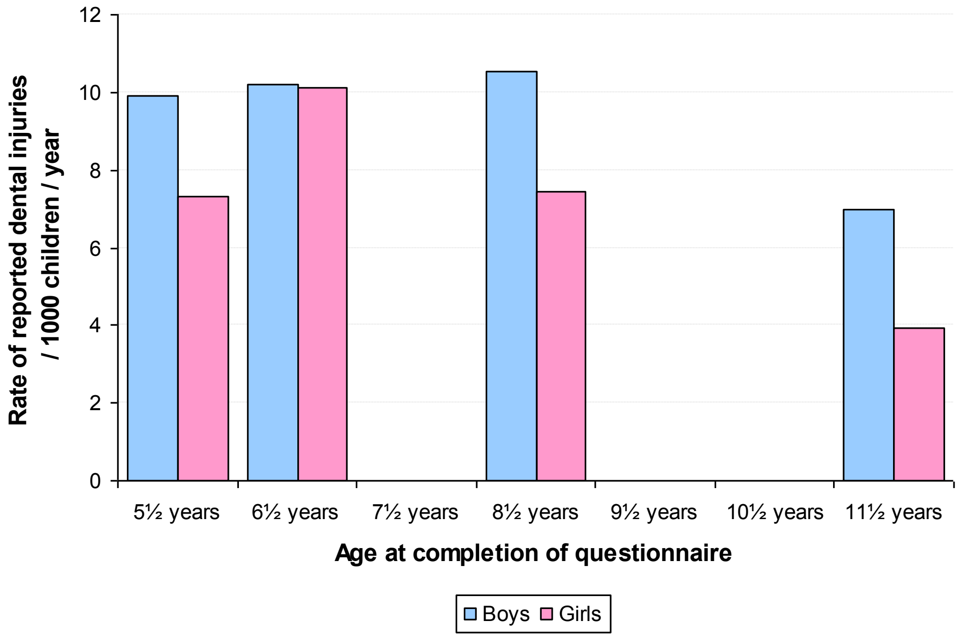
In all, 276/354 (78.0%) of dental injuries were reported in the 12 months prior to each questionnaire. The rates of dental injuries calculated from this figure are fairly constant from 5½ years to 8½ years, for both boys and girls, but then fall in both groups at 11½ years (Table 69, Figure 39).

Table 69: Rate of dental injuries per 1000 children per year, by age and sex

Age (years)	Reporting period	Rate of injuries / 1000 children / year	
		Boys	Girls
5½	12 months	9.91	7.33
6½	12 months	10.20	10.10
8½	12 months	10.53	7.43
11½	12 months	6.97	3.92

Note: n=276

Figure 39: Rate of dental injuries per 1000 children per year, by age and sex
Note: n=276



7.7.2 How the dental injury occurred

Information on the mechanism of the dental injury was available for 341/354 (96.3%) of the injuries (Table 70). The commonest cause for dental injury at all ages was falling or tripping (212/341, 62.2%), followed by contact with a person e.g. fighting or contact sport (87/341, 25.5%).

Table 70: Underlying mechanism of dental injuries by age

Mechanism of injury	Dental injuries (number)				
	5½ years	6½ years	8½ years	11½ years	Total
Transport injury - vehicle occupant	0	0	0	1	1
Transport injury - pedestrian	0	0	0	1	1
Blunt force - contact with object	6	7	11	16	40
Blunt force - contact with person	12	26	23	26	87
Blunt force - falling or tripping	59	47	36	70	212
Not known	1	7	2	3	13
Total	78	87	72	117	354

Note: n=354

7.7.3 Place where the dental injury occurred

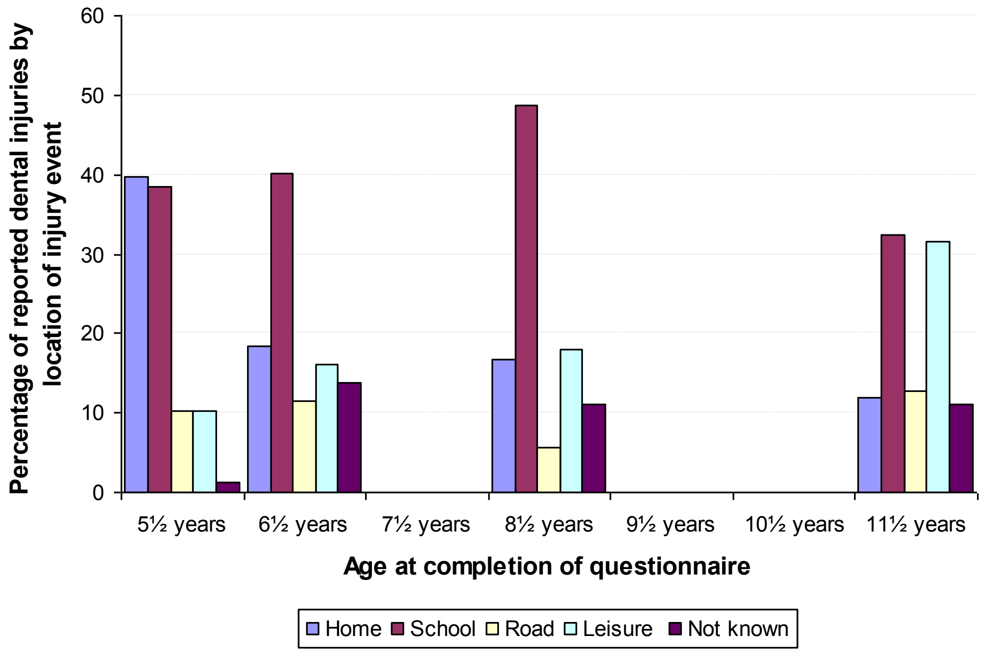
The location of the dental injury event was known in 320/354 (90.4%) cases (Table 71). Most injuries occurred in the school environment (138/320, 43.1%), followed by the home (73/320, 22.8%) and leisure (72/320, 22.5%) environments. The proportion of dental injuries occurring in the school environment increased to 8½ years, but then fell (Figure 40). With age, the home environment became increasingly less important, and the leisure environment became increasingly more important. Fifty injuries (15.6%) occurred at sporting activity locations.

Table 71: Location of dental injury events, by age

Location	Dental injury events (number and percentage)									
	5½ years		6½ years		8½ years		11½ years		Total	
	N	%	N	%	N	%	N	%	N	%
Home	31	39.74	16	18.39	12	16.67	14	11.97	73	20.62
School	30	38.46	35	40.23	35	48.61	38	32.48	138	38.98
Road	8	10.26	10	11.49	4	5.56	15	12.82	37	10.45
Leisure	8	10.26	14	16.09	13	18.06	37	31.62	72	20.34
Not known	1	1.28	12	13.79	8	11.11	13	11.11	34	9.60
Total	78	100.00	87	100.00	72	100.00	117	100.00	354	99.99

Note: Percentages may not equal 100 due to rounding. N=354

Figure 40: Change in the location of dental injuries, by age



Note: n=354

7.7.4 Who was with the child at the time of the dental injury

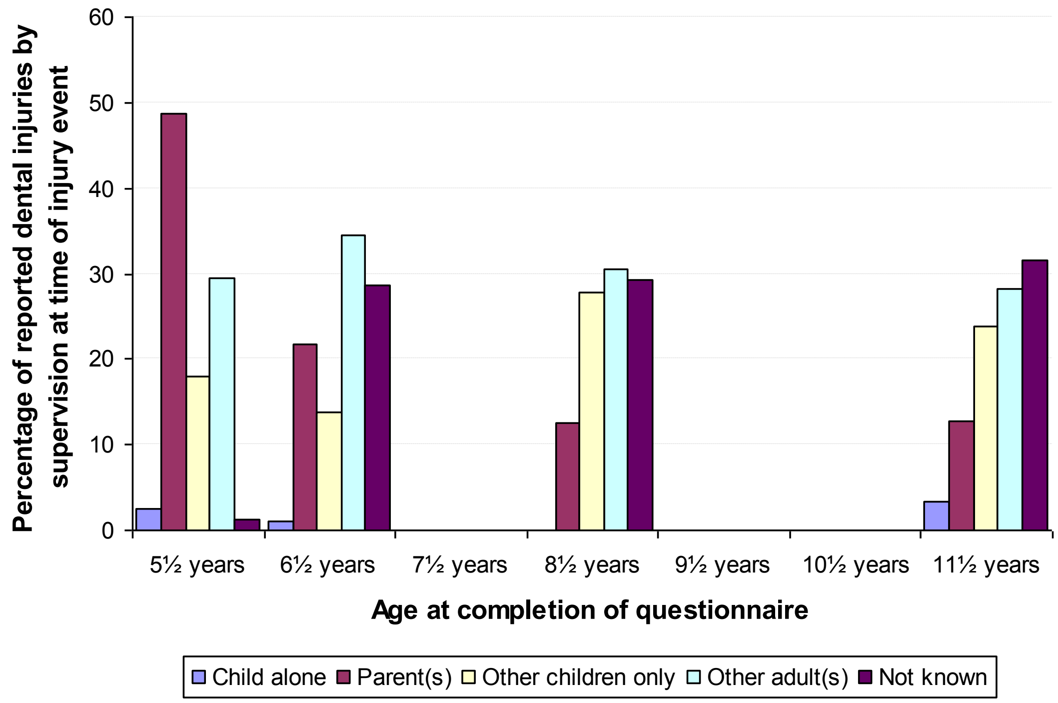
Data on who was with the child at the time of the dental injury was recorded in 270/354 cases (76.3%) (Table 72). Children were unlikely to be on their own, but were mostly in the care of an adult (189/270, 70.0%). There were no clear patterns across the age period regarding the proportion of supervision categories at the time of dental injuries (Figure 41).

Table 72: Who was with the child at the time of dental injury events, by age

Who was with the child	Dental injury events (number and percentage)								
	5½ years		6½ years		8½ years		11½ years		Total
	N	%	N	%	N	%	N	%	N
Child alone	2	2.56	1	1.15	0	0.00	4	3.42	7
Parent(s)	38	48.72	19	21.84	9	12.50	15	12.82	81
Other children	14	17.95	12	13.79	20	27.78	28	23.93	74
Other adult(s)	23	29.49	30	34.48	22	30.56	33	28.21	108
Not known	1	1.28	25	28.74	21	29.17	37	31.62	84
Total	78	100.00	87	100.00	72	100.00	117	100.00	354

Note: n=354

Figure 41: Who was with the child at the time of the dental injury, by age



Note: n=354

7.7.5 Treatment of reported dental injuries

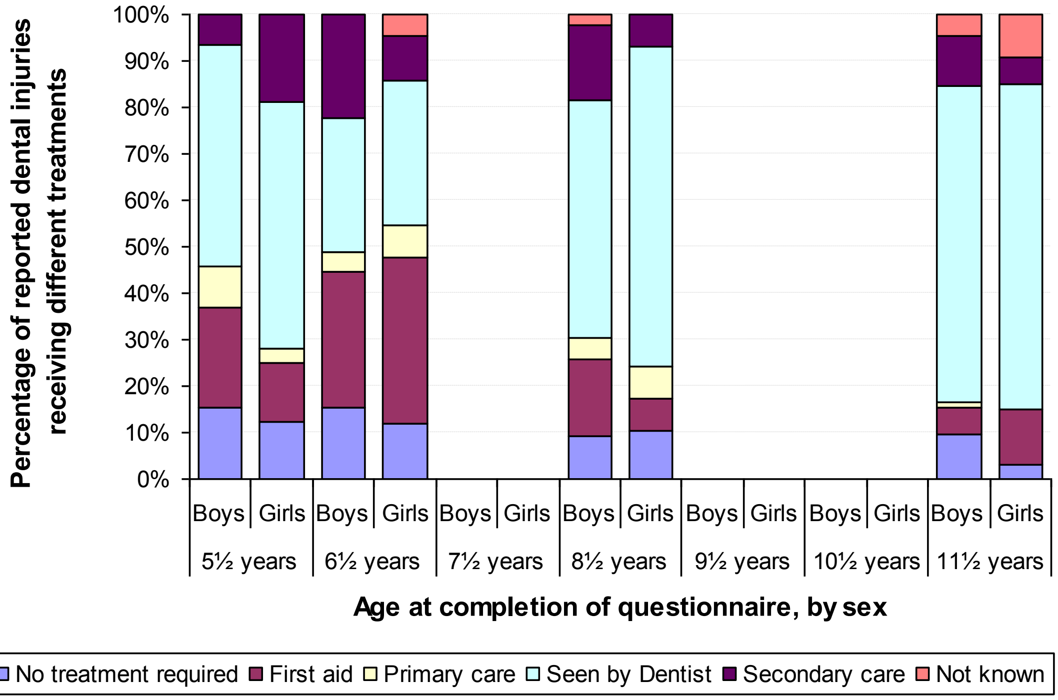
Information on the treatment sought for the reported dental injuries was available for 344 cases (344/354, 97.2%) (Table 73). Over half of dental injuries were seen by a dentist (187/344, 54.4%), plus a further 12.5% (43/344) were seen by a secondary care professional. Treatments were allocated to the ‘Secondary care’ category if the carer reported that the dental injury was treated ‘at hospital’. As Bristol has a dental hospital it is likely that a proportion of these injuries were seen at the dental hospital rather than in the Bristol Children’s Hospital or in an Emergency department. Four of the dental injuries recorded in the ‘no treatment’ category were following telephone contact with a dentist / health professional when it was determined that no further treatment was required. Figure 42 suggests that dental injuries in older children were more likely to be seen by a dentist than those in younger children, probably reflecting greater concern regarding damage to permanent teeth, compared with damage to deciduous teeth.

Table 73: Treatment received by children following dental injuries by age and sex

Age (Years)	Sex	Treatment received for dental injury (number of cases)						
		No treatment	First aid	Primary care	Dentist	Secondary care	Not known	Total
5½	Boys	7	10	4	22	3	0	46
	Girls	4	4	1	17	6	0	32
6½	Boys	7	13	2	13	10	0	45
	Girls	5	15	3	13	4	2	42
8½	Boys	4	7	2	22	7	1	43
	Girls	3	2	2	20	2	0	29
11½	Boys	8	5	1	57	9	4	84
	Girls	1	4	0	23	2	3	33
Total		39	60	15	187	43	10	354

Note: n=354

Figure 42: Percentage of dental injuries requiring different treatments, by age and sex



Note: n=354

7.7.6 Dental injuries and deprivation of area of residence of the child

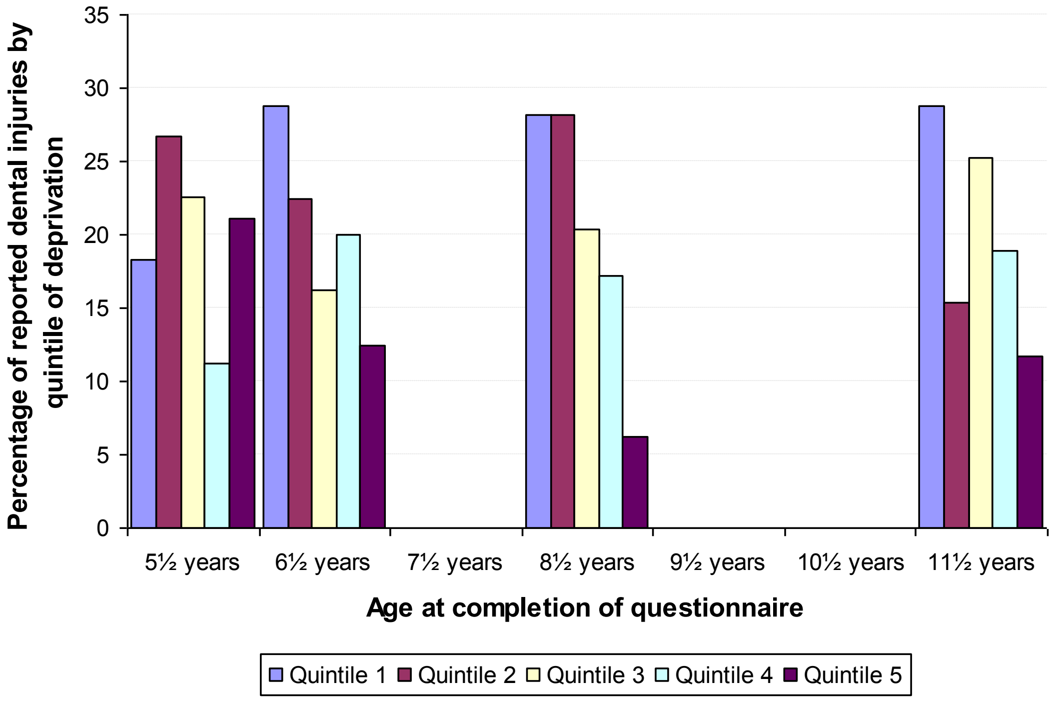
Information on the IMD 2000 score for the child's area of residence was known in 326/354 (92.1%) dental injury cases (Table 74). Dental injuries were commonest in quintile 1 (least disadvantaged). There appears to be a trend across quintiles with reduced proportion of dental injuries occurring in the more deprived areas of residence compared to the least disadvantaged areas (Figure 43).

Table 74: Dental injuries by quintile of deprivation and age

IMD quintile	Dental injury events (number and percentage)								
	5½ years		6½ years		8½ years		11½ years		Total
	N	%	N	%	N	%	N	%	N
Quintile 1	13	18.31	23	28.75	18	28.13	32	28.83	86
Quintile 2	19	26.76	18	22.50	18	28.13	17	15.32	72
Quintile 3	16	22.54	13	16.25	13	20.31	28	25.23	70
Quintile 4	8	11.27	16	20.00	11	17.19	21	18.92	56
Quintile 5	15	21.13	10	12.50	4	6.25	13	11.71	42
Total	71	100.00	80	100.00	64	100.00	111	100.00	326

Note: n=326

Figure 43: Percentage of dental injuries, by quintile of deprivation and age



Note: n=326

7.8 INGESTIONS

Ingestions were defined as the swallowing of any object or substance not suitable / intended to be swallowed. It therefore includes solid and liquid objects and substances, but excludes foreign bodies placed in orifices other than the mouth.

7.8.1 Number and rate of ingestion events

A total of 271 ingestion events were reported across the primary school-aged period (Table 75). The number of reported ingestions was commoner in boys than girls at all ages, and fell with age.

In all, 246/271 (90.8%) of the ingestion events were reported in the 12 months prior to each questionnaire. The rate of reported ingestions fell in both boys and girls between age 5½ and 11½ years (Table 76, Figure 44).

Table 75: Frequency of ingestions, by age and sex

Age (years)	Reporting period (years)	Number of injuries		
		Boys	Girls	Total
5½	4½ to 5½	64	44	108
6½	5½ to 6½	44	34	78
8½	7½ to 8½	28	19	47
11½	9 to 11½	23	15	38
Total		159	112	271

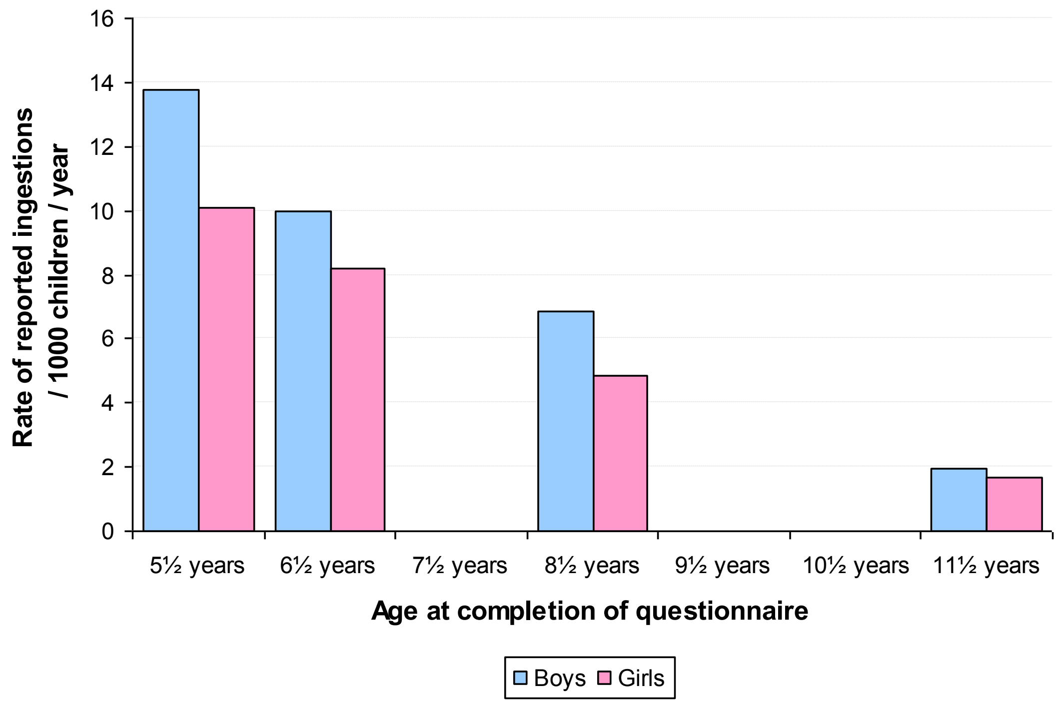
Note: n=271

Table 76: Rate of ingestions per 1000 children per year, by age and sex

Age (years)	Reporting period	Rate of injuries / 1000 children / year	
		Boys	Girls
5½	12 months	13.79	10.08
6½	12 months	9.98	8.18
8½	12 months	6.85	4.87
11½	12 months	1.95	1.68

Note: n=246

Figure 44: Rate of ingestions per 1000 children per year, by age and sex

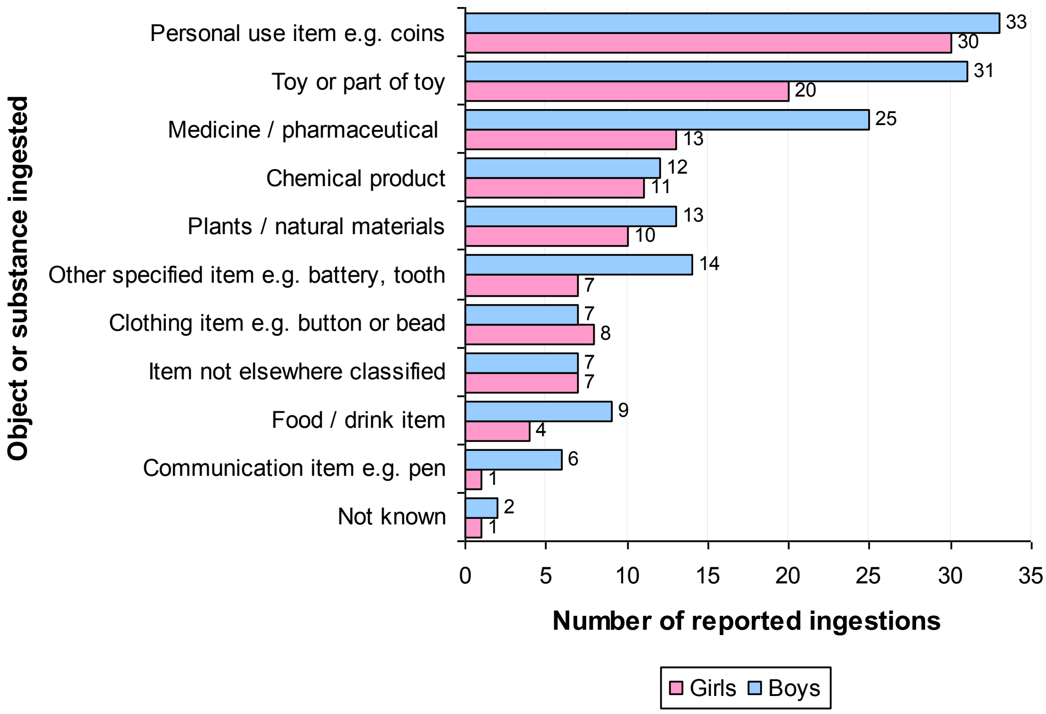


Note: n=246

7.8.2 Object / substance ingested

The nature of the object / substance ingested was known for 268/271 (98.9%) ingestions reported (Figure 45). The commonest ingestion categories were personal use items (n=63, 23.2%, all of these were coins), toys (n=51, 18.8%), and medicines or other pharmaceutical products (n=38, 14.0%). Coins, chemicals, plants, buttons / beads were ingested equally frequently between boys and girls, but toys or toy parts, medicines, batteries / teeth, food items (e.g. bones) and communication items (e.g. pen lids) were ingested by boys more often than girls.

Figure 45: Frequency of ingestions of different categories of objects / substances, by sex



Note: n=271

7.8.3 Place where the ingestion event occurred

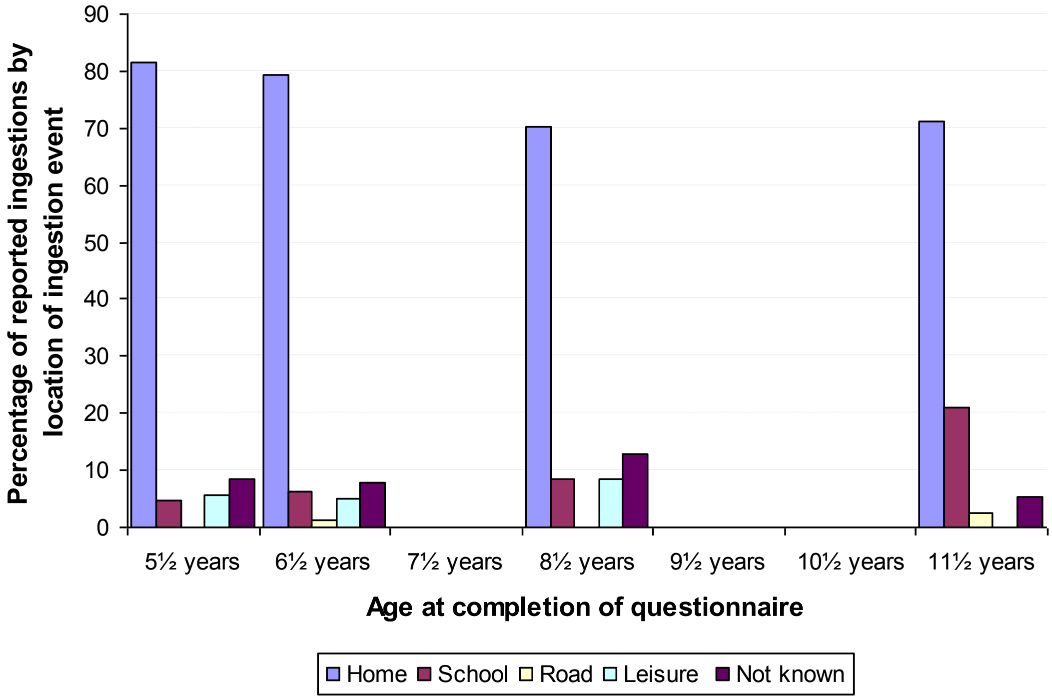
The location where the ingestion event took place was known for 248/271 (91.5%) cases. The majority of ingestions took place in the home (210/248, 84.7%), with very little variation with age (Table 77, Figure 46).

Table 77: Location of all ingestion events, by age

Location	Reported ingestions (number and percentage)									
	5½ years		6½ years		8½ years		11½ years		Total	
	N	%	N	%	N	%	N	%	N	%
Home	88	81.48	62	79.49	33	70.21	27	71.05	210	77.49
School	5	4.63	5	6.41	4	8.51	8	21.05	22	8.12
Road	0	0.00	1	1.28	0	0.00	1	2.63	2	0.74
Leisure	6	5.56	4	5.13	4	8.51	0	0.00	14	5.17
Not known	9	8.33	6	7.69	6	12.77	2	5.26	23	8.49
Total	108	100.00	78	100.00	47	100.00	38	100.00	271	100.00

Note: n=271

Figure 46: Location of ingestion event, by age



Note: n=271

7.8.4 Who was with the child at the time of the ingestion and the treatment required

Of 271 cases of ingestion, data was available on both the supervision of the child and the treatment of the ingestion on 231 (85.2%) occasions (Table 78). The majority (212/231, 91.8%) of injury events occurred when the child was under the supervision of an adult, and over three quarters of all occasions this was the child's parent (177/231, 76.6%). The percentage of ingestions that received medical attention was 107/231 (46.3%), of which 84.1% (90/107) were managed in secondary care.

Table 78: Who was with the child at the time of the ingestion, by treatment received for the injury sustained

Who was with the child	Treatment required for ingestions (number)					
	No treatment	First aid by parent or carer	Primary care doctor or nurse	Secondary care doctor or nurse	Not known	Total
Alone	7	0	3	3	1	14
Parent(s)	57	35	11	60	14	177
Other children	13	0	0	8	3	24
Other adult	16	4	1	13	1	35
Not known	6	3	2	6	4	21
Total	99	42	17	90	23	271

Notes: n=271
'No treatment' indicates that no specific action was taken by the parent or carer, whilst 'First Aid' is used if the child was encouraged to drink, made to vomit, stools checked, or slapped on the back / given Heimlich manoeuvre. The actions 'No treatment' or 'First Aid' were frequently the result of a telephone call by the parent or carer to the GP, the hospital or the ambulance service. The categories of 'Primary Care' and 'Secondary Care' are therefore only used if the child was physically seen / examined by a doctor or nurse in those settings.

7.8.5 Ingestions and deprivation of the area of residence of the child

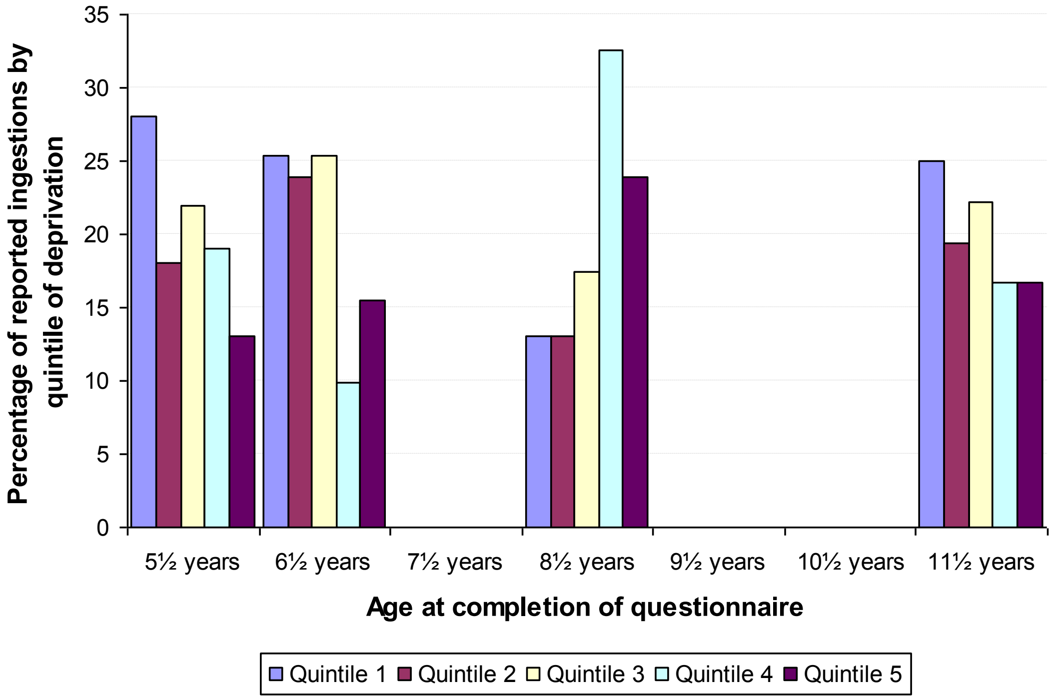
Data was available on the deprivation of the area of residence of the child using the IMD 2000 score, and the ingestion event on 253/271 (93.4%) occasions (Table 79). There appears to be very little pattern of ingestion occurrence by quintile of deprivation with age (Figure 47). A possible trend of less ingestion reporting in the lower quintiles seen at 5½, 6½ and 11½ years appears to be reversed at 8½ years.

Table 79: Ingestion events by quintile of deprivation and age

IMD	Reported ingestion events (number and percentage)								
	5½ years		6½ years		8½ years		11½ years		Total
	N	%	N	%	N	%	N	%	N
Quintile 1	28	28.00	18	25.35	6	13.04	9	25.00	61
Quintile 2	18	18.00	17	23.94	6	13.04	7	19.44	48
Quintile 3	22	22.00	18	25.35	8	17.39	8	22.22	56
Quintile 4	19	19.00	7	9.86	15	32.61	6	16.67	47
Quintile 5	13	13.00	11	15.49	11	23.91	6	16.67	41
Total	100	100.00	71	100.00	46	100.00	36	100.00	253

Note: n=253

Figure 47: Ingestion events by quintile of deprivation and age



Note: n=253

7.9 HEAD INJURIES

A head injury was defined as an injury that either resulted in a loss of consciousness or being 'knocked out', or one that did not result in loss of consciousness but was of a level of concern to the parent or carer that further attention was sought and the child was investigated (e.g. skull x-ray or scan) or admitted to hospital. Minor bumps or lacerations to the head were not coded as head injuries but included under 'bruising or swelling injuries' or 'cuts and wounds' as appropriate.

7.9.1 Number and rate of head injuries

One hundred and forty one injuries met the criteria for 'head injury'. Of these, only 22/141 (15.6%) were associated with loss of consciousness (Figure 47). The total number of head injuries at 5½, 6½ and 8½ years was relatively constant, but then increased at 11½ years. Head injuries were commoner in boys than girls at all ages. Of the 22 head injuries associated with a loss of consciousness the majority (17/22, 77.3%) occurred in boys.

Table 80: Frequency of head injuries, by age and sex

Age (years)	Reporting period (years)	Number of injuries						
		Boys		Girls		Total		
		LOC	No LOC	LOC	No LOC	LOC	No LOC	All HI
5½	4½ to 5½	3	16	0	7	3	23	26
6½	5½ to 6½	0	18	1	9	1	27	28
8½	7½ to 8½	4	19	1	6	5	25	30
11½	9 to 11½	10	32	3	12	13	44	57
Total		17	85	5	34	22	119	141

Note: n=141
LOC = head injury with loss of consciousness, No LOC = head injury without loss of consciousness but requiring investigation and / or admission to hospital. HI = Head injuries

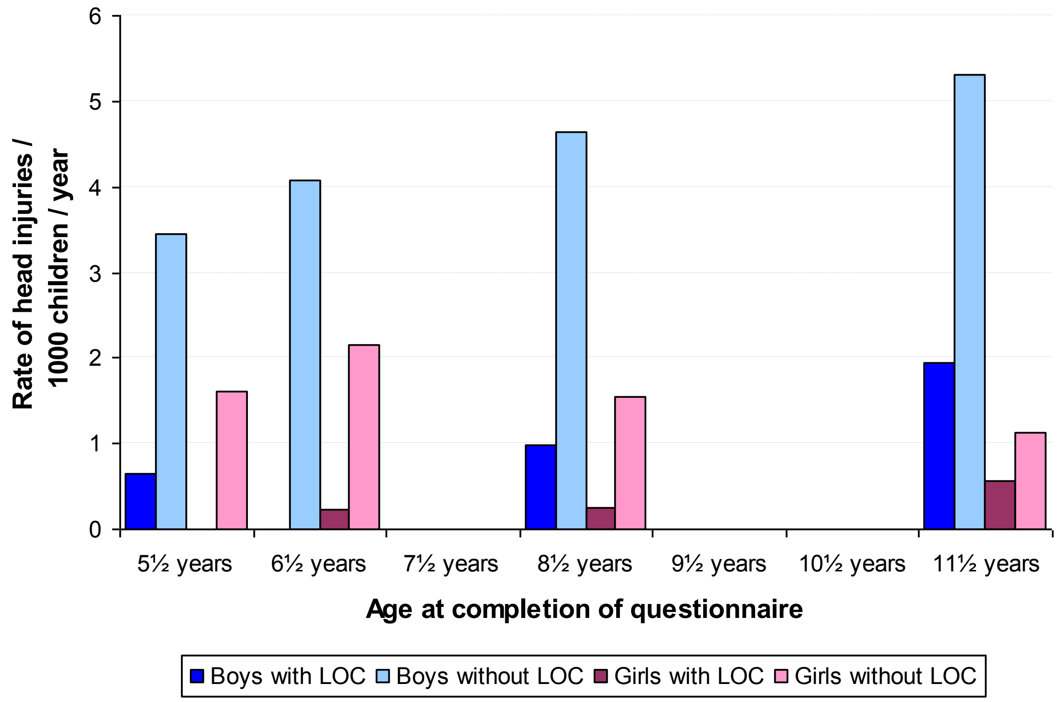
In all, 116 head injuries were reported in the 12 months prior to each questionnaire. The rate of head injuries (both with and without loss of consciousness) increased in boys throughout the data collection period. In comparison, there was no such pattern in girls, although small numbers make interpretation difficult (Table 81, Figure 48).

Table 81: Rate of head injuries per 1000 children per year, by age and sex

Age (years)	Reporting period	Rate of injuries / 1000 children / year			
		Boys		Girls	
		LOC	No LOC	LOC	No LOC
5½	12 months	0.65	3.45	0.00	1.60
6½	12 months	0.00	4.08	0.24	2.16
8½	12 months	0.98	4.65	0.26	1.54
11½	12 months	1.95	5.30	0.56	1.12

Note: n=116
LOC = head injury with loss of consciousness, No LOC = head injury without loss of consciousness but requiring investigation and / or admission to hospital. HI = Head injuries

Figure 48: Rate of head injuries with and without loss of consciousness per 1000 children per year, by age and sex



Note: n=116

7.9.2 How the head injury occurred

The underlying mechanism causing the head injury event was known in all cases. The commonest mechanism of both head injuries with (11/22, 50.0%) and without (70/119, 58.8%) loss of consciousness was blunt injury caused by falling, tripping or jumping (Table 82). The second most common cause of a head injury (without loss of consciousness) was contact with a person (e.g. fighting, 31/119, 26.1%).

Table 82: Underlying mechanism of head injury by age

Mechanism of injury	Type of injury	Head injuries (number)				
		5½ years	6½ years	8½ years	11½ years	Total
Transport injury - vehicle occupant	LOC	0	0	0	0	0
	No LOC	1	0	0	0	1
Transport injury - pedestrian	LOC	0	0	0	0	0
	No LOC	0	0	0	1	1
Blunt injury - contact with object or animal	LOC	0	0	1	1	2
	No LOC	0	3	5	8	16
Blunt injury - contact with person	LOC	1	0	1	7	9
	No LOC	4	4	7	16	31
Blunt injury - falling, tripping, or jumping etc	LOC	2	1	3	5	11
	No LOC	18	20	13	19	70
Total		26	28	30	57	141

Note: n=141
LOC = head injury with loss of consciousness, No LOC = head injury without loss of consciousness but requiring investigation and / or admission to hospital

7.9.3 Place where the head injury event occurred

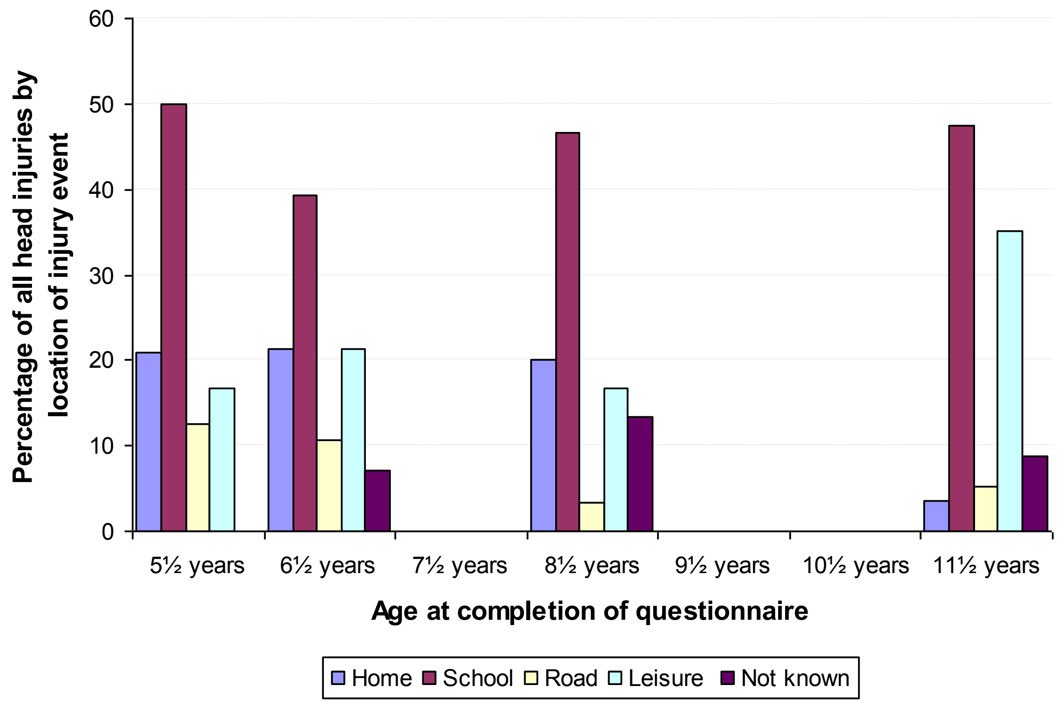
The location of the head injury event was known for 139/141 (98.6%) injuries (Table 83). Head injuries both with and without loss of consciousness were most likely to occur outside of the home (120/139, 86.3%). At 5½, 6½ and 8½ years about 20% of all head injuries did occur in the home, but this proportion decreases to less than 4% at 11½ years, when there is an increase in the proportion of head injuries occurring in the leisure environment (Figure 49). Head injuries were likely to occur at school (64/139, 46.0%) or at leisure venues (35/139, 25.2%). Twenty two of the head injuries (22/139, 15.8%) were specifically reported as having occurred at sporting venues (e.g. football pitch, gym, riding school), either at leisure (n=15) or at school (n=7).

Table 83: Location of head injury events with and without loss of consciousness by age

Location	Reported head injuries (number of cases)									
	With loss of consciousness					Without loss of consciousness				
	Age at completion of questionnaire (years)				Total	Age at completion of questionnaire (years)				Total
	5½	6½	8½	11½		5½	6½	8½	11½	
Home	1	0	1	1	3	4	6	5	1	16
School	1	0	0	5	6	11	11	14	22	58
Road	1	0	0	1	2	2	3	1	2	8
Leisure	0	1	3	6	10	4	5	2	14	25
Not known	0	0	1	0	1	0	2	3	5	10
Total	3	1	5	13	22	21	27	25	44	117

Note: n=139

Figure 49: Location of head injuries with and without loss of consciousness by age



Note: n=139
Columns combine head injuries with and without loss of consciousness at each data collection period

7.9.4 Treatment required following head injury event

The treatment required following the head injury was reported for 138/141 (97.9%) head injuries (Table 1). Four fifths of the head injuries received medical attention (110/138, 79.7%), compared with one fifth that did not (28/138, 20.3%). Of the 100 children attending secondary care, 15 suffered a loss of consciousness. One out of 15 (6.7%) of these children was reported to have been admitted to hospital, and 14/85 (16.5%) of the children who did not have a loss of consciousness were reported to have been admitted to hospital. It is of note that of 22 head injuries resulting in a loss of consciousness, six (27.3%) did not report seeking medical attention and were coded as either treated with first aid (n=5) or having no treatment (n=1).

Table 84: Treatment required for head injuries with and without loss of consciousness, by age and sex

Age (years)	Sex	Head injuries (number of cases)										
		No treatment required		First aid by parent or carer		Primary care doctor or nurse		Secondary care doctor or nurse		Not known		Total
		LOC	No LOC	LOC	No LOC	LOC	No LOC	LOC	No LOC	LOC	No LOC	
5½	Boys	0	2	0	1	0	2	3	11	0	0	19
	Girls	0	1	0	0	0	1	0	5	0	0	7
6½	Boys	0	1	0	0	0	2	0	15	0	0	18
	Girls	0	0	0	0	0	0	1	9	0	0	10
8½	Boys	1	2	1	1	0	2	2	13	0	1	23
	Girls	0	0	0	1	0	0	1	5	0	0	7
11½	Boys	0	5	3	6	1	2	6	18	0	1	42
	Girls	0	1	1	1	0	0	2	9	0	1	15
Total		1	12	5	10	1	9	15	85	0	3	141

Note: n=141

7.9.5 Head injuries and deprivation of area of residence of the child

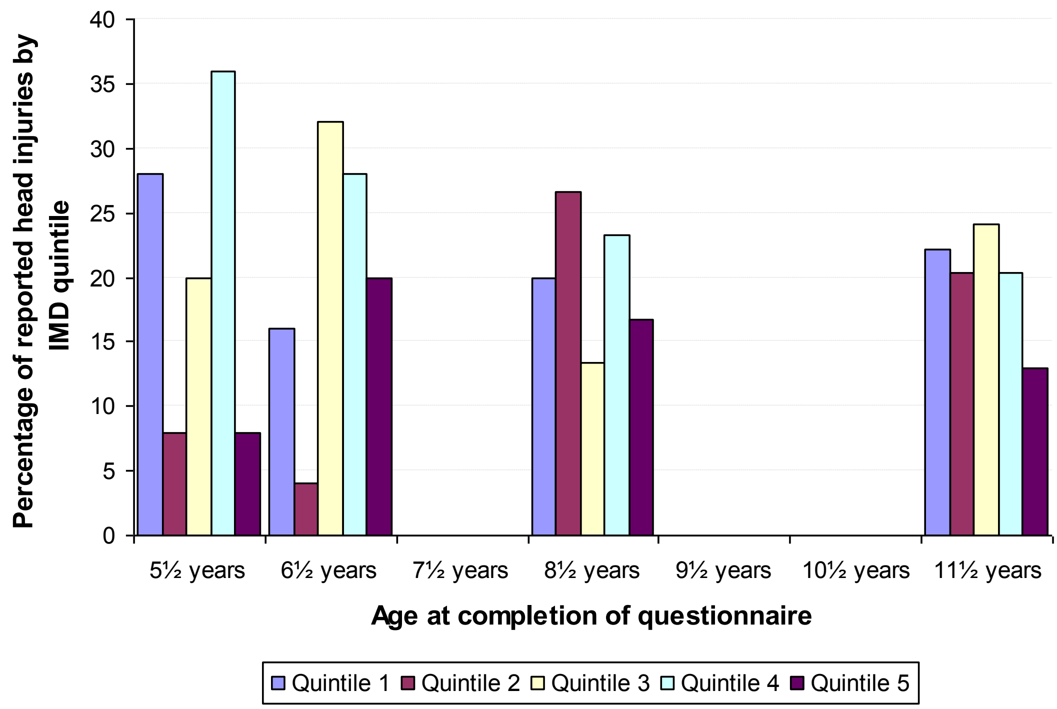
Data was available on the deprivation of the area of residence of the child using the IMD 2000 score, and the head injury event on 134/141 (95.0%) occasions (Table 85). For this analysis, head injuries causing a loss of consciousness and those that caused no loss of consciousness were grouped together in each data collection period. No pattern of head injury occurrence by quintile of deprivation with age was noted (Figure 50).

Table 85: Reported head injuries by quintile of deprivation and age

IMD	Reported head injuries (number and percentage)								
	5½ years		6½ years		8½ years		11½ years		Total
	N	%	N	%	N	%	N	%	N
Quintile 1	7	28.00	4	16.00	6	20.00	12	22.22	29
Quintile 2	2	8.00	1	4.00	8	26.67	11	20.37	22
Quintile 3	5	20.00	8	32.00	4	13.33	13	24.07	30
Quintile 4	9	36.00	7	28.00	7	23.33	11	20.37	34
Quintile 5	2	8.00	5	20.00	5	16.67	7	12.96	19
Total	25	100.00	25	100.00	30	100.00	54	100.00	134

Note: n=134

Figure 50: Reported head injuries by quintile of deprivation and age



Note: n=134

7.10 EYE INJURIES

A coding framework for injuries to the eye was established to differentiate those injuries resulting in a loss of vision from those resulting in no loss of vision. No eye injuries with a loss of vision were reported. The data presented here therefore represent injuries to the eye without loss of vision. Bruising or swelling injuries to the eye (i.e. 'black eyes') have already been reported

7.10.1 Number and rate of eye injuries

A total of 128 eye injuries were reported across the primary school-aged period (Table 86). Overall the number of eye injuries was greater in boys than in girls, and in boys increased with age. There was no clear pattern with age in the girls reporting eye injuries.

Table 86: Frequency of eye injuries, by age and sex

Age (years)	Reporting period (years)	Number of injuries		
		Boys	Girls	Total
5½	4½ to 5½	13	7	20
6½	5½ to 6½	15	16	31
8½	7½ to 8½	22	10	32
11½	9 to 11½	31	14	45
Total		81	47	128

Note: n=128

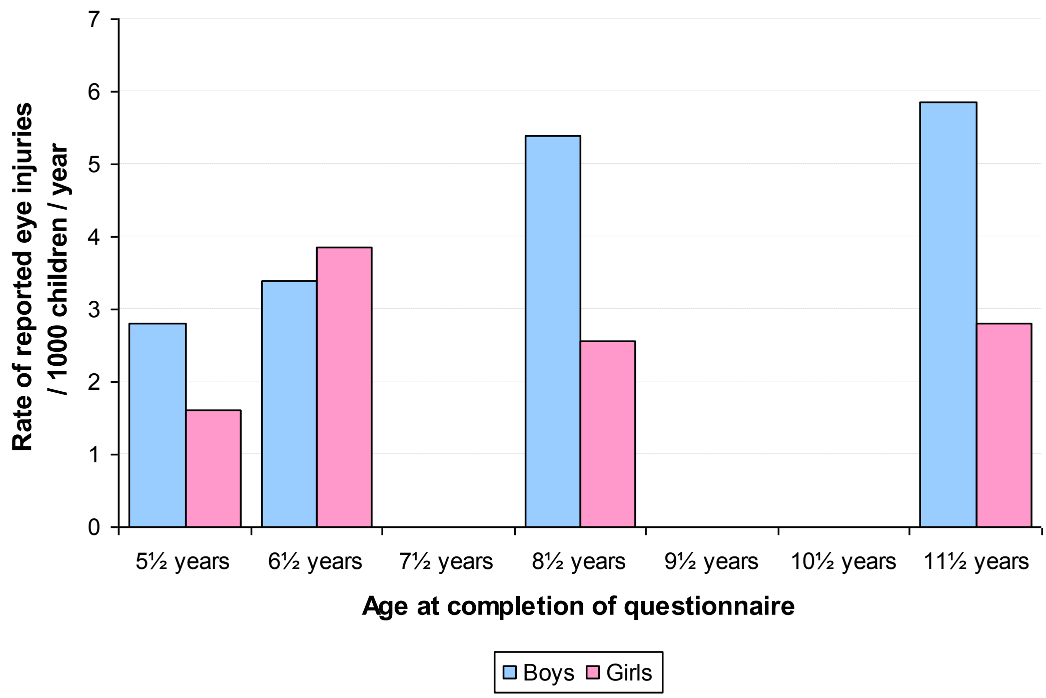
In all, 114 eye injuries were reported in the 12 months prior to each questionnaire. The rate of eye injuries in boys increased with age, whilst there is no similar pattern in girls (Table 87, Figure 51).

Table 87: Rate of eye injuries per 1000 children per year, by age and sex

Age (years)	Reporting period	Rate of injuries / 1000 children / year	
		Boys	Girls
5½	12 months	2.80	1.60
6½	12 months	3.40	3.85
8½	12 months	5.39	2.56
11½	12 months	5.85	2.80

Note: n=114

Figure 51: Rate of eye injuries per 1000 children per year, by age and sex



Note: n=114

7.10.2 How the eye injury occurred

Information on the underlying mechanism of the eye injury was available for 127/128 (99.2%) of the injuries (Table 88). The commonest cause of eye injuries at all ages was coming into contact with another person (59/127, 44.9%), followed by having a foreign body in the eye (36/127, 28.3%) and being hit in the eye with an object (25/127, 19.8%).

Table 88: Frequency of eye injuries by mechanism of injury and age

Mechanism of injury	Age at completion of questionnaire				Total
	5½ years	6½ years	8½ years	11½ years	
Blunt force - contact with object	4	5	7	9	25
Blunt force - contact with person	4	13	14	28	59
Blunt force - falling or tripping	2	2	1	1	6
Penetrating force - cutting	0	1	0	0	1
Foreign body	10	10	9	7	36
Not known	0	0	1	0	1
Total	20	31	32	45	128

Note: n=128

7.10.3 Place where the eye injury event occurred

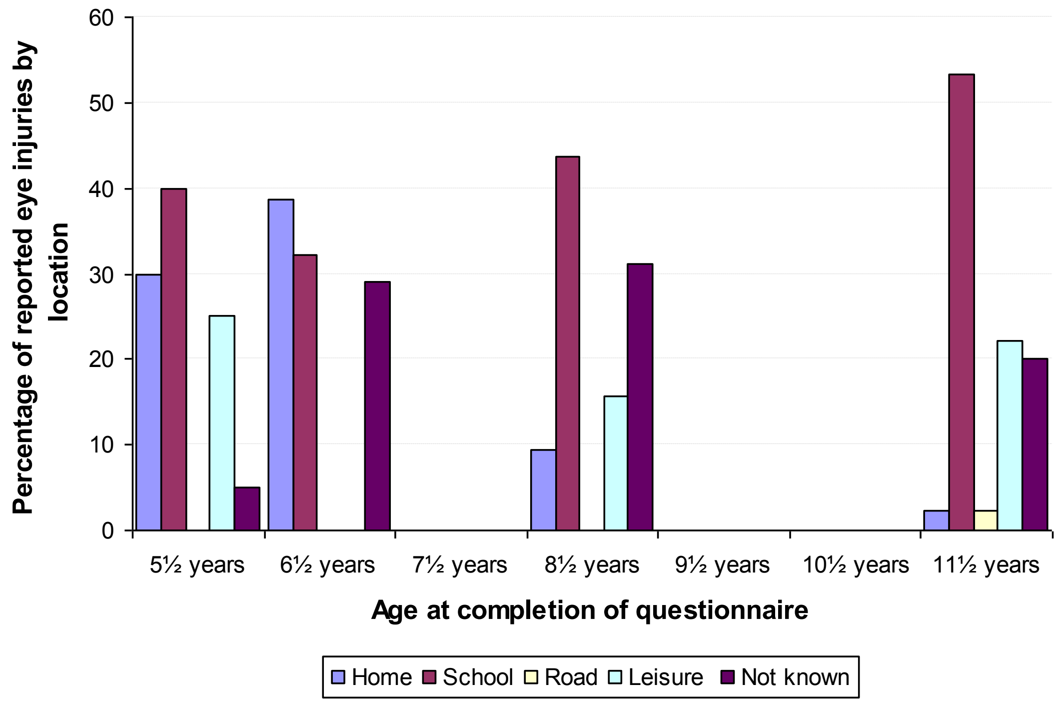
The location of the eye injury event was known in 99/128 (77.3%) cases (Table 89). Most injuries occurred in the school environment (56/99, 56.6%), followed by the home (22/99, 22.2%) and leisure (20/99, 20.2%) areas. The proportion of eye injuries occurring in the school environment increased with age, and the home became increasingly less important with age (Figure 52). Only one injury was reported to have occurred in the road environment.

Table 89: Location of eye injury events, by age

Location	Eye injury events (number and percentage)									
	5½ years		6½ years		8½ years		11½ years		Total	
	N	%	N	%	N	%	N	%	N	%
Home	6	30.00	12	38.71	3	9.38	1	2.22	22	17.19
School	8	40.00	10	32.26	14	43.75	24	53.33	56	43.75
Road	0	0.00	0	0.00	0	0.00	1	2.22	1	0.78
Leisure	5	25.00	0	0.00	5	15.63	10	22.22	20	15.63
Not known	1	5.00	9	29.03	10	31.25	9	20.00	29	22.66
Total	20	100.00	31	100.00	32	100.00	45	100.00	128	99.98

Note: Percentages may not total 100 due to rounding. N=128

Figure 52: Location of eye injury events, by age



Note: n=128

7.10.4 Who was with the child at the time of the eye injury event

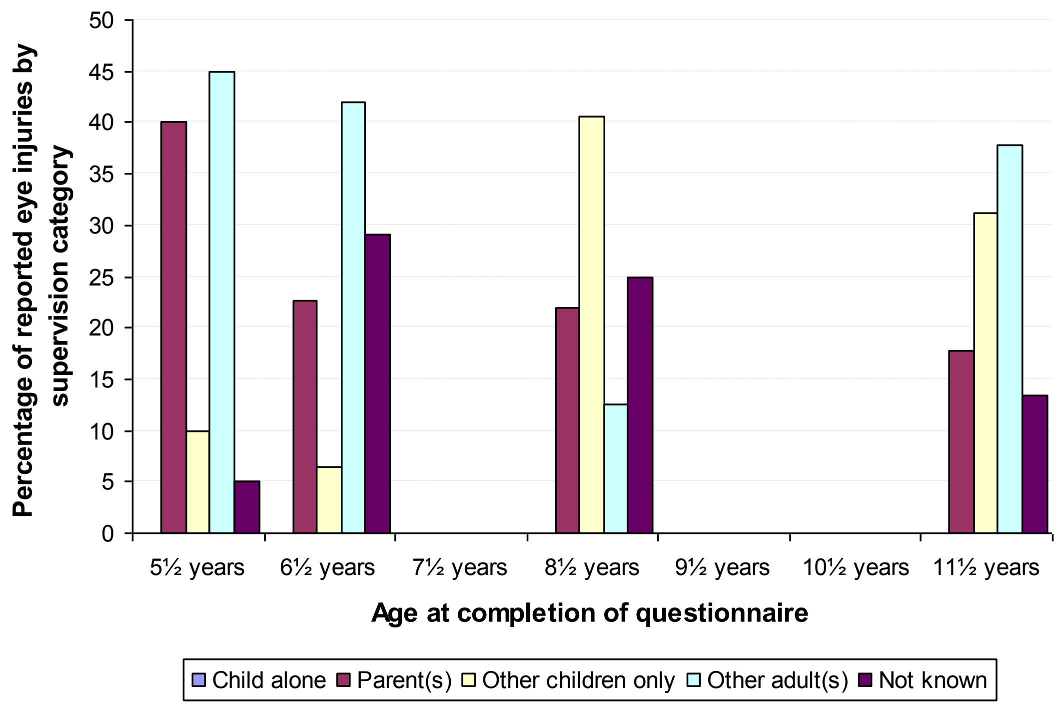
Data on the supervision of the child at the time of the eye injury were recorded in 104/128 (81.3%) cases (Table 90). No children were alone at the time of their eye injury. Children were with an adult or their parents on 73/104 (70.2%) of occasions. Children at 8½ and 11½ years were more likely to sustain an eye injury when with other children than when aged 5½ or 6½ years (Figure 53).

Table 90: Who was with the child at the time of eye injury events, by age

Who was with the child	Eye injury events (number and percentage)								
	5½ years		6½ years		8½ years		11½ years		Total
	N	%	N	%	N	%	N	%	N
Child alone	0	0.00	0	0.00	0	0.00	0	0.00	0
Parent(s)	8	40.00	7	22.58	7	21.88	8	17.78	30
Other children	2	10.00	2	6.45	13	40.63	14	31.11	31
Other adult(s)	9	45.00	13	41.94	4	12.50	17	37.78	43
Not known	1	5.00	9	29.03	8	25.00	6	13.33	24
Total	20	100.00	31	100.00	32	100.00	45	100.00	128

Note: n=128

Figure 53: Who was with the child at the time of eye injury event, by age



Note: n=128

7.10.5 Treatment required for eye injuries

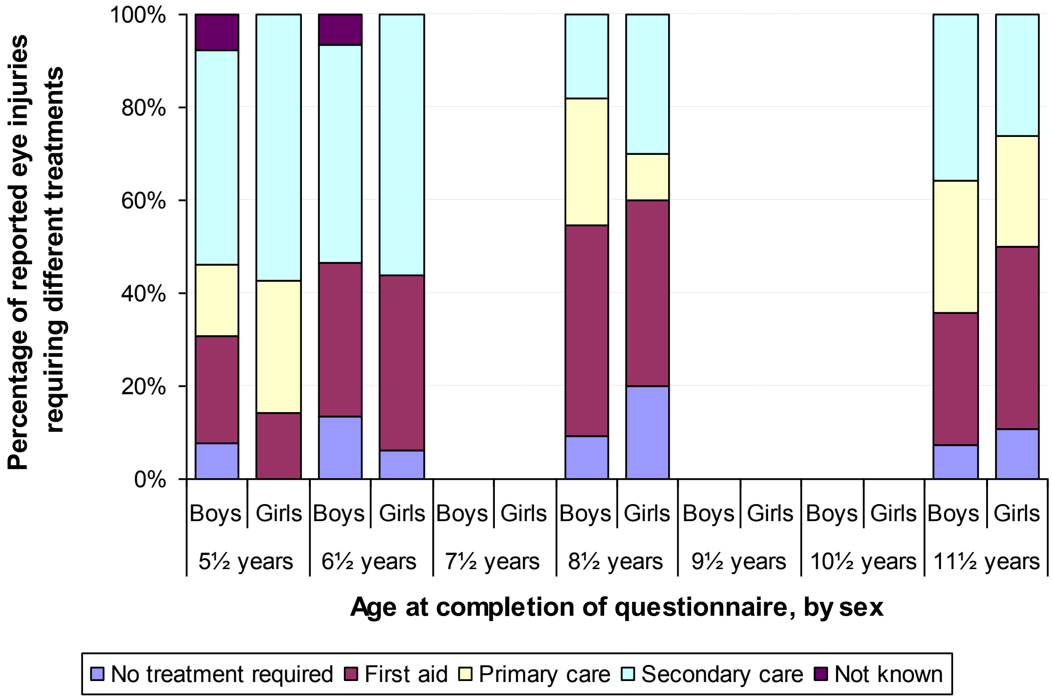
Information on the treatment required for reported eye injuries was available for 125/128 (97.7%) of cases (Table 91). Seventy five of 125 cases were reported to have received medical attention (60.0%), with 52/125 (41.6%) attending secondary care. None of the reported eye injuries required hospital admission. Although more eye injuries were reported in boys (n=81) than girls (n=47), the proportion of injuries requiring medical attention was similar; 58.0% in boys (47/81) and 59.6% in girls (28/47). Figure 54 suggests that the proportion of eye injuries receiving medical attention at younger ages (5½ and 6½ years) was greater than when older (8½ and 11½ years).

Table 91: Treatment received by children following eye injuries, by age and sex

Age (years)	Sex	Treatment of eye injuries (number of cases)					
		No treatment required	First aid by parent or carer	Primary care doctor or nurse	Secondary care doctor or nurse	Not known	Total
5½	Boys	1	3	2	6	1	13
	Girls	0	1	2	4	0	7
6½	Boys	2	5	0	7	1	15
	Girls	1	6	0	9	0	16
8½	Boys	2	10	6	4	0	22
	Girls	2	4	1	3	0	10
11½	Boys	2	6	8	14	1	31
	Girls	1	4	4	5	0	14
Total		11	39	23	52	3	128

Note: n=128

Figure 54: Treatment received by children following eye injuries by age and sex



Note: n=128

7.10.6 Eye injuries and deprivation of area of residence of the child

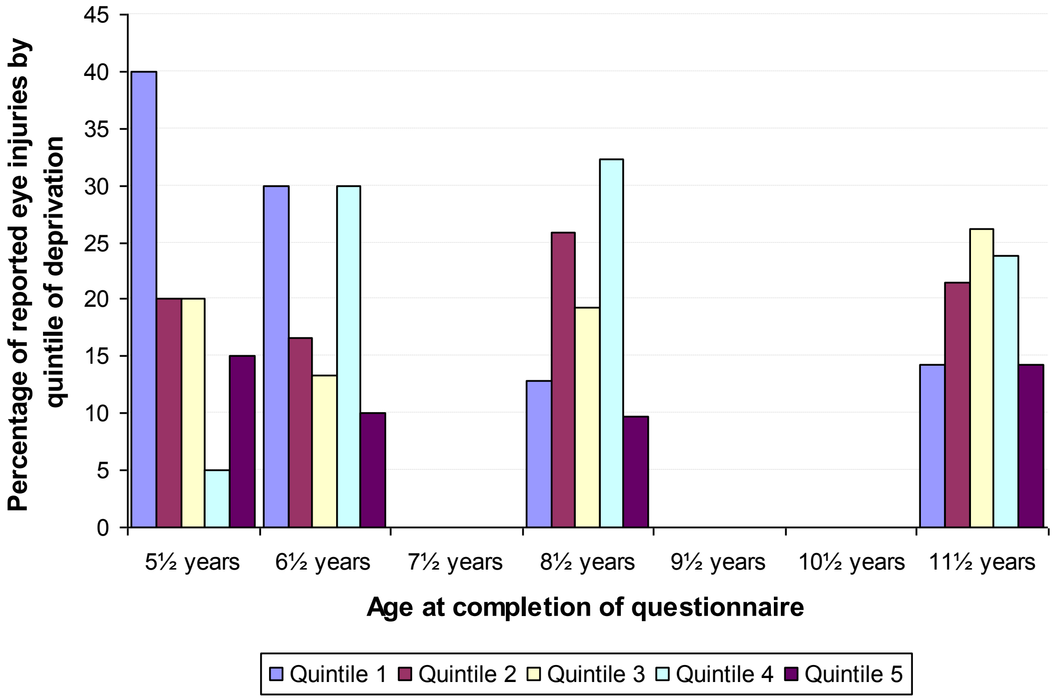
Information on the IMD 2000 score for the child's area of residence was known in 123/128 (96.1%) eye injury cases (Table 92). Eye injuries were least reported in quintile 5 (most disadvantaged) across all age groups (Figure 55). Otherwise there appeared to be no clear pattern of distribution of eye injuries by quintile of deprivation of area of residence.

Table 92: Number and percentage of eye injuries, by quintile of deprivation and age

IMD quintile	Eye injury events (number and percentage)								
	5½ years		6½ years		8½ years		11½ years		Total
	N	%	N	%	N	%	N	%	N
Quintile 1	8	40.00	9	30.00	4	12.90	6	14.29	27
Quintile 2	4	20.00	5	16.67	8	25.81	9	21.43	26
Quintile 3	4	20.00	4	13.33	6	19.35	11	26.19	25
Quintile 4	1	5.00	9	30.00	10	32.26	10	23.81	30
Quintile 5	3	15.00	3	10.00	3	9.68	6	14.29	15
Total	20	100.00	30	100.00	31	100.00	42	100.00	123

Note: n=123

Figure 55: Percentage of total eye injuries, by quintile of deprivation and age



Note: n=123

7.11 INJURY EVENTS OCCURRING IN THE ROAD ENVIRONMENT

The road environment is the place where children are most likely to sustain fatal injuries. Mechanisms of fatal injuries in the road environment may have similarities with non-fatal injuries in the road environment. Injuries reported by parents in ALSPAC that occurred in the road environment have therefore been described in this section and a further analysis of transport-related injuries are explored in section 7.12. Sections 7.11 and 7.12 contain data that has already been reported in the sections reporting different types of injury above.

For each injury event reported a code was allocated to identify the place where the injury event occurred. Injuries in the road environment could therefore be classified as occurring in the road, on the pavement, on a cycleway, or on a specified or unspecified public highway (if more detailed information was missing). This analysis describes injuries occurring in these settings, by a number of different causes.

7.11.1 Number and rate of road environment injuries

Using all reported injury events (n=12421) a total of 1317 injuries occurring in the road environment were reported across the primary school-aged period (Table 93). Overall the number of road environment injuries was greater in boys than in girls in the responses to each questionnaire.

Table 93: Frequency of road environment injuries in each reporting period, by age and sex

Age (years)	Reporting period (years)	Number of injuries		
		Boys	Girls	Total
5½	4½ to 5½	111	55	166
6½	5½ to 6½	168	136	304
8½	7½ to 8½	214	188	402
11½	9 to 11½	254	191	445
Total		747	570	1317

Note: n=1317

In all, 1097 of these injuries were reported in the 12 months prior to each questionnaire. The rate of injuries occurring in the road environment was higher in boys than girls at all ages (Table 94, Figure 56). In both boys and girls the rate increased from age 5½ to 8½ years and then fell by 11½ years.

Table 94: Rate of injuries occurring in the road environment / 1000 children / year, by age and sex

Age (years)	Reporting period	Rate of injuries / 1000 children / year	
		Boys	Girls
5½	12 months	23.92	12.61
6½	12 months	38.10	32.71
8½	12 months	52.39	48.17
11½	12 months	35.67	27.18

Note: n=1097

Figure 56: Rate of injuries occurring in the road environment / 1000 children / year, by age and sex

Note: n=1097

7.11.2 Type of injury sustained

Information on the outcome of the road environment injury event was coded for 1145/1317 (86.9%) cases (Table 95). The majority of the injuries sustained were cuts and wounds (643/1145, 56.2%) or bruising / swelling injuries (194/1145, 16.9%). In addition, a number of potentially more serious injuries occurred including 150 fractures (13.1%) and 10 head injuries (0.9%) of which two resulted in a loss of consciousness.

Table 95: Type of injury sustained by children injured in the road environment, by age and sex

Injury type	Road environment injuries (number of injuries)								Total
	5½ years		6½ years		8½ years		11½ years		
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	
Fracture	3	2	6	10	11	23	52	43	150
Cut / wound	68	31	96	68	132	97	99	52	643
Burn / scald	1	0	0	0	1	1	0	0	3
Bruising / swelling	19	8	28	15	29	24	39	32	194
Sprain / strain	0	1	3	5	5	17	11	24	66
Head injury	3	0	3	0	0	1	3	0	10
Dental injury	4	4	4	6	3	1	12	3	37
Other injury	4	5	3	2	6	3	7	12	42
Not known	9	4	25	30	27	21	30	25	171
Total	111	55	168	136	214	188	253	191	1316

Note: n=1316

7.11.3 How the road environment injury occurred

The mechanism of the road environment injury was known for 1296/1317 (98.4%) of cases (Table 96). Almost three quarters of these injury events were caused by the child 'falling, tripping, stumbling or jumping' when in the road environment (963/1296, 74.3%). 177/1296 (13.7%) injuries were transport-related blunt trauma, with almost half (83/177, 46.9%) occurring when the child was inside a vehicle, 41.2% (73/177) when the child was a pedestrian and 11.7% (21/177) when the child was a cyclist. Gender differences occurred in transport-related blunt trauma injuries with 56.6% (47/83) vehicle occupant injuries occurring in girls, in contrast to pedestrian injuries where 65.8% (48/73) occurred in boys and cycling injuries where 85.7% (18/21) occurred in boys.

Table 96: Mechanism of road environment injury by age and sex

Mechanism of injury event	Road environment injuries (number of injuries)								Total
	5½ years		6½ years		8½ years		11½ years		
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	
Blunt force – transport injury (vehicle occupant)	1	5	13	14	11	10	11	18	83
Blunt force – transport injury (pedestrian)	6	1	12	4	11	6	19	14	73
Blunt force – transport injury (cyclist)	1	0	3	0	5	0	9	3	21
Blunt force - Falling, tripping, stumbling or jumping	88	35	123	107	162	148	176	124	963
Other blunt injury	12	10	15	9	19	15	28	22	130
Other mechanism	2	3	1	1	4	4	4	7	26
Not Known	1	1	1	1	2	5	6	3	20
Total	111	55	168	136	214	188	253	191	1316

Note: n=1316
'Other blunt injury' includes contact with object, animal or person, crushing or abrading injuries. 'Other mechanism' includes cutting / penetrating injuries, biting / stinging injuries, sunburn, ingestions / foreign bodies etc.

7.11.4 Who was with the child at the time of the road environment injury and treatment required

Of the 1317 road environment injuries, data were available on the supervision of the child at the time of the event in 870 (66.1%) cases (Table 97). Children were just as likely to be injured in the road environment if they were alone or with other children (428/870, 49.2%), as they were when with their parents or other adults (442/870, 50.8%).

Information on the treatment sustained was available for 1271/1317 (96.5%) cases. The majority of children either required no treatment or first aid (725/1271, 57.0%) for their injury, whilst 43.0% (546/1271) required medical or dental attention. Of these, 424/546 were seen in secondary care, of which six required hospital admission.

Table 97: Who was with the child at the time of the road environment injury, by treatment received

Who was with the child	Treatment required (number of injuries)						
	No treatment required	First aid by parent or carer	Primary care doctor or nurse	Care by dentist	Secondary care doctor or nurse	Not known	Total
Alone	8	14	2	3	14	10	51
Parent(s)	37	171	35	7	121	3	374
Other children	74	153	22	7	112	9	377
Other adults	12	20	10	1	25	0	68
No known	31	205	32	3	152	23	446
Total	162	563	101	21	424	45	1316

Note: n=1316

7.11.5 Road environment injuries and deprivation of the area of residence

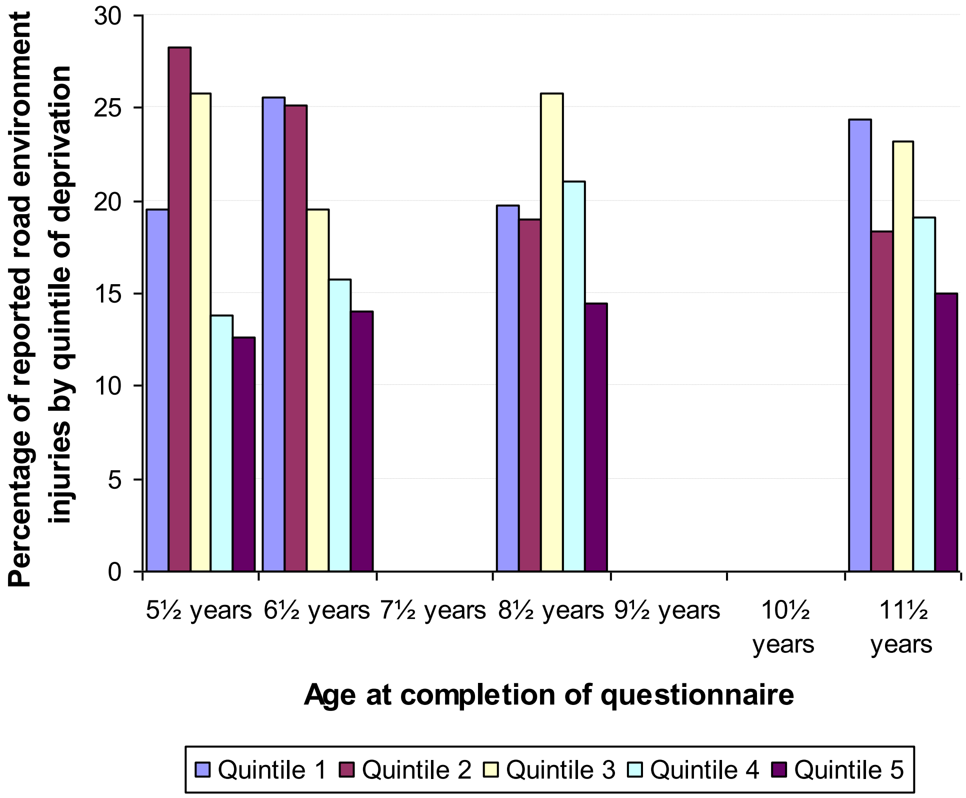
Data were available on the deprivation of the area of residence of the child, and the road environment injury event on 1244 /1317 (94.5%) occasions (Table 98). The proportion of reported road environment injury events fell between quintile 3 and quintile 5 in all four questionnaires (Figure 57). There was no consistent pattern of road environment reporting for quintiles 1 and 2 with age.

Table 98: Number and percentage of road environment injuries, by quintile of deprivation and age

IMD quintile	Road environment injuries (number and percentage)								
	5½ years		6½ years		8½ years		11½ years		Total
	N	%	N	%	N	%	N	%	N
Quintile 1	31	19.50	73	25.52	75	19.74	102	24.34	281
Quintile 2	45	28.30	72	25.17	72	18.95	77	18.38	266
Quintile 3	41	25.79	56	19.58	98	25.79	97	23.15	292
Quintile 4	22	13.84	45	15.73	80	21.05	80	19.09	227
Quintile 5	20	12.58	40	13.99	55	14.47	63	15.04	178
Total	159	100.00	286	100.00	380	100.00	419	100.00	1244

Note: n=1244

Figure 57: Percentage of road environment injuries, by quintile of deprivation and age



Note: n=1244

7.12 TRANSPORT-RELATED INJURIES

The coding used to classify the mechanism of injury occurrence identified injuries that were caused through transport-related mechanisms; specifically being a vehicle occupant, a pedestrian, a cyclist, a motorcyclist or rider, or another specified or unspecified transport injury mechanism. These injuries typically occurred on roads and public highways, but this was not a requirement of this coding. For example, a child injured whilst driving a car on a private race track would be classified as a transport-related injury, even though the event did not occur on a public highway or road.

7.12.1 Number and rate of transport-related injuries

Using all reported injury events (n=12421) a total of 191 transport-related injuries were reported across the primary school-aged period (Table 99). Boys sustained more transport-related injuries than girls at each reporting period.

Table 99: Frequency of transport-related injuries, by age and sex

Age (years)	Reporting period (years)	Number of injuries		
		Boys	Girls	Total
5½	4½ to 5½	11	6	17
6½	5½ to 6½	28	19	47
8½	7½ to 8½	27	19	46
11½	9 to 11½	46	35	81
Total		112	79	191

Note: n=191

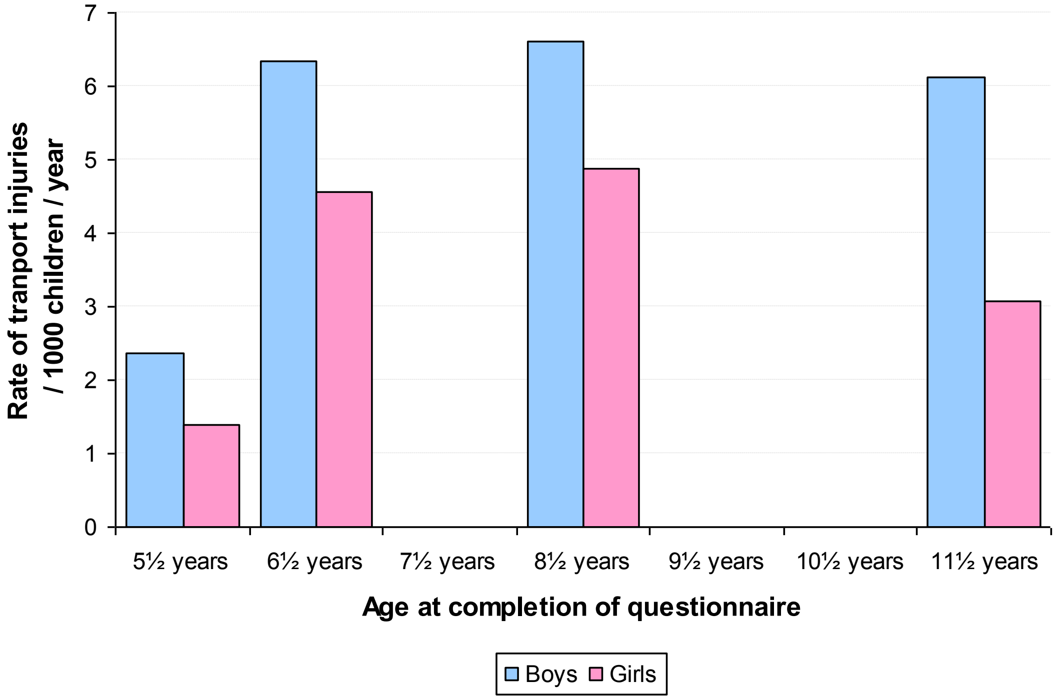
In all, 143 of these injuries were reported in the 12 months prior to each questionnaire. The rate of transport-related injuries is higher in boys than girls at all ages (Table 100, Figure 58). For both boys and girls rates peaked at 8½ years and then fell at 11½ years.

Table 100: Rate of reported transport-related injuries / 1000 children / year, by age and sex

Age (years)	Reporting period	Rate of injuries / 1000 children / year	
		Boys	Girls
5½	12 months	2.37	1.38
6½	12 months	6.35	4.57
8½	12 months	6.61	4.87
11½	12 months	6.13	3.08

Note: n=143

Figure 58: Rate of transport-related injuries per 1000 children per year, by age and sex



Note: n=143

7.12.2 Type of injury sustained

Information on the outcome of the transport-related injury event was coded for 125/191 (65.4%) cases (Table 101). Almost two thirds of injuries sustained were bruising / swelling injuries (49/125, 39.2%) or cut / wound injuries (31/125, 24.8%). The proportion of injuries that were fractures was 10.4% (13/125).

Table 101: Type of injury sustained in transport-related injury events, by age and sex

Injury type	Age and sex of child (number of injuries)								Total
	5½ years		6½ years		8½ years		11½ years		
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	
Fracture	1	1	1	1	3	2	3	1	13
Cut / wound	4	1	6	4	5	0	7	4	31
Burn / scald	0	0	0	0	1	0	0	0	1
Bruising / swelling	2	2	6	2	6	7	14	10	49
Sprain / strain	1	0	1	1	2	3	3	8	19
Head injury	1	0	0	0	0	0	1	0	2
Dental injury	0	0	0	0	0	0	1	1	2
Other injury	0	2	1	0	0	1	3	1	8
Not known	2	0	13	11	10	6	14	10	66
Total	11	6	28	19	27	19	46	35	191

Note: n=191

7.12.3 Location of the transport-related injury event

Data on the location of the transport-related injury event was available for 185/191 (96.9%) cases. Almost all of these events occurred when the child was in the road or crossing the road (173/185, 93.5%) (Table 102).

Table 102: Location of transport-related injury events, by age and sex

Place injury event occurred	Age and sex of child (number of injuries)								Total
	5½ years		6½ years		8½ years		11½ years		
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	
Road	8	6	26	18	25	16	40	34	173
Pavement	0	0	2	0	2	0	1	0	5
Car racing track	0	0	0	0	0	0	2	0	2
Other	1	0	0	0	0	2	1	1	5
Not known	2	0	0	1	0	1	2	0	6
Total	11	6	28	19	27	19	46	35	191

Note: n=191
The 'pavement' injuries were sustained when a child was hit by a vehicle whist on the pavement.
'Other' included a child being hit by a vehicle/trailer when on a driveway, in a car park, on a farm, on school premises etc.

7.12.4 Who was with the child at the time of the transport-related injury and treatment required

Of the 191 transport-related injury events, data were available on who was with the child at the time of the event in 176 (92.1%) cases (Table 103). Children were most likely to be injured in a transport-related injury event when with their parents (85/176, 48.3%) or with other children (46/176, 26.1%). They were less likely to be involved in a transport-related injury event if on their own (16/176, 9.1%). Information on the treatment sustained was available for 185/191 (96.9%) cases. The majority of children required medical attention (120/185, 64.9%), with only 21.6% (40/185) requiring no treatment. Of those requiring medical attention, most were seen in secondary care (93/120, 77.5%). Only one of the children was admitted to hospital following a transport-related injury event.

Table 103: Who was with the child at the time of the transport-related injury, by treatment received

Who was with the child	Treatment required (number of injuries)						
	No treatment	First aid by parent or carer	Primary care doctor or nurse	Care by dentist	Secondary care doctor or nurse	Not known	Total
Alone	5	0	1	0	8	2	16
Parent(s)	12	8	19	0	46	0	85
Other children	12	9	4	1	20	0	46
Other adults	7	5	1	0	16	0	29
No known	4	3	1	0	3	4	15
Total	40	25	26	1	93	6	191

Note: n=191

7.12.5 Transport-related injuries and deprivation of the area of residence

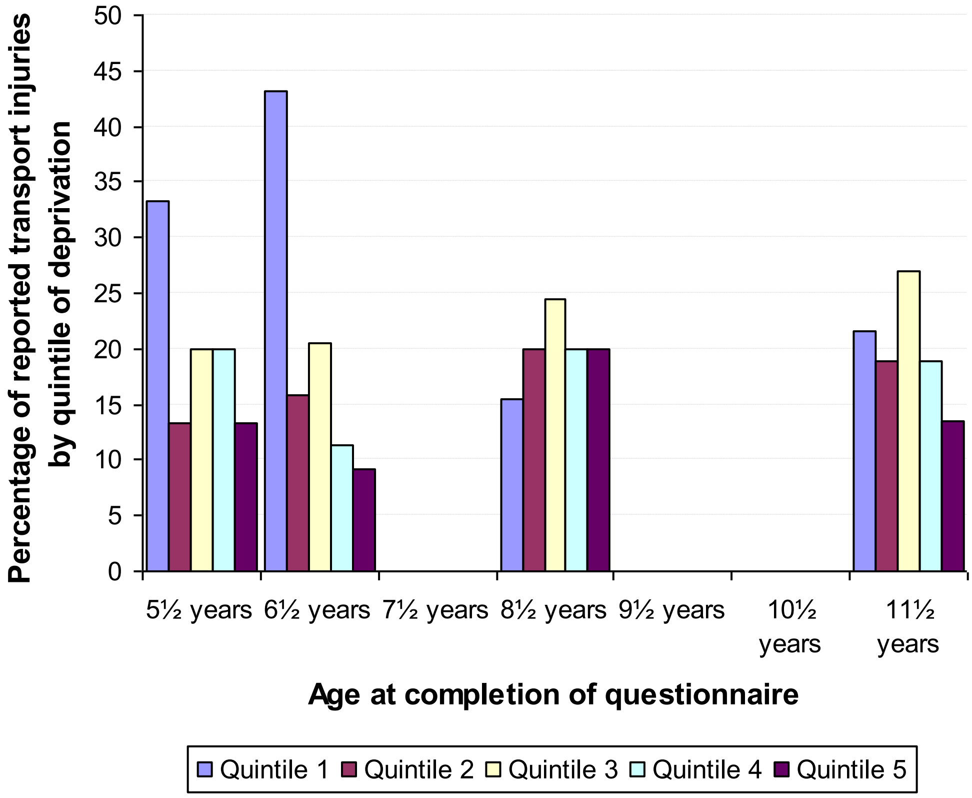
Data were available on the deprivation of the area of residence of the child, and the transport-related injury event in 178/191 (93.2%) occasions (Table 104). At age 5½ and 6½ years children in quintile 1 (least disadvantaged) have the highest proportion of transport-related injuries, but at ages 8½ and 11½ years there was no clear pattern of transport-related injuries with quintile of deprivation. At 5½, 6½ and 11½ years children in quintile 5 (most disadvantaged) have the lowest proportion of transport-related injuries (Figure 59).

Table 104: Transport-related injuries, by quintile of deprivation and age

IMD quintile	Dental injury events (number and percentage)								
	5½ years		6½ years		8½ years		11½ years		Total
	N	%	N	%	N	%	N	%	N
Quintile 1	5	33.33	19	43.18	7	15.56	16	21.62	47
Quintile 2	2	13.33	7	15.91	9	20.00	14	18.92	32
Quintile 3	3	20.00	9	20.45	11	24.44	20	27.03	43
Quintile 4	3	20.00	5	11.36	9	20.00	14	18.92	31
Quintile 5	2	13.33	4	9.09	9	20.00	10	13.51	25
Total	15	100.00	44	100.00	45	100.00	74	100.00	178

Note: n=191

Figure 59: Percentage of transport-related injuries, by quintile of deprivation and age



Note: n=191

7.13 SUMMARY OF CHAPTER

This chapter has explored the parent-reported injury data collected in four questionnaires as part of ALSPAC. The descriptive epidemiology of different types of injury has been reported. The commonest types of injuries; cuts and wounds, bruising and swelling, sprains and strains and fractures, reflect the frequencies of injury types reported in the background section of this thesis. The number of injury events illustrates the significant proportion of injuries that are treated at home with simple first aid and do not present to emergency departments.

The data has clearly illustrated the increased rate of injuries in boys compared with girls, except for burns and scalds. In addition it has demonstrated the shifting trend of injuries towards those occurring in leisure and school environments as children gain independence. A striking feature of the data has been the finding that the rate of injuries appears to be greater for the least disadvantaged groups for most ages and most injury types. This was an unexpected finding and an exploration of reasons for this finding is included in the discussion.

CHAPTER 8: ANALYSIS OF RISK FACTORS AND REPORTED SECONDARY CARE ATTENDED INJURY

The purpose of this chapter is to describe the relationship between injuries in primary school-aged children and a variety of factors in the child, their family, their home environment and their neighbourhood environment, using multiple logistic regression. The chapter will first define the injury (outcome or dependent) variable used, and secondly combine this with a variety of independent (or explanatory) variables within the observed data to explore univariable, and then multivariable, relationships. The multivariable model will be re-analysed using an imputed dataset and the differences between the observed and imputed results described. The chapter will conclude with an exploration of the impact of the home and neighbourhood on injury risk that is independent of factors in the child or their family.

8.1 DEFINITION OF THE INJURY VARIABLE

A total of 5752 families returned all four questionnaires that contained questions on injury during the period between five and 11 years of age. Using the free text information on the injuries provided by the parents, a total of 12,421 injuries were reported in these children. As no measure of severity of injury was available, the place of treatment of injury (at home, or at a primary or secondary care level) was used as a proxy for severity. Between the ages of 5-11 years, the parents and carers reported that 65.1% of the children had any injury, 40.9% had at least one injury of enough concern for the parent to seek some sort of medical attention for the child, and 32.6% of children had at least one injury that was considered serious enough to warrant medical attention in secondary care (i.e. hospital attendance) (Table 105).

The systematic review of cohort studies reporting childhood injuries demonstrated that the type and circumstances of injuries changed as children grew between five and 11 years. Therefore different independent variables may act as risk or protective factors for injury at different ages. Thirteen percent of early primary school-aged children (i.e. 5-7 years) and 24% of late primary school-aged children (8-11 years) sustained any injury severe enough to warrant treatment in secondary care. (Table 106).

Table 105: Prevalence of injury occurrence in observed data

Description (injury variable name)	Children with outcome (n)	Prevalence
Any injury sustained in any of the four injury questionnaires (AnyInjury)	3746	65.1%
Any medically attended injury reported in any of the questionnaires (AnyMAIany).	2356	40.9%
Any secondary care (i.e. hospital) attended injury reported in any of the questionnaires (AnySCIany).	1877	32.6%

Note: N=5752

Table 106: Prevalence of injuries requiring hospital attendance, by age

Description (outcome variable name)	Children with outcome (n)	Prevalence
Any secondary care (i.e. hospital) attended injury reported during the infant school period (AnySCI56).	739	12.9%
Any secondary care (i.e. hospital) attended injury reported during the junior school period (AnySCI811).	1374	23.9%

Note: N=5752

For regression analyses, children with any injury treated in secondary care were chosen as the primary outcome variable, stratified by age. Reasons for this choice included:

1) Results from published cohort studies often defined 'an injury' as one requiring treatment in secondary care. Choosing this outcome therefore enabled the opportunity of making comparisons with published research.
2) Logistic regression produces effect sizes expressed as odds ratios (OR) and these are usually interpreted as being equivalent to the relative risk (RR). The rarer the outcome of interest, the closer the approximation of the OR to the RR. Odds ratios always overestimate the size of the effect when interpreted as a relative risk and this overestimation increases particularly when the prevalence of the outcome of interest is over 20%.[198] It was therefore preferable to choose an injury variable with a prevalence of <20%. The choice of any secondary care injury sustained during the early and late primary school period resulted in two prevalence rates that produced ORs that were considered valid approximations of RR.

The higher prevalence of the injury variable in late primary school-aged children will result in narrower confidence intervals and p values that are lower for the same regression estimate than in the early primary school-aged children.

8.2 UNIVARIABLE ANALYSES

For each independent variable, the coding, the completeness and the prevalence were reported. Variables were re-coded into binary outcomes where possible and appropriate, and kept as ordinal categorical variables where necessary. A detailed description of each variable and an exploratory analysis of the association of each independent variable and injury using a X^2 test, stratified by age of the child, is provided in Appendix 7.

Using the null hypothesis of no association between the independent variable and the occurrence of any injury requiring secondary care attendance, unadjusted univariable logistic regression analyses of the relationship between independent variables and injury was undertaken in four groups; child, family, home and neighbourhood, stratified by age of child. For each independent variable the odds ratios, 95% confidence intervals and p values are recorded in Table 107.

Table 107: Unadjusted univariable analyses of factors associated with an outcome of secondary care attended injury, by age.

Variable	Data type (*Reference vs Comparison group) EP=Early primary, LP=Late Primary	Early primary		Late primary	
		Unadjusted OR (95% CI)	P value	Unadjusted OR (95% CI)	P value
Child variables					
Gender	Binary (*female vs male)	1.66 (1.42, 1.94)	<0.001	1.16 (1.03, 1.31)	0.016
Hearing impairment	Binary (EP: *no hearing assessment vs assessment, LP: *no impairment vs any)	1.17 (0.93, 1.46)	0.181	1.05 (0.81, 1.36)	0.697
Visual impairment	Binary (*no glasses vs given glasses)	0.74 (0.56, 0.99)	0.040	0.92 (0.73, 1.16)	0.463
Fine motor skills (Early primary only)	Binary (*normal vs bottom 10%)	0.96 (0.74, 1.26)	0.791		
Gross motor skills (Early primary only)	Binary (*normal vs bottom 10%)	0.80 (0.59, 1.08)	0.140		
Coordination (Late primary only)	Binary (*no DCD at 8yrs, vs yes)			0.88 (0.61, 1.26)	0.481
Hyperactivity	Categorical (trend)	1.17 (1.06, 1.28)	0.001	1.05 (0.97, 1.14)	0.193
Psychological difficulties	Categorical (trend)	1.04 (0.94, 1.15)	0.486	1.10 (1.03, 1.19)	0.006
Conduct problems	Categorical (trend)	1.11 (1.03, 1.18)	0.005	1.07 (1.02, 1.14)	0.013
Total behavioural problems	Categorical (trend)	1.19 (1.08, 1.31)	0.001	1.15 (1.07, 1.24)	<0.001
Learning difficulties	Binary (EP: *no learning problems vs problems, LP: *top 75% scores (IQ>97), vs bottom 25%)	1.31 (1.01, 1.69)	0.043	0.99 (0.85, 1.14)	0.850
Previous injury treated in hospital	Binary (*no injury vs any hospital treated injury)	3.31 (2.71, 4.04)	<0.001	1.60 (1.35, 1.89)	<0.001
Family variables					
Mothers age at child's birth	Categorical (Global p)		0.7853		0.4804
Number of younger siblings	Categorical (trend)	0.83 (0.73, 0.93)	0.002	1.04 (0.95, 1.13)	0.446
Number of older siblings	Categorical (trend)	1.17 (1.06, 1.30)	0.003	0.99 (0.91, 1.08)	0.777
Total number of siblings	Categorical (trend)	1.01 (0.91, 1.12)	0.845	1.01 (0.93, 1.09)	0.810
Mothers marital status	Binary (*married vs not married)	1.13 (0.91, 1.40)	0.261	1.10 (0.94, 1.30)	0.244
Mother lives with husband / partner	Binary (*yes vs no)	0.97 (0.74, 1.28)	0.831	1.17 (0.96, 1.42)	0.127
Mothers reported general health	Binary (*well/ mostly well vs unwell. often unwell)	1.43 (1.06, 1.93)	0.019	0.96 (0.72, 1.30)	0.814
Mothers reported alcohol consumption	Binary (EP: *< daily drinking vs ≥1-2u/d LP: *did not drink in last week vs did)	0.97 (0.79, 1.20)	0.791	1.03 (0.90, 1.19)	0.658

Mothers reported anxiety	Binary (EP: *none in past yr vs yes, LP: *none in past 3yrs vs yes)	1.09 (0.90, 1.31)	0.399	1.08 (0.94, 1.24)	0.294
Mothers reported depression	Binary (EP: *none in past yr vs yes, LP: *none in past 3yrs vs yes)	1.11 (0.92, 1.34)	0.268	1.15 (1.00, 1.33)	0.049
Mothers highest level of education	Binary (*>= 'O' level vs < 'O' level	0.92 (0.75, 1.11)	0.380	0.85 (0.73, 0.99)	0.039
Paternal social class	Binary (*non-manual vs manual)	1.14 (0.97, 1.35)	0.110	1.09 (0.96, 1.25)	0.175
Maternal life events score	Categorical (trend)	1.10 (0.99, 1.22)	0.071	1.23 (1.13, 1.34)	<0.001
Home variables					
Mothers satisfaction with home	Binary (*satisfied vs not satisfied)	1.08 (0.76, 1.54)	0.662	1.38 (1.00, 1.89)	0.050
Mothers reported problems with home	Binary (*not high score vs high score)	1.42 (1.12, 1.80)	0.004	1.13 (1.00, 1.29)	0.058
Wet or damp home	Categorical (Global p)		0.3087		0.2505
Home / garden invaded by pests	Binary (*no vs yes)	1.18 (0.93, 1.48)	0.166	1.10 (0.91, 1.32)	0.311
Crowding	Binary (*<=1 person/rm vs >1 person/rm)	1.26 (0.97, 1.64)	0.081	1.00 (0.77, 1.28)	0.976
Home has basic facilities	Binary (*yes vs no)	1.11 (0.60, 2.06)	0.734	0.82 (0.46, 1.45)	0.488
Mothers home ownership status	Binary (*not private rented vs private rented)	0.81 (0.51, 1.28)	0.370	1.48 (1.06, 2.05)	0.020
Number of house moves	Binary (*no moves vs any moves)	0.97 (0.81, 1.16)	0.742	1.18 (1.03, 1.36)	0.020
Mother reported financial difficulty	Categorical (trend)	0.03 (-0.08, 0.14)	0.591	1.17 (1.03, 1.33)	0.014
Neighbourhood variables					
Deprivation of area of residence	Categorical (trend)	1.03 (0.97, 1.09)	0.312	1.04 (1.00, 1.09)	0.081
Neighbourhood is a good place to live	Categorical (trend)	1.13 (0.98, 1.30)	0.091	1.12 (1.00, 1.25)	0.056
Neighbourhood problems score	Categorical (trend)	1.07 (0.96, 1.18)	0.235	1.07 (0.98, 1.16)	0.128
Mothers perception of traffic load	Binary (*not heavy vs heavy)	1.10 (0.91, 1.33)	0.330	1.08 (0.93, 1.26)	0.290
Mothers social support	Categorical (Global p)		0.112		0.227
Mothers social networks	Binary (*low social networks score vs high score)	0.84 (0.70, 1.01)	0.066	1.09 (0.95, 1.25)	0.233
Mothers relationship with neighbours	Binary (*not high score vs high score)	0.92 (0.77, 1.11)	0.398	1.18 (1.03, 1.36)	0.018
Neighbours care for mothers children	Binary (*no / rarely vs sometimes / often)	0.96 (0.82, 1.13)	0.650	1.01 (0.89, 1.14)	0.914

DCD = Developmental Coordination Disorder

The results of the unadjusted univariable analyses in Table 107 were used to determine which variables should be entered into the multivariable regression models. As stated previously (Methods, section 6.4.6), strict adherence to a p value cut off of 0.05 for the model entry criteria is unhelpful in an exploratory analysis such as this and therefore a more liberal cut off of <0.1 was applied. Independent variables with p<0.1 for either the early or late primary school-aged period are summarised in Table 108.

Table 108: Unadjusted variables for inclusion in multivariable analyses

Group	Variable	Early primary	Late primary
Child	Gender	✓	✓
	Visual impairment	✓	×
	Total behaviour problems	✓	✓
	Learning difficulties	✓	×
	Previous injury	✓	✓
Family	Number of younger siblings	✓	×
	Number of older siblings	✓	×
	Mothers general health	✓	×
	Mothers reported depression	×	✓
	Mothers highest educational level	×	✓
	Mothers life events	✓	✓
	Paternal social class	×	✓
Home	Crowding	✓	×
	Mother reported problems with home	✓	✓
	Mothers satisfaction with home	×	✓
	Mothers home ownership status	×	✓
	Number of house moves	×	✓
Neighbourhood	IMD of area	×	✓
	Mothers social networks	✓	×
	Mothers relationship with neighbours	×	✓
	Neighbourhood is a good place to live	✓	✓

Key: ✓ = variable included as univariable unadjusted p<0.1, × ≥ p.0.1, but variable retained as p value for other age group <0.1. IMD = Index of Multiple Deprivation 2000 score for area

Table 107 shows that a number of the child behaviour variables (hyperactivity, psychological difficulties, conduct problems and total behaviour problems) showed strong evidence against the null hypothesis for either early primary school-aged children, late primary school-aged children or both. In order that behaviour problems were not over-weighted in subsequent analyses, the composite variable of total behaviour problems was the only behaviour variable included in the multivariable analyses.

Behaviour problems are known to be commoner in boys, therefore possible interaction could have existed between the behaviour variables and gender. This was explored by repeating univariable analyses, stratified by gender, and comparing the confidence intervals for odds ratios of boys and girls (detailed in Appendix 7). The confidence intervals for boys and girls overlapped considerably for all behaviour variables suggesting no significant interactions were present.

8.3 MULTIVARIABLE ANALYSES OF OBSERVED DATA

The independent variables associated with secondary care attended injury with a p value of <0.1 on unadjusted univariable analyses were entered into a multivariable logistic regression model, and the results are shown in Table 109 (early primary age group) and Table 110 (late primary age group). The main results in these tables are highlighted in bold and illustrated by the letters A-D in Figure 60. Results in the block of cells represented as ‘A’ are the odds ratios of the association between injury and neighbourhood variables, adjusted for the other neighbourhood variables. Results in block ‘B’ indicate results for variables in the home adjusted for other home variables and neighbourhood variables. Results in block ‘C’ indicate results for family variables, adjusted for other family variables, home and neighbourhood variables. Results in block ‘D’ indicate odds ratios for child variables adjusted for other child variables, family, home and neighbourhood variables.

Figure 60: Diagrammatic representation of tables of results of the multivariable model

Variable group	**Compar-ison**	**Prev-alence**	**Un-adjusted**	**Adjusted within group Model 1, 5, 6 & 7**	**Model 2**	**Model 3**	**Model 4**
Neighbourhood				**A**			
Home					**B**		
Family						**C**	
Child							**D**

Note: For a description of Models 1-7 see Chapter 6, Table 31

Table 109: Multivariable analysis of independent variables and any secondary care treated injury in the early primary school period
* = Reference Group. § = prevalence of comparison group (%)

Variable name	Comparison	Prev§	Unadjusted variables		Adjusted within group (Models 1,5,6&7)		Model 2		Model 3		Model 4	
			OR (95%CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Early primary												
Neighbourhood variables												
IMD of area - (Qimd)	trend	N/a	1.03 (0.97, 1.09)	0.312	**1.02 (0.97, 1.09)**	**0.421**	1.02 (0.96, 1.09)	0.532	1.02 (0.95, 1.09)	0.572	1.02 (0.95, 1.10)	0.563
Mothers social networks (socnet5bin)	Binary (*not high support vs high)	27.1%	0.84 (0.70, 1.01)	0.066	**0.84 (0.70, 1.02)**	**0.072**	0.81 (0.67, 1.00)	0.045	0.87 (0.69, 1.08)	0.198	0.88 (0.70, 1.11)	0.283
Mothers relationship with neighbours (nvisits5b)	Binary (*not high score vs high score)	23.6%	0.92 (0.77, 1.11)	0.398	**0.97 (0.80, 1.18)**	**0.750**	0.98 (0.80, 1.21)	0.881	0.96 (0.76, 1.21)	0.736	0.95 (0.75, 1.20)	0.662
Home variables												
Crowding (Crowd7cat)	Binary (*<1 person/rm vs >1 pers/rm)	8.4%	1.26 (0.97, 1.64)	0.081	1.25 (0.95, 1.65)	0.112	**1.15 (0.86, 1.54)**	**0.353**	1.10 (0.77, 1.56)	0.603	1.09 (0.76, 1.57)	0.631
Mother reported problems with home (hprobs5bin)	Binary (*not high vs high)	9.8%	1.42 (1.12, 1.80)	0.004	1.42 (1.10, 1.83)	0.008	**1.46 (1.12, 1.91)**	**0.005**	1.49 (1.11, 1.99)	0.007	1.47 (1.09, 1.99)	0.012
Mothers satisfaction with home (home5)	Binary (*satisfied vs not satisfied)	4.9%	1.08 (0.76, 1.54)	0.662	1.00 (0.68, 1.46)	0.995	**1.05 (0.71, 1.56)**	**0.814**	1.26 (0.83, 1.91)	0.286	1.27 (0.83, 1.96)	0.275
Mothers home ownership (rent5)	Binary (*not private rented vs privt rent)	3.4%	0.81 (0.51, 1.28)	0.370	0.79 (0.49, 1.28)	0.343	**0.76 (0.45, 1.32)**	**0.339**	0.99 (0.55, 1.79)	0.975	0.94 (0.52, 1.73)	0.852
Number of house moves (moves5b)	Binary (*no moves vs any moves)	28.1%	0.97 (0.81, 1.16)	0.742	1.03 (0.86, 1.24)	0.757	**1.01 (0.83, 1.22)**	**0.918**	1.06 (0.85, 1.31)	0.609	1.04 (0.84, 1.30)	0.693
Family variables												
Parental social class (socclasscat)	Binary (*non-manual vs manual)	41.1%	1.10 (0.94, 1.29)	0.250	1.07 (0.90, 1.29)	0.434			**1.04 (0.85, 1.28)**	**0.691**	1.01 (0.82, 1.24)	0.929
Highest M qualification (edqual5bin)	Binary (*>= ‘O’ level vs < ‘O’ level	20.1%	0.92 (0.75, 1.11)	0.380	0.92 (0.73, 1.17)	0.508			**0.81 (0.62, 1.07)**	**0.139**	0.79 (0.60, 1.05)	0.102
No. of younger siblings (sibsYcat)	trend	N/a	0.83 (0.73, 0.93)	0.002	0.86 (0.73, 1.00)	0.047			**0.88 (0.74, 1.05)**	**0.144**	0.88 (0.74, 1.06)	0.176
No. of older siblings (sibsOcat)	trend	N/a	1.17 (1.06, 1.30)	0.003	1.13 (0.99, 1.29)	0.082			**1.17 (1.01, 1.36)**	**0.040**	1.16 (0.99, 1.36)	0.063
Mothers general health (mhealth6)	Binary (*well vs unwell)	5.7%	1.43 (1.06, 1.93)	0.019	1.42 (1.00, 2.00)	0.052			**1.38 (0.94, 2.01)**	**0.099**	1.25 (0.85, 1.85)	0.261
Maternal depression (depr6)	Binary (*none in past yr vs yes)	20.8%	1.11 (0.92, 1.34)	0.263	1.00 (0.80, 1.25)	0.984			**0.95 (0.74, 1.22)**	**0.687**	0.91 (0.71, 1.17)	0.468
Maternal life events score (life6cat)	trend	N/a	1.10 (0.99, 1.22)	0.071	1.09 (0.98, 1.22)	0.126			**1.02 (0.90, 1.16)**	**0.718**	0.99 (0.87, 1.13)	0.892
Child variables												
Visual impairment (km2071b0)	Binary (*no glasses vs given glasses)	9.8%	0.74 (0.56, 0.99)	0.040	0.76 (0.57, 1.02)	0.069					**0.89 (0.64, 1.24)**	**0.485**
Total behavioural problems (total6Cat)	trend	N/a	1.19 (1.08, 1.31)	0.001	1.18 (1.07, 1.31)	0.001					**1.15 (1.01, 1.31)**	**0.029**
Learning difficulties (kp1220b)	Binary (*no learning problems vs problems)	8.3%	1.31 (1.01, 1.69)	0.043	1.18 (0.90, 1.55)	0.223					**1.05 (0.74, 1.49)**	**0.798**
Previous injury treated in secondary care (anysci34)	Binary (*no injury vs any injury)	10.0%	3.31 (2.71, 4.04)	<0.001	3.35 (2.73, 4.10)	<0.001					**3.91 (3.07, 4.98)**	**<0.001**
Gender (kz021b)	Binary (*fem vs male)	50.5%	1.66 (1.42, 1.94)	<0.001								

Table 110: Multivariable analysis of independent variables and any secondary care treated injury in the late primary school period, observed data
* = Reference Group. § = prevalence of comparison group (%)

Variable name	Comparison	Prev§	Unadjusted variables		Adj within group only (M1, M7, M8,M9)		Model M2		Model M3		Model M4	
			OR (95%CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Late primary												
Neighbourhoodl variables												
IMD of area (Qimd)	trend	N/a	1.04 (1.00, 1.09)	0.081	**1.04 (1.00, 1.09)**	**0.068**	1.06 1.01, 1.12)	0.025	1.06 (1.00, 1.13)	0.044	1.05 (0.99, 1.12)	0.123
Mothers social networks (socnet9bin)	Binary (*not high support vs high)	26. 3%	1.09 (0.95, 1.25)	0.233	**1.07 (0.93, 1.24)**	**0.340**	1.06 (0.91, 1.24)	0.459	1.07 (0.90, 1.28)	0.424	1.07 (0.88, 1.30)	0.492
Mothers relationship with neighbours (nvisits7b)	Binary (*not high score vs high score)	23.4%	1.18 (1.03, 1.36)	0.018	**1.15 (0.99, 1.35)**	**0.066**	1.21 (1.03, 1.42)	0.024	1.22 (1.01, 1.46)	0.037	1.25 (1.02, 1.53)	0.030
Home variables												
Crowding (crowd10cat)	Binary (*<=1 person/rm vs >1 pers/rm)	6.2%	1.00 (0.77, 1.28)	0.976	1.01 (0.77, 1.31)	0.953	**0.95 (0.71, 1.26)**	**0.718**	0.83 (0.58, 1.17)	0.284	0.74 (0.49, 1.11)	0.143
M reported prob with home (hprobs7bin)	Binary (*high score vs not high score)	8.8%	1.03 (0.83, 1.27)	0.797	1.04 (0.82, 1.32)	0.750	**1.06 (0.82, 1.37)**	**0.655**	0.90 (0.66, 1.21)	0.476	0.82 (0.58, 1.16)	0.261
Mothers satisfaction with home (home7)	Binary (*satisfied vs not satisfied)	3.3%	1.38 (1.00, 1.89)	0.050	1.25 (0.87, 1.81)	0.222	**1.27 (0.87, 1.86)**	**0.218**	1.10 (0.71, 1.69)	0.671	1.13 (0.71, 1.80)	0.610
Mothers home ownership status (rent7)	Binary (*not private rented vs priv rent)	3.0%	1.48 (1.06, 2.05)	0.020	1.36 (0.94, 1.95)	0.102	**1.36 (0.88, 2.10)**	**0.160**	1.80 (1.12, 2.89)	0.015	1.95 (1.11, 3.43)	0.021
Number of house moves (moves7b)	Binary (*no moves vs any moves)	23.5%	1.18 (1.03, 1.36)	0.020	1.18 (1.01, 1.37)	0.033	**1.15 (0.97, 1.36)**	**0.114**	1.00 (0.83, 1.220	0.970	1.01 (0.81, 1.25)	0.957
Family variables												
Parental social class (socclasscat)	Binary (*non-manual vs manual)	41.1%	1.12 (0.99, 1.27)	0.071	1.15 (0.99, 1.33)	0.067			**1.16 (0.98, 1.38)**	**0.084**	1.18 (0.97, 1.42)	0.091
Highest M qualification (edqual9bin)	Binary (*>= 'O' level vs <'O' level)	21.5%	0.85 (0.73, 0.99)	0.039	0.84 (0.69, 1.02	0.077			**0.89 (0.71, 1.11)**	**0.290**	0.95 (0.73, 1.23)	0.711
No. of younger sibs (sibsYCat2)	trend	N/a	1.04 (0.95, 1.13)	0.446	1.03 (0.92, 1.15)	0.654			**1.06 (0.93, 1.22)**	**0.371**	1.10 (0.95, 1.27)	0.219
No. of older sibs (sibsOCat2)	Trend	N/a	0.99 (0.91, 1.08)	0.777	0.99 (0.89, 1.11)	0.894			**0.99 (0.87, 1.13)**	**0.882**	0.99 (0.86, 1.15)	0.942
Mothers reported general health (mhealth9)	Binary (*well / mostly well vs unwell / often unwell)	4.4%	0.96 (0.72, 1.30)	0.814	0.81 (0.56, 1.16)	0.246			**0.67 (0.43, 1.02)**	**0.061**	0.78 (0.49, 1.24)	0.300
Maternal depression (depr9)	Binary (*none in past 3yrs vs yes)	23.4%	1.15 (1.00, 1.33)	0.049	1.08 (0.91, 1.28)	0.361			**1.09 (0.90, 1.32)**	**0.375**	1.03 (0.83, 1.27)	0.821
Maternal life events score (life9cat)	trend	N/a	1.23 (1.13, 1.34)	<0.001	1.21 (1.10, 1.32)	<0.001			**1.20 (1.08, 1.33)**	**0.001**	1.13 (1.01, 1.27)	0.031
Child variables												
Visual impairment (f7vs010b2)	Binary (*no impairment vs problem)	9.2%	0.92 (0.73, 1.16)	0.463	0.88 (0.68, 1.13)	0.317					**0.82 (0.60, 1.13)**	**0.231**
Total behavioural problems (total9Cat)	Trend	N/a	1.15 (1.07, 1.24)	<0.001	1.10 (1.01, 1.20)	0.029					**1.12 (1.00, 1.25)**	**0.051**
Learning difficulties (learndiff8b)	Binary *top 90% scores (>87), vs lower 10%)	9.9%	0.84 (0.68, 1.04)	0.111	0.82 (0.65, 1.03)	0.092					**0.81 (0.60, 1.10)**	**0.179**
Previous secondary care treated injury (anysci56)	Binary (*none vs any secondary care treated injury)	12.8%	1.60 (1.35, 1.89)	<0.001	1.61 (1.33, 1.95)	<0.001					**1.58 (1.24, 2.02)**	**<0.001**
Gender (kz021b)	Binary (*fem vs male)	50.5%	1.16 (1.03, 1.31)	0.016								

For the early primary school-aged children none of the neighbourhood variables were associated with increased risk of secondary care attended injury greater than could have occurred by chance, although mothers with high social networks scores (i.e. high levels of social support) had a weak protective association (OR=0.84 (95%CI: 0.70, 1.02), p=0.072). For home variables; a high score on the variable of ‘mother reported problems with the home’ was associated with increased injury risk (OR=1.46 (95%CI: 1.12, 1.91), p=0.005), as was the family variable of the child having two or more older siblings (OR=1.17 (95%CI: 1.01, 1.36), p=0.040). The strongest associations were found for child variables; previous injury (i.e. during the pre-school period) treated in secondary care (OR=3.31 (95%CI: 3.07, 4.98), p<0.001) and a high total behaviour problems score (OR=1.15 (95%CI: 1.01, 1.31), p=0.029).

For the late primary school-aged children none of the neighbourhood variables were strongly associated with increased risk of secondary care attended injury, although two variables had a borderline statistically significant result; high index of multiple deprivation score (i.e. greater deprivation) (OR=1.04 (95%CI: 1.00, 1.09), p=0.068) and high maternal relationships with neighbours score (where a high score indicated a strong relationship) (OR=1.15 (95%CI: 0.99, 1.35), p=0.066). None of the home variables were associated with injury greater than could have occurred by chance. Of the family variables, a high maternal life events score (i.e. large numbers of maternal life events) was strongly associated with increased risk of injury (OR=1.20 (95%CI: 1.08, 1.33), p=0.001), manual social class was associated with a weak increased risk (OR=1.16 (95%CI: 0.98, 1.38), p=0.084) and poor maternal general health was weakly protective for injury (OR=0.67 (95%CI: 0.43, 1.02), p=0.061). The strongest risk factor was a previous secondary care attended injury (i.e. during the early primary school-aged period) (OR=1.58 (95%CI: 1.24, 2.02), p<0.001). A borderline statistically significant child variable was total behaviour problems (OR=1.12 (95%CI: 1.00, 1.25), p=0.051).

8.4 MULTIVARIABLE ANALYSES OF IMPUTED DATA

The technique of multiple imputation was used to create a second dataset where all of the missing values in the observed data had been replaced with values modelled on the available data.

The multivariable logistic regression model was re-run and the results of the association between risk and protective factors and any secondary care attended injury are shown in Table 111 for the early primary school-aged period and Table 112 for the late primary school-aged period.

Table 111: Multivariable analysis of independent variables and any secondary care treated injury in the early primary school period, imputed data.
* = Reference Group. § = prevalence of comparison group (%)

Variable name	Comparison	Prev§	Unadjusted variables		Adjusted within group (M1, M7, M8, M9)		Model M2		Model M3		Model M4	
			OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Early primary												
Neighbourhood variables												
IMD of area - (Qimd)	trend	N/a	1.03 (0.97, 1.09)	0.309	**1.03 (0.97, 1.09)**	**0.374**	1.02 (0.96, 1.08)	0.583	1.01 (0.95, 1.08)	0.688	1.02 (0.96, 1.08)	0.599
Mothers social networks (socnet5bin)	Binary (*not high support vs high)	28.4%	0.84 (0.70, 1.01)	0.064	**0.85 (0.71, 1.03)**	**0.090**	0.81 (0.72, 1.04)	0.116	0.90 (0.74, 1.08)	0.257	0.92 (0.76, 1.11)	0.390
Mothers relationships with neighbours (nvisits5b)	Binary (*not high score vs high score)	24.3%	0.92 (0.76, 1.11)	0.383	**0.92 (0.79, 1.15)**	**0.622**	0.96 (0.79, 1.16)	0.657	0.96 (0.79, 1.17)	0.696	0.96 (0.79, 1.17)	0.685
Home variables												
Crowding (Crowd7cat)	Binary (*<1 person/rm vs >1 pers/rm)	9.0%	1.24 (0.96, 1.61)	0.103	1.22 (0.94, 1.58)	0.139	**1.19 (0.92, 1.55)**	**0.188**	1.25 (0.94, 1.67)	0.131	1.17 (0.87, 1.57)	0.291
M reported prob with home (hprobs5bin)	Binary (*not high vs high)	10.2%	1.39 (1.10, 1.77)	0.006	1.40 (1.10, 1.79)	0.007	**1.38 (1.08, 1.77)**	**0.010**	1.36 (1.06, 1.75)	0.017	1.35 (1.05, 1.75)	0.021
Mothers satisfaction with home (Home5)	Binary (*satisfied vs not satisfied)	5.0%	1.07 (0.75, 1.51)	0.725	0.95 (0.66, 1.36)	0.772	**0.92 (0.64, 1.33)**	**0.658**	0.95 (0.66, 1.38)	0.783	0.95 (0.65, 1.39)	0.798
Mothers home ownership (rent5)	Binary (*not private rented vs privt rent)	3.6%	0.82 (0.52, 1.30)	0.397	0.79 (0.50, 1.27)	0.328	**0.79 (0.50, 1.27)**	**0.329**	0.80 (0.50, 1.29)	0.365	0.77 (0.47, 1.24)	0.278
Number of house moves (moves5b)	Binary (*no moves vs any moves)	30.0%	0.97 0.82, 1.16)	0.771	0.99 (0.82, 1.18)	0.885	**0.98 (0.82, 1.18)**	**0.851**	1.05 (0.88, 1.27)	0.578	1.06 (0.88, 1.28)	0.574
Family variables												
Parental social class (socclasscat)	Binary (*non-manual vs manual)	41.8%	1.11 (0.95, 1.31)	0.189	1.11 (0.94, 1.31)	0.234			**1.07 (0.90, 1.28)**	**0.429**	1.04 (0.87, 1.24)	0.639
Highest M qualification (edqual5bin)	Binary (*>= 'O' level vs < 'O' level	20.3%	0.91 (0.75, 1.11)	0.346	0.86 (0.70, 1.08)	0.160			**0.83 (0.67, 1.03)**	**0.088**	0.80 (0.64, 0.99)	0.041
No. of younger siblings (sibsYcat)	trend	N/a	0.82 (0.73, 0.93)	0.002	0.85 (0.74, 0.98)	0.027			**0.83 (0.72, 0.96)**	**0.012**	0.83 (0.72, 0.97)	0.016
No. of older siblings (sibsOcat)	trend	N/a	1.18 (1.06, 1.31)	0.002	1.11 (0.98, 1.25)	0.087			**1.07 (0.94, 1.22)**	**0.288**	1.07 (0.94, 1.21)	0.325
Mothers reported general health (mhealth6)	Binary (*well/ mostly well vs unwell / often unwell)	5.9%	1.42 (1.06, 1.92)	0.020	1.34 (0.98, 1.83)	0.069			**1.29 (0.94, 1.77)**	**0.118**	1.25 (0.91, 1.73)	0.173
Maternal depression (depr6)	Binary (*none in past yr vs yes)	21.5%	1.11 (0.92, 1.34)	0.268	1.02 (0.83, 1.24)	0.855			**1.00 (0.81, 1.22)**	**0.967**	0.99 (0.81, 1.22)	0.929
Maternal life events score (life6cat)	trend	N/a	1.11 (1.00, 1.23)	0.056	1.10 (0.98, 1.23)	0.094			**1.08 (0.97, 1.21)**	**0.159**	1.04 (0.93, 1.17)	0.474
Child variables												
Visual impairment (km2071b0)	Binary (*no glasses vs given glasses)	9.8%	0.74 (0.56, 0.99)	0.040	0.73 (0.55, 0.98)	0.035					**0.70 (0.52, 0.94)**	**0.019**
Total behavioural problems (total6Cat)	trend	N/a	1.18 (1.07, 1.30)	0.001	1.16 (1.05, 1.28)	0.004					**1.13 (1.02, 1.26)**	**0.021**
Learning difficulties (kp1220b)	Binary (*no learning problems vs problems)	8.4%	1.30 (1.00, 1.68)	0.049	1.15 (0.88, 1.51)	0.291					**1.13 (0.86, 1.50)**	**0.374**
Previous injury treated in secondary care (anysci34)	Binary (*no injury vs any 2ndary care treated injury)	10.0%	3.31 (2.71, 4.04)	<0.001	3.28 (2.68, 4.01)	<0.001					**3.32 (2.70, 4.08)**	**<0.001**

Table 112: Multivariable analysis of independent variables and any secondary care treated injury in the late primary school period, imputed data.
* = Reference Group. § = prevalence of comparison group (%)

Variable name	Comparison	Prev§	Unadjusted variables		Adjusted within group (M1, M7, M8, M9)		Model M2		Model M3		Model M4	
			OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Late primary												
Neighbourhood variables												
IMD of area (Qimd)	trend	N/a	1.04 (0.99, 1.09)	0.090	**1.04 (1.00, 1.09)**	**0.060**	1.04 1.00, 1.09)	0.074	1.04 (0.99, 1.09)	0.129	1.04 (0.99, 1.09)	0.126
Mothers social networks (socnet9bin)	Binary (*not high support vs high)	28.4%	1.10 (0.96, 1.26)	0.182	**1.08 (0.94, 1.24)**	**0.300**	1.08 (0.94, 1.24)	0.301	1.09 (0.94, 1.25)	0.243	1.12 (0.97, 1.29)	0.117
Mothers relationship with neighbours (nvisits7b)	Binary (*not high score vs high score)	24.2%	1.18 (1.03, 1.36)	0.018	**1.18 (1.02, 1.36)**	**0.023**	1.20 (1.04, 1.38)	0.014	1.18 (1.02, 1.36)	0.026	1.19 (1.03, 1.38)	0.017
Home variables												
Crowding (crowd10cat)	Binary (*<=1pers/rm vs >1 pers/rm)	7.3%	0.93 (0.73, 1.20)	0.583	0.91 (0.71, 1.17)	0.473	**0.89 (0.69, 1.15)**	**0.390**	0.88 (0.67, 1.15)	0.360	0.89 (0.68, 1.16)	0.386
M reported prob with home (hprobs7bin)	Binary (*high score vs not high score)	9.2%	1.04 (0.84, 1.28)	0.730	1.00 (0.80, 1.24)	0.991	**1.00 (0.80, 1.24)**	**0.977**	0.96 (0.77, 1.19)	0.691	0.93 (0.74, 1.16)	0.513
Mothers satisfaction with home (Home7)	Binary (*satisfied vs not satisfied)	3.4%	1.38 (1.01, 1.90)	0.045	1.40 (1.01, 1.94)	0.043	**1.41 (1.02, 1.95)**	**0.039**	1.36 (0.99, 1.89)	0.066	1.33 (0.96, 1.85)	0.094
Mothers home ownership status (rent7)	Binary (*not private rented vs priv rent)	3.1%	1.51 (1.09, 2.10)	0.012	1.42 (1.02, 1.97)	0.039	**1.42 (1.01, 1.97)**	**0.039**	1.35 (0.97, 1.88)	0.079	1.36 (0.97, 1.90)	0.072
Number of house moves (moves7b)	Binary (*no moves vs any moves)	25.0%	1.17 (1.02, 1.35)	0.025	1.15 (1.00, 1.33)	0.051	**1.16 (1.00, 1.34)**	**0.046**	1.12 (0.97, 1.29)	0.137	1.12 (0.96, 1.29)	0.140
Family variables												
Parental social class (socclasscat)	Binary (*non-manual vs manual)	41.8%	1.11 (0.98, 1.26)	0.106	1.16 (1.02, 1.32)	0.023			**1.15 (1.01, 1.32)**	**0.042**	1.15 (1.00, 1.32)	0.044
Highest M qualification (edqual9bin)	Binary (*>= 'O' level vs <'O' level)	21.6%	0.85 (0.73, 0.99)	0.035	0.84 (0.72, 0.98)	0.027			**0.84 (0.72, 0.99)**	**0.032**	0.85 (0.73, 1.00)	0.051
No. of younger sibs (sibsYCat2)	trend	N/a	1.03 (0.94, 1.13)	0.485	1.00 (0.91, 1.11)	0.992			**1.00 (0.90, 1.11)**	**0.953**	1.01 (0.91, 1.12)	0.819
No. of older sibs (sibsOCat2)	Trend	N/a	0.98 (0.90, 1.07)	0.639	1.00 (0.91, 1.10)	0.946			**1.02 (0.92, 1.13)**	**0.727**	1.03 (0.93 1.13)	0.617
Mothers general health (mhealth9)	Binary (*well / vs unwell)	4.6%	0.95 (0.70, 1.28)	0.730	0.84 (0.62, 1.14)	0.263			**0.83 (0.62, 1.13)**	**0.242**	0.81 (0.60, 1.11)	0.187
Maternal depression (depr9)	Binary (*none in past 3yrs vs yes)	24.9%	1.15 (0.99, 1.32)	0.060	1.08 (0.93, 1.25)	0.309			**1.08 (0.93, 1.25)**	**0.333**	1.04 (0.90, 1.21)	0.588
Maternal life events score (life9cat)	trend	N/a	1.22 (1.12, 1.32)	<0.001	1.21 (1.11, 1.32)	<0.001			**1.19 (1.09, 1.30)**	**<0.001**	1.17 (1.07, 1.28)	<0.001
Child variables												
Visual impairment (f7vs010b2)	Binary (*no impairment vs problem)	9.3%	0.92 (0.73, 1.16)	0.491	0.91 (0.72, 1.15)	0.425					**0.90 (0.71 1.15)**	**0.408**
Total behavioural problems (total9Cat)	Trend	N/a	1.16 (1.07, 1.25)	<0.001	1.16 (1.08, 1.26)	<0.001					**1.15 (1.06, 1.25)**	**0.001**
Learning difficulties (learndiff8b)	Binary *top 90% scores (>87), vs lower 10%)	12.7%	0.85 (0.69, 1.05)	0.141	0.82 (0.66, 1.01)	0.061					**0.82 (0.66, 1.02)**	**0.082**
Previous secondary care treated injury (anysci56)	Binary (*none vs any secondary care treated injury)	12.8%	1.60 (1.35, 1.89)	<0.001	1.58 (1.33, 1.87)	<0.001					**1.56 (1.31, 1.84)**	**<0.001**

Using the imputed dataset it was shown that, for the early primary school-aged children, none of the neighbourhood variables were associated with increased risk of secondary care attended injury greater than could have occurred by chance, although mothers with high social networks scores had a waek protective association (OR=0.85 (95%CI: 0.71, 1.03), p=0.090). For home variables; a high score on the variable of mother reported problems with the home was associated with increased injury risk (OR=1.38 (95%CI: 1.08, 1.77), p=0.010). For family variables having two or more younger siblings was protective for injury (OR=0.83 (95%CI: 0.72, 0.96), p=0.012) and a weak protective association was seen for children whose mothers had less than 'O' levels (or equivalent) as their highest educational qualification (OR=0.83 (95%CI: 0.67, 1.03), p=0.088). The strongest associations were found for child variables; previous injury treated in secondary care (i.e. during the pre-school period) (OR=3.32 (95%CI: 2.70, 4.08), p<0.001) and a high total behaviour problems score (OR=1.13 (95%CI: 1.02, 1.26), p=0.021) indicated increased risk of injury, whilst visual impairment was associated with a protective effect on injury (OR=0.70 (95%CI: 0.52, 0.94), p=0.019).

For the late primary school-aged children, the imputed dataset showed that the neighbourhood variables associated with increased risk of secondary care attended injury included having a high maternal relationship with neighbours score (OR=1.18 (95%CI: 1.02, 1.36), p=0.023), and having a high index of multiple deprivation score (i.e. more deprivation) had a borderline statistically significant increased association with injury (OR=1.04 (95%CI: 1.00, 1.09), p=0.060). For home variables, three had associations with increased risk of injury; poor maternal satisfaction with the home (OR=1.41 (95%CI: 1.02, 1.95), p=0.039), living in private rented accommodation (as opposed to any other home ownership status) (OR=1.42 (95%CI: 1.01, 1.97), p=0.039) and having one or more house moves in the previous two years (OR=1.16 (95%CI: 1.00, 1.34), p=0.046). Of the family variables, a high maternal life events score was strongly associated with increased risk of injury (OR=1.19 (95%CI: 1.09, 1.30), p<0.001), manual social class had a weaker association with risk of injury (OR=1.15 (95%CI: 1.01, 1.32), p=0.042) and having less than 'O' levels as mothers highest educational qualification had a protective association with injury (OR=0.84 (95%CI: 0.72, 0.99), p=0.032). A previous secondary care attended injury (i.e. during the early primary school-aged period) was the strongest child factor associated with increased risk of injury (OR=1.56 (95%CI: 1.31, 1.84), p<0.001), plus a high total behaviour problems score (OR=1.15 (95%CI: 1.06, 1.25), p=0.001). Being in the lowest 10% of scores on the Weschler Intelligence Scale for Children

(IQ) had a weak protective association with injury (OR=0.82 (95%CI: 0.66, 1.02), p=0.082).

8.5 COMPARISON OF RESULTS FROM OBSERVED AND IMPUTED DATA

The multiple imputation process replaced the missing data in the observed dataset with values modelled on the available data, producing a second, complete, dataset. Because the data is complete, the results from an imputed dataset may be considered more valid than results from an observed dataset. The process of imputation would be expected to increase the prevalence of the variables within this imputed data compared to the observed data. This increase in the prevalence of variables varied between <0.1% (early primary school age children, previous hospital attended injury) and 2. 8% (late primary school age children, learning difficulties).

A comparison of the results from the observed and imputed datasets is shown in Table 113. Compared with the results of the multivariable analysis of the observed data, the measures of association found in the imputed data show narrower 95% confidence intervals around the odds ratios (secondary to a larger sample being included in the analysis), but no change in the direction of the odds ratios, or change of an odds ratio with strong evidence against the null into one with weak/negligible evidence or vice versa. On some occasions imputation led to an association that was not greater than could have occurred by chance (or borderline) becoming more statistically significant (i.e. less likely to have occurred by chance).

Table 113: Comparison of observed and imputed data on odds ratios for injury occurrence

Variable name	Early primary school age						Late primary school age					
	Observed data			Imputed data			Observed data			Imputed data		
	Prev	OR (95% CI)	P value	Prev	OR (95% CI)	P value	Prev	OR (95% CI)	P value	Prev	OR (95% CI)	P value
Neighbourhood variables only (adjusted within group)												
IMD of area	N/a	1.02 (0.97, 1.09)	0.421	N/a	1.03 (0.97, 1.09)	0.374	N/a	1.04 (1.00, 1.09)	0.068	N/a	1.04 (1.00, 1.09)	0.060
Mothers social networks score	27.1%	0.84 (0.70, 1.02)	0.072	28.4%	0.85 (0.71, 1.03)	0.090	26. 3%	1.07 (0.93, 1.24)	0.340	28.4%	1.08 (0.94, 1.24)	0.300
Mothers relationship with neighbours	23.6%	0.97 (0.80, 1.18)	0.750	24.3%	0.92 (0.79, 1.15)	0.622	23.4%	1.15 (0.99, 1.35)	0.066	24.2%	1.18 (1.02, 1.36)	0.023
Home variables adjusted for home and neighbourhood												
Crowding	8.4%	1.15 (0.86, 1.54)	0.353	9.0%	1.19 (0.92, 1.55)	0.188	6.2%	0.95 (0.71, 1.26)	0.718	7.3%	0.89 (0.69, 1.15)	0.390
M reported probs with home	9.8%	1.46 (1.12, 1.91)	0.005	10.2%	1.38 (1.08, 1.77)	0.010	8.8%	1.06 (0.82, 1.37)	0.655	9.2%	1.00 (0.80, 1.24)	0.977
Mothers satisfaction with home	4.9%	1.05 (0.71, 1.56)	0.814	5.0%	0.92 (0.64, 1.33)	0.658	3.3%	1.27 (0.87, 1.86)	0.218	3.4%	1.41 (1.02, 1.95)	0.039
Mothers home ownership	3.4%	0.76 (0.45, 1.32)	0.339	3.6%	0.79 (0.50, 1.27)	0.329	3.0%	1.36 (0.88, 2.10)	0.160	3.1%	1.42 (1.01, 1.97)	0.039
Number of house moves	28.1%	1.01 (0.83, 1.22)	0.918	30.0%	0.98 (0.82, 1.18)	0.851	23.5%	1.15 (0.97, 1.36)	0.114	25.0%	1.16 (1.00, 1.34)	0.046
Family variables adjusted for family, home and neighbourhood												
Parental social class	41.1%	1.04 (0.85, 1.28)	0.691	41.8%	1.07 (0.90, 1.28)	0.429	41.1%	1.16 (0.98, 1.38)	0.084	41.8%	1.15 (1.01, 1.32)	0.042
Mothers highest qualification	20.1%	0.81 (0.62, 1.07)	0.139	20.3%	0.83 (0.67, 1.03)	0.088	21.5%	0.89 (0.71, 1.11)	0.290	21.6%	0.84 (0.72, 0.99)	0.032
No. of younger siblings	N/a	0.88 (0.74, 1.05)	0.144	N/a	0.83 (0.72, 0.96)	0.012	N/a	1.06 (0.93, 1.22)	0.371	N/a	1.00 (0.90, 1.11)	0.953
Number of older siblings	N/a	1.17 (1.01, 1.36)	0.040	N/a	1.07 (0.94, 1.22)	0.288	N/a	0.99 (0.87, 1.13)	0.882	N/a	1.02 (0.92, 1.13)	0.727
Mothers reported general health	5.7%	1.38 (0.94, 2.01)	0.099	5.9%	1.29 (0.94, 1.77)	0.118	4.4%	0.67 (0.43, 1.02)	0.061	4.6%	0.83 (0.62, 1.13)	0.242
Maternal self reported depression	20.8%	0.95 (0.74, 1.22)	0.687	21.5%	1.00 (0.81, 1.22)	0.967	23.4%	1.09 (0.90, 1.32)	0.375	24.9%	1.08 (0.93, 1.25)	0.333
Maternal life events score	N/a	1.02 (0.90, 1.16)	0.718	N/a	1.08 (0.97, 1.21)	0.159	N/a	1.20 (1.08, 1.33)	0.001	N/a	1.19 (1.09, 1.30)	<0.001
Child variables adjusted for child, family, home and the neighbourhood												
Wears glasses / Visual impairment	9.8%	0.89 (0.64, 1.24)	0.485	9.8%	0.70 (0.52, 0.94)	0.019	9.2%	0.82 (0.60, 1.13)	0.231	9.3%	0.90 (0.71 1.15)	0.408
Total behavioural problems	N/a	1.15 (1.01, 1.31)	0.029	N/a	1.13 (1.02, 1.26)	0.021	N/a	1.12 (1.00, 1.25)	0.051	N/a	1.15 (1.06, 1.25)	0.001
Learning difficulties or bottom 10% IQ	8.3%	1.05 (0.74, 1.49)	0.798	8.4%	1.13 (0.86, 1.50)	0.374	9.9%	0.81 (0.60, 1.10)	0.179	12.7%	0.82 (0.66, 1.02)	0.082
Previous hospital attended injury	10.0%	3.91 (3.07, 4.98)	<0.001	10.0%	3.32 (2.70, 4.08)	<0.001	12.8%	1.58 (1.24, 2.02)	<0.001	12.8%	1.56 (1.31, 1.84)	<0.001

Note: Prev = prevalence. N/a = prevalence not available as this variable was an analysis for trend across >2 categories

The variables from both observed and imputed data that appear to have the strongest evidence against the null hypothesis as having a true association with injuries attended in secondary care are shown in Table 114.

Table 114: Variables associated with secondary care attended injury, showing strong evidence against the null hypothesis

Age	Level	Observed data	Imputed data
Early primary school age	Neighbourhood	None	None
	Home	1) Mother reported problems with the home (increased risk)	1) Mother reported problems with the home (increased risk)
	Family	None	1) Increasing number of younger siblings (reduced risk)
	Child	1) Increasing score on total behaviour problems (increased risk) 2) Previous hospital attended injury (increased risk)	1) Increasing score on total behaviour problems (increased risk) 2) Previous hospital attended injury (increased risk) 3) Child wears glasses (reduced risk)
Late primary school age	Neighbourhood	None	1) High score on mothers relationship with neighbours (increased risk)
	Home	None	None
	Family	1) Increasing maternal life events score (increased risk)	1) Increasing maternal life events score (increased risk)
	Child	1) Previous hospital attended injury (increased risk)	1) Previous hospital attended injury (increased risk) 2) Increasing score on total behaviour problems (increased risk)

Multiple imputation increased the number of independent variables with strong evidence against the null hypothesis of an association with injury risk. The imputed data suggests that:

For early primary school-aged children;

- Increased risk of injury was seen with maternal reported problems in the home, higher child total behaviour problems score, and a previous hospital attended injury in the child. A reduced risk of injury was seen with the child having two or more younger siblings or wearing glasses at age 5 five years.

For late primary school-aged children;

- Increased risk of injury was seen with having a high rating on mother's relationship with her neighbours, with a high maternal life events score, higher child total behaviour problems score, and a previous hospital attended injury in the child

Variables found to have weak or negligible evidence against the null hypothesis of an association with secondary care attended injury are shown in Table 115. It is acknowledged that the distinction between strong and weak evidence against the null hypothesis is an arbitrary one, based on the OR and 95% confidence intervals.

Table 115: Variables associated with secondary care attended injury, showing weak / negligible evidence against the null hypothesis

Age	Level	Complete outcome dataset analysis	Multiply imputed data analysis
Early primary school age	Neighbourhood	None	None
	Home	None	None
	Family	1) Increasing number of older siblings (increased risk)	None
	Child	None	None
Late primary school age	Neighbourhood	None	None
	Home	None	1) Mothers dissatisfaction with home (increased risk) 2) Family lives in private rented accommodation (increased risk) 3) One or more house moves (increased risk)
	Family	None	1) Paternal manual social class (increased risk) 2) Mother's highest educational qualification less than 'O' level (reduced risk)
	Child	1) Increasing score on total behaviour problems (increased risk)	None

A number of variables that were not associated with injury in the observed data, appeared to become so in the multiply imputed data, particularly for the late primary school-aged children; maternal dissatisfaction with the home, living in private rented accommodation and having more than one recent house move, manual paternal social class and mother having her highest educational qualification less than ‘O’ level. The confidence intervals of the odds ratios for these variables were all tightened through the imputation process so that their ranges narrowly failed to include 1.0. These variables are unlikely to have a significant contribution to injury risk in these children.

For late primary school-aged children, a high score on child total behaviour problems had only weak evidence against the null hypothesis in the complete outcome dataset, however repeat of this analysis with the multiply imputed dataset strengthened this association, such that it appears to have strong evidence against the null hypothesis.

8.6 CONTRIBUTION OF HOME AND NEIGHBOURHOOD FACTORS TO INJURY RISK

To assess the impact of the home and the neighbourhood on injury risk for children, over and above that due to family and child factors, a series of analyses using likelihood ratios were conducted. The likelihood ratio test compared the log likelihoods of a model containing one group of variables alone to a model that contained all the other groups of variables. For example, to assess the contribution of home variables independently, the first model calculated the log likelihood for home variables alone, and the second model the log likelihood for neighbourhood, family and child variables. A p value of <0.05 for the log likelihood estimation for these two models would suggest that the models had a greater difference than would have occurred by chance, and that the single group of variables was contributing to injury outcomes independently. Results of the likelihood ratio tests are shown in Table 116 and Table 117. Analysis using likelihood ratio tests on an imputed dataset is not supported in STATA, therefore this analysis was conducted on the observed data only.

Table 116: Log likelihood ratio analyses of contributions to injury risk, early primary school age children
LR p-value = p value of the likelihood ratio X^2 analysis

Variable name	Adjusted within group (Models 1, 5,6&7)			Model 2			Model 3			Model 4		
	OR (95% CI)	P value	LR p-value	OR (95% CI)	P value	LR p-value	OR (95% CI)	P value	LR p-value	OR (95% CI)	P value	LR p-value
Early primary												
Neighbourhood variables												
IMD of area - (Qimd)	**1.02 (0.97, 1.09)**	**0.421**		1.02 (0.96, 1.09)	0.532		1.02 (0.95, 1.09)	0.572		1.02 (0.95, 1.10)	0.563	
Mothers social networks (socnet5bin)	**0.84 (0.70, 1.02)**	**0.072**	0.149	0.81 (0.67, 1.00)	0.045	0.294	0.87 (0.69, 1.08)	0.198	0.452	0.88 (0.70, 1.11)	0.283	0.587
Mothers relationship with neighbours (nvisits5b)	**0.97 (0.80, 1.18)**	**0.750**		0.98 (0.80, 1.21)	0.881		0.96 (0.76, 1.21)	0.736		0.95 (0.75, 1.20)	0.662	
Home variables												
Crowding (Crowd7cat)	1.25 (0.95, 1.65)	0.112		**1.15 (0.86, 1.54)**	**0.353**		1.10 (0.77, 1.56)	0.603		1.09 (0.76, 1.57)	0.631	
Mother reported problems with home (hprobs5bin)	1.42 (1.10, 1.83)	0.008		**1.46 (1.12, 1.91)**	**0.005**		1.49 (1.11, 1.99)	0.007		1.47 (1.09, 1.99)	0.012	
Mothers satisfaction with home (home5)	1.00 (0.68, 1.46)	0.995	**0.016**	**1.05 (0.71, 1.56)**	**0.814**	0.031	1.26 (0.83, 1.91)	0.286	0.071	1.27 (0.83, 1.96)	0.275	0.115
Mothers home ownership (rent5)	0.79 (0.49, 1.28)	0.343		**0.76 (0.45, 1.32)**	**0.339**		0.99 (0.55, 1.79)	0.975		0.94 (0.52, 1.73)	0.852	
Number of house moves (moves5b)	1.03 (0.86, 1.24)	0.757		**1.01 (0.83, 1.22)**	**0.918**		1.06 (0.85, 1.31)	0.609		1.04 (0.84, 1.30)	0.693	
Family variables												
Parental social class (socclasscat)	1.07 (0.90, 1.29)	0.434					**1.04 (0.85, 1.28)**	**0.691**		1.01 (0.82, 1.24)	0.929	
Highest M qualification (edqual5bin)	0.92 (0.73, 1.17)	0.508					**0.81 (0.62, 1.07)**	**0.139**		0.79 (0.60, 1.05)	0.102	
No. of younger siblings (sibsYcat)	0.86 (0.73, 1.00)	0.047					**0.88 (0.74, 1.05)**	**0.144**		0.88 (0.74, 1.06)	0.176	
No. of older siblings (sibsOcat)	1.13 (0.99, 1.29)	0.082	0.005				**1.17 (1.01, 1.36)**	**0.040**	0.022	1.16 (0.99, 1.36)	0.063	0.042
Mothers general health (mhealth6)	1.42 (1.00, 2.00)	0.052					**1.38 (0.94, 2.01)**	**0.099**		1.25 (0.85, 1.85)	0.261	
Maternal depression (depr6)	1.00 (0.80, 1.25)	0.984					**0.95 (0.74, 1.22)**	**0.687**		0.91 (0.71, 1.17)	0.468	
Maternal life events score (life6cat)	1.09 (0.98, 1.22)	0.126					**1.02 (0.90, 1.16)**	**0.718**		0.99 (0.87, 1.13)	0.892	
Child variables												
Visual impairment (km2071b0)	0.76 (0.57, 1.02)	0.069								**0.89 (0.64, 1.24)**	**0.485**	
Total behavioural problems (total6Cat)	1.18 (1.07, 1.31)	0.001	<0.001							**1.15 (1.01, 1.31)**	**0.029**	<0.001
Learning difficulties (kp1220b)	1.18 (0.90, 1.55)	0.223								**1.05 (0.74, 1.49)**	**0.798**	
Previous injury treated in secondary care (anysci34)	3.35 (2.73, 4.10)	<0.001								**3.91 (3.07, 4.98)**	**<0.001**	

Table 117: Log likelihood ratio analyses of contributions to injury risk, late primary school age children
LR p-value = p value of the likelihood ratio X^2 analysis

Variable name	Adjusted within group (Models 1, 5,6&7)			Model 2			Model 3			Model 4		
	OR (95% CI)	P value	LR p-value	OR (95% CI)	P value	LR p-value	OR (95% CI)	P value	LR p-value	OR (95% CI)	P value	LR p-value
Late primary												
Neighbourhood variables												
IMD of area (Qimd)	**1.04 (1.00, 1.09)**	**0.068**		1.06 1.01, 1.12)	0.025		1.06 (1.00, 1.13)	0.044		1.05 (0.99, 1.12)	0.123	
Mothers social networks (socnet9bin)	**1.07 (0.93, 1.24)**	**0.340**	0.038	1.06 (0.91, 1.24)	0.459	0.035	1.07 (0.90, 1.28)	0.424	0.064	1.07 (0.88, 1.30)	0.492	0.048
Mothers relationship with neighbours (nvisits7b)	**1.15 (0.99, 1.35)**	**0.066**		1.21 (1.03, 1.42)	0.024		1.22 (1.01, 1.46)	0.037		1.25 (1.02, 1.53)	0.030	
Home variables												
Crowding (crowd10cat)	1.01 (0.77, 1.31)	0.953		**0.95 (0.71, 1.26)**	**0.718**		0.83 (0.58, 1.17)	0.284		0.74 (0.49, 1.11)	0.143	
M reported prob with home (hprobs7bin)	1.04 (0.82, 1.32)	0.750		**1.06 (0.82, 1.37)**	**0.655**		0.90 (0.66, 1.21)	0.476		0.82 (0.58, 1.16)	0.261	
Mothers satisfaction with home (home7)	1.25 (0.87, 1.81)	0.222	**0.115**	**1.27 (0.87, 1.86)**	**0.218**	0.107	1.10 (0.71, 1.69)	0.671	0.0117	1.13 (0.71, 1.80)	0.610	0.125
Mothers home ownership status (rent7)	1.36 (0.94, 1.95)	0.102		**1.36 (0.88, 2.10)**	**0.160**		1.80 (1.12, 2.89)	0.015		1.95 (1.11, 3.43)	0.021	
Number of house moves (moves7b)	1.18 (1.01, 1.37)	0.033		**1.15 (0.97, 1.36)**	**0.114**		1.00 (0.83, 1.220	0.970		1.01 (0.81, 1.25)	0.957	
Family variables												
Parental social class (socclasscat)	1.15 (0.99, 1.33)	0.067					**1.16 (0.98, 1.38)**	**0.084**		1.18 (0.97, 1.42)	0.091	
Highest M qualification (edqual9bin)	0.84 (0.69, 1.02	0.077					**0.89 (0.71, 1.11)**	**0.290**		0.95 (0.73, 1.23)	0.711	
No. of younger sibs (sibsYCat2)	1.03 (0.92, 1.15)	0.654					**1.06 (0.93, 1.22)**	**0.371**		1.10 (0.95, 1.27)	0.219	
No. of older sibs (sibsOCat2)	0.99 (0.89, 1.11)	0.894	0.044				**0.99 (0.87, 1.13)**	**0.882**	0.075	0.99 (0.86, 1.15)	0.942	0.123
Mothers reported general health (mhealth9)	0.81 (0.56, 1.16)	0.246					**0.67 (0.43, 1.02)**	**0.061**		0.78 (0.49, 1.24)	0.300	
Maternal depression (depr9)	1.08 (0.91, 1.28)	0.361					**1.09 (0.90, 1.32)**	**0.375**		1.03 (0.83, 1.27)	0.821	
Maternal life events score (life9cat)	1.21 (1.10, 1.32)	<0.001					**1.20 (1.08, 1.33)**	**0.001**		1.13 (1.01, 1.27)	0.031	
Child variables												
Visual impairment (f7vs010b2)	0.88 (0.68, 1.13)	0.317								**0.82 (0.60, 1.13)**	**0.231**	
Total behavioural problems (total9Cat)	1.10 (1.01, 1.20)	0.029	<0.001							**1.12 (1.00, 1.25)**	**0.051**	**<0.001**
Learning difficulties (learndiff8b)	0.82 (0.65, 1.03)	0.092								**0.81 (0.60, 1.10)**	**0.179**	
Previous secondary care treated injury (anysci56)	1.61 (1.33, 1.95)	<0.001								**1.58 (1.24, 2.02)**	**<0.001**	

Table 116 shows that for early primary school-aged children the greatest contribution to injury risk comes from the child variables, with a statistically significant but reduced contribution coming independently from family variables and a statistically significant but further reduced contribution coming from home variables. The neighbourhood variables do not have a contribution greater than would be expected by chance.

For late primary school-aged children, Table 117 shows that the greatest contribution to injury risk comes from the child variables. No contribution greater than could have occurred by chance was seen from family or home variables, but a statistically significant but reduced non-hierarchical contribution was seen from neighbourhood variables.

8.7 SUMMARY OF CHAPTER

The results show that for both early and late primary school-aged children in this cohort, child factors, specifically a previous injury requiring treatment at hospital, and a high score on a total behaviour problems scale were the main factors associated with injury occurrence. An increased maternal life events score was a consistent family risk factor for injuries in late primary school-aged children in both observed and imputed data. Maternal reported problems with the home was a consistent home risk factor for injuries in early primary school-aged children in both the observed and imputed data.

In neither the observed nor the imputed data did neighbourhood factors appear to play a significant role in the risk of injury for early or late primary school-aged children when home, family and child variables were taken into account. There was weak evidence against the null hypothesis for neighbourhood factors playing an independent role in child injuries for late primary school-aged children in the log likelihood estimations on the observed data.

CHAPTER 9: DISCUSSION

This study comprised of three main components; a systematic review of cohort studies, an overview of descriptive injury data from ALSPAC, and an analysis of risk and protective factors for injury using that data. This chapter will summarise the results of each component, critique and compare with the published literature, and offer an interpretation of the results. The chapter will then consider the contributions of the study to the field and the implications of the findings for research and policy.

9.1 SYSTEMATIC LITERATURE REVIEW

9.1.1 Summary of the results of the review

The systematic review of cohort studies reporting injuries in school-aged children identified 44 papers reporting 18 different cohort studies that met the inclusion criteria and theses are reported in detail in Chapter 4. Included papers reporting the descriptive epidemiology of injuries showed that boys sustained more injuries than girls at all ages with the sex difference increasing with age, supporting the findings of published reviews[1;5;199] and primary research.[8;15;26;200] The most frequent type of injury in younger school-aged children was cuts and wounds, to be replaced by fractures and sprains/strains as children grew older. This pattern is similar to data published from emergency departments in the UK[7;201;202] although the level of detail available through the ALSPAC study allowed more detailed breakdown of injury types than some surveillance systems, and it was notable that the most recent cohort study reporting injuries in children aged 5-11 years in the UK was from 1970. The mechanism most likely to cause injury was falling, though definitions used to categorise mechanism of injury varied, and there was rarely adequate reporting of mechanism of injury to make comparisons between publications. In particular, mechanisms of injuries sustained during sports participation were rarely specified. School and leisure environments replaced the home as the most frequent site of the injury event with increasing child age. Severity of injury could be reported in a number of different ways, but was most frequently reported using “medical attention” as a proxy for severity of injury. The level of severity of injury reported varied widely depending on setting and injury definition. It was disappointing that very few cohort studies reported the short or long term consequences of injury, when this information has the potential to be a useful advocacy tool for injury prevention.[203] The descriptive reporting of injuries in the cohorts from the UK broadly matched the

Twenty seven papers from 15 cohorts reported factors influencing injury risk. Risk factors in the child associated with increased injury risk across more than one cohort or setting included male sex, psychological difficulties, hyperactivity, aggressive or antisocial behaviour, and risk taking behaviour. Behavioural difficulties, particularly in boys, have been well recognised as a risk factor for unintentional injuries.[150;204;205] Risk factors in the family similarly associated with increased injury risk included having many siblings and a relatively young mother. No environmental risk factors were consistently reported as being associated with increased injury risk across more than one cohort or setting.

The systematic review helped to identify the variables which were selected for the descriptive and analytical studies.

9.1.2 Strengths and limitations of the review with a commentary on their impact

The study was conducted using published systematic review principles for observational studies. A number of potential limitations were identified. Even though no English language limitation was applied in the search strategy, only one paper was identified in a language other than English.[162] It is possible that other non-English language papers may have been identified through the inclusion of more electronic databases but this would have resulted in increased technical challenges of translation and increased time taken to complete the review. Only four papers were identified from low and middle income countries (LMICs).[139;162;177;178] This may be a complete reporting of cohort studies in these countries; a possible consequence of the expense of establishing longitudinal follow up studies, or the review may have failed to identify some cohorts if findings have not been published or failed to be identifiable by the search strategy used. Not surprisingly, heterogeneity existed between included studies with respect to date of study, setting, participants, methodology and classification systems for measuring risk factors or assessing injury severity. Authors used variable definitions of ‘an injury’ although most defined injury as that requiring medical attention. The problem of variable definitions of injury is ongoing[104;106] and has been explored in more detail in Chapter 3. Whilst the methods of synthesising observational data within systematic reviews are still being developed, the implications of unrecognised confounding are well known and therefore statistical pooling was not attempted.[127-129]

The strengths of the review were based on its rigorous attempt to identify studies meeting the inclusion criteria. A comprehensive grey literature search yielded more included papers than the electronic database searches, increasing the likelihood of complete study identification. Cohort studies were included in the review only if the children were healthy at the time of recruitment, that is, before any injuries occurred. This was to reduce any potential response bias or recall bias that are recognised limitations of parental reporting of injury events in case control studies, or other retrospective designs where the participants are identified after the injury event. Published methods for the management of citations, quality appraisal, data extraction and synthesis were used[206] to improve validity of the findings of the review. The review was successfully able to report the epidemiology of injuries occurring to school-aged children for comparison with ALSPAC and to identify potential risk factors for inclusion in the regression analyses of ALSPAC data. In addition, the review was able to identify gaps in the research literature with regard to setting of future studies (LMIC), methodologies (use of standardised definitions and classification systems of injury), and risk factor analyses (particularly home and environment risks).

9.2 DESCRIPTIVE ANALYSIS OF INJURIES IN ALSPAC

9.2.1 Comparison of descriptive analysis results with published data

12,421 injury events were reported in 5498 children aged 5-11 years in four primary school-aged questionnaires that contained questions on childhood injury in the Avon Longitudinal Study of Parents and Children. The methods used in the descriptive analysis of these injuries are summarised in sections 6.1 and 6.3 and the results are presented in Chapter 7. The overall frequency and rate of injury events was greater in boys than girls at all ages, consistent with evidence from other cohort studies in the UK[33;133;140;152] and abroad.[138;139;162] In this study the gender difference persisted for all injury types except burns and scalds (which were commoner in girls than boys in the late primary school children). The distribution of gender by injury type was not reported in any of the cohorts identified in the systematic review. The World Report on Child Injury Prevention reports a higher mortality from burns for girls compared to boys.[1]

The rate of injury events in the ALSPAC data increased between 5½ and 8½ years and then fell at 11½ years. In contrast, the Dunedin Multidisciplinary Child

Development Study described, in a series of three papers, the injuries occurring in a cohort of 1139 children between the ages of six and 11 years in New Zealand,[134;168;169] and provided data indicating that injury rates increased between the first (age 6-7 years) and last (age 10-11 years) assessments.

Parents in ALSPAC reported the five commonest types of injuries occurring in the 12 months prior to each questionnaire were, in order; cuts / wounds, bruising / swelling, fractures / dislocations, burns / scalds and sprains / strains. The proportion of reported injuries that received medical attention varied by injury type; from 100% of fractures to 52% of sprains and strains, 41% of cuts / wounds, 23% of bruising / swelling, or 11% of burns / scalds. No other cohorts identified in the review reported data at this level of detail for comparison. For each of the five main types of injury reported in ALSPAC, the location of the injury event changed from the home (in early primary school-aged children) to school / leisure environments (in late primary school-aged children), identical to the pattern identified in the Dunedin cohort.[134;168;169] Less common injury types in ALSPAC included dental injuries, ingestions, head injuries, and eye injuries.

In the road environment, data from ALSPAC showed that 57% of vehicle occupant injuries were sustained by girls, whilst 66% of pedestrian injuries and 86% of cycling injuries occurred to boys. One hundred and ninety one transport-related events were reported with 94% occurring in the road, and 65% receiving medical attention. Only one child required hospital admission as a result of a transport-related injury. In the literature review no other cohort identified road environment or transport-related injury events in this level of detail for children aged up to 11 years for comparison.

9.2.2 Strengths and limitations of using free text of injury reports

The strengths of the free text parent-reported injuries included:

- the opportunity for parents to record circumstances of the injury event in their own terms
- information on the circumstances of the injury event was requested for every injury reported
- the depth of detail provided by parents
- the high response rate from the questionnaires resulting in large numbers of injury events being recorded

Due to the high retention rate of parents and carers in the study during the primary school-aged years the ALSPAC team were able to send out questionnaires to 82.5% (11549/13998) of the original cohort of infants alive at 12 months when the children commenced primary school (at 5½ years) and to 73.7% (10311/13998) of the original cohort at 11½ years. Response rates to the questionnaires were very high throughout the period, at 78.0% at 5½ years, falling to 69.5% at 11½ years. These features result in this being the richest dataset of injuries for primary school-aged children in the UK to date. The descriptive injury data presented in this thesis is the most recent and detailed parent-reported injury data for this age group believed to be available in the UK.

Weaknesses of using parent-reported free text included:

- attrition from the cohort resulting in it becoming less representative of the local population than at the time of recruitment
- non-random loss to follow up which may have resulted in a retained cohort that would report differently to the non-retained cohort
- the loss of families of lower socioeconomic status may underestimate the frequencies of reported injuries in both absolute terms and in relative terms when considering trends in injury frequency by socioeconomic status
- the recall period of 12 months for the first three questionnaires and 2½ years for the last questionnaire resulting in likely underreporting of injuries due to difficulties of remembering events over long periods of time, particularly for the last questionnaire at age 11
- no validation of the parentally-reported injuries
- potential under-reporting of injuries because as children grow older, parental knowledge of minor injuries sustained by their children decreases

The weaknesses of the free text injury data relate to features common to all longitudinal studies as well as some specific issues. In this study the first three questionnaires had a recall period of 12 months, and the last had a recall period of up to 2½ years. Studies have shown that the longer the recall period, the more likely that injuries will not be reported.[120] This is particularly likely for those injuries that did not require assessment or treatment from a health professional. Due to the confidentiality agreements made with parents, there has been no validation of parent-reported injuries with primary or secondary care records. For these reasons it is probable that the number of injuries reported in the period 5-11 years of age has underestimated the true prevalence of injury.

The free text descriptions of injury events were coded using a categorisation process modified from the International Classification of External Causes of Injury (ICECI) system.[183] Strengths of the method used for coding the free text injury data included:

1) the adaptation of this existing published injury classification system which will allow the future comparison of injuries recorded in ALSPAC with other datasets coded using the same system
2) the ability of the ICECI system to code the richness of the majority of free text information provided by the parents of children in ALSPAC
3) the existing clear guidance on how the ICECI codes should be applied, particularly the inclusion and exclusion criteria which provided guidance to enable accurate and consistent application of codes
4) The semi-automated system of application of the ICECI codes using the ‘update query’ facility in Microsoft Access which helped to reduce the risk of errors during the application of codes.

Weaknesses of the coding system included:

1) the inadequate level of detail available within the ICECI system for some descriptive data and the need to generate additional codes to capture this detail
2) the need to generate additional modules to those provided in the ICECI system (to code who was with the child at the time of injury, type of injury sustained, part of the body injured and the treatment received for the injury)
3) the risk of errors associated with data cleaning, particularly relating to the reassignment of accident number codes when the ALSPAC administration team had allocated an ‘accident number = 99’ code, plus the duplicate entries that were identified and cleaned
4) The risks associated with a single person applying the codes such that there was no formal checking of the application of the ICECI codes and the newly generated coding framework.

9.2.3 Impact of strengths and weaknesses on descriptive analysis results

9.2.3.1 Rate of injury occurrence

Evidence identified in the systematic review[134;168-171] indicated that injuries increased with increasing age of school-aged children. In this study of primary school-aged children, parentally-reported injuries increased to age 8½ and then decreased at 11½ years. There are a number of possible reasons why the rate of injuries recorded at 11 ½ years was lower than that at 8 ½ years, but the most likely are reporting biases;

a) Under-reporting by children - as children grow older they may be less likely to report more minor injuries to their parents
b) Under-reporting by parents due to lack of knowledge of the injury event – parents will be unable to report an injury event if that event was not directly witnessed by the parents, and the injuries sustained were not reported to the parents by their children.
c) Under-reporting by parents due to perception of unimportance – an equivalent injury in a younger child may be reported whilst one in an older child was not reported. This may be because older children were perceived as more 'robust'. Parents will vary in their perceptions of importance of some injuries (e.g. bruises / grazes / sprains). This type of under-reporting is supported by evidence relating to bruising or swelling injuries. The commonest part of the body reportedly affected by bruising and swelling in this dataset was the head or face (49% of all bruising reported) compared to the next most frequent location, thigh / leg (11% of all bruising reported). Bruising to a child's knee and shin is extremely common during childhood and therefore it is likely that the occurrence of this type of injury was not perceived to be important enough to report. This was further evidenced in the free text where some parents reported generalisations that did not contribute to the data (e.g. *"he always has bruises on his legs"*)
d) Under-reporting by parents due to recall bias at 11½ years – parents were asked to report injuries occurring 'since the child's 9th birthday' when they were sent the 11½ year questionnaire. This is a long recall period and it is likely that the more minor injuries occurring at the beginning of that period will have been forgotten. For this reason the rates of injuries reported in Chapter 7 included only those injuries reported to have occurred in the 12 months prior to return of each questionnaire, so that an equivalent time

period was used for all four questionnaires. This process resulted in recall bias being less likely to have affected the rates of injuries identified.

9.2.3.2 Severity of injuries reported

Injury researchers use different systems for the classification of injury severity[116-118] and this challenge has been described in Section 3.7. This study has used the place/person providing treatment of injury as a proxy for the severity of the injury. The rationale for this decision was that injury severity scales were not used in ALSPAC at the time of collection of data on injuries, and the assumption that severe injuries were more likely to require medical attention than minor injuries. Within the group of injuries where medical attention was sought, it was assumed that those attending secondary care settings were likely to be more severe than those attending primary care settings. Whilst these assumptions are likely to be true we know that attendance at accident and emergency departments is affected by a number of factors,[7;207] all of which are likely to have influenced health seeking behaviour in this study:

- The parent's perception of the severity of the injury
- The confidence of the parent to manage the injury independently
- The parent's belief that intervention of the healthcare service will be effective
- The parent's perception of the relative ability of primary and secondary care to appropriately manage the injury
- The proximity to primary and secondary healthcare facilities

The proportion of different injury types requiring medical attention varied considerably; 52% of sprains / strains, 41% of cuts / wounds, 23% of bruising / swelling, and 11% of burns / scalds. This difference suggests that parental perception of the severity of injury has influenced the decision to seek medical attention. A burn or scald may be perceived as being a relatively 'significant' injury and therefore a greater proportion of the total burns and scalds have been recalled and reported by the parents to ALSPAC, including the more minor ones that the parents treated independently. Hence only a small percentage (11%) of those reported received medical attention. In contrast, it might be expected that there would be many more sprains / strains, cuts / wounds and bruising / swelling injuries and that parents may not perceive these as important as burns / scalds. Only the more severe ones are recalled and reported to ALSPAC and therefore the percentage of those reported that received medical attention is greater (52%, 41% and 23% respectively).

Parents will vary in their confidence to treat injuries themselves and monitor their child afterwards for consequences of that injury. A number of free text entries suggested that medical attention was not sought because the parent had clinical knowledge themselves, e.g. *'I am a nurse'* or *'his father is a doctor'*. It is possible that if the cohort attrition has been greater for parents in lower socioeconomic groups than those in higher socioeconomic groups that the retained cohort could be more likely to contain parents with clinical experience or knowledge.

Proximity to a children's accident and emergency department was not assessed in this study although has been shown to be a significant predictor of A&E attendance.[208-210] There is one dedicated children's A&E close to the city centre in Bristol, and one general A&E in the north east of the city that also saw children during the period when data was collected. Families living closer to the hospitals would be more likely to attend than those living on the outer boundary of the ALSPAC catchment area, especially for those injuries that were perceived as less severe. In contrast certain injury types, such as fractures, were likely to attend A&E irrespective of the distance to the hospital because the pain and visible deformity may indicate the severity of the injury and the need for medical attention.

9.2.3.3 Head injuries

Twenty two of 141 head injuries (15.6%) were associated with a reported loss of consciousness. It might be expected that the parent of a child sustaining a head injury with a loss of consciousness would seek medical attention for their child, yet in six cases the child was reported to have not received medical attention; five were treated with first aid and one required 'no treatment'. This reporting could be valid, or it could be artefact due to either:

- An error due to the parent unintentionally completing the wrong box on the questionnaire
- A transcription error during the entry of the free text into the ALSPAC database

Due to the unexpected nature of the parental response in these six cases, each entry was checked to confirm there had been no errors during the process of coding; no errors were identified. Assuming the lack of medical attention is valid, this finding could either represent a misunderstanding by parents of the potential significance of a head injury resulting in loss of consciousness, or it may indicate that the parents of these six children had some healthcare training or experience that resulted in them deciding to observe their child themselves rather than seek an alternative medical opinion. The lack of understanding of the significance of a head injury with unconsciousness may be real as published research suggests that parents may not know how to respond to such situations,[211] may not perceive a need for knowledge of first aid[212] and trials of teaching paediatric first aid via primary care have not changed knowledge and safety practice.[213] A first injury has been described as a 'teachable moment' for engaging parents in injury prevention interventions.[214]

Bruising and swelling to the face and head was the commonest type of bruising and swelling reported, followed by that occurring to the thigh and leg. Bruising to the lower leg is known to be extremely common in this age group. In contrast, sustaining a 'black eye' or bruising and swelling to the face or head is uncommon and may be more likely to be perceived as serious and therefore be recalled and reported.

9.2.4 Socioeconomic distribution of injuries

In the descriptive analysis of parentally-reported injuries in this study (Chapter 7), an unexpected finding was that of fewer injury events reported in quintile 5 compared to quintile 1 (i.e. the reverse of the expected distribution). This finding may be real or artefact due to a number of methodological issues;

- Differential recall and reporting – families in quintile 1 may be better at recalling and reporting injuries than families in quintile 5. Families in quintile 5 may have more stressful circumstances (e.g. relating to housing, employment, and health) or more chaotic lifestyles that could impact on their recall of injuries in their children, particularly those perceived as less serious. The fact that the distribution of more serious injuries such as fractures, which generally all require medical attention, also showed a reduced incidence in quintile 5 compared to the other quintiles, suggests that recall and reporting are unlikely to explain this finding fully.

- Differential loss to follow up – families in lower socioeconomic status groups were less likely to remain in the study and therefore there is less data available from families in the most disadvantaged circumstances/
- This study included all parentally-reported injuries, and did not limit the data to the most serious injuries. Previous reports of inequality by socioeconomic groups have tended to focus on serious or fatal injuries. If more minor injuries do not exhibit variation by socioeconomic group, then this could mask any effect in more serious injuries.
- The distribution identified in this study could be an artefact of the method used to determine quintiles of deprivation. The loss to follow up in any longitudinal study is not random; families with the greatest disadvantage and with the greatest need are often those least able or interested in contributing to a long term research study. This means that with time the cohort becomes increasingly biased towards more advantaged families. The quintiles of IMD 2000 were created by using all those families where a postcode was available at age five, ranking them on their IMD score and then dividing the cohort into five equally sized groups for comparison. When the retained cohort is divided into quintiles, quintile 5 used in this analysis would be more affluent than the lowest quintile drawn from the population as a whole. This may mean that it would not be possible to determine valid inequality by deprivation of area of residence in this study.

For some injury types (e.g. dental, eye, or head injuries, and ingestions) the numbers of all reported injuries were small, so patterns of reduced incidence with increasing deprivation could be artificial due to random variation in small numbers. However, the consistency of the finding across all injury types, including those where numbers of reported incidence were much greater (cuts and wounds, bruising and swelling, burns and scalds, and sprains and strains) supports the interpretation that this finding is real. One interpretation, that this finding is due to reporting bias because parents from less disadvantaged areas are more likely to report more minor injuries than parents from more disadvantaged areas, is possible, but is not supported by the finding that the same pattern of reduced incidence in families living in the least disadvantaged areas also occurs for fractures, all of which are likely to be both identified and treated in secondary care, and reported to ALSPAC. This tends to suggest that the finding is real and may reflect different patterns of exposure, with children from more affluent areas more likely to participate in physical play and activities that increase exposure to injury risk.

9.3 RISK AND PROTECTIVE FACTORS FOR INJURY

9.3.1 Prevalence of risk factors associated with injury

The methods used in the risk factor analysis are summarised in sections 6.2 and 6.4 and the results presented in Chapter 8. Unadjusted univariable analyses performed on the observed data indicated that male sex, visual impairment, hyperactivity, psychological difficulties, conduct problems, past history of having an injury, having two or more younger siblings, two or more older siblings, poor maternal health, high maternal life events score, poor maternal satisfaction with the home, maternally reported problems with the home, living in private rented accommodation, frequent house moving, and having a good relationship with neighbours were all statistically significantly associated with the risk of injury in the child. These were included in a multivariable logistic regression model of injury risk, run on the observed data and then a dataset where missing data had been imputed.

For the early primary school-aged children three variables were found to be associated with an increased risk of injury in the imputed dataset; maternally reported problems with the home, an injury treated in secondary care during the pre-school period and children having a high 'total behaviour problems' score.

The strengths and limitations of the multivariable analysis employed in this study are summarised below. Two variables with a protective effect for injuries in the early primary school age child were having two or more younger siblings and a child having a visual impairment.

For the late primary school-aged children regression analyses on the imputed data showed that there were four variables with strong evidence against the null hypothesis for association with injury; children with a previous injury receiving treatment in secondary care, children with a high 'total behaviour problems' score, mothers with a strong relationship with their neighbours and mothers with high life events scores. Five other variables were found to have weak evidence against the null hypothesis; living in private rented accommodation, having one or more house moves in the previous two years, or having parents with a socioeconomic classification of manual social class.

The prevalence of the variables found to be associated with injury is important, since a commonly occurring variable with only a mildly increased risk may be of greater importance for policy and practice than one with a high risk, but that occurs only rarely. The strongest predictor of injuries in both age groups was a previous injury treated in secondary care. Ten percent of early primary school-aged children and 12.8% of late primary school-aged children had sustained a previous injury treated in secondary care illustrating the importance of this variable for predicting children at risk of further injuries.

Table 109 indicates that the prevalence of mothers reporting low levels of social networks was 27.1%. Other mothers (i.e. those without low levels of social networks) had children aged 5-7 years in whom there was a reduced risk of parent reported injury treated in secondary care with borderline statistical significance (OR=0.84 (95%CI: 0.70, 1.02), p=0.072). Although this variable showed only weak evidence against the null hypothesis of no association with injury, the high prevalence of poor social networks (27.1%) indicates that this factor may be relevant when interpreting the importance of social networks and injury risk. Considering other neighbourhood variables; Table 110 indicated that the 23.4% of mothers who had good relationships with their neighbours, had children with a borderline statistically significant 15% increased association of risk of injury (OR=1.15 (95% CI: 0.99, 1.35), p=0.066). Although of borderline statistical significance, the data suggest that an apparently desirable social situation to which people may aspire (i.e. having large social networks) may be associated with increased risk of parentally reported injury in those children, although the mechanism of this action is unclear. Forty one percent of late primary school aged children had a father in a low social class (as determined by manual occupation). These children had a weak evidence against the null hypothesis with an association of borderline statistical significance between low social class and injury risk of OR=1.16 (95% CI: 0.98 (CI: 0.98, 1.38), p=0.084).

Caution should be taken not to over-interpret the prevalence of many of the variables used in the analysis. When constructing categories of variables, data were clustered in categories that created relatively even distributions across the range of data, rather than clustered into categories determined by clinical or behavioural cut offs. This decision was taken on the recommendation of the ALSPAC statistician, to facilitate interpretation of trends across the range of data, by ensuring approximately even sized groups. This decision could be challenged by other researchers, but the alternative, to use clinical or behavioural ‘cut offs’ risked creating categories with very small numbers of data, reducing the robustness of the statistical test, and thereby making interpretation of outputs from the multivariable regression model more difficult. In addition, different experts will consider different cut-offs of clinical and behavioural measures to be important. This issue has therefore been listed below as a limitation of the analysis.

9.3.2 Strengths and limitations of the analysis of risk and protective factors

Strengths of the analyses include:

1) Using data from those families that completed all four injury questionnaires resulted in the advantage that there was an injury variable for all the cases included in the analysis.
2) The recognition that the range of variables that influence injury risk can be grouped at different levels. The levels used in this analysis (the child, family, the home and the neighbourhood) were chosen to try to explore the widest range of levels of influence, from those inherent in the individual at risk of injury, to those over which the child may have little or no influence. The need to consider this full range arose from an understanding of models of influence in public health, such as those by Dahlgren and Whitehead.[186] A published hierarchical model for multiple regression[187] was chosen for the analysis of these multiple levels. The hierarchy proposed that the wider determinants of health (e.g. the neighbourhood) were likely to exert influence through more proximal determinants (such as the family or the individual). The study aimed to assess whether influence at the level of the environment was real and independent of factors at the level of the child or family.
3) The multivariable regression model used four hierarchical levels (child, family, home and neighbourhood) rather than the three levels (child, family and environment) intended at the protocol stage of the study. This decision acknowledged that the child or family were less likely to be able to exert an effect over variables in the neighbourhood (e.g. traffic load on the street, maternal perception of neighbourhood) than in the child's home environment (e.g. home has basic facilities, home has problems with damp etc). The hierarchical analysis model therefore allowed for variables from the neighbourhood to be analysed more 'distally' to those in the home.
4) Variables included in the hierarchical analytical framework for multivariable regression used an entry threshold of $p<0.1$. The advantage of this approach was that it allowed a more liberal inclusion of variables than using a cut off of $p<0.05$. The risk of using a lower p value was that failing to meet that value would exclude a variable that has a borderline statistically significant

association in the univariable analysis but may contribute to the outcome when considered within a multivariable model.

5) The stratification of the analysis by age (into 'early primary' school-aged children and 'late primary' school-aged children) acknowledged that as children grow, their changing physical and cognitive development will influence their ability to manage potential injury risks and in the activities that will expose them to injury risks.
6) An analysis of both observed and imputed data was undertaken, which enabled a comparison of the results from the different methods. The imputed data generated odds ratios with reduced standard errors and consequently narrower confidence intervals. The associations between independent variables and the injury variable that were identified as occurring more frequently than by chance using the observed data, were reproduced in the imputed data with no change in the direction of effect and minimal change in strength of association. The imputed data were able to indentify variables associated with injury that were not revealed in the observed data.
7) The method used to impute missing data was one considered to be current 'best practice'.[191;195-197] A greater number of imputations was undertaken (n=100) than the current standard recommended (n=50). This was to ensure the imputation model was robust against future calls that lower numbers were inadequate. Increasing the number of imputations increases the uncertainty built into the imputed dataset, which results in a reduced risk of making Type 1 errors as a result of lower standard errors.

Limitations of the analyses included:

1) Only the children of families that returned all four questionnaires containing injury questions were included in the regression analyses. The failure to return questionnaires resulted in missing data, a potential limitation of the study (and a recognised risk in any longitudinal study). The number of cases included in the analysis was almost halved from 10,324 (who had returned at least one of the four questionnaires) to 5752 (who returned all four questionnaires). Although this decision resulted in a dataset where the presence or absence of an injury was known for every case, the reduced number of cases reduced the power of the study to detect differences in risk between groups of participants.
2) Families that returned all four of the injury questionnaires were likely to differ from those that did not return all four questionnaires. By limiting the analyses

to those families that did return all four questionnaires will have created a selection bias. Families that engage with research studies may be more health-aware and more likely to adopt health improving behaviours, a form of response bias known as the 'healthy participant effect'.[215] Families that have returned all four questionnaires in this study will have remained in contact with a research study for over six years and therefore may well illustrate this phenomenon. If that health-awareness extends to injury-risk awareness, then the number of injuries sustained by children in this study may be lower than those that have dropped out of the study, or in the general public.

3) The regression analyses were exploratory and consequently tested the association of multiple independent variables with the outcomes of interest. The potential weakness of this approach was that, by chance, variables could be found to have an association with an OR and p value <0.05. For this reason the explanatory variables chosen to be included in the regression analyses were limited to those reported in published analyses identified through the systematic review (i.e. to test them within ALSPAC) or, where little evidence was available (e.g. neighbourhood variables), a theoretical mechanism of association could be hypothesised. This was a more conservative approach but one less at risk of over interpretation of chance findings.
4) A conceptual model using a linear hierarchy of effect was used in these analyses. Relationships between variables are rarely only linear. Whilst the primary route of effect might be through the proposed linear pathway, it is likely that feedback and influence upwards through the hierarchy and sideways across the hierarchy would also occur, and this has not been explored within this study.
5) The cohort studies identified in the systematic review, and in the ALSPAC cohort study used in this thesis, were not developed with the specific intention of analysing the association between environmental factors and injury risk. Hence the analyses undertaken and reported in this thesis were limited to those variables that were collected by the ALSPAC team at the time. Direct measures of the environment (e.g. traffic load on street, access to safe play areas, state of repair of the home) were usually not collected and therefore the analysis required the use of proxy measures rather than true measures of the environment. For example, type of housing tenure was used as a proxy for the standard of housing. Private landlords do not have the same requirements to maintain their premises to certain standards as do council or social landlords, and therefore the quality (and by implication

safety) of private rented accommodation may be lower than in council or social housing. In this study children living in private rented accommodation were found to be at increased risk of injury, compared to those living in owned or council / social housing. Future cohort studies, or questionnaires within existing cohort studies, could be designed to specifically explore the association between the home or the neighbourhood and injury. They could directly measure environmental variables and therefore directly contribute to hypothesis generation. The use of proxy measures for the environment is likely to bias the results towards the null, and may have contributed to the finding of relatively little contribution to injury risk from home or neighbourhood variables in this study.

6) The data were re-coded into categories that resulted in an even distribution of data across the range of categories, rather than categories that might reflect clinical or behavioural ‘cut-offs’ (which may be contested, and may result in some categories with very small numbers of data). This decision, based on the advice from the ALSPAC statistician, resulted in difficulty in interpreting the importance of the prevalence of categories of data with respect to the apparent association of injury risk.

9.3.3 Factors in the child

Using the multiply imputed dataset the variables most strongly associated with increased risk of injury after adjustment for other variables in the early primary school-aged children and late primary school-aged children were factors related to the children themselves.

9.3.3.1 Age and development

The study demonstrated that factors associated with injury varied by the age of the child, justifying the decision to stratify the analyses by age. A child’s development is associated with the risk and occurrence of unintentional injury. Whilst development is usually related to a child’s age, children develop cognitive, physical and behavioural skills at different rates and therefore age should only be used as a proxy for development. The Child Accident Prevention Trust has recently produced guidelines for the prevention of unintentional injury based upon child development up to the age of 11 years.[97]

The data from ALSPAC have clearly demonstrated the changing risk factors for injury with age. Starting with the pre-mobile population, Warrington and Wright reported the commonest injuries to infants aged six months were caused by falls (especially rolling from beds and sofas or being dropped by the person carrying them) and burn /scald injuries (particularly hot drinks being spilt over infants).[216] Not surprisingly, the parenting and supervision of the infant was a key factor in the mechanism of the majority of these injury events. The role of the parent was important in a study of injuries occurring to 10,431 children at the age of two years; 26% of the cohort experienced at least one injury, and 15% had more than one.[217] Twenty four percent had a major fall, 8% a burn / scald and 5% an ingestion injury. Being in a single-parent family was statistically significantly associated with having a burn / scald, with having more than one injury and having an injury resulting in a scar. In a study of the pre-school children in ALSPAC, Reading et al found that factors in the child (such as male sex, high levels of activity or motor development and behaviour problems) were more likely to predict any accident, or medically attended accidents between six months and 4½ years, than factors in the child's environment.[207] In a study of fractures in school-aged children aged between nine and 11 years in ALSPAC, Clark et al demonstrated that children with a lower bone mass were more likely to fracture than those with normal or high bone mass.[218]

9.3.3.2 Gender

The increased frequency of injuries in boys compared with girls is clearly illustrated in this dataset and is consistent with the evidence from other cohort studies reporting gender differences in similar aged cohorts[133;138-140] and from population based studies[219] and reviews.[1] The two injury types where the total number of injuries was more common in girls than boys were sprains or strains, and burns or scalds. For both injury types there were more injuries in boys than girls at 4½ - 5½ years, but at older ages, and in total, the injuries were more frequent in girls.

The objects causing the burn or scald were most frequently (in order) cooking appliances, food/drink, ironing or cleaning appliance and cooking utensils. For each of these four object categories girls sustained more burns and scalds than boys. The increased prevalence of burns and scalds in girls may reflect socio-cultural norms in promoting exposure in girls to burn and scald risk situations, e.g. increased exposure of girls to cooking and ironing activities than boys as the girls mature between 6½ and 11½ years. The increased prevalence of sprains and strains in girls is not known to have been reported elsewhere.

The World report on child injury prevention states that, under the age of 15, there are 24% more injury deaths in boys than girls.[1] A number of factors are thought to contribute to the increased occurrence of injuries in boys.[220] As reported in this study, different types of injuries may reflect different activities and exposures to injury risk. For example, in a study of leisure injuries, football injuries were the commonest cause of injuries in boys, whilst netball and horse riding caused the most injuries in girls.[221]

Boys are thought to be more likely to have a greater disparity than girls between their gross motor development and their executive functions determining judgement of risk, which may account for the consistent observation of increased injury occurrence in boys. The interaction between risk appraisal, risk taking behaviour and motor development is complex. In the National Child Development Study boys aged seven to 11 with fidgety or sensitive behaviour, or low educational ability had an increased association with traffic injuries.[11] Boys may demonstrate increased risk-taking behaviour and poorer risk appraisal of situations,[222] and there may be different levels of exploration and activity between boys and girls.[223;224]

9.3.3.3 Behaviour

This study identified an association between injuries requiring treatment in secondary care and children having behaviour problems. Children aged 5-7 years with a high total behaviour problems score had increased odds of injury (OR=1.13 (95%CI: 1.02, 1.26), p=0.021) as did children aged 8-11 years, (OR=1.15 (95%CI: 1.06, 1.25), p=0.001). ‘Behaviour problems’ includes a range of difficulties, including hyperactivity, impulsivity, aggression and oppositional behaviour, and depending on author definition, may also include emotional difficulties. Problem behaviours have been associated with increased risk of injury in primary school aged children in other cohort studies[26;162;225-227] and in studies using other designs.[205;228-230] Boys have been reported to have more problem behaviours associated with injury than girls.[27;31;226]

In this study, behaviour was an important predictor of secondary care attended injury, with unadjusted univariable associations for injuries, greater than could have occurred by chance, identified for a range of behavioural variables including; Hyperactivity in early primary school aged children (Pearson X^2 = 10.4342, p=0.005) but not late primary school aged children, Psychological difficulties in late primary school aged children (Pearson X^2 = 7.4322, p=0.024), but not early primary school aged children, Conduct problems for both early (Pearson X^2 = 10.1275, p=0.018) and late (Pearson X^2 = 6.9993, p=0.072) primary school aged children, and Total Behaviour Problems in both early (Pearson X^2 = 12.8153, p=0.002) and late (Pearson X^2 = 13.2349, p=0.001) primary school aged children. Statistical advice stated that including all the behavioural variables risked overweighting behaviour within the regression model and therefore only Total Behaviour Problems was included in the model. The consequence of this decision was that the interaction and relative contribution of different behavioural problems has not been explored and therefore could be the focus of post doctoral research. Identification of those factors exerting the greatest influence on injury risk could then be the focus of targeted interventions.

The total behaviour score used in this study was a variable derived from the Strengths and Difficulties Questionnaire completed when the child was aged six and aged nine. This widely used assessment tool can produce a score between 0-31. For this study a score of nine or above was considered to be high. This tool would allow the identification of children at increased risk of injury or further injury. Support for parents to manage children with problem behaviours may result in reduced injury occurrence.[231] Behaviours associated with injuries have been theoretically clustered into three constructs; activity level, impulsivity and inhibitory control and interventions may be targeted to specific problem areas.[204] Families that may benefit from such support may be identified through the system of notifying GPs, School Nurses and Health Visitors when a child attends an NHS emergency treatment setting following an injury or early signs of behavioural difficulties may be addressed through parenting to avoid the establishment of behavioural problems and their associated risk of injury.

9.3.3.4 Previous injury

An injury treated in secondary care during the pre-school period showed strong evidence against the null hypothesis of an increased risk for injury during the early primary school aged period (OR=3.32 (95%CI: 2.70, 4.08), p<0.001). This finding is similar to that of Bijur et al who reported that injuries requiring hospitalisation that occurred during the pre-school period were strong predictors of injury at 5-10 years in the Child Health and Education Study (RR=2.5 (95%CI: 2.0, 3.3)).[225] In this study, late primary school-aged children who had sustained an injury receiving treatment in secondary care during the early primary school-aged period were more likely to be injured and require attention in secondary care (OR=1.56 (95%CI: 1.31, 1.84), $p<0.001$).

The fact that some children have repeat injuries whilst others do not, led to the concept of 'injury proneness' as an inherent factor in the child.[232] This concept has been challenged as it suggests that the child or their family can do little to prevent injuries from occurring. Whilst some authors report that injury proneness does exist independent of personal factors,[233] the evidence seems to support the opinion that family, social and environmental factors are generally more important in predicting repeat injuries in children than factors in the child.[234;235] Ordonana et al in a study of twins has reported that family factors (such as parenting and supervision) and home factors (such as physical hazards) are more predictive of repeat injury than factors in the child.[236]Factors in the child that are associated with repeat injuries are male sex,[219;237] and behaviour problems.[238] It is of note that the majority of the research in this area is among preschool children rather than those of school age. That some children do sustain more repeat injuries indicates a group suitable for targeted injury prevention interventions.

9.3.4 Factors in the family

9.3.4.1 Maternal life events

The family variable most strongly associated with increased risk of injury was for late primary school-aged children whose mothers had a high life events score (OR=1.19 (95%CI: 1.09, 1.30), $p<0.001$). The association was not found for early primary school-aged children. The variable was derived from maternal self report of 44 life events occurring during the previous year, and was administered when the index child was aged six and aged nine. A 'high' life events score was categorised as a mother reporting that seven or more of the life events had occurred. The mechanism by which increased maternal life events increases risk is unclear but could relate to the mother's capacity to supervise her child appropriately in the context of multiple other pressures. The fact that the variable was not associated with injury in younger children may suggest that older children are more aware of, and influenced by, stresses occurring within the family than younger children.

In a study of injuries in preschool children conducted using data from the ALSPAC study, Reading et al reported that neighbourhood variation in childhood injury rates was entirely explained by child, parent and household factors, one of which was the presence of life events to members of the household.[28] In the systematic review of cohort studies conducted as part of this thesis, Langley reported that in the Dunedin Multidisciplinary Child Development Study there was no association between injury and families who scored highly on a family adversity index.[155] Pless et al, using data from the British 1958 National Child Development Study found that road traffic injuries were increased if a number of individual family life events had taken place for boys (being taken into care of social services or not living with natural mother) and for girls (living with 'family problems').[11] The impact of family life events on childhood injury has been recognised for some time, being reported by Horwitz et al in 1988 as an independent predictor of child injuries requiring medical care.[239] More recently MacKinley et al have reported an association between having four or more life events in the family in the previous year and subsequent traumatic brain injury in children.[240]

9.3.4.2 Parenting

In the four questionnaires, parents were asked "who was with the child at the time of the injury?" It is assumed that this question was included in the questionnaires by the ALSPAC research team as an attempt to establish whether the child was supervised at the time of the injury event, yet the question does not result in responses with a level of detail that would enable interpretation of whether active supervision had occurred. Furthermore, injury questions were included in the questionnaires relatively unchanged from one questionnaire to the next. It could be presumed that this was to enable observation of trends over time, but perhaps failing to acknowledge that whilst supervision of infants and preschool children would be appropriate, for school aged children parental supervision is not possible for a significant proportion of the day when the child is at school and there is a need for reduced supervision to enable the child to develop independence and self-confidence. It is therefore necessary to avoid over-interpretation of the questions on supervision, although the descriptive responses to these questions have been detailed in Chapter 7 for completeness.

Responses to the question of who was with the child at the time of the injury indicate that the majority of the injury events occurred when the child was with an adult and not when the child was alone or with peers. This suggests that the injuries did not occur due to a basic lack of adult oversight, but rather that the child was not *actively* supervised when the injury event took place. Evidence to support this assumption comes from the data on ingestion injuries where the child was reported to be with an adult at the time that 92% of the ingestion events took place. It would seem unlikely that an adult 'actively supervising' a child would allow them to ingest an object or substance. It therefore seems possible that the parents and carers completing the questionnaires have interpreted the term 'being with the child' to mean 'being close by'. Burn and scald injuries occurring when the child was with peers were more likely to need medical attention than those occurring when the child was with an adult, suggesting that the presence of an adult may have reduced the severity of the burn or scald sustained, or that the children were engaged in activities with a higher risk when alone. Injuries occurring in the road environment were just as likely to have occurred when the child was alone or with peers as when the child was with their parents or another adult, suggesting that the presence of other persons did not influence the risk of injury.

Caregiver supervision has been shown in case control studies to influence children's risk of medically attended injuries. [241] Being with a parent may increase exposure to injury risk situations (e.g. a father encouraging a child to run faster, or participate in sports). Parents' attitudes to risk may vary between boys and girls, with boys given greater freedom to explore their environment and test their abilities.[223;241] In a study of travel to school Towner et al found that boys were more likely to travel unaccompanied on their journey to and from school than girls, and were also more likely to ride bicycles to school.[242] Green et al reported how parents differed in controlling children's behaviour in the road environment through physical (e.g. holding hands) or verbal means and did not take full advantage of the opportunities to educate the child regarding road safety.[243]

In a review of the role of supervision and child injury prevention Morrongiello and Schell highlight the difficulties of developing evidence based guidelines for parents and carers on how much supervision is necessary to help keep children safe.[108] The evidence is difficult to synthesise partly because of varying interpretation and use of the term 'supervision' and methods to measure supervision. Children are likely to alter their behaviour in the presence of an adult although girls appear to be more influenced by adult presence than boys. In addition, adults vary in their supervision depending on a number of factors such as their perceptions of the risk of the activity, the vulnerability of the child and their self-efficacy to protect the child.[108;244;245] Parents and carers need to strike the right balance between enabling a child to explore their environment, test their abilities and develop their motor skills, coordination and judgement, whilst still preventing their child from inappropriate or excessive risk of injury. Parents will vary in making such a balance. Literature on parenting interventions for child health outcomes primarily relates to parents and preschool children,[231;246;247] although the role of parenting on the health outcomes of school aged children is the subject of some interest with the development of scales to measure parental supervision practices being extended to school aged children between the ages of 6-12 years.[248] It could be hypothesised that effective preschool parenting may prevent the problem behaviours seen in school aged children that are associated with injury occurrence. Thereby parenting interventions with preschool children could be considered a primary prevention intervention for injuries in school aged children.

9.3.4.3 Siblings

This study found a reduced injury risk with having two or more younger siblings (OR=0.83 (95%CI: 0.72, 0.96), p=0.012). Published evidence from the systematic review identified increased risk with 1-2 siblings[227] or 4 or more siblings[14], but neither of these studies specified whether the siblings were older or younger than the index child. In this study having two or more older siblings was associated with increased risk of injury in the univariable analyses, but the variable was unable to reject the null hypothesis when included in the multivariable regression model. No other published literature has been identified that has reported a reduced risk of injury in children who have two or more younger siblings. If a child has multiple younger siblings a parent may be more likely to be supervising the younger children and at the same time supervising the index child, than if a child has older siblings.

Nathens et al in a case control study of children under the age of 6 years who died or were hospitalised as a result of injury found that the presence of an older sibling was associated with injury, and that it was greatest if the birth interval between the injured child and the older sibling was small.[249] Morrongiello found that older siblings can influence the injury risk behaviours of younger siblings, especially if the two siblings had a positive relationship with one another.[250] However boys and girls differed in their approach to influencing their younger sibling with boys using fun as the driver for behaviour change, whilst girls used safety. The relationship between child supervisors and supervisees is emerging as complex with poor compliance from the younger supervisee appearing to be more predictive of injury than inappropriate supervision by the older sibling[251] but also older siblings not responding appropriately to injury risks.[252]

9.3.5 Factors in the environment

Children aged 5-11 years spend a significant proportion of their day outside of the family home, at school during weekdays and at leisure during weekends. In this age group injuries are increasingly sustained outside of the family home, and the environment in which a child sustains their injury may be considerably different to the environment where the child lives. Despite this, the majority of the children in this study will have attended a primary school close to their family home and will thus have undertaken most of their leisure activities in this area. Therefore the decision to explore environmental factors using two groups (home and neighbourhood) was considered appropriate. Variables considered as ‘home’ factors were those it was considered that the family may have had the potential to influence (e.g. relating to the quality of the internal home setting). Variables that were beyond the direct control of the family were considered to be neighbourhood factors. Analysis of the environmental variables in two separate groups may have had the consequence of producing the limited associations between the environment and injury risk seen in this study. A further analysis where all environmental variables were analysed together would be required to explore whether this theoretical possibility was real.

9.3.5.1 The child’s home

All of the variables used to explore the relationship between the child’s home and their injury risk were maternally reported (e.g. Mothers feelings about the home, mothers reported problems with the home, mother’s reporting of damp and water problems in the home, basic home facilities etc). The ALSPAC researchers had not visited the home or attempted to verify the reports made by the mother (e.g. with reports from the father, or from the child). Mothers will perceive different home circumstances differently and therefore the validity of the variables used to explore injury risk and the home environment of the child are acknowledged.

Using the variables available, early primary school-aged children appeared to have an increased risk of injury if they lived in a home where the mother reported problems with the physical home environment (OR=1.38 (95%CI: 1.08, 1.77), p=0.010). This variable was derived from a series of questions relating to poorly fitting windows or doors, problems with ventilation or problems with noise between rooms. A poorly built or maintained home may present a young child with an environment with greater exposure to injury risks, although may also indicate a family less able to manage those risks for their child (e.g. due to financial, capacity or lifestyle reasons). A poor physical home environment (lack of basic facilities) was associated with increased risk of road traffic injury at age seven years in the UK National Child Development Study (OR=1.37 (95%CI: 1.1, 1.8)).[11] Housing standards have been associated with child injury[253;254] although the evidence of effectiveness of home modification to reduce injury is lacking.[76]

For the late primary school-aged children the home environment was associated with increased injury occurrence if there was poor maternal satisfaction with the home, if the family was living in private rented accommodation rather than owner occupied or social / council rented accommodation, or if the family had experienced one or more house moves in the previous two years. Families who live in privately rented accommodation may be more likely to move frequently, and the maintenance of such accommodation may not be regulated to the same standards as social or council rented accommodation.[255 254] Kendrick et al were able to demonstrate that living in rented accommodation was associated with increased risk of primary care attended injuries and emergency department attended injuries in pre-school children in a cohort study in Nottingham.[25] Hence these factors may be related and represent a living environment where there may be increased levels of risk of injury for children.

9.3.5.2 The neighbourhood

As with the home environment, the variables used to explore the neighbourhood in which the child was resident were recorded in questionnaires from the mother and there was no independent validation of the reported neighbourhood. The only exception was the use of the Index of Multiple Deprivation which was independently derived using routinely collected information on the area of residence.

Only one maternally reported variable from the neighbourhood was associated with injury; late primary school-aged children whose mothers had a strong relationship with their neighbours had a weak increased risk of having a secondary care attended injury (OR=1.18 (95%CI: 1.02, 1.36), p=0.023). This association was not found for the early primary school-aged children. The variable was derived from a series of questions related to whether the mother and her neighbours visited each other's homes, and whether the neighbours ever looked after the mother's children. Close neighbourhoods may be perceived as safe neighbourhoods; if neighbours are more aware of children playing outside and of strangers within their community, parents may allow their children to play outside the home and believe them to be safe. However, such neighbourhood awareness may not be a substitute for parental observation of children to help them avoid or manage situations that expose them to injury risk.

The interpretation of the association between the Index of Multiple Deprivation score for the postcode of residence and injury is discussed below in the section on socioeconomic status and injury.

9.3.6 Socioeconomic status and injury

Data from a range of UK study designs illustrate inequalities in childhood injury prevalence, and associations between social or material disadvantage and injury occurrence, are most clearly indicated for certain injury types such as road traffic injuries and fire injuries.[16;17;21;256] Measures of socioeconomic disadvantage vary, with some publications using parental (primarily paternal) occupation as the indicator of socioeconomic status (SES).[17;21] The value of such measures for maternal and child outcomes has been the topic of some debate [257;258] and parental (primarily maternal) educational attainment or income has been suggested as a preferable measure of individual SES. Low parental education may be used as a proxy for disadvantaged socioeconomic status, since the first is a risk factor for the latter. Furthermore, low parental educational attainment may reflect the ability of parents to access and use health promotion information relating to child safety. Research from the UK tends not to use such individual measures of SES, although they are used in Europe[259;260] and elsewhere.[261] In the UK area based measures of SES have been widely used to describe inequalities in childhood injury occurrence for primary school aged children. [17;22;23;256;262;263] Published reviews of socioeconomic differences in childhood injury have illustrated the differences in measures used to determine disadvantage, in reporting of inequality by injury type, and in comparisons of inequality within and between countries.[1;257;264-266]

In this study, different measures of socioeconomic status provided differing evidence of associations between socioeconomic status and parent reported injuries in children aged 5-11 years.

For the late primary school-aged children, regression analyses on the imputed data showed that there was an association between paternal occupation and sustaining an injury, with increased injury for children whose fathers were in manual social groups compared to non-manual groups (OR=1.15, (95%CI: 1.01, 1.32). This finding supports that of other literature where lower SES as determined by paternal occupation is associated with increased risk of injury.[17;265;267;268] In contrast, the analysis of injury risk for the early primary school-aged children, by SES as determined by paternal occupation did not provide evidence against the null hypothesis (OR=1.07, (95%CI: 0.90, 1.28).

Late primary aged children whose mothers achieved least well educationally (where the highest educational qualification attained was less than ‘O’ level) had a reduced risk of sustaining an injury during the period of follow up (OR=0.84, (95%CI: 0.72, 0.99), whilst those of early primary school age had a weak protective association (OR=0.83, (95%CI: 0.67, 1.03). An explanation of the finding in this study could be that poorer educational attainment leads to reduced employment opportunities, and consequent reduced financial ability to provide opportunities for their children to engage in leisure or sport activities that may be associated with increased injury risk. These findings are in contrast to published literature[259;269] where higher educational attainment is associated with reduced injury risk. A cohort study from China identified in the systematic review (Peng[162]) reported that mothers with a ‘high’ level of education (level unspecified) had children with higher levels of injury between the ages of 7-13 years (RR=1.23, (95%CI: 1.07, 1.33)).

This study attempted to explore socioeconomic inequality using an area based indicator of disadvantage, the Index of Multiple Deprivation 2000 (IMD 2000), which was based on the postcode where the child lived when aged five years. The IMD 2000 indicated the relative disadvantage of a geographical area based on an index compiled from a number of measures of disadvantage (income dependent on means tested benefits, employment, health, housing quality, educational attainment, access to services, levels of crime and disorder and the physical environment). The IMD 2000 compared quintiles of deprivation, where quintile 1 is the most affluent, and quintile 5 is the most disadvantaged. In the multiple regression model no association was found for the early primary school-aged children’s injury risk and quintile of IMD (OR=1.03, (95%CI: 0.97, 1.03), and only a weak association against the null hypothesis was seen for the late primary school-aged children, (OR=1.04, (95%CI: 1.00, 1.09). This again contrasts with published literature. Studies from the UK showing positive associations between area based deprivation and increased risk of road traffic injury,[22;23;256;262] falls,[256] burns and poisonings,[22;23] or measures of all injuries.[263] A child’s neighbourhood is likely to become more influential as they begin to spend greater periods of time outside the home, yet at the age of 5-11 years the amount of time a child spends independently in their neighbourhood or community is still relatively limited, and often under some degree of parental supervision. Research undertaken on the pre-school ALSPAC cohort has shown that individual and family factors account for the majority of any variation in neighbourhood rates of childhood accidents for children under the age of five years, and that any differences in injury risk between neighbourhoods is likely to be explained by geographical clustering of similar types of children, families and households rather than differences in the neighbourhood in which the children live.[28]

In the UK and other high income countries the association between a child's neighbourhood and their risk of injury is complex.[28;270] This is perhaps related to the affluence of high income countries where the life experience of all children is considerably safer than for children living in low and middle income countries. For example, all public playgrounds have soft play surfaces, pedestrians are separated from traffic by pavements, cars made after 1965 should have seatbelts and all cars should have annual road worthiness checks (MOTs) if over three years old. Similarly, the difference in injury risk between children in the least and most disadvantaged communities in a high income country appears to be less than that for a low or middle income country, e.g. the home environment is more likely to be of a good standard, and is relatively homogenous between communities. The complexity of the relationships between social determinants and injury in high income countries has been illustrated with traffic related childhood injury in Sweden, showing that socioeconomic differences in injury depend on the context of the factors explored.[270;271] The complexity of these interactions between variables may have the consequence that it is harder to illustrate inequality in overall non-fatal injury risk for children as has been attempted in this study. In contrast we know from the many examples of inequality have been published for particular types of injury, or for fatal injuries that inequality in injury risk for children continues to exist in high income countries and such inequality needs to be reduced.

West et al[140;272] have proposed that there is an equalisation of injury risk in older children; that as children grow into adolescents, the inequality in injury occurrence diminishes. Research in other high income countries lends some support to this theory, where school girls in Sweden demonstrated equalisation for some injury types (traffic related injury, or self inflicted injury) occurring at different ages.[273] Whilst this evidence is based upon children aged 11 years and older, the underlying principle is that individual, peer and cultural factors exert increasingly important influence during the transition from childhood to adulthood. That influence is unlikely to commence abruptly, but rather be of a gradually increasing importance throughout childhood as the individual gains independence. It could therefore be speculated that the older children in this study are experiencing some degree of equalisation of injury risk and that could be contributing to the ability to demonstrate differences in injury risk by a range of measures of socioeconomic status.

9.3.7 Factors not associated with injury

Cohort studies can be useful to determine the association between two variables that have been hypothesised as related in other studies. The finding of no association can be particularly valuable if this can prevent erroneous information being given to parents (e.g. the lack of an association between MMR and autism).[274] Previous cohort studies have found an increased association between injury and having a young mother[162;225] or having large numbers of siblings.[14;26;166;227] This study did not find those associations. The reasons for this are more likely to be due to the changing social contexts of families in this study (relatively increased affluence of all families including those with young mothers, the rising average maternal age at first pregnancy, and falling average family size with fewer mothers having multiple children) or due to features of the study design (such as differential loss to follow up of younger mothers) rather than the interpretation that the previously reported findings were erroneous. The difference in these findings between UK cohort studies illustrates the importance of having contemporary cohort analyses to inform policy and practice.

9.4 GENERALISABILITY OF RESULTS

This study has explored the relationship between a variety of individual, family, home and neighbourhood factors with secondary care attended injuries in children aged 5-11 years in the South West of England. The cohort was recruited in 1990-1991 and data for this study were collected between 1996 and 2002. The cohort was considered to be representative of the population of Great Britain at the planning stage, and therefore the findings should be broadly generalisable to children of this age group across the country. There are two main caveats to this generalisation; the differential loss to follow up of the cohort resulting in a less disadvantaged cohort being retained, and the changing demographics of both the former Avon area and Great Britain as a whole. Bristol has seen significant inward international migration in recent years, both from economic migrants and those seeking asylum from persecution. There were small, well established Asian and Afro Caribbean communities in Bristol at the time of recruitment to ALSPAC, but considerable international migration from Eastern European and Black African communities has occurred since recruitment to this cohort. The cohort as it now stands is not representative of the child population in Avon or of Great Britain more generally with respect to ethnic diversity. The differing practices of child care, injury prevention and safety policy in other high income countries, together with the varying changes in population demographics across high income countries will limit the generalisability of the findings of this study outside of the UK.

Since recruitment to the study there have also been changes to the life experiences of children in the UK. Children have been growing up experiencing increasingly sedentary play opportunities compared to previous generations. The children in this cohort sustained more of their injuries in the school and leisure environments, and fewer injuries in the home environment, as they have grown between five and 11 years. The majority of children in this study will have attended a primary school close to their family home and will thus have undertaken most of their leisure activities in this area. With increasing leisure time being spent in the home, for example playing computer games or watching television, and less engaged in physical play outside, their exposure to injury risk will be modified, most likely towards a reduction in injury occurrence. In addition, safety interventions such as safer playground design or the use of child resistant closures will have contributed to a reduction in injury occurrence. The concern regarding increasing incidence of overweight and obesity during the primary school-aged period has resulted in renewed encouragement for children to engage in physical play activities, which is likely to have the consequence of increasing exposure to injury risk situations once more.

9.5 CONTRIBUTION TO RESEARCH

The aim of this study was to explore the relative contribution of individual, family, home and neighbourhood factors to injury risk in children aged 5-11 years, using data from the Avon Longitudinal Study of Parents and Children. In meeting this aim the study has made new contributions to injury research.

9.5.1 Contributions from the systematic review of cohort studies

The systematic review of cohort studies highlighted a small number of features relating to the child or their family that were consistently associated with increased injury risk across more than one cohort or setting; male sex, a child with psychological, behavioural or risk-taking problems, and a child with a large number of siblings or a relatively young mother. These findings informed the analysis of risk factors for injury in the ALSPAC data.

Most cohorts appeared not to have collected information on the child's environment and very few reported analyses exploring the association of environmental factors with injury. The review identified how infrequently cohorts collected repeated measures in order to assess temporal changes in injury occurrence.

A systematic review of child cohort studies reporting injury has not been published previously. The review undertaken for this study was published in a peer reviewed journal; a copy of this is included in Appendix 8.

9.5.2 Contributions from the descriptive reporting of injuries in ALSPAC

A coding manual was developed based on the International Classification of External Causes of Injury (ICECI) system. This resource will be available for application to other injuries reported in ALSPAC in the future, and will allow comparison with data from other sources that have been coded using ICECI. The coding was applied to 12,421 parentally-reported injury events, resulting in the most detailed injury dataset for primary school-aged children in the UK.

The coded data provided detailed descriptions of the distribution of injuries by age, gender, location, and mechanism. For most types of injury the data was in greater detail than that previously published. One consistent, and unexpected, finding was an increased occurrence of injuries in the least disadvantaged quintile compared to the most deprived, as measured by the Index of Multiple Deprivation 2000.

9.5.3 Contributions from the multivariable analyses of risk factors for injury

The multivariable logistic regression analysis indicated that the variables with the strongest associations with injury (male sex, having a previous injury treated in secondary care, and having behaviour problems) were consistent with evidence from previous cohort studies.

Results from this study not previously reported in the literature from cohort studies included an increased injury risk associated with children whose mothers had many life events, mothers who had good relationships with their neighbours, children who lived in privately rented accommodation, had more than one house move in the previous two years or whose parents were in a manual social class. A reduced injury risk was found to be associated with children having two or more younger siblings, children who had visual impairment or children whose mothers had low educational attainment.

9.6 IMPLICATIONS FOR RESEARCH

9.6.1 For cohort studies recording injury outcomes

The review identified methodological issues for cohort studies reporting the epidemiology of child injury;

- To support international comparisons of childhood injury epidemiology there should be consensus regarding definition of 'an injury', and of systems to classify the circumstances of the injury event and the severity of the injury sustained
- Study teams should maximise the potential of the design by undertaking repeated measures of injury and other risk factor occurrence and follow up children over extended periods of time, including after the injury. This will facilitate understanding of trends relating to age and development, and the consequences of injury occurrence
- To understand the association between factors in the home and neighbourhood and injury risk, cohort studies should proactively collect data about the environment
- Systematic review methodology increasingly considers the inclusion of non-trial and observational evidence to support the development and implementation of interventions and policy. Hence all study designs require adequate indexing to support ease of identification, yet cohort studies were rarely found to be indexed. Journal editors could support this through the requirement for keywords that reflect study design.

To understand the contribution of a child's environment to the risk of injury, research needs to continue to be undertaken in a variety of settings and populations.

Researchers working with ALSPAC have supported the development of cohort studies in other countries, including Jamaica and South Africa. Both of these cohorts have collected data on injury occurrence but have not had the capacity to analyse the data. The experience of analysing injuries in this study could support analyses in the Jamaican and South African cohorts. There would be a need to ensure that the classification systems used to code the circumstances of the injury event and the severity of injury were similar to those used in ALSPAC. Assessment of the impact of socioeconomic status would require the identification of appropriate local individual and area based measures of disadvantage.

9.6.2 Further analyses of ALSPAC data

Further analyses of data from this study could be undertaken to explore both descriptive epidemiology and risk factors for injury. The study highlighted two particular injuries (burns / scalds and ingestions) where combining outputs from this study with pre-school injury data would enable a more complete descriptive epidemiology of trends with age and development. This would require re-coding of the pre-school injury free text data using the coding framework developed and described in this thesis.

The coding system developed for this study could be applied to free text information regarding road accidents that was collected from the children in the cohort when they were 13 years old. Combined with pre-school injury data that had been re-coded using the new coding system would provide a dataset for injuries occurring in the road environment from birth through to age 13. Such a dataset could be used to describe and analyse how the risk of sustaining injuries in the road environment changes with child development.

A number of measures of behaviour (e.g. hyperactivity and conduct problems) were found to be associated with injury but only a combined behaviour measure ('total behaviour problems') was entered into the multivariable analysis to avoid overweighting behaviour within the model. Furthermore, sub-categories of behaviour may be independently associated with injury occurrence,[275] e.g. hyperactivity contains both attention and impulsivity components. Analysis of the co-linearity of the behaviour variables (e.g. through exploration of their correlation coefficients) would be helpful to indicate how strongly these variables are related to one another and their suitability for independent inclusion in a model. Bullying was not explored in this study but may be associated with injury,[276] both for the perpetrator and the victim,[277;278] and therefore warrants assessment. Variables related to bullying were collected during the ALSPAC study.

The study demonstrated the strong association between a history of a previous injury treated in secondary care and a subsequent injury. Combining pre-school and primary school-aged data would enable identification of children with multiple injuries between birth and 11 years of age, and allow exploration of the variables associated with repeat injuries. The results would contribute to our understanding of the relative contribution of individual, family, home and neighbourhood factors that lead to repeat injuries and how those contributions change with increasing age of the child. Such evidence may enable hypothesis generation for targeted prevention activities for these families.

In the future, the genetic epidemiology of childhood injury is likely to be an important field of research. This study will be able to contribute to a planned project to establish an injury score for each child in ALSPAC which will then be analysed against specific genetic profiles.

The validity of the results of this study could be tested through sub-analyses. This study used a dataset generated from parents who returned all four injury questionnaires in the primary school-aged period (n=5752). A dataset generated from parents who had returned at least one of the four questionnaires would have included almost double the number of children (n=10,324). Assuming an imputed dataset for the 10,324 children was a valid representation of the true dataset were it complete, the greater sample size should result in an odds ratio closer to the true odds of association and narrower 95% confidence intervals.

Non-random loss to follow up is one of the recognised weaknesses of cohort studies. The ALSPAC cohort is no longer representative of the England population. A stratified sub-sample of the cohort could be identified that accurately reflected the socioeconomic and ethnic distribution of the national population, and the analysis re-run. Comparison of the sub-sample results with this study would inform our ability to generalise the findings to the country as a whole.

The measure of deprivation used in this study (IMD 2000 score of the postcode of the child's home at age five) showed a reverse gradient for the majority of types of injury, i.e. increased injuries reported in the least deprived areas. As children grow and spend increasing time outside the home, factors in the school and leisure environment become more likely to be associated with injury. This study assessed a number of school variables, however, data for the majority of children were missing, and therefore these variables were considered unsuitable for analysis. A further study could apply an IMD 2000 score to the postcode of the child's school to explore whether an association exists with injury by deprivation of area of education. This analysis would be challenging due to the proportion of children known to have moved schools between the ages of five and 11 years. Further measures of the school environment may be available from the Local Authority, e.g. proportion of school grounds available as playing field, or traffic density on the school street etc.

9.6.3 Research using other study designs

The systematic review focussed on evidence from prospective cohort studies, in which a wide range of injury events of variable severity were reported. Very few child deaths from injury were included and therefore the analyses mostly reported risk factors for non-fatal injury. A systematic review of case control studies where cases were children who had died from injury may yield insight into environmental predictors of fatal child injuries and lead to hypotheses for the prevention of such injuries. Such a review would allow international comparison of environmental factors for fatal child injury. Individual (child) factors cannot account for all inter-country variation in injury occurrence, and therefore further research is needed to explore environmental and societal factors associated with increased injury risk. A variety of study designs may be required to understand the factors that result in such differing injury rates.

9.7 IMPLICATIONS FOR PRACTICE AND POLICY

Injuries remain one of the leading causes of death and disability for children over the age of one year in the UK and socioeconomic differences persist in the occurrence of injury. Policy makers need to know the scale and distribution of injuries in order to tackle the problem. ALSPAC provides the most contemporary data for primary school-aged injuries available in the UK. Previous cohort studies, e.g. the Newcastle Thousand Families study,[163] and the 1958[164;165] and 1970[26] birth cohort studies were undertaken when the circumstances and experiences of children aged 5-11 years were very different from today. Life expectancy and health care opportunities were reduced, standards of living, income and housing were relatively lower, and the environment and community in which children grew up was different. Societal changes have resulted in a greater diversity of local communities,[279] later age of first birth[279] (fewer young mothers), changes to family structure[280;281] (e.g. co-habiting, parents, working mothers, fewer siblings), less active play and a tendency to protect children from harms that have a low probability of happening (e.g. stranger danger) but may be of significant concern to parents, and result in children having fewer opportunities for freedom to play outside the home.[282]

This study has found that associations with injury risk are greatest for factors in the individual child or their family rather than in the child's home or their environment. Recent UK Governments have invested heavily in the regeneration of disadvantaged neighbourhoods.[283] Whilst this may have outcomes and benefits for the families within those neighbourhoods and may contribute to the reduction in inequalities in health and wellbeing,[284] this study suggests that changing a child's neighbourhood is unlikely to have a major influence on their risk of parent reported injury. Greater reduction in child injury may be gained by focusing on children at risk of injury (e.g. those with, or at risk of, behavioural difficulties), families with complex lifestyles (e.g. those where mothers report multiple life events), or improving the quality of the homes of children (e.g. those where mothers report problems with the home).

9.7.1 Scald prevention

Hot drinks being knocked or spilt over children are a well recognised cause of scalds in pre-school children. Hot food and drink was reported to have caused scalds and burns in 186 injury events in school-aged children and accounted for a fifth (21.1%) of all burns and scald injuries. Of the 34 burns and scalds serious enough to require treatment in primary or secondary care almost all were due to hot drinks being spilt or dropped over children. This suggests that the risk of scalds from hot drinks does not stop when a child starts school. Awareness of the continuation of risk for younger school-aged children should be disseminated to practitioners and parents.

9.7.2 Behavioural risk factors for injury

This study demonstrated that children with behaviour problems were at greater risk of having an injury requiring treatment in secondary care. Changing established behaviour patterns is challenging even when the individual wishes to change their behaviour (e.g. stopping smoking).[285] In children, who may have less insight into the need for behaviour change than adults, may find it even harder to change their behaviour, especially to prevent an injury that may not happen. In these circumstances environmental, product or process change may be an effective alternative to behaviour change. For example, children with hyperactivity and impulsive behaviour may not look carefully for traffic risks when crossing the road.[286] If changing the road environment makes the easiest place to cross the road also the safest place to cross the road, then this is likely to benefit all children, including those who are hyperactive and impulsive. If families understand their child's level of judgement and self control they may be more likely to provide appropriate supervision in the road environment,[287;288] and children with hyperactivity and impulsivity could be offered appropriate training in how to cross the road safely.

9.7.3 Risks associated with increasing physical activity

Concerns regarding the increasing prevalence of children who are overweight or obese, and the need to promote sustainable transport, support the promotion of active play and travel for children, including walking and cycling to school.[282] Therefore there is a dilemma for practitioners; this study shows that active play and travel are associated with increased frequency of injuries. Sprains and strains were common in children at 8½ and 11½ years, often due to due to falling / tripping events or over-exertion and were frequently sustained in leisure or school environments. The promotion of non-competitive and competitive sports[289] may therefore increase the rate of such injuries due to increased exposure to risk situations. The analysis of injuries occurring in the road environment showed that the risk appeared to be greatest at age 8½ years, and that one in ten (10.4%) of the transport-related injury events (being a vehicle occupant, a pedestrian, a cyclist or a motorcycle rider or passenger) resulted in a fracture, indicating the potential seriousness of injuries occurring in this setting. Increasing the number of cyclists is likely to ultimately result in safer cycling; it would lead to increased awareness of cyclists by other road users, and encourage local authorities to alter the road environment towards the needs of the cyclist, e.g. through provision of cycle lanes.[290] However, until such time, child cyclists will be exposed to a relatively high risk environment and a greater number of injuries are likely to be seen.

Although not all risk can be avoided, those that are potentially modifiable should be reduced and evidence-based interventions should be used where available. These include the use of warm-up exercises before sport,[291] programmes to teach skills of independent safe road crossing (e.g. Kerbkraft[73]), adult accompaniment on the home-school journey,[292] and programmes to improve visibility for pedestrians and cyclists.[293] Interventions to promote behaviour change in other road users (such as enforcement of speed limits, traffic calming, and road layout re-design),[294] disincentives to driving whilst under the influence of alcohol or drugs, whilst using a mobile phone or whilst tired, and those to reduce the number of cars in use (e.g. through provision of efficient public transport alternatives).

9.7.4 The intentional / unintentional injury spectrum

As outlined in Section 3.4, injury researchers have historically dichotomised injury events into those considered intentional and those unintentional. The descriptive epidemiology in this study showed that children often sustained injuries when they were with a parent or adult, suggesting that failure to protect a child could be considered a degree of 'neglect', and that this could be considered to have occurred even when adults are with their children. The implication is not that adults should be directly observing their school aged child at all time, nor that they should always be in close proximity in order to help them stay safe. From a child protection perspective the focus on intentional injury may be unhelpful, since it is likely to miss cases where harm has occurred due to failure to keep a child safe. Assessment of the components of parental supervision that keep school-aged children safe is an area of ongoing research,[295;296] as is the study of the influences on school-aged children's decision making about taking injury risk.[297] This study collected information on injuries by the action of another person and did not attempt to differentiate injuries by intent. The injury events reported consequently illustrate the extent to which injuries can occur when a child is with an adult but the study cannot adequately assess supervision.

9.8 SUMMARY OF CHAPTER

This chapter has summarised the three main components of the thesis; the systematic literature review of cohort studies, the analysis of the descriptive injury data from ALSPAC and of risk and protective factors for injuries in school aged children. In turn the strengths and limitations of each component have been considered and each has also been set within the context of the published literature. These considerations are applied to the findings, which when placed in the context of the methodological issues raised in Chapter 3, and the literature arising from other study designs, allows an attempt at a meaningful interpretation. The lack of strong evidence of associations between a child's environment and their risk of injury may be due to the limitations imposed by the variables that were available in ALSPAC relating to the child's home or their neighbourhood, and a dependence on proxy measures. None the less, the study has confirmed some factors as important predictors of future injury (such as male sex, behaviour problems, and having a previous injury), and has identified a range of other factors that may lend themselves to future study.

The chapter ends with a consideration of the ability to apply the findings to a wider population than the sample from which the data arose, and a reflection of the implications of this study for research and policy and practice.

CHAPTER 10: CONCLUSIONS

This thesis aims to summarise the evidence from cohort studies of injury occurrence and risk factors for injury in school aged children, to describe the injuries occurring to primary school aged children in an area of England, and to explore the relationship between secondary care attended injuries in those children and risk factors in the child, their family, their home and their neighbourhood. A review of the literature from cohort studies on injuries occurring to primary school aged children (which was conducted as part of this thesis) has shown that few cohort studies have used the full potential of their design by using repeated measures to assess temporal change. Most cohort studies have concentrated on descriptive analysis of injury with few reporting on the analysis of risk factors, and there is a paucity of evidence relating to the role that a child's environment can have on their risk of sustaining an injury. This thesis has attempted to explore these issues, using the ALSPAC database over a period of time when a child attends primary school. This is an important phase in the child's life course where transitions from early childhood to adolescence are starting to take place.

This study utilised the database collated through the Avon Longitudinal Study of Parents and Children, currently the most comprehensive contemporary British cohort for this age group. Over 12421 injury events were reported by the parents of children in the cohort, when the children were aged between 5 and 11 years. Descriptive information from these injury events illustrated the commonest types of injury that had been sustained; cuts and wounds, bruising and swelling, fractures, burns and scalds, and sprains and strains. A clear gender difference was demonstrated with boys sustaining more injuries than girls for all injury types except burns and scalds. The changing patterns of injury type and location as the children grew older, were demonstrated. A notable and unexpected finding, which may be due to methodological decisions or may be real, was that of a higher reporting of injuries in families living in the least disadvantaged areas, a finding contradictory to the published and well known association between injury and disadvantage. For some injury types (e.g. dental, eye, or head injuries, and ingestions) the numbers of all reported injuries were small, so patterns of reduced incidence with increasing deprivation could be artificial due to random variation in small samples. However, the consistency of the finding across all injury types, including those where numbers of reported incidence were much greater (cuts and wounds, bruising and swelling, burns and scalds, and sprains and strains) supports the interpretation that this finding is real. One interpretation, that this finding is due to reporting bias because parents from less disadvantaged areas are more likely to report more minor injuries than parents from more disadvantaged areas, is possible, but is not supported by the finding that the same pattern of reduced incidence in families living in the least disadvantaged areas also occurs for fractures, all of which are likely to be both identified and treated in secondary care, and reported to ALSPAC. This tends to suggest that the finding is real and may reflect different patterns of exposure, with children from more affluent areas more likely to participate in physical play and activities that increase exposure to injury risk.

The study aimed to test the null hypothesis that there was no additional independent risk of injury from home or neighbourhood factors over and above that from factors in the child or their family. The multivariable regression analysis found strong associations with injury risk for child factors such as male sex, behaviour problems and having a previous injury. At the family level, a higher risk of injury was found for children whose mothers reported multiple life events and a reduced risk of injury was found for children with two or more younger siblings. Maternally reported problems with the home were associated with an increased risk of injury, but few other home factors were found to have associations with injury greater than could have arisen by chance. Neighbourhood factors were not shown to have an association with injury risk. The analysis was therefore unable to reject the null hypothesis for neighbourhood factors, and identified only weak evidence to reject the null hypothesis of no independent association for home variables. The study therefore supports the theory that a hierarchical relationship for injury risk factors does exist, with the strongest associations being for factors closest to the individual, i.e. child factors and the weakest associations being for factors the most distal to the individual, i.e. neighbourhood factors. This finding may be due to the limitations imposed by the variables that were available in ALSPAC relating to the child’s home or their neighbourhood, and the dependence on proxy measures, rather than variables specifically collected to test associations at these levels of influence.

Effective child injury prevention starts with the identification of the circumstances and factors associated with specific injury types. The patterns that arise can then lead to hypotheses of aetiology and opportunities for universal and targeted interventions. This thesis has described an initial exploration of a complex and detailed dataset of children’s injuries. It has identified some new associations and has generated a range of future research questions. It is hoped that the findings of this study will provide a useful contribution to this important field of research.

THE EPIDEMIOLOGY OF INJURIES IN PRIMARY SCHOOL-AGED CHILDREN

Part 2 of 2: Appendices and References

JULIE ANN MYTTON

A thesis submitted in partial fulfilment of the requirements of the University of the West of England, Bristol for the degree of Doctor of Philosophy

Faculty of Health and Life Sciences,
University of the West of England, Bristol
March 2011

APPENDIX 1: DATA EXTRACTION FORM

Systematic review of child cohorts reporting injury	**Study ID:** *(JM to complete)*

Reference details

Reference title____

Authors____

Journal, date, issue & pages_____________________________________

Source of reference *(JM to complete)*_______________________________

Name of larger/primary study (if applicable)__________________________

Study methods

Methodology Recruited cohort □ Subsample of a recruited cohort □

Other cohort □ (specify) _________________________

Stated aim(s) of larger/primary study_______________________________

____

Stated aim(s) of this publication (e.g. from abstract)___________________

____

Selection criteria for primary study cohort___________________________

____

Selection criteria for this publication cohort__________________________

____

Number of eligible children recruited to primary study at beginning:
*(Leave cells blank if data not stated. Mark cells with * if data obtained from secondary source & indicate source below)*

Boys			**Girls**			**Total recruited**		
Numerator		**Denominator**	**Numerator**		**Denominator**	**Numerator**		**Denominator**
#	**%**	**#**	**#**	**%**	**#**	**#**	**%**	**#**

Secondary source ______________________________Or Not applicable □

Age (yrs) at recruitment to primary study ____________________________

Age (yrs) at data collection periods during in primary study:

Period 1 ______ Period 2 ______ Period 3 _______ Period 4 ______

Main ethnic groups at recruitment (# / % / both)________________________________

____ Or Not stated □

Poverty / Deprivation / Social class index used in primary study_____________________

____Or Not applicable □

Location (e.g. Country / county / city):____

Setting: Urban □ Rural □ Mixed □ Not stated □

Author comparison of those recruited to those un-recruited in primary study:
Reported □ Not reported □

If reported, give details:
____

Participants recruited in this publication
*(Leave cells blank if data not stated. Mark cells with * if data obtained from secondary source & indicate source below)*

	Boys			Girls			Total participants		
	Numerator		Denominator	Numerator		Denominator	Numerator		Denominator
	#	%	#	#	%	#	#	%	#
T1									
T2									
T3									

Specify age (yrs) at Time periods 1 / 2 / 3 in this publication:

T1 _____T2 _____T3 _____Secondary source _____________________Or Not applicable □

Main ethnic groups in this publication (#)____

____Or Not stated □

Poverty / Deprivation / Social class index used in this publication____________________

____ Or Not applicable □

Author comparison of those retained to those lost to follow up in this publication:

Not reported □ Reported □ (give details): __________________________________

Loss to follow up in this publication (from original eligible sample), #(%) ________________

Reported injury outcomes____

____

Author definition of 'injury'____

____

____

Results

How was information on results collected?
(*List every instrument used in this publication, giving details where possible e.g. "Parental postal questionnaire, completed at data collection period 2, relating to previous 4 year period"*)

Analysis of results: Descriptive epidemiological paper □ Analytical paper: □

If Analytical paper, give details of main analyses conducted

Data 1 (*LT & MB to extract data as published. JM to additionally calculate missing information e.g. totals or % as required)*

Outcome		Boys (N=______)	Girls (N=______)	Total (N=______)
Area	**Detail**	e.g. # / % / rate of children injured / injuries sustained	e.g. # / % / rate of children injured / injuries sustained	e.g. # / % / rate of children injured / injuries sustained
Any injury				
Repeat injuries (>1/child or>1/event)				
Type of injury	Cut / wound			
	Fracture			
	Bruising			
	Head injury			
	Crush injury			
	Sprain/strain			
	Burn / scald			
Data source: Table No. ____ Page No. ____ Info dispersed thro text? Y/N	Foreign body			
	Ingestion			
	Drown / near			
	Gunshot			
	Multiple			
Mechanism of injury	Fall (from height / on flat etc)			
	Sharp object			
	Blunt object			
	Crush			
	Motor /RTA			
	Other road (e.g. cycle, pedestrian, etc)			
	Hot, cold or caustic agent			
Data source: Table No. ____ Page No. ____ Info dispersed thro text? Y/N	Falling object			
	Firearm			
	Bite / sting			
	Choking or airway problem			
	Water			
	Self inflicted			

Data 2

Outcome		Boys (N=______)	Girls (N=______)	Total (N=______)
Area	**Detail**	e.g. # / % / rate of children injured / injuries sustained	e.g. # / % / rate of children injured / injuries sustained	e.g. # / % / rate of children injured / injuries sustained
Part of body injured ***Data source:*** Table No. ____ Page No. ____ Info dispersed thro text? Y/N	Head and / or face			
	Eyes only			
	Teeth only			
	Trunk or body			
	Upper limb / hand			
	Lower limb / foot			
	'Limb' (not otherwise specified)			
Severity of injury (specify classification) ***Data source:*** Table No. ____ Page No. ____ Info dispersed thro text? Y/N	1			
	2			
	3			
	4			
	5			
	6			
	Death			
Resulting disability (how & when assessed?) ***Data source:*** Table No. ____ Page No. ____ Info dispersed thro text? Y/N	Scars			
	Sensory			
	↓ Physical activity			
Location of injury event ***Data source:*** Table No. ____ Page No. ____ Info dispersed thro text? Y/N	Home			
	School			
	Leisure			
	Road			

Explanatory variables

Individual (Child) variables	Family variables	Environmental variables

Authors published conclusions (including results and 95% CIs if available)

____

Reviewers interpretation of conclusions reported (e.g. are conclusions appropriate for the results published? Etc)

____

Quality assessment of paper

Only brief comments required Questions adapted from http://www.phru.nhs.uk/casp/. *Accessed 17.2.06*

1) Does the study address a clearly focussed issue? *(I.e. is there a clear research question, for example relating to the population studied? the risk factors studied? Or the outcomes considered? etc)*

Yes / No / Unclear

2) Is the cohort representative of a defined population? *(I.e. allows results to be generalised to that population?)*

Yes / No / Unclear

3) Were the outcomes appropriately measured to minimise bias? *(I.e. Is there a more appropriate method of measuring outcomes to reduce bias that is still pragmatic? Consider whether e.g. assessments were subjective or objective? Validated measures were used? Attempts were made to minimise detection bias?)*

Yes / No / Unclear

4) Was the duration of follow up of subjects long enough to answer the research question posed?

Yes / No / Unclear

5) Was loss to follow up of subjects clearly stated? *(If yes, could it have affected interpretation of results?)*

Yes / No / Unclear

6) Have authors identified potential confounding factors? *(If Yes, give details)*

Yes / No / Unclear

7) If there was an analysis, did the authors account for potential confounding factors *(e.g. with regression or stratification)*

Yes / No / Unclear / Not applicable

8) If there was an analysis, did the authors report and manage missing data appropriately? *(If Yes, give details)*

Yes / No / Unclear / Not applicable

9) If there was an analysis, are the results reported with precision estimates where appropriate? *(e.g. confidence intervals, p values)*

Yes / No / Unclear / Not applicable

10) Is the nature of the cohort study being exploited to its full potential? *(e.g. if data available for an analytical study have the authors conducted an analysis or simply reported descriptively?)*

Yes / No / Unclear

11) Are the results believable? *(I.e. could they be due to bias, chance or confounding, not otherwise specified above?)*

Yes / No / Unclear

APPENDIX 2: SYSTEMATIC REVIEW TABLE - PAPERS REPORTING CHILDHOOD INJURY

44 papers reporting childhood injury from 18 different cohort studies
*Reported injury outcomes: [Source of injury data: Child report, Parent report, School report (Teacher or Nurse), GP contact, Medical Records, Other]
** Quality rating: [A] = Good (i.e. sound methodology and clear reporting, no concerns), [B] = Adequate (i.e. minor methodological or reporting concerns but not to the extent that the validity of the reported results are questioned) or [C] = Poor (i.e. significant methodological or reporting concerns such that serious doubt is placed on the validity of the published results).

Name of cohort study, First year of recruitment	Author, year	Age at Follow up: Number at follow up / Number recruited (%)	Reported injury outcomes*	Results: descriptive reporting of injuries sustained	Results: analysis of variables considered to influence the risk of injury	Comment [Quality rating**]
Cohort from Baise, China, 2002	Chen, 2005a	T1 (12-19yrs): 1840/1855 (99.2%)	Unintentional injury [P, S]	**Frequency**: 595/1840 (32.3%) children aged 11-18 sustained 833 injuries during 12 months of follow up. 186/1840 (10.1%) adolescents had >1 injury. **Mechanism**: Of 833 injuries (274, 33.0%) were falls, being struck by an object or person (165, 19.8%), lacerations or wounds from sharp objects (118, 14.1%), motor vehicle or transportation injuries (42, 5.0%), burns or scalds (33, 4.0%), bites/stings (29, 3.4%), choking/airway problem (18, 2.2%), poisoning (6, 0.7%) or 'other' (includes drowning, fire crackers, electrocution) (149, 17.8%) **Severity of injury**: No care received 79/833 (9.6%), care from parent or teacher 400/833 (48.0%), care from school medical staff 99/833 (11.9%), outpatient care 223/833 (26.8%) or hospitalisation 32/833 (3.8%). Time missed from school: <1day 289/833 (34.7%), 1-3 days 427/833 (51.2%), 4-6 days 58/833 (7.0%), >=7 days 60/833 (7.2%) **Location:** Home 270/833 (32.3%, 40.7% of injuries to girls occurred in the home), School 295/833 (35.3%), on the Road 81/833 (9.7%), or elsewhere 189/833 (22.7%) **Type, part of body** and **consequences** :not reported.	**Child variables**: males had greater risk than females (OR=1.25, CI=1.02 to 1.53), Injury incidence rate decreased with increasing age (41.4/100 students aged 11 years to 20.2/100 students aged 18 years). Younger students had more injuries than those aged 17-18 (for 11-13yr olds OR=1.51, CI=1.00 to 2.26, for 14-16 yr olds OR=2.94, CI=1.96 to 4.42). Students from majority ethnic groups (Han and Zhuang) had almost identical rates, that were much lower than all minority ethnic groups (p=0.02). **Family variables**: Single children had higher rates than those with sibs (p<0.01), For children with divorced parents living with grandparents had less risk than with fathers or mothers only (p=0.03), risk was higher with lower family income (p<0.01), and with lower parental educational level (p<0.01). Controlling for gender, age, ethnicity and mothers education, students whose family had the middle income band had increased risk of injury compared with those in lowest band (OR=1.42 CI=1.11 to 1.81). **Environmental variables**: none reported	Robust paper [A]

	Chen, 2005b	T1 (14-19yrs): 1474/1549 (95.2)	Unintentional injury [P, S]	**Frequency**: 442/1474 (30.0%) children aged 13 to 18 years sustained any injury during the 12months of follow up. **Type, mechanism, part of body, severity, location** and **consequences**: not reported.	**Child variables**: Boys had significantly higher injury rates than girls (32.6% vs 27.4%, p=0.03). Minority ethnic groups had significantly higher injury rates than non-minority groups (45.9% vs 28.7% (Han) or 29.3% (Zhuang), p=0.01). Injury rate decreased from 42.7% at age 13-14 years to 20.2% at 17-18 years. After controlling for gender, age, ethnicity in multivariate regression models, the psychological symptoms of somatisation (OR=2.00, 95%CI 1.52-2.63), obsessive-compulsiveness (OR=2.10, 95%CI 1.71-2.58), anxiety (OR=2.08, 95%CI 1.62-2.66), depression (OR=2.00, 95%CI 1.59-2.51), interpersonal-sensitivity (OR=1.66, 95%CI 1.34-2.06) and psychoticism (OR=1.60, 95%CI 1.26-2.03) all remained associated with elevated injury risk at statistically significant levels. **Family variables**: Adolescents living in families with only one child had significantly higher rates than children in families with more than one child (32.3% vs 27.5%, p=0.05). The injury rate among divorced families was no different from families where parents were married. **Environmental variables**: none reported.	Robust paper. Injury rate fell with increasing adolescent age. Psychological problems may be risk factors for nonfatal unintentional injuries in adolescents in China, independent of demographics. Authors acknowledge that self report risks underreporting of injuries and the risks of bias in using SCL-90-R (and the fact that this was only measured at baseline) [A]
Cohort from Maanshan, China, 2001	Peng, 2003	T1 (7-13yrs): 1983/2005 (98.9%)	Type and mechanism of injury. Influence of child and family variables on injury risk [P,S]	**Frequency**: 607/1983 (30.6%) children had 843 injuries during the 1 year study (32.1% boys and 29.1% girls had any injury). 427 children had one injury, and 180/1983 (9.1%) children had >1 injury (97/999 (9.7%) of boys, and 83/984 (8.4%) of girls). There was no apparent increasing or decreasing trend in frequency of injury occurrence with increasing child age from 6 to 11yrs **Mechanism**: The five commonest mechanisms of injury (in decreasing order) were: falls, blunt objects, choking or airway problems, sharp objects and hot / cold or caustic agents.. **Type, severity, part of body, location** and **consequences**: not reported.	**Child variables**: For all mechanisms of injury, occurrence was higher in children with behaviour problems at all ages, except for animal bites and drowning. Boys were more likely to have injuries if they had behaviour problems than girls. Relative risk of injury for antisocial behaviour RR=2.042, 95% CI=1.373-3.011, neurotic behaviour RR=1.963, 95% CI=1.359-2.815 or mixed behaviour RR=1.717, 95% CI=1.373-3.011. **Family variables**: RR of injury in child significantly higher if young (22 years or less) mother (RR=2.248, 95% CI=1.036-4.720), Mother with high level of education (RR=1.233, 95% CI=1.072-1.326), Difficult pregnancy (RR=1.352, 95% CI=1.079-1.689), Insufficient injury prevention in family (RR=1.332, 95% CI=1.033-1.711), and reduced if Parent accompanied children to school (RR=0.713, 95% CI=0.604-0.886). **Environmental variables**: none reported	Author states a number of variables that have been collected but results are not reported in this publication, and used some variables without clear explanation of hypothesis guiding the analysis (e.g. difficult pregnancy). Mothers with high levels of education increase their child's risk of injury – this is contrary to other reports. Unclear why authors conclude that "some people are fundamentally more prone to incidence of injury" or that injuries are in general inevitable [B]

Cohort from Kaohsiung, Taiwan, 1995	Yang, 1998	T1 (14-16yrs): nk/13335 (nk)	Type, circumstances, body part involved and location of injury [S]	**Frequency**: 3640/13335 (27.3%) children aged 13-15 yrs sustained injuries during follow up period of 9 months, including 210 children (1.6%) who sustained more than 1 injury, and 50 (0.4%) children who sustained 3 or more injuries. (All rates reported below are per 10,000 student hours) **Type**: bruising/ /abrasion/ swelling = 0.73, wounds/ punctures = 0.48, fracture/dislocation/sprain = 0.14, concussion/foreign body/burn = 0.03. **Part of body**: upper limb = 0.78, lower limb = 0.35, head / face = 0.15, eyes = 0.04, mouth / teeth = 0.03 & trunk / body = 0.03. **Location**: In school = 1.38, at leisure (before or after school) = 0.73. **Mechanism, severity** and **consequences**: not reported	**Child variables**: Injury rates higher for boys than girls at all grades (RR = 2.34 (CI 2.17 – 2.53), younger age - Seventh grade students had highest incidence rates (RR = 1.33 (CI 1.21 – 1.46) compared to grade 9 students). Overall rate of school injuries 27.3 per 100 students /yr high in comparison with other studies. More injuries occurred in unsupervised areas than in supervised ones. Injuries not involving other students (RR=2.64, 95%CI 2.24 to 2.86) compared with injuries where other student involved (RR= 4.53, 95% CI 4.19 to 4.96). **Family and environment variables**: none reported.	Descriptive reporting of injuries, stratified by age and gender. Classifications of injuries and circumstances differ from other papers, limiting ability to make direct comparisons. Strengths of study include random selection of schools, reduced reporting bias by collecting information on all injuries requiring any treatment, and efforts made to estimate denominator of supervised and unsupervised time [B]
West of Scotland 11-16 Study, 1994	West P, 2004	T1 (11yrs): 2586/2793 (93.0%). T2 (13yrs): 2371/2793 (84.9%). T3 (15yrs): 2196/2793 (78.6%)	At age 13 and 15; self report serious injuries in previous year. Type of injury, and location where injury happened [C]	**Frequency**: At age 13yrs, 646/1910 (33.8%) children sustained injuries in the previous year (385/982 (39.2%) boys and 261/928 (28.1%) girls. At age 15yrs. 948/1920 (49.4%) children sustained injuries in the previous year (576/993 (58.0%) boys and 372/927 (40.1%) girls). **Type**: At age 15yrs, 192/1921 (10.0%) children had suffered a burn or scald, 24/1922 (1.2%) had been a pedestrian injured in a motor vehicle accident and 182/1924 (9.5%) had been injured in a personal attack. 611/1924 (31.8%) had been injured whilst participating in sport. **Mechanism, severity, part of body, location** and **consequences**: not reported.	**Child variables**: male sex. **Family variables**: Socioeconomic status: Author testing theory that the trend for increasing injury incidence in decreasing SES groups is attenuated during adolescence. At 15 years, no significant trend in boys or girls for burns or RTAs, but statistically significant trend exists for attacked injuries in boys (p=0.000), and any accident (p=0.004), and reverse gradient for sports injuries in girls (p=0.001). Author concludes that evidence of equalisation is found in pedestrian RTAs (both sexes), and burns/scalds and sports injuries (females). In contrast, a marked SES gradient exists for violence related injuries in 15 yr old males. **Environment variables**: none reported	The measures used for accidents varied at the three time points reported. Both occupational and non-occupational SES measures provided similar results [A]

National Longitudinal Survey of Children & Youth, 1994	Soubhi, 2004a	T1 (4-11yrs): 9796/15468 (63.3%)	Number, type, and cause of injuries occurring in previous 12 months requiring medical attention. Body part injured. Relationship of number of injuries to child, family and neighbourhood factors [P]	**Frequency**: 632/5357 (11.8%) children sustained injuries between the ages of 4 and 11 during 12 months of follow up. **Type, mechanisms, severity, part of body, location and consequences**: not reported	**Child variables**: Girls had fewer injuries than boys even after controlling for family SES, # persons in household, restriction of activity by main caregiver, depression, and past injuries (adj OR = 0.64, 95% CI=0.54-0.74, p<0.001). **Family variables**: below average consistency of parenting significantly associated with increased risk of injury (adj OR = 1.43 (95% CI=1.22-1.68, p<0.001). **Environmental variables**: None of the variables considered (neighbourhood cohesion / problems / disadvantage, % families on low income) were associated with a risk of injury greater than chance.	Author states that data was collected on nature and type of injury, body part injured etc, but no results in this publication. States that small numbers of injured children did not allow breakdown of cases into specific injury causes and outcomes, yet 632/5387 (11.8%) children were injured, so not small numbers. Author reports that OR of injury if living in enumeration area with high proportion of low income is significant, yet 95%CI includes 1.00 and therefore finding could be due to chance [B]
	Soubhi, 2004b	T1 (4-11yrs): 9796/15468 (63.3%)	Number of injuries in previous 12 months requiring medical attention. Relationship of number of injuries to child, family and neighbourhood factors [P]	**Frequency, type, mechanisms, severity, part of body, location and consequences**: not reported	**Child variables**: For children 4-11yrs being a girl was associated with lower odds of injury (OR=0.64, 95%CI 0.54 to 0.74). **Family variables**: inconsistent parenting was linked to sizeable and significant risk of injury (OR=1.43, 95%CI 1.22 to 1.68). **Environmental variables**: none reported.	The injury results appear to be a duplication of those reported in Soubhi 04a [B]
Add Health Study, 1994. Also known as National Longitudinal Study of Adolescent Health	Hammig, 2001	T1 (11-18yrs): 1314/1314 (100%)	Being injured in a fight in the previous 12 months [C] Injuring someone else in a fight in the previous 12 months [C]	**Frequency**: 242/1314 (18.4%) boys reported injuring themselves in a fight during the previous 12 months, and 618/1314 (47.0%) boys reported they had injured someone else during a fight in the previous 12 months. **Type, severity, part of body, location and consequences:** not reported.	**Child variables**: Multivariate regression showed that variables independently associated with injuring self included group fighting 3+ times (OR=1.97; 95% CI=1.1-3.5), and fighting with a stranger (2.01; 1.3-3.1). Variables independently associated with injuring others included group fighting 1-2 times (2.51; 1.8-3.5) and 3+ times (5.67; 3.2-10.0), fighting with a stranger (1.69; 1.2-2.4) and using a weapon (2.24; 1.4-3.7) **Family and environmental variables**: none reported	Author only followed up the 1314 children who had been in fights, therefore cannot generalise to the other 1833 children in this cohort who were not in fights. [B]

Cohort from Kamphaeng Phet Province Vaccination Study, 1991	Kozik, 1999	T1 (nk): 6378/7875 (81.0%)	Cause of injury deaths, type and mechanism of nonfatal injuries [C,P,R]	**Frequency**: 4184/6378 (66%) children sustained 7544 injuries over 1 year. 2288/3231 (71%) boys had 4346 injuries and 1896/3147 (60%) girls had 3198 injuries. 2080/6378 (33%) children had more than one injury (1224/3231 (38%) boys and 856/3147 (27%) girls). **Type**: Of 7144 injuries detailed; cuts/wounds (including bites) 2977/7144 children (41.6%), burns/scalds 1273/7144 (17.8%), near drowning 871/7144 (12.2%) and ingestions 1287144 (1.8%). **Mechanism**: bites/stings (21.4%), sharp objects (20.3%), thermal/caustic (17.8%), water / near drowning (12.2%), falls (11.7%), motor vehicle occupant (6.1%), blunt objects (5.0%), motor vehicle pedestrian (3.8%), ingestions (1.8%), and landslides (0.2%). 46% of pedestrian injuries occurred as child walked beside road, 46% while crossing road, 7% while at school and 2% while in the rice fields. Of pedestrian injuries, 77% hit by motorcycles. **Severity**: only reported as deaths. 20/6378 children died of injuries during the 1 year follow up (0.05%). **Part of body, location and consequences**: not reported.	**Child variables**: Boys experienced significantly more injuries than girls in all age groups and all categories, except for landslides, poison ingestion and burns. Risk of a motor vehicle injury of any kind was 1.4 times greater for boys than girls of any age (RR=1.4, 95% CI = 1.2-1.6). **Family and environment variables**: none reported.	Few studies have such large cohorts, especially from lower income countries. The study was reportedly on primary school children but states the age range was from 2-16. Study retained as specified to be a study of children in school, and proportion of children under 4 likely to be small. Having very young children do self-report of injuries over one year could be problematic. Different mechanisms of injury (e.g. landslides, animal bites, MVI) reflects different exposures. Given self-report tends to result in underreporting, the high injury and death rates show just how dangerous this kind of environment can be and the potential for injury prevention [B]
Adolescent Injury Control Study, 1990	Anderson, 1994	T1 (14-18yrs): 1245/1400 (89.0%)	Time to first injury [C, S, O]	**Frequency**: 498e/1245 (~40%) children between the ages of 12 and 16 sustained injuries during 24 months of follow up. **Mechanism**: 55% of injuries were sport related **Location**: The proportion of home and school injuries was 'similar' **Type, severity, part of body and consequences**: not reported.	**Child variables**: None reported. **Family variables / Environmental variables**: Using % of families below poverty level in township of residence (high, middle or low) as indicator of SES, no statistically significant difference was seen in time to first injury, home versus school injures, or for sport related versus non sport related injuries (data not reported). SES does not seem to be a risk factor for injury in this cohort. Author states similar findings using number of adults living in the home and parental education as alternative indicators of SES, but data not reported.	Three different measures of SES were used and authors did not find differences in injury risk for any of them. Presumably, the results are reliable and appropriate. Different methods of measuring SES may account for why this finding is not replicated in other studies. Authors used time to first injury to get over the problem that some children will have only one injury whilst others may have many, but this variation leads to difficulty interpreting confidence intervals [A]

Cohort from Eastern Shore, Maryland, 1986	Alexander, 1992	T1 (13-15yrs): 612/878 (69.7%). T2 (14-16yrs): 632/878 (72.0%)	Self reported medically attended injuries. Risk ratios for injury by sex, race, parental education, risk taking behaviour, sports participation, parental supervision and employment [C,P]	**Frequency**: 288/612 (47.0%) children sustained injuries at 1 year follow up (Grade 9) and 212/632 (33.5%) children sustained injuries at 2 yr follow up (10th Grade). **Type, mechanism, severity, part of body, location and consequences**: not reported.	**Child variables**: Behavioural predictors of injury in multivariate logistic regression models, after adjustments for sex, race and parents education: 9th Grade = Male sex (OR=1.96, CI=1.26 to 3.04), Lifetime marijuana use 1-5 times (OR= 2.03, CI=1.11 to 3.71), employment >11 hr/wk (OR=2.37, CI=1.26 to 4.45). 10th Grade: alcohol use in last 1-2 days (OR=1.69, CI=1.05 to 2.71), playing in 1-3 different school sports teams (OR=1.66, CI=1.11 to 2.57). In high school students increased risk of injury with sex and race may be mediated by risk behaviour. **Family and environmental variables**: none reported.	Large numbers of non-respondents to initial invite to participate. Authors only report that non-recruited students did not differ significantly in race and sex from enrolled students. Self report of injury may result in recall bias. Inconsistency of data numbers between tables 2 and 3 not explained [B]
Carolina Longitudinal Study, 1981	Cobb, 1995	T1 (14-18yrs): 271/695 (39.0%)	Occurrence of injury / close call in the previous year, mechanism of injury, severity of injury, degree to which subjects expressed that they tested the limits of or were careless in their behaviour during the injury/close call event [C].	**Frequency**: 131/695 (18.8%) children aged 9 to 13 years sustained injuries during follow up to 14 to 18 years. **Mechanism**: Of 129 injuries reported, motor vehicle accidents 46/129 (35.7%), sports injuries 31/129 (24.0%) and blunt objects 8/124 (6.5%), with minor occurrence of firearm injuries 2/129 (1.6%), and 1 ingestion 1/129 (0.8%). 'Other injuries accounted for 34/129 (26.4%). **Severity**: 9/129 (7.0%) of injuries were reported as very minor (e.g. scratch, bruise), 77/129 (59.7%) were minor (e.g. sprained ankle), 34/129 (26.4%) were major (e.g. fracture), 3/129 (2.3%) were serious (e.g. head injury) and 6/129 (4.7%) were fatal (3 MVI, 2 firearm incidents and 1 overdose). **Location**: Injuries occurred in the Road 46/129 (35.7%), and at leisure (sports) 31/129 (24.0%) and at work 7/129 (5.4%). **Type, part of body and consequences**: not reported.	**Child variables**: males (55%) more likely to be injured than females (42%) ($\chi2$ (1) = 4.97, p<.05). Adolescents with childhood aggressive behaviour more likely to be injured than non-aggressive peers (67% vs 45%; $\chi2$ (1) = 7.26, p<.01), or have close calls (68% vs 49%; $\chi2$ (1) = 4.16, p<.05). Males showed more risk taking behaviour and were more likely to be injured as a result than females ($\chi2$ (1) = 4.35, p<.05), and more likely to have close calls than females ($\chi2$ (1) = 4.29, p<.05). Positive relationship between injury and close calls ($\chi2$ (1) = 5.35, p<.05). **Family and environmental variables**: none reported.	Interesting that in a relatively small cohort of 271 adolescents there were 6 injury related deaths over one year and this finding was not commented on in the discussion. Unclear whether these deaths were included in the results data (assumed not). Author has used 271 as denominator for injury analysis (i.e. injuries in those who reported an injury or close call), for this study use 695 (injuries in whole cohort) . SES was not found to be significantly associated with injury, but method of measuring SES not reported, therefore finding difficult to interpret. [B]

Christchurch Child Development Study, 1977	Horwood, 1989	T1 (6yrs): 1115/1265 (88.1%). T2 (7yrs): 1107/1265 (87.5%). T3 (8yrs): 1092/1265 (86.3%). T4 (9yrs): 1079/1265 (85.3%). T5 (10yrs): 1067/1265 (84.3%).	General practitioner attendance for accidents, hospital admission or hospital outpatient attendance for accidents [P,G,R]	**Frequency / type / severity**: For 1265 5-10 yr old children: 8% of all GP visits, 32.2% of hospital outpatient visits & 12.1% of hospital admissions were due to injuries. Rate of GP consultations for injury increased from 15.5/100 children at 5-6yrs to 24.8/100 at 9-10yrs. Rates of accidents needing outpatient care varied, with max rate of 188.6/1000 children at 7-8 yrs. Rates of hospital outpatient visits fell over the same period. Outpatient visits for fractures appeared near constant (83.4/1000 at 5-6yrs and 81.5/1000 at 9-10yrs). 16.6% of all outpatient visits were for fractures. Visits for burns/scalds rose from 6.3/1000 at 5-6yrs to 10.1/1000 at 7-8yrs and fell to 3.7/1000 by 9-10 years, accounting for 1.2% of all visits. Accidental poisoning (0.8% of hospital outpatients appointments) was commonest at 5-6yrs (14.3/1000), & did not occur by 8-9 yrs. Rates of admissions for injuries reached a maximum of 14.6/1000 children at 7-8yrs. Fracture admissions rose from age 5-6yrs (1.8/1000) to 7-8yrs (6.4/1000) and were 5.6/1000 at 9-10yrs. Burns and scalds and poisoning were rare causes of admission after 5-6yrs. **Mechanism, part of body and consequences**: not reported	**Child, family and environmental variables**: none reported.	No CI or p-values reported so hard to tell if results are greater than could have arisen by chance. Author includes children less than 5 years in discussion when they were not included in this study. No analysis of results by mechanism of injury reported therefore discussion of priorities for injury prevention do not follow from the results of the study[B]
	Fergusson, 1995	T1 (15-16yrs): 954/1265 (75.4%)	Unintentional injuries in period 14-16 years, injuries requiring medical treatment or hospital treatment. Intentional injuries - suicide attempt and ideation. [C,P,R]	**Frequency / severity**: Authors compared the mean number of unintentional injuries, the mean number of unintentional injuries requiring medical attention and the mean number of injuries requiring hospital treatment for those identified as having conduct / oppositional defiant disorder at 15/16yrs, being recurrent (10+) offenders, or being classified as a multiple problem teenager, or not being identified with these three antisocial behaviours. Mean numbers of injuries were greater for all three injury categories in the antisocial disorder groups than those without the antisocial disorders, but only reached statistical significance for mean number of unintentional injuries in children with conduct/oppositional defiant disorder (n=153, mean injuries=3.1) and those without (n=801, mean injuries=2.3), $p<0.001$. **Type, mechanism, part of body, location and consequences**: not reported.	**Child variables**: no statistically significant associations were identified between injury and antisocial behaviour as assessed by parent and self report of (i) conduct disorder / oppositional defiant disorder (ii) recurrent (10+) offending over 2 years or (iii) being classified as a multiple problem teenager (i.e. early onset sexual activity, cannabis use, alcohol abuse, conduct / oppositional disorder and official police contact). Author suggested reasons for results: association varies throughout childhood, and not demonstrated between 14 & 16yrs of age, many injuries may have been the result of sporting participation and not antisocial behaviour, or methodological shortcomings in the measurement of behaviour or injury. **Family and environment variables**: none reported.	Very specific question addressed in this paper. Multiple sources of information has been collected at regular intervals from young people and parents - minimises errors in data collection and makes conclusions more robust [B]

	McKinley, 2002	T1 (13yrs): 939/1265 (74.2%)	Mild head injury (Loss of consciousness <20 mins, hospitalisation <2days, no skull fracture) experienced at age 6-10 years. [P,R]	**Frequency / type / part of body**: 53/1265 (4.2%) children between the ages of 6 and 10 sustained mild head injuries. 16/53 (30%) were girls and 37/53 (70%) were boys. **Mechanism, location and consequences**: not reported. .	**Child, family and environmental variables**: none reported.	Study looked at cognitive and behavioural consequences of mild head injury, not variables predictive or protective of injury. Rigorous definition of mild head injury. [B]
Cohort from Seattle, 1975	Padilla, 1976	T1 (~12-13yrs): 138/150 (92.0%). T2 (+5 months) 103/150 (68.7%)	Accidents resulting in (1) no injury, (2) injury not requiring first aid (3) injury requiring first aid (4) injury requiring medical attention (5) injury requiring hospitalisation (6) fatal injury. [C]	Injuries reported for sub-sample of recruited cohort (n=56). No data on whole cohort **Frequency, type, mechanism, severity, part of body, location and consequences**: not reported.	**Child variables**: risk taking behaviour and readjustment following stressful life events. **Family and environment variables**: none reported	Only selected descriptive and analytical results reported for the 56 students who were high or low on the life events scale. This may account for the lack of findings on the ANOVA of risk taking behaviour. Author failed to acknowledge or explain a statistically significant difference in the high life event scorers who had no injuries and the low life event who had no injury (p<0.005) Assessment of risk taking behaviour measured in subjective fashion (direct observation) - though did use trained observers and interrater agreement was required. [C]

Dunedin Multidisciplinary Child Development Study, 1975	Langley, 1981	T1 (6-7yrs): 1072/1160* (92.4%). *1037+123 subsequently traced	Frequency, type and mechanism of injury [P]	**Frequency**: 232/1072 (22%) children sustained 273 injuries between the ages of 6 and 7yrs. 37/1072 (3.5%) children had 2 or more accidents during the two year period. **Type**: Of 273 injuries 120 were cuts/wounds (44%), 45 (16%) fractures, 26 (10%) 'superficial' injuries, 24 (9%) contusions, 14 (5%) intracranial injury/concussion, 11 (4%) crush injuries, 8 (3%) sprains, 8 (3%) burns/scalds, 5 (2%) foreign bodies, 6 (2%) multiple injuries, and 6 (2%) other injuries. **Mechanism**: of 273 injuries, 121 (44%) were due to falls, 49 (18%) sharp objects, 27 (10%) blunt objects (e.g. being struck), 25 (9%) crush injuries, 12 (4%) motor vehicle accidents, 11 (4%) cycle / pedestrian road accidents, 6 (2%) thermal injuries, 4 (1.5%) falling objects, 6 (2%) suffocation, submersion or foreign bodies, 5 (2%) environment factors, 2 (0.7%) poisoning, 2 (0.7%) over exertion injuries. **Severity**: 25/273 (9%) children were hospitalised, 11 for one day, 5 for 2-69 days, 4 for >70 days, 5 duration not known. **Location**: Injuries occurred at Home (52%), School (19%), on the Road (11%), and at Play (8%). **Consequences**: scars (40/273, 15%), emotional difficulties (24/273, 9%), physical disability or disfigurement at one month (68/273, 25%). **Part of body**: not reported	**Child, family and environmental variables**: none reported.	Risk of recall bias with recall of injuries over two years, and reporting bias with self-reported injuries. Conclusions are largely the views of the authors rather than arising from the data [B]

	Langley, 1985	T1 (8-9yrs): 818/1037 (78.9%)	Type of injury, mechanism and severity of injury [P,R]	**Frequency**: 211/818 (25.8%) children sustained 283 injuries in 256 injury events between 8-9 yrs. 25/818 (3.1%) injured on 2 occasions, and 10 (1.2%) injured on 3 occasions. **Type**: Of 283 injuries 91 were cuts/wounds (32%), 50 (18%) fractures, 3 (1%) dislocations, 53 (19%) contusions, 18 (6%) intracranial injury/concussion, 9 (3%) crush injuries, 17 (6%) sprains, 10 (4%) burns/scalds, 9 (3%) foreign bodies/substances, 10 (4%) dental injuries, and 13 (4.6%) other injuries. **Mechanism**: of 256 injury events, 114 (44.5%) were due to falls, 25 (10.0%) sharp objects, 65 (25.4%) blunt objects (e.g. being struck), 16 (6.3%) crushing, 35 (13.7%) cycling / skateboarding. **Severity**: AIS score = 1 (minor) 183/283 (65%) injuries, AIS2 (moderate) = 69/283 (24%) injuries, AIS3 (severe) = 15/283 (5%) injuries. AIS not known - 16/283 (6%) injuries. 20/818 (2%) children hospitalised, 198/818 (24%) attended a specialist clinic. **Location**: Home (104/256, 41%, of which 59 were outside), School (56/256, 22%, of which 42 were in playground), on the Road (17%), and at Play (a place for recreation or sport) (10%). **Part of body and consequences**: not reported.	**Child, family and environmental variables**: none reported.	Consistency checks suggest that response errors were low in this sample, but still likely to underestimate injuries due to recall bias. Severity coding may underestimate severity of injury if incomplete information is available [B]

	Langley, 1987a	T1 (10-11yrs): 925/1037 (89.2%)	Type, severity and circumstances of injuries sustained in previous 2 years [P,R]	**Frequency**: 307/803 (38.2%) children has 413 injuries between 10-11 yrs. 83/803 (10.3%) had 2 or more injuries. **Type**: Of 413 injuries 113 were cuts/wounds (27%), 84 (20%) fractures, 4 (1%) dislocations, 75 (18%) contusions, 17 (4%) intracranial injury/concussion, 3 (1%) crushings, 73 (18%) sprains, 5 (1%) burns/scalds, 4 (1%) foreign bodies/substances, 12 (3%) dental injuries, and 15 (3.6%) other injuries. **Mechanism**: of 413 events: 222 (53.8%) were falls, 69 (16.7%) blunt objects (e.g. being struck), 37 (9.0%) motor vehicle RTA (includes one death), 54 (13.1%) cycling injuries. **Severity**: AIS score = 1 (minor) 298/413 (72%) injuries, AIS2 (moderate) = 77/413 (19%) injuries, AIS3 (severe) = 14/413 (3%) injuries. AIS not known - 24/413 (6%) injuries. 17/803 (2%) children hospitalised, 301/803 (37.5%) attended A&E, 53/803 (6.6%) saw their GP. **Location**: Home (114/413, 28%), School (116/413, 28%, of which 81 (70%) were in the playground or during sport), on the Road (66/413, 16%), and at Leisure (a place for recreation or sport, other than school) (78/413, 19%). **Part of body and consequences**: not reported.	**Child, family and environmental variables**: none reported.	Uses Abbreviated Injury Scoring system to classify severity of injury. Author suggests need to focus on A& E surveillance systems but does not acknowledge the proportion of injuries that do not present to hospital, or issues such as access affecting likelihood of attending A&E [B]

	Langley, 1987b	T1 (7yrs): 954/1037 (92.0%). T2 (9yrs): 818/1037 (78.9%). T3 (11yrs): 781/1037 (75.3%)	Relationship between injury and a variety of personal and family variables. [C,P,G,R]	**Frequency**: 371/781 (47.5%) children sustained 602 injuries between the ages of 7 and 11 years. **Type, mechanism, severity, part of body, location and consequences**: not reported.	**Child variables**: male sex (cf girls, chi2 = 9.99, df=3, p=0.019) although sex only explained 10% variance, combined personal adversity measure (behaviour ratings, IQ, long jump & bead stringing) (chi2=38.62, df=21, p=0.011) - although the variables that went into it were not individually significant, and it only accounted for 2% of the variance in injury score. There were no significant associations between injury and parent or teacher rated behaviour problems, intelligence, reading ability, language skills or motor ability. **Family variables**: There were no significant associations between injury and changes of residence, family size, changes to parent figure, socioeconomic status (father's occupation), maternal mental health, family relationships, or family adversity index. **Environmental variables**: none reported	Author reports that none of the variables were significantly associated with injury, and concludes that psychosocial factors are unhelpful in predicting childhood injury. This seems counter-intuitive and does not support findings in other literature. The sample used was found to be largely similar to that not included, except on two variables but these are not specified, so unclear if they could account for the results. The methodology used appears rigorous [A]

	Chalmers, 1989	T1 (12-13yrs): 738/1037 (71.2%)	Type, severity, circumstances and treatment of injuries sustained in previous 2 years [C,R]	**Frequency**: 377/738 (51.1%) children sustained 636 injuries during 550 injury events between 12-13 yrs (rate= 74.5 incidents per 100 children per 2 years). 128/738 (17.3%) had more than one injury event, and 68 incidents resulted in 86 secondary (or more) injuries. **Type**: Of 550 primary injuries; 117 were cuts/wounds (21%), 109 (20%) fractures, 13 (2%) dislocations, 69 (12.5%) contusions/haematomas, 35 (6%) intracranial injury/concussion, 146 (26%) sprains, 9 (2%) burns/scalds, 9 (2%) bites / stings, 31 (6%) dental injuries, and 12 (2%) other injuries. **Mechanism**: 203 (53.8%) due to falls, 239 (43.57%) blunt objects (i.e. striking against an object or person), 139 (25.3%) blunt objects (i.e. being struck by an object or person), 18 (3.3%) motor vehicle RTA, 6 (1.1%) cycle or pedestrian RTA. **Severity**: AIS score = 1 (minor) 405/550 (74%) injuries, AIS2 (moderate) = 128/550 (23%) injuries, AIS3 (severe) = 7/550 (1%) injuries. AIS not known - 10/550 (2%) injuries. 20/550 (3.6%) children were hospitalised, 336e/550 (61%) children attended A&E, 149e/550 (27%) children initially saw their GP. **Location**: Home (22%, of which, 63% occurred 'outside'), School (29%, of which 67% were in the playground or during sport), Road (14%), and at Leisure (a place for recreation or sport, other than school) (24%) **Consequences**: 388/550 (70%) of injuries resulted in a disability from the day following the injury. 30% disabilities were recreational (e.g. not able to take part in sport) and 23% locomotor (e.g. not able to run or walk). 40% lasted < 1 week, 21% lasted 1-2 weeks, 19% lasted 2-4 weeks, 20% lasted >4 weeks (8 thought permanent) **Part of body**: not reported	**Child variables**: male sex (injury rate = 85.0 per 100 per 2 years, 95% CI = 81.4-88.6) significantly greater than for females (63.1 per 100 per 2 years, 95% CI = 58.0-68.0) (z=6.896, p<0.001) **Family and environmental variables**: none reported	Descriptive study only. Author emphasises the need to change adolescent's attitude to injury on basis of reported importance of chance or bad luck. First attempt within study to address issues of intent and long-term disability [B]

	Lodge, 1990	T1 (14-15yrs): 849/1037 (81.9%)	Type, circumstances, severity, intent, treatment, consequences of injuries sustained during previous 2 years [C,R]	**Frequency**: 429/849 (50.5%) children had 705 injuries in 657 events between 14-15yrs. 161/849 (19.0%) had 2+ events. **Type**: Of 657 primary injuries; 96 were wounds (14.6%), 180 (27.4%) fractures, 74 (11.3%) bruising, 30 (4.6%) head injuries, 200 (30.4%) sprains, 4 (0.6%) crushes, 13 (2%) burns/scalds, 6 ingestions (0.9%), 9 (1.4%) bites/stings, 25 (3.8%) dental 20 (3%) 'other' **Mechanisms** (>1 can apply), 254 (38.7%) falls, 284 (43.%) striking against object/person, 181 (28%) being struck by object / person, 48 (7.3%) cycling, 13 (2%) thermal, 112 (17%) over exertion. **Severity**: AIS score = 1 (minor) 548/657 (83%), AIS2 (moderate) = 97/657 (15%), AIS3 (severe) = 12/657 (2%). 35/657 (5.3%) were hospitalised, 401/657 (61%) A&E, 23/657 (3.5%) GP+A&E, & 191/657 (29%) GP only. **Location**: Home (18%, of which 54% 'outside'), School (28%, of which 46% playground/sport), Road (12%), and Leisure (31%). **Consequences**: Disability from the day after injury in 77%, mostly recreational (20%) or locomotor (31%). 35% of disabilities lasted <1 wk,18% 1-2 wks and 13% 2-4 wks, 12% >4wks (10 thought permanent) **Part of body**: not reported	**Child variables**: male sex **Family and environmental variables**: none reported	Descriptive paper. Risk of recall bias with 2 year period of recall. Lack of confidence in severity rating - Proportion of minor (AIS1) injuries may be overestimated since injuries were assumed to be minor if no detail provided (though minor injuries are more likely to be unreported with a 2 year recall period). Usefulness of disability rating unclear since those students interviewed close to their 15th birthdays may only have had a short period to report continuing disability [B]
	Begg, 1990	T1 (14-15yrs): 848/1037 (81.8%)	Type and treatment of any injuries sustained during previous 2 years [C,R]	**Frequency / location**: 58/848 (6.8%) children sustained injuries during road crashes between the ages of 14 and 15. **Mechanism**: 14/58 (24.1%) injuries were due to motor vehicle RTAs (4 motorcycle, 10 motor vehicle). 44/58 (75.9%) injuries were non-motor vehicle (5 pedestrian and 39 bicycle). **Severity**: 5 adolescents were hospitalised, 32 sought A&E treatment, 18 were treated by GP and 3 by 'other' **Type, part of body and consequences**: not reported.	**Child, family and environmental variables**: none reported.	Descriptive paper. Risk of recall bias with 2 year period of recall [B]

	Begg, 1991	T1 (14-15yrs): 848/1037 (81.8%)	Type, circumstances, and severity of 'bicycle road crash' injuries sustained during previous 2 years and for which medical attention was sought. Cycling experience and safety equipment used [C,R]	**Frequency**: 39/848 (4.6%) children sustained bicycle related injuries between the ages of 14 and 15 (rate = 4.7 per 100 adolescents per 2 years). **Mechanism**: 7/39 struck by vehicle, 8/39 struck another bicycle, 10/39 struck stationary objects (e.g. kerb) and 15/39 lost control & struck no object. **Severity**: Injury Severity Score (ISS) 1 or 2 = 34/39 (87.2%), ISS3 = 1 (2.6%), ISS4 = 1 (2.6%), ISS5 = 3 (7.7%). 3/39 (7.7%) injuries were admitted to hospital, 36/39 (92.3%) were not. **Part of body**: limb injuries 30/39 (76.9%), head/face injuries (0.9%) **Type and consequences**: not reported.	**Child, family and environmental variables**: none reported.	Descriptive paper. Risk of recall bias with 2 year period of recall. The high % of injuries occurring in daylight, on dry, tar sealed, speed restricted roads merely reflects exposure (children are more likely to cycle if daylight and on good, dry, slow roads. One suicide (CO poisoning) and one death due to RTA occurred just before study, and did not appear in results[B]
	Begg, 1992	T1 (14-15yrs): 848/1037 (81.8%)	Type, circumstances, and severity of motor vehicle crash injuries sustained during previous 2 years and for which medical attention was sought. Safety equipment used [C,R]	**Frequency / location**: 13/848 (1.5%) children sustained motor vehicle injuries between the ages of 14 and 15 (9/13 were car crashes, and 4/13 were motor cycle crashes) **Severity**: For car crash injuries 5/9 had an AIS (minor) =1, Injury severity Score (ISS)2 = 2/9, ISS5 = 1/9 and ISS9 = 1/9. 2 adolescents were admitted to hospital as a result of their injuries and 7 were not. For motor cycle injuries all 4 had an AIS=1. One cohort member died in an RTA shortly before the data collection period. **Type, mechanism, part of body and consequences**: not reported	**Child, family and environmental variables**: none reported.	Descriptive paper. Risk of recall bias with 2 year period of recall. Reporting of severity of injury and part of body injured unclear[B]

	Jones, 2002	T1 (5yrs): 984/1037 (94.9%). T2 (7yrs): 871/1037 (84.0%). T3 (9yrs): 815/1037 (78.6%). T4 (11yrs): 897/1037 (86.5%). T5 (13yrs): 739/1037 (71.3%). T6 (15yrs): 848/1037 (81.8%). T7 (18yrs): 876/1037 (84.5%).	Number of fractures at specific sites at each phase of study. Fracture rate / 1000 person-yrs, for each period studied and for 5-18yrs. % fracture free at 18 yrs. Proportion sustaining >1 fracture. Odds ratios of fracture by SES. [P,C,R]	**Frequency / type**: 525/1037(50.6%) children sustained a fracture between the ages of 5 and 18yrs. At age 5-6yrs 41/871 (4.7%) children sustained a fracture, at 7-8yrs 38/815 (4.7%), at 9-10yrs 77/897 (8.6%), at 11-12yrs 103/739 (13.9%), at 13-14yrs 142/848 (16.7%) and at 15-17yrs 124/876 (14.2%). At all ages more boys than girls had fractures. Peak times for fractures for girls between ages of 11-13yrs when 12.9% fractured and for boys between ages 13-15 years, when 21.6% fractured. **Part of body**: Most common type of fractures at these times were toe/foot, finger/hand and wrist/forearm for girls and finger/hand + wrist forearm for boys. **Mechanism, severity, location, and consequences**: not reported.	**Child variables**: boys had more fractures than girls at all ages. **Family variables**: Participants with lower SES slightly higher fracture rates from those with higher SES, but not greater than could have arisen by chance **Environmental variables**: none reported	Complete fracture records collected for large representative sample seen regularly are rare. Author reports odds ratio of fracture differed by SES, but reported confidence interval included 1.0, so finding not greater than could have occurred by chance. Author states a follow up rate of 61% but this is the % retained of those seen at age 5, not of those enrolled at age 3[B]
	Jones, 2004	T1 (5yrs): 853/1037 (82.3%). T2 (7yrs): 821/1037 (79.2%). T3 (9yrs): 771/1037 (74.3%). T4 (11yrs): 675/1037 (65.1%). T5 (13yrs): 707/1037 (68.2%). T6 (15yrs): 809/1037 (78.0%). T7 (18yrs): 833/1037 (80.3%).	Total fractures at any site 0-18yrs, wrist or forearm fractures 0-18yrs, Prepubertal (<9in girls, <11 in boys) vs adolescent fractures [P,C,R]	**Frequency / type**: 279 boys had fractures 11-18 yrs, 187 girls had fractures between 9-18 yrs. **Mechanism, severity, part of body, location, and consequences**: not reported.	**Child variables**: Risk of all fractures elevated in relation to a standard deviation unit increase in mean weight from age 5-18 yrs (RR=1.15, 95% CI 1.03-1.28), or mean height from age 5-18 yrs (RR=1.13, 95% CI 1.02-1.24). Risk of pre-pubertal fractures but not adolescent fractures elevated in relation to a standard deviation unit increase in mean birth length (RR=1.28, 95% CI 1.04-1.58) and mean BMI from ages 5-18 yrs (RR=1.24, 95% CI 1.02-1.52). For teenagers personal daily smoking increased risk (RR=1.43, 95% CI 1.05-1.95). Birth weight, participant occasional smoking, breastfeeding and sports participation had no significant effect on fracture risk. **Family variables**: Maternal smoking had no significant effect on fracture risk **Environmental variables**: none reported	Unclear why preterm infants were stated to be ineligible as participants, but then reported in the results. Fractures were reported at regular intervals during growth, helping to reduce recall bias [B]

Cohort from South Wales, 1972	Davidson, 1987	T1 (5yrs): 953/1163 (81.9%). T2 (8yrs): 831/1163 (71.5%)	Any injury occurring between 5-8 years as indicated in the casualty department records of 3 local hospitals serving the cohort population. Relationship of any injury to maternal personality variables. [R]	**Frequency**: 272/831 (32.7%) children sustained any injury between the ages of 5 and 8yrs. 174/439 (39.6%) of boys and 98/392 (25.0%) of girls. **Type, mechanism, severity, part of body, location and consequences**: not reported.	**Child variables**: male sex, soiling problems, management problems, fears associated with injury. Reduced risk of injury if child not soiling (RR=0.67, 95%CI = 0.47-0.94) and child having few or no fears (RR=0.67, 95%CI = 0.47-0.94) **Family variables**: moderate or high maternal neuroticism (p=0.001) and number of children in the family. Having only one or two children in the family had reduced risk of injury (RR=0.58, 95%CI=0.38-.89) **Environmental variables**: none reported.	Method of obtaining injury data from 3 casualty departments serving the catchment area of cohort might miss injuries presenting outside the area. Only selective results reported. Author reports an r of 0.28 being a significant positive correlation with p<0.0001 [B]
	Davidson, 1988	T1 (5yrs): 951/1163 (81.8%). T2 (8yrs): 951/1163 (81.8%)	The number and type of injuries occurring between 5-8 years of age as indicated in the hospital records of 3 local hospitals serving the cohort population. Relationship of injuries to child behaviour variables. [R]	**Frequency**: 306/951 (32%) children sustained 416 injuries between the ages of 5 and 8yrs (rate= 15 injuries per 100 children per year). 37.2% boys (191/513) and 26.3% girls (115/438) had 1 or more injuries during the 3 years. 95/951 (10.0%) children had 2 or more injuries during the 3 years (12.5% boys (64/513) and 7.1% girls (31/438)). **Type**: lacerations (35.3%), head injuries (15.3%), fractures (14.1%), sprains (9.8%), bruising / abrasions (5.7%), foreign body (3.5%), burn/scald (1.0%), nerve/vascular/tendon injury (0.2%) **Mechanism, severity, part of body, location and consequences**: not reported.	**Child variables**: male sex (RR =1.52, 95% CI= 1.23-1.88, Attributable risk AR = 21.9%, CI=10.5-31.9), mild discipline problems (RR= 1.29, CI=1.04-1.60), severe discipline problems (RR severe injury = 1.4, CI=1.02-1.92) (discipline problems AR = 7.0% (CI=0.5-13.1)) , encopresis (NB only suffered by 3% children, mostly boys) (RR = 1.72, CI=1.15-2.58, AR=2.6%, CI=0.4-4.8), fearful children (RR an injury = 1.95, CI=1.35-2.83, RR severe injury =2.34, CI=1.34-4.09) (NB linear relationship between number of fears and risk of injury in girls, but only boys with marked fears showed increase in risk). **Family variables**: Difficult to discipline children with mothers with mid to high Neuroticism scores had increased RR of injury = 1.34, p<0.05. **Environmental variables**: none reported	Hospital attended injuries skews towards more serious injury. Unclear how well specific questions taken from questionnaire correlate with the conduct problems and hyperactivity being assessed. Many analyses conducted on very small numbers (<10) e.g. encopresis, threatening validity. Data in Tables 3 and 6 do not add to totals reported. Difficult to compare findings with other published studies as constructs measured so differently, but author compares with Bijur and Manhiemer studies [C for analysis, B for descriptive reporting of injuries]

Child Health & Education Study (CHES), 1970. Originally the 1970 British Birth Cohort Study (BCS70)	Bijur, 1988a	T1 (5yrs): 12372/16004* (77.3%). T2 (10yrs): 10394/16004 (64.9%). *alive at age 5	Injuries between ages of 5-10 yrs: age of child when accident happened, where it happened, circumstances of accident, description of injuries, place of treatment, and type of treatment. [P]	**Frequency**: 4376e/10394 (42.1%) children sustained injuries between the ages of 5 and 10 years (2623e/5354 (49.0%) boys and 1754e/5040 (34.8%) girls). **Severity**: 441e/10394 (4.3%) had 1 or more injury requiring hospitalisation (273e/5354 (5.1%) boys and 171e/5040 (3.4%) girls). 3939e/10394 (37.9%) children had 1 or more injury treated with ambulatory care (2350e/5354 (43.9%) boys and 1583e/5040 (31.4%) girls). **Type / severity**: 71% injuries were 'mild' (e.g. sprains, strains, contusions and lacerations), 15% were fractures, 10% head injuries, 3% burns / scalds, and <1% were 'serious' (e.g. amputations, spinal cord injury, near drowning or ingestions) **Mechanism, part of body, location and consequences**: not reported	**Child variables**: None reported. **Family variables**: Number of older children in family was marginally associated (p<0.005) with the proportion of children hospitalised for accidental injuries at age 5-10 years. Living in a household of 4 or more children increases risk of hospitalised accidents OR 1.91 (1.16 – 3.12) when adjusted for social factors 1.87 (CI 1.14 – 3.06), adjusted for maternal factors 1.90 (1.15 – 3.13), or Child factors 1.72 (1.04 – 2.83). **Environmental variables**: none reported	Appears robust. Well reported apart from unclear type of injury [A]
	Bijur, 1988b	T1 (5yrs): nk/16004* (nk). T2 (10yrs): 10394/16004 (64.9%). *alive at age 5	Injuries requiring medical advice or treatment between ages of 5-10 yrs: age of child when accident happened, where it happened, circumstances of accident, description of injuries, place of treatment, and type of treatment. [P]	**Frequency**: 4380/10394 (42.1%) children sustained any injury between the ages of 5 and 10yrs. 1344/10394 (12.9%) children had >1 accident or injury. **Type / severity**: Injury rates: non-skull fractures = 8.8 injuries / 100 children, burns /scalds = 1.7 injuries / 100 children, mild head injuries = 15 injuries / 100 children, severe head injuries = 5.6 injuries / 100 children, ingestions = 0.4 / 100 children, 'other mild trauma' = 25.8 / 100 children, and 'other severe trauma' = 0.4 / 100 children. **Mechanism, part of body, location and consequences**: not reported.	**Child variables**: Any injuries at <5yrs age (each additional injury associated with increase of 15.7% for injury >5yrs, risk much higher for 3+ injuries pre-school), male sex (boys had 22.4 more injuries per 100 children than girls aged 5-10), high aggression scores (a one standard deviation increase on aggression scale associated with 6.7 more injuries per 100 children (p<0.001)). All statistically significant risk factors. **Family variables**: Young mother (20-24 years, 6.5 injuries / 100 children more than if mother >24 years), fewer younger siblings (for each additional younger sibling, rate of injury decreases by 4.9 per 100 children (p<0.05)), many older siblings (for each additional older sibling, rate increases by 2 per 100 children (p<0.001)) **Environmental variables**: none reported	Appears that the vast majority of injuries will be sustained by children who cannot be identified as high risk. Could be considered that having more younger siblings should be a risk factor rather than a protective one (e.g. that more younger siblings distract parents from caring for you) [B]

	Bijur, 1988c	T1 (5yrs): 10394/16004* (64.9%). T2 (10yrs): 10245/16407** (64.9%). *alive at age 5, **added eligible sample	Accidents requiring medical advice or treatment between the ages of 5-10 years, including proportion with one or more, or three or more accident, those requiring hospitalisation, location, cause, and type of injury. [P]	**Frequency**: 4739/10245 children sustained any injury between the ages of 5 and 10yrs (46.3%). 398/10245 children sustained >3 injury event between 5 and 10 years (3.9%). **Severity**: 441/10245 children were hospitalised for injury between 5 and 10 years of age. **Type, mechanism, part of body, location and consequences**: not reported.	**Child variables**: none reported. **Family variables**: living in a household of 4 or more children increases risk of hospitalised accidents (OR=1.91, 95%CI: 1.16 to 3.12) when adjusted for social factors (OR=1.87, 95%CI: 1.14 to 3.06), adjusted for maternal factors (OR=1.90, 95%CI: 1.15 to 3.13), and Child factors (OR=1.72, 95%CI: 1.04 to 2.83). OR for injury for children with 1-3 sibs = Not specified. Number of older children in family was associated with the proportion of children hospitalised for injuries at age 5-10 years (p<0.005). **Environmental variables**: none reported	Unclear derivation of some data. Authors conclusion does not appear to be supported by data reported e.g. author states that findings support premise that more injuries occur in disadvantaged families, but not convinced of this. Author states that a fall in the OR from 1.91 (unadjusted) to 1.87 (after adjustment for social factors) is a 22% reduction (?). Decision to hospitalise a child may be affected by social conditions of household as well as severity of the injury. Long recall period of 5 years for injuries may result in underreporting of injuries [B]
	Bijur, 1990	T1 (5yrs): NS/13000 (nk%). T2 (10yrs): 3182/NS (nk%)	Accidents (head injuries, limb fractures, burns, limb lacerations) between ages of 5 and 10 years who received ambulatory treatment or hospitalisation of one night or less. [P]	**Frequency / type / part of body**: 114 children sustained mild head injuries between 5-10 years, 601 sustained limb fractures, 136 sustained burns, and 605 sustained lacerations to the limbs. 6014 children sustained no injuries between 5-10 years. **Mechanism, severity, location and consequences**: not reported	**Child, family and environmental variables**: none reported. Post injury characteristics of children with head injuries compared to those with other injuries or no injuries.	Recall period of 5 years risks under reporting of injuries. Appropriate design and conduct of study to determine consequences of injury. Little detail given of primary study. Not clear what denominators were for surveys at ages 5 and 10 from this publication, and how many children could be classified with 'other injuries' between ages of 5-10 years .

	Beattie, 1999	T1 (10-16yrs): 958/1416* (68.0%). *traced as resident in Scotland	Accidents between ages 10-16 years: age, circumstances of accident, type of injuries, treatment required. [C,P]	**Frequency**: 408/958 (42.6%) children sustained 589 injuries during 576 injury events between the ages of 10 and 16 years. 52% boys and 33% girls sustained at least one injury. **Type**: 154/580 (26.6%) of injuries were fractures. **Mechanism**: Falls 34% (196/576), Collisions 23% (132/576), Cycle/pedestrian road accidents 9% (52/576), motor vehicle road accidents 5% (30/576), assaults 3% (15/576) and 'other' 26% (151/576). 11% of all injuries were due to sport (67/589). **Part of body**: Upper limb/hand 36.4% (211/579), Lower limb/foot 28.7% (166/579), head/face 23.0% (133/579), neck/spine 2.8% (16/579), trunk/body 1.2% (7/579), unspecified 7.9% (46/579). **Severity**: AIS Minor = 70.3% (407/579), moderate = 29.7% (172/579), severe = 0%. **Location and consequences**: not reported.	**Child variables**: male sex. **Family variables**: Injury rates did not differ by social class **Environmental variables**: Injury rates did not differ by health board region	Text states that there were a 'few fatal cases' but does not provide details. 6 yr recall period risks bias through underreporting of injuries. Large health board regions could mask areas of inequality in injury. No apparent difference in social class - author states due to equalisation of injury risk between childhood and adolescence, but could it be a consequence of underreporting of injury events due to long recall period? [B]
Cambridge Study of Delinquent Development, 1961	West, 1977	T1 (18yrs): 389/411 (94.6)	Injuries sustained between ages of 16-18 years, cause, circumstances and consequences of injury [C]	**Frequency**: 195/389 boys sustained injuries between the ages of 16 and 18 (rate= 50%). **Severity**: 134/195 injuries required time off school/ work. **Location**: 65/195 (37%) injuries occurred at school/work, 31/195 (18%) at leisure, 32/195 (18%) on the Road (%), 29/195 (17%) in fights, and 17/195 (10%) during other activities. **Type, mechanism part of body and consequences**: not reported.	**Child variables**: delinquency and recidivism statistically associated with occurrence of injury, and severe injuries requiring hospital treatment. Those injured during sporting activities were least likely to be delinquent. **Family and environmental variables**: none reported	[B]
	Shepherd, 2002	T1 (18yrs): 387/411 (94.2)	Injuries sustained between ages of 16-18 years: intent and location [C]	**Frequency**: 211/387 boys sustained an injury between the ages of 16 and 18 (rate= 55%). **Mechanism**: 31/211 (14.7%) injuries were due to assaults, & 23/387 (10.9%) in road traffic accidents. **Location**: 23/211 (10.9%) Injuries occurred at Home, 46/211 (21.8%) at leisure ('sports injuries') and 81/211 (38.4%) were work related ('industrial'). **Type, severity, part of body and consequences**: not reported	**Child variables**: Increased risk of being injured if reported by teacher to be antisocial (OR 1.39, CI: NS), Increased risk of being injured in an assault if teacher reported troublesome behaviour (OR 4.36, CI= 2.01-9.46), Daring (OR=3.20, CI=1.49-6.90), Low IQ (OR=3.62, CI=1.68-7.82). **Family variables**: Increased risk of being injured in an assault if large family (OR=2.89, CI=1.33-6.26) and low income (OR=3.09, CI=1.42-6.70). **Environmental variables**: none reported	Author concludes that injuries are symptoms of antisocial personality that arises in childhood and persists into adulthood Conclusions appear appropriate for results published. [A]

	Shepherd, 2004	T1 (18yrs): 389/411 (94.6)	Injuries sustained between ages of 16-18 years, cause, circumstances and consequences of injury [C]	**Frequency**: 211/387 boys sustained injuries between the ages of 16 and 18 (rate= 55%). **Location**: 78/211 (37.0%) occurred at school/work, 45/211 (21.3%) at leisure (sports), 29/211 (13.7%) due to assault and 23/211 (10.9%) occurred at home. **Type, mechanism, severity part of body and consequences**: not reported.	**Child variables**: Low heart rate at age 16-18 positively associated with injury at age 16-18 years (low heart rate associated with physical fitness) **Family and environmental variables**: none reported	Only very limited analysis of predictors of injury at 16-18 reported in this publication [B]
National Child Development Study (NCDS), 1958. Also known as the 1958 British Birth Cohort, originally the 1958 Perinatal Mortality Study (PMS)	Peckham, 1973	T1 (7yrs): nk/17418 (nk). T2 (11yrs): '>15000'/17418 (nk)	Type and location of injuries between 7-11 yrs of age [P]	**Frequency / type**: 29.1% boys and 23.4% of girls suffered one or more accidents between 7 and 11 years of age resulting in a burn, a laceration requiring 10 or more stitches, a fracture or a head injury causing loss of consciousness. **Type**: Other injuries included near drowning (3.3% children) and ingestions (2.3% children). **Severity**: Accidents accounted for 2.2% of all hospital admissions for the cohort. **Location**: Home (17% of cohort), School (3%), and on the Road (2%). **Mechanism, part of body and consequences**: not reported.	**Child variables**: none reported **Family variables**: Increased incidence of injury reported for manual social groups **Environmental variables**: none reported.	Low rate of injuries reported in line with definition of injury being only severe injuries. Increased incidence of injury in lower social classes not supported by statistical evidence [B]
	Peckham, 1976	T1 (7yrs): 12764/17418 (73.3%). T2 (11yrs): nk/17418 (nk). T3 (16yrs): 15245/17418 (87.5%)	Admission to hospital and attendance at casualty in last year and by age 16. [P,S]	**Frequency / severity**: 465e/11626 (4.0%) children aged 16 years had an accident or injury causing more than one week of school to be missed in the previous 12 months. 2302e/11626 (19.8%) had attended a hospital casualty department in the previous 12 months. **Type, mechanism, part of body, location and consequences**: not reported.	**Child, family and environmental variables**: none reported.	Broad paper recording description of injuries only. No interpretation or analysis presented [B].

	Pless, 1989	T1 (0-7yrs): 13653/17418 (78.4%). T2 (7-11yrs): 17653/17418 (78.4%). T3 (12-16yrs): 11507/17418 (66.1%)	Number and severity of road traffic injuries (RTIs). Relationship of injuries to physical, developmental, behavioural and family variables. [P,S]	**Frequency / type / location**: 431 RTIs sustained in 13653 children aged 8 to 11yrs (3.16%) and 588 RTIs sustained in 11507 children aged 12 to 16yrs (5.11%). **Severity**: Between 8-11yrs, 298/13653 (2.2%) children hospitalised (206/7100 (2.9%) boys and 92/6553 (1.4%) girls), and 133/13653 (0.7%) not hospitalised (85/7100 (1.2%) boys and 48/6553 (0.7%) girls). Between 12-16 years, 127/11507 (1.1%) children hospitalised (93/5984 (1.5%) boys and 34/5523 (0.6%) girls) and 461/11507 (4.0%) not hospitalised (302/5984 (5.0%) boys and 159/5523 (2.9%) girls) **Mechanism, part of body and consequences**: not reported	**Child variables**: Increased risk of injury for boys aged 7 years who appeared "scruffy and underfed" (OR=1.69; 95% CI: 1.1-2.7), had a sensory deficit (OR=1.54; 95% CI: 1.1-2.1), were fidgety (OR=1.67; 95% CI: 1.2-2.4) or sensitive (OR=1.38; 95% CI: 1.1-1.8), Girls aged 7 years who had poor gross motor control (OR=1.68; 95% CI: 1.1-2.6). Boys aged 11 years who appeared "scruffy and underfed" (OR=1.99; 95% CI: 1.1-3.4). **Family variables**: increased risk of injury for boys aged 7 years living in homes lacking basic amenities (OR=1.37; 95% CI: 1.1.-1.8) or ever been taken into care of social services (OR=1.64; 95% CI: 1.1-2.9), Girls aged 7 years having family problems (OR=2.00; 95% CI: 1.3-3.1). Boys aged 11 years not living with natural mother (OR=1.98; 95% CI: 1.1-3.5) or ever been taken into care of social services (OR=2.22; 95% CI: 1.3-3.7), Girls aged 11 years having family problems (OR=1.64; 95% CI: 1.1-2.4). Stepwise logistic regression results: Boys aged 7 years who were fidgety and in care of local authority had OR of 1.8 risk of subsequent RTI, Girls aged 7 years who were maladjusted and had family problems – 80% greater likelihood of RTI, and Girls aged 11 years – living in crowded home and fidgety – OR of 1.56. **Environmental variables**: none reported	Gender distribution of injuries comparable to other population-based studies, but not the lack of social class inequalities. 4 year recall period likely to result in parental underreporting of injuries. Validity of instruments used (e.g. Rutters) not reported. Author conclusion that major risks for RTIs among children not those associated with personal or family characteristics and that emphasis should be placed on environmental factors probably inappropriate since NCDS not designed to investigate injury and factors of relevance may not have been tested [B]
	Bijur, 1991	T1 (16yrs): 12018e/17418 (69%). T2 (23yrs): 8231/17418 (47.3%)	Injuries resulting in hospital care, occurring between 15-17 yrs. Effect of parent-adolescent conflict and other individual and family factors [C,P]	**Frequency**: 1507/8231 children sustained injuries between the ages of 15 and 17yrs (rate= 18%), boys 1035/4097 (25.3%) and girls 472/4134 (11.4%). 277/8231 (3.4%) children sustained 2 or more injuries requiring either outpatient or inpatient care (Boys 216/4097 (5.3%) and girls 61/4134 (1.5%)). **Severity**: 202/8231 (2.5%) children had injuries requiring hospitalisation (boys 150/4097 (3.7%), girls 52/4134 (1.3%)). 1305/8231 (15.9%) children had injuries requiring outpatient treatment (Boys 855/4097 (20.1%), and girls 420/4134 (10.2%). **Type, mechanism, part of body, location and consequences**: not reported.	**Child variables**: male sex, antisocial behaviour, overactivity, high parent-adolescent conflict scale scores and >4 alcoholic drinks per week at age 16 (all p<0.001). Rate of hospitalised injuries in boys with high parent-adolescent conflict was 2.3 times that of low-conflict group, & for females it was 2.4 times, but non-significant for outpatient care injuries (after controlling for adolescent alcohol consumption/wk, occupation of father, number of moves, & quality of housing) **Family variables**: adolescents who moved home at increased risk of injury (p<0.001). **Environmental variables**: none reported	Conclusions are cautious and in line with findings. The authors acknowledge that many adolescent problem behaviours are interrelated and it is hard to tease apart their effects [B]

	Cumberland, 2004	T1 (11yrs): 12534/17418 (72.0%). T2 (11-16yrs): 12534/17418 (72.0%)	Unintentional injuries requiring hospital care – inpatients (0-16yrs, 17-33yrs) and outpatients (11-16yrs, 17-33yrs). [P,S]	**Frequency / severity**: 2040/8558 children with normal vision had unintentional injury requiring outpatient care between the ages of 11 and 16 (rate=23.8%) (Boys 1301/4266 (30.5%), girls 739/4292 (17.2%)). 112/368 children with colour vision defect had unintentional injury requiring outpatient care between the ages of 11 and 16 (rate=30.4%) (Boys 101/316 (32.0%), girls 11/52 (21.2%)). In total 2152/8926 children had unintentional injury requiring outpatient care between the ages of 11 and 16 (rate=24.1%) (Boys 1402/4582 (30.6%), girls 750/4344 (17.3%)). **Type, mechanism, part of body, location and consequences**: not reported.	**Child variables**: presence of colour vision deficiency did not appear to increase the risk of unintentional injury in boys or girls. **Family and environmental variables**: none reported	Short publication with limited detail reported [B]
	Rahi, 2006	T1 (16yrs): 8861/17418 (50.9%)	Unintended injury needing hospital care - inpatient (0-16yrs, 17-33yrs) or outpatient (12-16yrs, 17-33yrs). Relationship to behaviour and sports participation. [P,S]	**Frequency, type, mechanism, severity, part of body, location and consequences**: not reported	**Child variables**: children aged 12-16 years with amblyopia were no more likely than those with normal vision to have unintentional injuries requiring outpatient care (p=0.482 for mild amblyopia, p=0.858 for moderate/severe amblyopia) (analyses adjusted for social class, sex, ever having strabismus, treatment for amblyopia). Compared with children with normal vision, those with resolved amblyopia had fewer accidents requiring hospital care between 7-11 years (OR=0.33, 95%CI: 0.12 to 0.89), but no statistically significant difference in inpatient or outpatient care between 12 and 16 years. **Family and environmental variables**: none reported	Only a proportion of the cohort at 16 is included in analysis (those not traceable at 23, 33 and 41 were excluded). Authors do not state how representative the study sample was of the original cohort. Publication described the association of amblyopia with a range of outcomes (including injury) but did not explore the interaction of variables with injury outcomes [B]

Newcastle Thousand Families Study, 1947	Miller, 1974	T1 (5yrs): 847/1142 (74.2%). T2 (15yrs): 763/1142 (66.8%)	Number, type, location, mechanism and severity of injuries. Attendance at hospital outpatients or admission to hospital for injuries. Disability resulting from injuries. [P,S,G,R]	**Frequency**: 377/781 (48.3%) children sustained 663 injuries between the ages of 5 and 15 years (rate= 0.085 injuries per child per year). Frequency of injuries decreased with increasing age. Boys were more likely than girls to have injuries at all ages, the difference widening with age. **Type**: Of 663 injuries 103 (15.5%) were fractures, 55 (8.3%) were cuts, and 31 (4.7%) were burns. **Mechanism**: falls (>50%), fighting and injuries on the road were 'common'. **Severity**: 390/663 (58.8%) injuries attended hospital and 39 (5.9%) led to admission. **Location**: Home (26.3%), School (18,6%), on the Road (36.8%), and Outside at play (18.3%). **Consequences**: 2 children each lost an eye, and one had extensive scarring following a burn. **Part of body**: not reported	**Child variables**: Increased incidence of injury reported for children with lower intelligence, lack of initiative, poor concentration, and poor physical agility. **Family variables**: increased injury risk for social groups 3,4 and 5, mothers who were poor at coping, and providing supervision. **Environmental variables**: none reported.	Author reported factors associated with increased risk of injury not supported with statistical evidence in text. Results related to greater injuries in boys and a move away from home accidents to those occurring outside the home are in line with other research [B]

APPENDIX 3: SYSTEMATIC REVIEW TABLE - RISK FACTORS ASSOCIATED WITH INJURY (ODDS RATIOS), BY RISK FACTOR

Risk factor category	**Cohort (Country) Author, Year**	**Outcome variable**	**Exposure variable**		**Effect estimate (95% Confidence Interval)**
			Comparison group	**Reference group**	
Individual risk factors					
Sex	NLSCY (Canada), Soubhi 2004a[18]	Risk of any injury 4-11 years	Boys	Girls	OR=1.56 (1.35 to 1.85)
	Baise City, (China) Chen, 2005a[13]	Risk of any injury aged 11-18 years	Boys	Girls	OR=1.25 (1.02 to 1.53)
	Eastern Shore, (US) Alexander, 1992[22]	Risk of injury whilst in 9^{th} Grade (~14-15 yrs)	Boys	Girls	OR=1.96 (1.26 to 3.04)
	South Wales, (UK) Davidson, 1988[39]	Risk of injury at 5-8 yrs	Boys	Girls	RR=1.52 (1.23 to 1.88)
	Kamphaeng Phet Province (Thailand), Kozik, 1999[20]	Risk of having a motor vehicle accident whilst enrolled in school	Boys	Girls	RR=1.4 (1.2 to 1.6)
Age	Baise City, (China) Chen, 2005a[13]	Risk of any injury	11-13 yr olds 14-15 yr olds	17-18 yr olds 17-18 yr olds	OR=1.51 (1.00 to 2.26) OR=2.94 (1.96 to 4.42)
Ethnicity	Baise City, (China) Chen, 2005a[13]	Risk of any injury aged 11-18 years	Students from minority ethnic groups	Students from one of the main ethnic groups	OR=1.67 (1.05 to 2.66)
Growth	DMCDS, (NZ) Jones, 2004[38]	Risk of any fracture 5-18 yrs	Children with a standard deviation increase in mean weight	Mean weight at age 3	RR=1.14 (1.03 to 1.27)*
			Children with a standard deviation increase in mean height	Mean height at age 3	RR=1.13 (1.01 to 1.23)*
			Children with a standard deviation increase in mean weight	Weight from ages 5-18 yrs	RR = 1.15 (1.03 to 1.28)*
			Children with a standard deviation increase in mean height	Height from ages 5-18 yrs	RR = 1.13 (1.02 to 1.24)*

		Risk of prepubertal fractures	Children with a standard deviation increase in mean birth length	Mean birth length	RR=1.28 (1.04 to 1.58)*
			Children with a standard deviation increase in BMI	Body Mass Index (BMI) aged 5-18 yrs	RR=1.24 (1.02 to 1.52)*
Sensory deficit	NCDS, (UK) Pless, 1989[52]	Risk of road traffic injuries at 7-11 yrs	Boys with sensory deficit	Boys without sensory deficit	OR=1.54 (1.1 to 2.1) [Girls had CI crossing 1.0]
	NCDS, (UK) Rahi, 2006[53]	Risk of injury at 7-11 yrs	Children with resolved amblyopia (Note: small numbers)	Children with normal vision	OR=0.33 (0.12 to 0.89)
Coordination / motor skills	NCDS, (UK) Pless, 1989[52]	Risk of road traffic injuries at 7-11 yrs	Girls with poor gross motor control	Girls with normal gross motor control	OR=1.68 (1.1 to 2.6) [Boys had CI crossing 1.0]
	Eastern Shore, (US) Alexander, 1992[22]	Risk of injury when in 10th Grade	Children playing in 1-3 team sports in previous 12 months	Children not playing in team sports in previous 12 months	OR=1.66 (1.11 to 2.57)
	CSDD, (UK) Shepherd, 2002[48]	Risk of injury at 16-18 yrs	Boys with 'low' heart rate at 16-18 years (rate unspecified)	Boys without low heart rate	OR=1.72 (1.14 to 2.60)
Concentration and attention	NCDS, (UK) Pless, 1989[52]	Risk of road traffic injuries at 7-11 yrs	'Fidgety' boys (parental report)	Boys not considered 'fidgety'	OR=1.67 (1.2 to 2.4) [Girls had CI crossing 1.0]
Psychological difficulties	South Wales, (UK) Davidson, 1988[39]	Risk of injury at 5-8 yrs	Children with marked fears	Children without marked fears	RR=1.95 (1.35 to 2.83)
	NCDS, (UK) Pless, 1989[52]	Risk of road traffic injuries at age 7	'Sensitive' boys (parental report)	Boys not reported 'sensitive'	OR=1.38 (1.1 to 1.8) [Girls had CI crossing 1.0]
			'Maladjusted' girls (parental report)	Girls not reported 'maladjusted'	OR=1.8 (NS)
	Maanshan City, (China) Peng, 2003[14]	Risk of injury at age 7-13 yrs	Neurotic behaviour (parental report)	Child not reported neurotic	RR=1.96 (1.36 to 2.82)
	Baise City, (China) Chen, 2005b[12]	Risk of injury at 13-18 yrs	Self reported somatisation	Children with low somatisation score	OR=2.00 (1.52 to 2.63)†
			Self reported obsessive-compulsiveness	Children with low obsessive-compulsiveness score	OR=2.10 (1.71 to 2.58)†
			Self reported anxiety	Children with low anxiety score	OR=2.08 (1.62 to 2.66)†
			Self reported depression	Children with low depression score	OR=2.00 (1.59 to 2.51)†
			Self reported interpersonal-sensitivity	Children with low interpersonal-sensitivity score	OR=1.66 (1.34 to 2.06)†
			Self reported psychoticism	Children with low psychoticism score	OR=1.60 (1.26 to 2.03)†

Behavioural difficulties	Maanshan City, (China) Peng, 2003[14]	Risk of injury at age 7-13 yrs	Parent-reported antisocial behaviour	Children without antisocial behaviour	RR=2.04 (1.37 to 3.01)
	Add Health study, (USA) Hammig, 2001[19]	Risk of injuring self between 11-18 yrs	Self reported group fighting 3+ times in past 12 months	No group fighting or group fighting 1-2 times	OR=1.97 (1.1 to 3.5)
			Self reported fighting with a stranger in past 12 months	No fighting with strangers	OR=2.01 (1.3 to 3.1)
		Risk of injuring others when aged 11-18 yrs	Self reported group fighting 1-2 times in past 12 months	No group fighting	OR=2.51 (1.8 to 3.5)
			Self reported group fighting 3+ times in past 12 months	No group fighting or group fighting 1-2 times	OR=5.67 (3.2 to 10.0)
			Self reported fighting with a stranger in past 12 months	No fighting with strangers	OR=1.69 (1.2 to 2.4)
			Self reported use of a weapon	No weapon use	OR=2.24 (1.4 to 3.7)
	CSDD, (UK) Shepherd, 2002[48]	Risk of injury at 16-18 yrs	Boys who were antisocial (teacher report)	Boys not reported to be antisocial	OR=1.93 (NS)
		Risk of injury in an assault at 16-18 yrs	Boys who engaged in troublesome behaviour (teacher report)	Boys who did not engage in troublesome behaviour	OR=4.36 (2.01 to 9.46)
	South Wales, (UK) Davidson, 1988[39]	Risk of injury at 5-8 yrs	Children with discipline problems	Children without discipline problems	RR=1.29 (1.04 to 1.60)
Personal risk taking behaviour	CSDD, (UK) Shepherd, 2002[48]	Risk of injury at 16-18 yrs	Boys who engaged in 'daring' behaviour (parent report)	Boys who did not engage in 'daring' behaviour	OR=3.20 (1.49 to 6.90)
	DMCDS, (NZ) Jones, 2004[38]	Risk of fracture	Personal daily smoking in teenagers	Not smoking, or occasional smoking	RR=1.43 (1.05 to 1.95)
	Eastern Shore, (US) Alexander, 1992[22]	Risk of injury whilst in 9th Grade (~14-15 yrs)	Self report of lifetime marijuana use 1-5 times	Not having taken marijuana	OR= 2.03 (1.11 to 3.71)[‡]
		Risk of injury whilst in 10th Grade (~15-16 yrs)	Self report of alcohol use on 1-2 days in previous 30 days	No alcohol use in previous 30 days	OR=1.69 (1.05 to 2.71)[‡]
			Self report of alcohol use on 3 or more days in previous 30 days	No alcohol use in previous 30 days	OR=1.74 (1.07 to 2.84)[‡]
Employment	Eastern Shore, (US) Alexander, 1992[22]	Risk of injury whilst in 9th Grade (~14-15 yrs)	Self report of working 11 or more hours per week	Working none or less than 11 hours per week	OR=2.37 (1.26 to 4.45)
Previous injuries	CHES, (UK) Bijur, 1988b[42]	Risk of injuries at 5-10 yrs	Children having 3 or more injuries before 5 years of age	Children having no injuries before the age of 5 years	RR=5.9 (4.4 to 8.8)

		Risk of injuries requiring hospitalisation at 5-10 yrs	Children admitted to hospital 1 or more times for injuries before 5 years of age	Children not admitted to hospital for injuries before 5 years of age	RR=2.5 (2.0 to 3.3)
Family risk factors					
Family size	CHES, (UK) Bijur, 1988c[44]	Risk of injuries requiring hospitalisation at 5-10 yrs	Children living in a household with 4 or more children	Children living in a household with 1-3 children	OR=1.91 (1.16 to 3.12)[§]
	South Wales, (UK) Davidson, 1987[40]	Risk of injury at 5-8 yrs	Children living in household with 1-2 children	Children living in household with more than 2 children	RR=0.58 (0.38 to 0.89)
	CSDD, (UK) Shepherd, 2002[48]	Risk of injury in an assault at 16-18 yrs	Children living in a large family at 8-10 years	Children not living in a large family at 8-10 years	OR=2.89 (1.33 to 6.26)
Young maternal age	Maanshan City, (China) Peng, 2003[14]	Risk of injury at 7-13 yrs	Having a mother aged 22 years or younger at birth of study child	Having a mother older than 22 years at birth of study child	RR=2.25 (1.04 to 4.72)
Parent figure	NCDS, (UK) Pless, 1989[52]	Risk of road traffic injuries at 12-16 yrs	Boys not living with natural mother at age 11	Boys living with natural mother	OR=1.98 (1.1 to 3.5)
Family income	CSDD, (UK) Shepherd, 2002[48]	Risk of being injured in an assault at age 16-18 yrs	Children from families with low incomes	Children from families not on low incomes	OR=3.09 (1.42 to 6.70)
	Baise City, (China) Chen, 2005a[13]	Risk of injury at 12-19 yrs	Adolescents from family in middle income band	Adolescents from family in lowest income band	OR=1.42 (1.11 to 1.81)
Parental education	Maanshan City, (China) Peng, 2003[14]	Risk of injury at 7-13 yrs	Child's mother had 'high' level of education (unspecified)	Child's mother did not have 'high' level of education	RR=1.23 (1.07 to 1.33)
Parenting ability and activity	NLSCY (Canada), Soubhi 2004a[18]	Risk of injury at 4-11 yrs	Children with below average consistency of parenting	Children with average or above average consistency of parenting	OR=1.43 (1.22 to 1.68)[**]
	Maanshan City, (China) Peng, 2003[14]	Risk of injury at 7-13 yrs	Children with poor injury prevention activity at home	Children with adequate or good injury prevention activity at home	RR=1.33 (1.03 to 1.71)
			Children whose parents accompanied them to school	Children who were unaccompanied to school	RR=0.71 (0.06 to 0.87)
Family dysfunction	NCDS, (UK) Pless, 1989[52]	Risk of road traffic injury at age 7-11 years	Boys who appeared to be 'scruffy and underfed' (teacher report) at age 7	Boys who were not 'scruffy and underfed'	OR=1.69 (1.1 to 2.7)
			Boys who had ever been in care of social services	Boys never taken into care of social services	OR=1.64 (1.1 to 2.9)

			Girls from homes with 'family problems'	Girls from homes without 'family problems'	OR=2.00 (1.3 to 3.1)
			Boys who were 'fidgety' and in care of local authority	Boys not 'fidgety' or in care of local authority	OR=1.8 (NS)
		Risk of road traffic injury at age 12-16 years	Boys who appeared to be 'scruffy and underfed' (teacher report) at age 11	Boys who were not 'scruffy and underfed'	OR=1.99 (1.1 to 3.4)
			Boys who had ever been in care of social services	Boys never taken into care of social services	OR=2.22 (1.3 to 3.7)
			Girls from homes with 'family problems'	Girls from homes without 'family problems'	OR=1.64 (1.1 to 2.4)
			Girls who were 'fidgety' and living in a crowded home	Girls not 'fidgety' or in crowded home	OR=1.56 (NS)
Environmental risk factors					
Physical home environment	NCDS, (UK) Pless, 1989[52]	Risk of road traffic injury at age 7	Boys living in homes lacking basic amenities	Boys living in homes with basic amenities	OR=1.37 (1.1 to 1.8)

Note: 'Greater than by chance' indicates studies where 95% confidence intervals do not contain OR=1.00 or RR=1.00, or where p-values are <0.05
NS = Not stated
DMCDS = Dunedin Multidisciplinary Child Development Study
NCDS = National Child Development Study
CSDD = Cambridge Study of Delinquent Development
CHES = Child Health and Education Study
NLSCY = National Longitudinal Study of Children and Youth
[*] Adjusted for sex and age
[†] Adjusted for sex, age and ethnicity
[‡] Adjusted for sex, race and parents educational level
[§] Adjusted for family SES, family income, housing quality, maternal mental health, maternal education, maternal employment, family structure, child aggression, child independence and child overactivity
[**] Adjusted for SES, the number of people in the household, caregiver's physical and mental health, and a past history of injury

Appendix 4: Systematic review table - risk factors associated with injury (p values), by cohort

Cohort (Country), Year of recruitment	Factors assessed by author			Author reported associations with increased risk of injury (p<0.05)		
	Individual risk factors	**Family risk factors**	**Environmental risk factors**	**Comparison group**	**Reference group**	**p value**
Cohort from Baise, (China), 2002 [12,13]	✓	✓		Boys	Girls	0.04
				Trend for decreasing injury with increasing age		<0.01
				Minority ethnic group	Majority ethnic group	0.02
				1 child in family	2 children in family	<0.01
				Living with father alone	Living with mother alone or grandparents	0.03
				Father has university education	Father has lower level of education	<0.01
				Mother has university education	Mother has lower level of education	<0.01
				Family monthly income <2000 Yuan	Family monthly income >2000 Yuan	<0.01
				Mean raw scores on parent psychological symptoms checklist (SCL-90-R) for injured children (for somatisation, obsessive-compulsiveness, interpersonal sensitivity, depression, anxiety, phobia, paranoid ideation and psychoticism)	Mean raw scores on parent psychological symptoms checklist (SCL-90-R) for uninjured children	<0.01
Cohort from Maanshan, (China), 2001 [14]	✓	✓		Children with antisocial or neurotic behaviour problems	Children without antisocial or neurotic behaviour problems	0.000
West of Scotland 11-16 Study (UK), 1994 [16]	✓	✓		For boys, increasing trend for any accident or injury at age 15 across social class I to V		0.004
				For boys, increasing trend for being injured in an assault at age 15 across social class I to V		0.000
				For girls decreasing trend for being injured in sports at age 15 across social class I to V		0.001
Carolina Longitudinal Study, (USA), 1981 [23]	✓	✓		Boys	Girls	<0.05
				Caucasian females	African-American females	<0.05
				Adolescents deemed aggressive as children	Adolescents not considered aggressive as children	<0.01
				Risk taking behaviour in boys	Risk taking behaviour in girls	<0.05

Christchurch Child Development Study, (New Zealand), 1977 [26]	✓	✓		Having conduct or oppositional defiant disorder	Not having conduct or oppositional defiant disorder	<0.01
Dunedin Multidisciplinary Child Development Study, (New Zealand), 1975 [35]	✓	✓		Boys aged 7-11 years	Girls aged 7-11 years	0.019
				Children with high personal adversity index (includes behaviour, reading, IQ, fine and gross motor coordination)	Children without high personal adversity index (includes behaviour, reading, IQ, fine and gross motor coordination)	0.011
Cohort from South Wales, (UK), 1972 [40]	✓	✓		Boys	Girls	<0.05
				Children with mothers having high or middle scores for neuroticism	Children with mothers having low scores for neuroticism	0.001
Child Health & Education Study (CHES), (UK). 1970 [42-45]	✓	✓	✓	Boys	Girls	<0.001
				Boys with high levels of aggression	Boys with lower levels of aggression	<0.001
				Boys with high levels of overactivity	Boys with low levels of overactivity	<0.001
				Children having 3 or more injuries between 0-5 years	Children having none or 1-2 injuries between 0-5 years	<0.001
				Children having one or more injury requiring hospitalisation between 0-5 years	Children having no injuries requiring hospitalisation between 0-5 years	<0.001
				Children of mothers who are 5 years or more younger than other mothers	Children of mothers who were not in the youngest age group	<0.001
				Children with older siblings	Children without older siblings	<0.001
				Children living in a family with 4+ other children	Children living in a family with less than 4 children	<0.001
				Children occupying a middle birth position	Children occupying the youngest or the oldest birth position	<0.05
National Child Development Study (NCDS), (UK), 1958 [52,54]	✓	✓	✓	Boys having hospitalised injuries	Girls having hospitalised injuries	<0.001
				Boys having injuries requiring ambulatory care	Girls having injuries requiring ambulatory care	<0.001
				Children drinking more than 4 alcoholic drinks per week at age 15-16 years	Children drinking 4 alcoholic drinks per week or less at age 15-16 years	<0.001
				Children with 2 or more house moves	Children with 0 or 1 house moves	<0.001
				Children with high antisocial behaviour scores at age 11	Children with lower antisocial behaviour scores at age 11	<0.001
				Children with high overactive behaviour scores at age 11	Children with lower overactive behaviour scores at age 11	<0.001

Newcastle Thousand Families Study, (UK), 1947 [55]	✓	✓	Children aged 5-15 years with mothers who have poor coping skills	Children aged 5-15 years with mothers who had adequate coping skills	'Statistically significant difference', p=NS
			Children aged 5-15 years with lower intelligence	Children aged 5-15 years with normal intelligence	'Statistically significant difference', p=NS

*Associations failing to reach significance at p<0.05 level, not reported. Effect estimates (OR or RR) reported separately in Tables 2 and 3. NS = Not stated. N/a = Not applicable

APPENDIX 5: INJURY QUESTIONNAIRES

Injury questions from Child Based Questionnaire KM; *My five year old son/daughter*

A1. a) Has she been **burnt or scalded** since she was 4½ years old?

Yes ☐1 No ☐2 → **If no, go to A2a on page 4**

If yes, b) how many times? ☐☐

For each burn or scald please describe below what happened:

		1st accident	**2nd accident**	**3rd accident**
c)	Place accident happened (e.g. kitchen, garden, school)	....	....	....
d)	What was she burnt with? (e.g. tea, iron, electric fire)	....	....	....
e)	Date of accident (month, year)	....	....	....
f)	Injuries caused (if no injury write none)	....	....	....
g)	Who was with her?	....	....	....
h)	What did the person with her do?			
	Nothing	☐1	☐1	☐1
	Treated her themselves	☐2	☐2	☐2
	Took to doctor	☐3	☐3	☐3
	Took to hospital	☐4	☐4	☐4
	Other (please describe)	☐5	☐5	☐5
		....	....	....
i)	What treatment did the person with her give?	....	....	....
j)	What other treatment did she have?	....	....	....

A1. k) Please describe how each accident happened:

Burn 1 ....

Burn 2 ....

Burn 3 ....

A2. a) Has she had a **bad fall** since she was 4½ years old?

Yes [1] No [2] → **If no, go to A3a on page 5**

If yes, b) how many times? [ ][ ]

For each fall please describe below what happened:

		1st fall	2nd fall	3rd fall
c)	Place accident happened (e.g. kitchen, garden, school)	....	....	....
d)	What did she fall from (e.g. table, wall, climbing frame)?	....	....	....
e)	Date of fall (month, year)	....	....	....
f)	Injuries caused (if no injury write none)	....	....	....
g)	Who was with her?	....	....	....
h)	What did the person with her do?			
	Nothing	1	1	1
	Treated her themselves	2	2	2
	Took to doctor	3	3	3
	Took to hospital	4	4	4
	Other (please describe)	5	5	5
		....	....	....
i)	What treatment did the person with her give?	....	....	....
j)	What other treatment did she have?	....	....	....

A2. k) Please describe how each accident happened:

Fall 1 ....

Fall 2 ....

Fall 3 ....

A3. a) Has she **swallowed anything** she shouldn't have (such as pills, buttons, disinfectant) since she was 4½ years old?

Yes [1] No [2] → **If no, go to A4a on page 6**

If yes, b) how many times? [ ][ ]

For each time please describe below what happened:

		1st accident	**2nd accident**	**3rd accident**
c)	Place accident happened (e.g. your home, school, at friend's)	....	....	....
d)	What did she swallow?	....	....	....
e)	Date of accident (month, year)	....	....	....
f)	Who was with her?	....	....	....
g)	What did the person with her do?			
	Nothing	1	1	1
	Treated her themselves	2	2	2
	Took to doctor	3	3	3
	Took to hospital	4	4	4
	Other (please describe)	5	5	5
		....	....	....
h)	What treatment did the person with her give?	....	....	....
i)	What other treatment did she have?	....	....	....

A3. j) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

A4. a) Has she had any **other accidents or injuries** since she was 4½ years old?

Yes ☐1 No ☐2 → **If no, go to A5 on page 7**

If yes, b) how many other accidents? ☐☐

For each accident or injury please describe below what happened.

		1st accident	**2nd accident**	**3rd accident**
c)	Place accident happened (e.g. kitchen, garden, street, school)	....	....	....
d)	What happened?	....	....	....
e)	Date of accident (month, year)	....	....	....
f)	Injuries caused (if no injury write none)	....	....	....
g)	Who was with her?	....	....	....
h)	What did the person with her do?			
	Nothing	☐1	☐1	☐1
	Treated her themselves	☐2	☐2	☐2
	Took to doctor	☐3	☐3	☐3
	Took to hospital	☐4	☐4	☐4
	Other (please describe)	☐5	☐5	☐5
		....	....	....
i)	What treatment did the person with her give?	....	....	....
j)	What other treatment did she have?	....	....	....

A4. k) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

A5. Has she had any of the following happen since she was 4½? (tick all that apply)

a)	Broken arm/hand	1
b)	Broken leg/foot	1
c)	Broken/cracked skull	1
d)	Other broken bone (please describe).................	1
e)	Unconscious because of a head injury	1
f)	Cut(s) requiring stitches	1
g)	Burn or scald having a skin graft	1
h)	A road traffic accident	1
i)	An accident in a playground	1
j)	An accident at school, nursery, crèche	1
k)	Stung by wasp or bee	1
l)	Bitten by animal or human (please describe)	1 ....
m)	Badly sunburnt	1
n)	Nearly drowned	1
o)	Front tooth (teeth) knocked out	1
p)	Front tooth/teeth chipped or injured	1
q)	Other tooth/teeth knocked out or chipped	1

Injury questions from Child Based Questionnaire KP; *My son/daughter growing up*

SECTION D: ACCIDENTS AND INJURIES

However careful a parent is, most children have accidents at some time or other. Please list on the next pages the times your child has had an accident, whether or not he was injured as a result.

D1. a) Has he been burnt or scalded in the past 12 months?

Yes [1] No [2] → **If no, go to D2a on page 34**

If yes, b) how many times? [ ][ ]

For each accident please describe below what happened:

		1st accident	2nd accident	3rd accident
c)	Place accident happened (e.g.kitchen, park, school)	....	....	....
d)	What was he burnt with? (e.g. tea, iron, electric fire, bonfire, fireworks)	....	....	....
e)	Date of accident (month, year)	....	....	....
f)	Injuries caused (if no injury write none)	....	....	....
g)	Who was with him?	....	....	....
h)	What did the person with him do?			
	Nothing	1	1	1
	Treated him themselves	2	2	2
	Took to doctor	3	3	3
	Took to hospital	4	4	4
	Other (please describe)	5	5	5 ....
i)	What treatment did the person with him give?	....	....	....
j)	What other treatment did he have?	....	....	....

k) Please describe how each accident happened:

Burn 1 ....

Burn 2 ....

Burn 3 ....

D2. a) Has he had an accident while playing sports or games in the past 12 months?

Yes [1] No [2] → **If no, go to D3a on page 35**

If yes, b) how many times? [|]

For each accident please describe below what happened:

		1st accident	**2nd accident**	**3rd accident**
c)	Place it happened (e.g.playground, street, school)	....	....	....
d)	What happened (e.g.hit by ball, fell off trampoline)	....	....	....
e)	Date of accident (month, year)	....	....	....
f)	Injuries caused (if no injury write none)	....	....	....
g)	Who was with him?	....	....	....
h)	What did the person with him do?			
	Nothing	1	1	1
	Treated him themselves	2	2	2
	Took to doctor	3	3	3
	Took to hospital	4	4	4
	Other (please describe)	5	5	5
		....	....	....
i)	What treatment did the person with him give?	....	....	....
j)	What other treatment did he have?	....	....	....

k) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

D3. a) Has he swallowed anything he shouldn't have (such as pills, buttons, disinfectant) in the past 12 months?

Yes [ ]1 No [ ]2 → **If no, go to D4a on page 36**

If yes, b) how many times? [ ][ ]

For each time please describe below what happened:

		1st accident	2nd accident	3rd accident
c)	Place accident happened (e.g. your home, school, at friend's)	....	....	....
d)	What did he swallow? (e.g. bleach, aspirin, marble)	....	....	....
e)	Date of accident (month, year)	....	....	....
f)	Who was with him?	....	....	....
g)	What did the person with him do?			
	Nothing	[ ]1	[ ]1	[ ]1
	Treated him themselves	[ ]2	[ ]2	[ ]2
	Took to doctor	[ ]3	[ ]3	[ ]3
	Took to hospital	[ ]4	[ ]4	[ ]4
	Other (please describe)	[ ]5	[ ]5	[ ]5
		....	....	....
h)	What treatment did the person with him give?	....	....	....
i)	What other treatment did he have?	....	....	....

j) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

D4. a) Has he had any injuries involving traffic in the past 12 months?

Yes [1] No [2] → **If no, go to D5a on page 37**

If yes, b) how many times? [ ][ ]

For each accident or injury please describe below what happened:

		1st accident	**2nd accident**	**3rd accident**
c)	Where was he and what was he doing (e.g. sitting in car; riding a bicycle)	....	....	....
d)	What happened (e.g. car hit tree; cycle toppled into path of motor vehicle)	....	....	....
e)	Date of accident (month,year)	....	....	....
f)	Injuries caused (if no injury write none)	....	....	....
g)	Who was with him?	....	....	....
h)	What did the person with him do?			
	Nothing	1	1	1
	Treated him themselves	2	2	2
	Took to doctor	3	3	3
	Took to hospital	4	4	4
	Other (please describe)	5	5	5
		....	....	....
i)	What treatment did the person with him give?	....	....	....
j)	What other treatment did he have?	....	....	....

k) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

D5. a) Has he <u>ever</u> been injured by the action of another person (whether intentionally or not)

Yes [1] No [2] → **If <u>no</u>, go to D6a on page 38**

If <u>yes</u>, b) how many times? [ ][ ]

For each time please describe below what happened:

		1st injury	2nd injury	3rd injury
c)	Person involved (e.g. stranger, sister, child's father)	....	....	....
d)	What happened ?	....	....	....
e)	Date of injury (month, year)	....	....	....
f)	Who else was with him?	....	....	....
g)	What did the person with him do?			
	Nothing	1	1	1
	Treated him themselves	2	2	2
	Took to doctor	3	3	3
	Took to hospital	4	4	4
	Other (please describe)	5	5	5
		....	....	....
h)	What treatment did the person with him give?	....	....	....
i)	What other treatment did he have?	....	....	....

j) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

D6. a) Has he had any other accidents or injuries in the past 12 months?

Yes ☐1 No ☐2 → **If no, go to D7 on page 39**

If yes, b) how many times? ☐☐

For each time please describe below what happened:

		1st accident	2nd accident	3rd accident
c)	Place accident happened (e.g. kitchen, garden, street, school)	....	....	....
d)	What happened?	....	....	....
e)	Date of accident (month, year)	....	....	....
f)	Injuries caused (if no injury write none)	....	....	....
g)	What did the person with him do?			
	Nothing	☐1	☐1	☐1
	Treated him themselves	☐2	☐2	☐2
	Took to doctor	☐3	☐3	☐3
	Took to hospital	☐4	☐4	☐4
	Other (please describe)	☐5	☐5	☐5
		....	....	....
h)	What treatment did the person with him give?	....	....	....
i)	What other treatment did he have?	....	....	....

j) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

D7. Has he had any of the following happen since he was born? (tick all questions and all time periods that apply)

		(i) Yes, aged 0 - 2 years	(ii) Yes, aged 3-4 years	(iii) Yes, since 5th birthday
a)	Broken arm/hand	1	1	1
b)	Broken leg/foot	1	1	1
c)	Broken/cracked skull	1	1	1
d)	Other broken bone (please describe).................	1	1	1
e)	Unconscious because of a head injury	1	1	1
f)	Cut(s) requiring stitches	1	1	1
g)	Burn or scald having a skin graft	1	1	1
h)	A road traffic accident	1	1	1
i)	An accident in a playground	1	1	1
j)	An accident at school, nursery, creche	1	1	1
k)	Stung by wasp or bee	1	1	1
l)	Bitten by animal or human please tick and describe	1	1	1
m)	Badly sunburnt	1	1	1
n)	Nearly drowned	1	1	1
o)	Front tooth (teeth) knocked out	1	1	1

			(i) Yes, aged 0 - 2 years	(ii) Yes, aged 3 - 4 years	(iii) Yes, since 5th birthday
D7.	p)	Front tooth/teeth chipped or injured	1	1	1
	q)	Other tooth/teeth knocked out or chipped	1	1	1

D8. Has the study child ever had an accident that has had effects that are still present? (Please tick all that apply)

a)	yes, a scar	1
b)	yes, a behaviour difference	1
c)	yes, other (please tick and describe)	1

....

Injury questions from Child Based Questionnaire KS; *My son/daughter's health*

SECTION E: ACCIDENTS AND INJURIES

However careful a parent is, most children have accidents at some time or other. Please list on the next pages the times your child has had an accident, whether or not he was injured as a result.

E1. a) Has he been burnt or scalded in the past 12 months?

Yes [1] No [2] → **If no, go to E2a on page 33**

If yes, b) how many times? [|]

For each accident please describe below what happened:

		1st accident	2nd accident	3rd accident
c)	Place accident happened (e.g.kitchen, park, school)	....	....	....
d)	What was he burnt with? (e.g. tea, iron, electric fire, bonfire, fireworks)	....	....	....
e)	Date of accident (month, year)	....	....	....
f)	Injuries caused (if no injury write none)	....	....	....
g)	Who was with him?	....	....	....
h)	What did the person with him do?			
	Nothing	1	1	1
	Treated him themselves	2	2	2
	Took to doctor	3	3	3
	Took to hospital	4	4	4
	Other (please describe)	5	5	5
		....	....	....
i)	What treatment did the person with him give?	....	....	....
j)	What other treatment did he have?	....	....	....

k) Please describe how each accident happened:

Burn 1..

Burn 2..

Burn 3..

E2. a) Has he had an accident while playing sports or games in the past 12 months?

Yes [ ] 1 No [ ] 2 →**If no, go to E3a on page 34**

If yes, b) how many times? [ ][ ]

For each accident please describe below what happened:

		1st accident	**2nd accident**	**3rd accident**
c)	Place it happened (e.g.playground, street, school)	....	....	....
d)	What happened (e.g. hit by ball, fell off trampoline)?	....	....	....
e)	Date of accident (month, year)	....	....	....
f)	Injuries caused (if no injury write none)	....	....	....
g)	Who was with him?	....	....	....
h)	What did the person with him do?			
	Nothing	[ ] 1	[ ] 1	[ ] 1
	Treated him themselves	[ ] 2	[ ] 2	[ ] 2
	Took to doctor	[ ] 3	[ ] 3	[ ] 3
	Took to hospital	[ ] 4	[ ] 4	[ ] 4
	Other (please describe)	[ ] 5	[ ] 5	[ ] 5
		....	....	....
i)	What treatment did the person with him give?	....	....	....
j)	What other treatment did he have?	....	....	....

k) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

E3. a) Has he swallowed anything he shouldn't have (such as pills, buttons, disinfectant) in the past 12 months?

Yes ☐1 No ☐2 → **If no, go to E4a on page 35**

If yes, b) how many times? ☐☐

For each time please describe below what happened:

		1st accident	**2nd accident**	**3rd accident**
c)	Place accident happened (e.g. your home, school, at friend's)	....	....	....
d)	What did he swallow? (e.g. bleach, aspirin, marble)	....	....	....
e)	Date of accident (month, year)	....	....	....
f)	Who was with him?	....	....	....
g)	What did the person with him do?			
	Nothing	☐1	☐1	☐1
	Treated him themselves	☐2	☐2	☐2
	Took to doctor	☐3	☐3	☐3
	Took to hospital	☐4	☐4	☐4
	Other (please describe)	☐5	☐5	☐5
		....	....	....
h)	What treatment did the person with him give?	....	....	....
i)	What other treatment did he have?	....	....	....

j) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

E4. a) Has he had any injuries involving traffic in the past 12 months?

Yes [1] No [2] →**If no, go to E5a on page 36**

If yes, b) how many times? [ ][ ]

For each accident or injury please describe below what happened:

		1st accident	2nd accident	3rd accident
c)	Where was he and what was he doing (e.g. sitting in car; riding a bicycle)?	....	....	....
d)	What happened (e.g. car hit tree; fell off bike)	....	....	....
e)	Date of accident (month, year)	....	....	....
f)	Injuries caused (if no injury write none)	....	....	....
g)	Who was with him?	....	....	....
h)	What did the person with him do?			
	Nothing	1	1	1
	Treated him themselves	2	2	2
	Took to doctor	3	3	3
	Took to hospital	4	4	4
	Other (please describe)	5	5	5
		....	....	....
i)	What treatment did the person with him give?	....	....	....
j)	What other treatment did he have?	....	....	....

k) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

E5. a) Has he **ever** been injured by the action of another person (whether intentionally or not)?

Yes [1] No [2] → **If no, go to E6a on page 37**

If yes, b) how many times? [ ][ ]

For each time please describe below what happened:

		1st injury	2nd injury	3rd injury
c)	Person involved (e.g. stranger, sister, child's father)	…………………	…………………	…………………
d)	What happened ?	…………………	…………………	…………………
e)	Date of injury (month, year)	…………………	…………………	…………………
f)	Who else was with him?	…………………	…………………	…………………
g)	What did the person with him do?			
	Nothing	1	1	1
	Treated him themselves	2	2	2
	Took to doctor	3	3	3
	Took to hospital	4	4	4
	Other (please describe)	5	5	5
		…………………	…………………	…………………
h)	What treatment did the person with him give?	…………………	…………………	…………………
i)	What other treatment did he have?	…………………	…………………	…………………

j) Please describe how each accident happened:

Injury 1 ……………………………………………………………………………………

Injury 2 ……………………………………………………………………………………

Injury 3 ……………………………………………………………………………………

E6. a) Has he had any other accidents or injuries in the past 12 months?

Yes ☐1 No ☐2 →**If no, go to E7 on page 38**

If yes, b) how many times? ☐☐

For each time please describe below what happened:

		1st accident	2nd accident	3rd accident
c)	Place accident happened (e.g. kitchen, garden, street, school)	....	....	....
d)	What happened?	....	....	....
e)	Date of accident (month, year)	....	....	....
f)	Injuries caused (if no injury write none)	....	....	....
g)	What did the person with him do?			
	Nothing	☐1	☐1	☐1
	Treated him themselves	☐2	☐2	☐2
	Took to doctor	☐3	☐3	☐3
	Took to hospital	☐4	☐4	☐4
	Other (please describe)	☐5	☐5	☐5
		....	....	....
h)	What treatment did the person with him give?	....	....	....
i)	What other treatment did he have?	....	....	....

j) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

E7. Has he had any of the following happen **since he was born**? (tick all questions and all time periods that apply)

		(i) **Yes, aged 0 - 2 years**	(ii) **Yes, aged 3-4 years**	(iii) **Yes, aged 5-6 years**	(iv) **Yes, since 7th birthday**
a)	Broken arm/hand	1	1	1	1
b)	Broken leg/foot	1	1	1	1
c)	Broken/cracked skull	1	1	1	1
d)	Other broken bone (please describe).........................	1	1	1	1
e)	Unconscious because of a head injury	1	1	1	1
f)	Cut(s) requiring stitches	1	1	1	1
g)	Burn or scald needing a skin graft	1	1	1	1
h)	A road traffic accident	1	1	1	1
i)	An accident in a playground	1	1	1	1
j)	An accident at school, nursery, crèche	1	1	1	1
k)	Stung by wasp or bee	1	1	1	1
l)	Bitten by animal or human (please tick and describe)	1	1	1	1
m)	Badly sunburnt	1	1	1	1
n)	Nearly drowned	1	1	1	1
o)	Front tooth (teeth) knocked out	1	1	1	1
p)	Front tooth (teeth) chipped or injured	1	1	1	1
q)	Other tooth/teeth knocked out or chipped	1	1	1	1

E8. Has the study child ever had an accident that has had effects that are still present? (Please tick all that apply)

a)	yes, a scar	1
b)	yes, a behaviour difference	1
c)	yes, other	1

For any of the above, please describe

....

Louisa & Nicholas

Ellie

Donna

Injury questions from Child Based Questionnaire KW; *Being a girl / boy*

SECTION C: ACCIDENTS AND INJURIES

However careful a parent is, most children have accidents at some time or other. Please list on the next pages the times your child has had an accident, whether or not she was injured as a result.

C1. a) Has she been burnt or scalded since her 9th birthday?

Yes [1] No [2] → **If no, go to C2a on page 21**

If yes, b) how many times? [ ][ ]

For each accident please describe below what happened:

		1st accident	2nd accident	3rd accident
c)	Place accident happened (e.g.kitchen, park, school)	....	....	....
d)	What was she burnt with? (e.g. tea, iron, electric fire, bonfire, fireworks)	....	....	....
e)	Date of accident (month, year)	....	....	....
f)	Injuries caused (if no injury write none)	....	....	....
g)	Who was with her?	....	....	....
h)	What did the person with her do?			
	Nothing	1	1	1
	Treated her themselves	2	2	2
	Took to doctor	3	3	3
	Took to hospital	4	4	4
	Other (please describe)	5	5	5
		....	....	....
i)	What treatment did the person with her give?	....	....	....
j)	What other treatment did she have?	....	....	....

k) Please describe how each accident happened:

Burn 1...

Burn 2...

Burn 3...

C2. a) Has she had an accident while playing sports or games **since her** 9^{th} **birthday**?

Yes [1] No [2] → **If no, go to C3a on page 22**

If yes, b) how many times? [ ][ ]

For each accident please describe below what happened:

		1st accident	**2nd accident**	**3rd accident**
c)	Place it happened (e.g. playground, street,) school)	....	....	....
d)	What happened (e.g. hit by ball, fell off trampoline)?	....	....	....
e)	Date of accident (month, year)	....	....	....
f)	Injuries caused (if no injury write none)	....	....	....
g)	Who was with her?	....	....	....
h)	What did the person with her do?			
	Nothing	1	1	1
	Treated her themselves	2	2	2
	Took to doctor	3	3	3
	Took to hospital	4	4	4
	Other (please describe)	5	5	5
		....	....	....
i)	What treatment did the person with her give?	....	....	....
j)	What other treatment did she have?	....	....	....

k) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

C3. a) Has she swallowed anything she shouldn't have (such as pills, buttons, disinfectant) **since her 9th birthday?**

Yes ☐1 No ☐2 → **If no, go to C4a on page 23**

If yes, b) how many times? ☐☐

For each time please describe below what happened:

	1st accident	2nd accident	3rd accident
c) Place accident happened (e.g. your home, school) at friend's)	....	....	....
d) What did she swallow? (e.g. bleach, apirin, marble)	....	....	....
e) Date of accident (month, year)	....	....	....
f) Who was with her?	....	....	....
g) What did the person with her do?			
Nothing	☐1	☐1	☐1
Treated her themselves	☐2	☐2	☐2
Took to doctor	☐3	☐3	☐3
Took to hospital	☐4	☐4	☐4
Other (please describe)	☐5	☐5	☐5
	....	....	....
h) What treatment did the person with her give?	....	....	....
i) What other treatment did she have?	....	....	....

j) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

C4. a) Has she had any injuries involving traffic since her 9th birthday?

Yes [1] No [2] → **If no, go to C5a on page 24**

If yes, b) how many times? [ ][ ]

For each accident or injury please describe below what happened:

	1st accident	**2nd accident**	**3rd accident**
c) Where was she and what was she doing (e.g. sitting in car, riding a bicycle)?	....	....	....
d) What happened (e.g. car hit tree, fell off bike)	....	....	....
e) Date of accident (month, year)	....	....	....
f) Injuries caused (if no injury write none)	....	....	....
g) Who was with her?	....	....	....
h) What did the person with her do?			
Nothing	1	1	1
Treated her themselves	2	2	2
Took to doctor	3	3	3
Took to hospital	4	4	4
Other (please describe)	5	5	5
	....	....	....
i) What treatment did the person with her give?	....	....	....
j) What other treatment did she have?	....	....	....

k) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

C5. a) Has she been injured by the action of another person, whether intentionally or not **since her 9th birthday**? (Don't include sports injuries here but include them in C2).

Yes [1] No [2] → **If no, go to C6a on page 25**

If yes, b) how many times? [ ][ ]

For each accident please describe below what happened:

		1st injury	**2nd injury**	**3rd inury**
c)	Person involved (e.g. stranger, sister, child's father)	....	....	....
d)	What happened?	....	....	....
e)	Date of injury (month, year)	....	....	....
f)	Who else was with her?	....	....	....
g)	What did the person with her do?			
	Nothing	1	1	1
	Treated her themselves	2	2	2
	Took to doctor	3	3	3
	Took to hospital	4	4	4
	Other (please describe)	5	5	5
		....	....	....
h)	What treatment did the person with her give?	....	....	....
i)	What other treatment did she have?	....	....	....

j) Please describe how each accident happened:

Injury 1 ....

Injury 2 ....

Injury 3 ....

C6. a) Has she had any other accidents or injuries since her 9th birthday?

Yes ☐1 No ☐2 → **If no, go to C7 on page 26**

If yes, b) how many times? ☐☐

For each time please describe below what happened:

		1st accident	2nd accident	3rd accident
c)	Place accident happened (e.g. kitchen, garden, street, school)	....	....	....
d)	What happened?	....	....	....
e)	Date of injury (month, year)	....	....	....
f)	Injuries caused (if no injury write none)	....	....	....
g)	What did the person with her do?			
	Nothing	☐1	☐1	☐1
	Treated her themselves	☐2	☐2	☐2
	Took to doctor	☐3	☐3	☐3
	Took to hospital	☐4	☐4	☐4
	Other (please describe)	☐5	☐5	☐5
		....	....	....
h)	What treatment did the person with her give?	....	....	....
i)	What other treatment did she have?	....	....	....

j) Please describe how each accident happened:

Accident 1 ....

Accident 2 ....

Accident 3 ....

C7. Has she had any of the following happen **since she was born**? (tick all questions and all time periods that apply)

		(i) **Yes, aged 0 - 4 years**	(ii) **Yes, aged 5-8 years**	(iii) **Yes, since her 9th birthday**
a)	Broken arm/hand	1	1	1
b)	Broken leg/foot	1	1	1
c)	Broken/cracked skull	1	1	1
d)	Other broken bone (please describe).....................	1	1	1
e)	Unconscious because of a head injury	1	1	1
f)	Cut(s) requiring stitches	1	1	1
g)	Burn or scald needing a skin graft	1	1	1
h)	A road traffic accident	1	1	1
i)	An accident in a playground	1	1	1
j)	An accident at school, nursery, crèche	1	1	1
k)	Stung by wasp or bee	1	1	1
l)	Bitten by animal or human (please tick and describe)	1	1	1
m)	Badly sunburnt	1	1	1
n)	Nearly drowned	1	1	1
o)	Front tooth (teeth) knocked out	1	1	1
p)	Front tooth (teeth) chipped or injured	1	1	1
q)	Other tooth/teeth knocked out or chipped	1	1	1

C8. Has the study child ever had an accident that has had effects that are still present? (Please tick all that apply)

a)	yes, a scar	1
b)	yes, a behaviour difference	1
c)	yes, other	1

For any of the above, please describe

....

....

APPENDIX 6: CODING MANUAL

Avon Longitudinal Study of Parents and Children

Coding manual for injuries reported in children over 5 years of age

Julie Mytton

Date: 7th April 2008

Contents

Part A: Introduction

The purpose of the manual

The Avon Longitudinal Study of Parents and Children (ALSPAC) is an ongoing English longitudinal cohort study of 14,541 pregnancies commenced in 1991, and to date has followed up just under 14,000 children who are now approaching 15 years of age.

The study has collected information on the injuries sustained by the children at multiple time points during the study through questionnaires sent to the parents or primary caregivers. Much of this information has been collected in a manner that allows direct computer entry and analysis. However, at each occurrence when a carer reported an injury in their child, the carer was given an opportunity to write detail of what happened during the injury event. This ‘free text’ information provides valuable insight into the context and process of the injury event. It needs to be managed through the careful coding of the content in a manner that will allow future interpretation and analysis.

This manual has been written to enable the coding of that free text information. It has been written specifically for the coding of injuries sustained during the primary school-aged period (5-11 years), but is likely to be applicable to injuries sustained during the secondary school age period (12-16 years).

Four questionnaires administered during this period requested information on childhood injuries. Those questionnaires were:

1. Questionnaire KM: *My five year old son / daughter* (administered at 65 months)
2. Questionnaire KP: *My son / daughter growing up* (administered at 78 months)
3. Questionnaire KS: *My son / daughter‘s health* (administered at 103 months)
4. Questionnaire KW: *Being a girl / boy* (administered at 140 months)

The manual is intended to be used by those engaged in the coding process. Correct and consistent application of codes is vital if the analysis of injury information collected during ALSPAC is to be valid. This manual is therefore intended to be used as a day-to-day reference tool.

How the manual has been developed

Free text information on the injuries sustained during the pre-school period was coded using a pragmatic and evolving system that was developed in-house. During a review of this coding framework it became apparent that the existing coding system would not meet the needs of the new data to be coded.

A search for existing coding frameworks for injury identified three main classification systems;

- The International Classification of External Causes of Injury (ICECI) - a related classification in the World Health Organisation Family of International Classifications

- The Injury Database (IDB) Coding Manual - developed for the recording of information of injuries at emergency departments across the European Union, developed using ICECI and designed as a tool to enable effective injury surveillance systems to be established

- The Nordic Medico-Statistical Committee Classification of External Injury Codes (NOMESCO) - developed to facilitate injury prevention and control

Review of these three classification systems indicated that the ICECI system would be the most appropriate to code the information collected through ALSPAC. This was because of its ability to code the richness of the information available through ALSPAC, and its establishment as a global classification system which would allow the comparison of ALSPAC data with other datasets coded to the same system around the world.

The ICECI system is divided in to modules and items. Each module covers a certain specific area of enquiry. There are seven core modules and a further 5 additional modules which provide a greater level of detail for certain core modules. The core modules are numbered C1 to C7:

C1	Intent	(+ additional module: Violence)
C2	Mechanism	(+ additional module: Transport)
C3	Object / substance	
C4	Place	(+ additional module: Place)
C5	Activity	(+ 2 additional modules: Sports & Occupational)
C6	Alcohol use	
C7	Drug use	

Within each module is a hierarchical list of items, each of which has a designated code, plus specific inclusion and exclusion criteria for that item. ICECI has been designed so that certain elements of ICECI can be used as required by the data collection system to which it is being applied.

For this handbook the mechanism module (C2) and Place module (C4) have been used. The level of detail of coding available through ICECI is greater than that needed to code the ALSPAC data, so an appropriate level of coding has been identified for each module.

ICECI does not provide codes for such information as the person(s) with the child at the time of injury, the treatment provided to the child, the part of the body injured or the type of injury resulting from the injury event. For these areas of data the original ALSPAC coding frameworks have been updated and inconsistencies clarified.

Each coding module in this manual begins with a section that provides a definition of the module, a guide for how codes in that module should be used (with examples where appropriate), the format of codes for that module, and the source of the codes for that module.

How to use the manual

Guide to which sections of the manual to use for different questions in the questionnaires

Note: symbols *,‡,¥,§ and $ indicate question responses that should be considered together before coding using the indicated framework. Question marks (?) indicate responses that may or may not provide information suitable for coding.

65 month questionnaire

No.	Question	Date of injury	Location of injury event	Mechanism of injury	Part of body injured	Outcome of injury event	Person with child	Treatment
	ALSPAC or ICECI framework	ALSPAC	ICECI	ICECI	ALSPAC	ALSPAC	ALSPAC	ALSPAC
A1	**Has s/he been burnt or scalded since 4½ yrs old?**							
c	Place accident happened		✓					
d	What was he/she burnt with?							
e	Date of accident	✓						
f	Injuries caused?			? ✓*	? ✓	? ✓		
g	Who was with her/him?						✓	
h	What did person with her/him do? Other							✓$
i	What treatment did the person with her / him give?							✓$
j	What other treatment did s/he have?							✓$
k	Describe how each accident happened			✓*				
A2	**Has s/he had a bad fall since 4½ yrs old?**							
c	Place accident happened		✓					
d	What did s/he fall from?							
e	Date of fall	✓						
f	Injuries caused?			? ✓*	? ✓	? ✓		
g	Who was with her/him?						✓	
h	What did person with her/him do? Other							✓$
i	What treatment did the person with her / him give?							✓$
j	What other treatment did s/he have?							✓$
k	Describe how each accident happened			✓*				
A3	**Has s/he swallowed anything s/he shouldn't have since 4½ yrs old?**							
c	Place accident happened		✓					
d	What did s/he swallow?							
e	Date of accident	✓						
f	Who was with her/him?						✓	
g	What did person with her/him do? Other							✓$
h	What treatment did the person with her / him give?							✓$
i	What other treatment did s/he have?							✓$
j	Describe how each accident happened			✓				
A4	**Has s/he had any other accidents or injuries since 4½ yrs old?**							
c	Place accident happened		✓					
d	What happened?			✓*				
e	Date of accident	✓						
f	Injuries caused				?X	✓		
g	Who was with her/him?						✓	

h	What did person with her/him do? Other							✓$
i	What treatment did the person with her / him give?							✓$
j	What other treatment did s/he have?							✓$
k	Describe how each accident happened			✓*				

78 month questionnaire (Questions D1-6), 103 month questionnaire (Questions E1-6), or 11y questionnaire (Questions C1-6)

No.	Question	Date of injury	Location of injury event	Mechanism of injury	Part of body injured	Outcome of injury event	Person with child	Treatment
	ALSPAC or ICECI framework	ALSPAC	ICECI	ICECI	ALSPAC	ALSPAC	ALSPAC	ALSPAC
Q1	**Has s/he been burnt or scalded in the past 12 months / since …..?**							
c	Place accident happened		✓					
d	What was he/she burnt with?							
e	Date of accident	✓						
f	Injuries caused?			?✓‡	?✓	?✓		
g	Who was with her/him?						✓	
h	What did person with her/him do? Other							✓¥
i	What treatment did the person with her / him give?							✓¥
j	What other treatment did s/he have?							✓¥
k	Describe how each accident happened			✓‡				
Q2	**Has s/he had an accident whilst playing sports or games in the past 12 months / since ….?**							
c	Place it happened		✓					
d	What happened?			✓‡				
e	Date of accident	✓						
f	Injuries caused?				?✓	?✓		
g	Who was with her/him?						✓	
h	What did person with her/him do? Other							✓¥
i	What treatment did the person with her / him give?							✓¥
j	What other treatment did s/he have?							✓¥
k	Describe how each accident happened			✓‡				
Q3	**Has s/he swallowed anything s/he shouldn't have in the past 12 months / since……?**							
c	Place accident happened		✓					
d	What did s/he swallow?							
e	Date of accident	✓						
f	Who was with her/him?						✓	
g	What did person with her/him do? Other							✓
h	What treatment did the person with her / him give?							✓
i	What other treatment did s/he have?							✓
j	Describe how each accident happened			✓				
Q4	**Has s/he had any injuries involving traffic in the past 12 months / since……?**							
c	Where was s/he and what was		✓	✓‡				

	s/he doing?							
d	What happened?			✓‡				
e	Date of accident	✓						
f	Injuries caused?				?✓	?✓		
g	Who was with her/him?						✓	
h	What did person with her/him do? Other							✓¥
i	What treatment did the person with her / him give?							✓¥
j	What other treatment did s/he have?							✓¥
k	Describe how each accident happened			✓‡				
Q5	**Has s/he ever been injured by the action of another person / since……..?**							
c	Person involved						✓§	
d	What happened?			✓‡				
e	Date of injury	✓						
f	Who else was with her/him?						✓§	
g	What did person with her/him do? Other							✓¥
h	What treatment did the person with her / him give?							✓¥
i	What other treatment did s/he have?							✓¥
j	Describe how each accident happened			✓‡				
Q6	**Has s/he had any other accidents or injuries in the past 12 months / since…..?**							
c	Place accident happened		✓					
d	What happened?			✓‡				
e	Date of accident	✓						
f	Injuries caused				?✓	?✓		
g	What did person with her/him do? Other							✓¥
h	What treatment did the person with her / him give?							✓¥
i	What other treatment did s/he have?							✓¥
j	Describe how each accident happened			✓‡				

Part B: Coding the injury event using adapted versions of the ICECI classification system

Mechanism of injury event

Definition
The way in which the injury was sustained (i.e. how the person was hurt)

Guide for use

- A physical injury results when human tissue is acutely exposed to some form of energy and sustains some form of damage. An injury may also result from an insufficiency of any of the vital elements (e.g. lack of oxygen during drowning or strangulation)
- Injuries are often the result of a sequence of events. Different types of mechanisms can be broadly separated into the ***underlying*** mechanism (i.e. that involved at the start of the injury event) and the ***direct*** mechanism (i.e. that producing the actual physical harm)
- The underlying and direct mechanisms may be the same, or may be separated by an intermediate mechanism.
- Because injury events often involve more than one mechanism, and the sequence of events may not be clear, identifying the underlying mechanism may be difficult.
- Up to two mechanism codes could be produced per injury event (one underlying and one direct), coded in that order
- If more than one injury results from the injury event, select the mechanism that resulted in the most severe injury.
- If more than one injury results from the injury event and the injuries are equally severe, or it is not known which is more severe, select the mechanism associated with the underlying and direct cause for the injury mentioned first in the case information
- The ICECI classification system codes mechanism of injury to three coding levels; the second and third being progressively more detailed. For coding the ALSPAC free text data, information will be coded to the second coding level only (except for transport-related injuries where the third level is necessary for identifying the vehicle, if any, involved in the injury event)

Examples
a) If a girl trips over a toy and cuts her forehead on a table, then the tripping over the toy is the underlying mechanism, and cutting her head on the table is the direct mechanism.
b) If a boy cuts his finger with a knife, then cutting his finger is both the underlying and the direct mechanism of injury

Code format
nn.n

Source
ICECI module C2: mechanism of injury (full version) (ICECI manual page 30)

Mechanism of injury coding framework

* 3rd level code used for transport injury events only

1st level code	2nd level code	3rd level code*	Mechanism	Inclusions (and exclusions)
1			**Blunt force**	
	1		Transport injury event	
		1	Victim was a Vehicle occupant	
		2	Victim was a Pedestrian	
		3	Victim was a Pedal cyclist	Not used for ‘fell off bike’ (use 1.5) where no other vehicle specified
		4	Victim was a Motorcyclist / motorcycle rider	
		8	Other specified transport injury event	
		9	Unspecified transport injury event	
	2		Contact with object or animal	Includes being hit by moving object (e.g. stick) or walking into something (e.g. wall), or being hit by falling or thrown object, or being hit by animal (e.g. kicked). Excludes contact with ground (use 1.5)
	3		Contact with person	Includes being hit, struck, kicked by person (including self) whether intentional or not
	4		Crushing	Includes pinching or crushing between objects or persons
	5		Falling, stumbling, jumping, pushed	Includes tripping or slipping on same level, from a height when falling, jumping or diving (including from steps) NB 1.5 used for DMech (direct mechanism) implies injury secondary to contact with ground. Used as default if UMech = fall but DMech not specified.
	6		Abrading, rubbing	
	8		Other specified contact with blunt force	
	9		Unspecified contact with blunt force	
2			**Piercing / penetrating force**	
	1		Scratching, cutting, tearing, severing, gashed or grazed	Includes being scratched or clawed by person or animal, or ripping, sawing or hacking off, (excludes biting (use 2.3), cut by machinery (use 3.2) or being stabbed (use 2.2))
	2		Puncturing, stabbing	Includes being shot by firearm or other weapon, as well as cutting or puncturing by a sharp object
	3		Biting, stinging, invenomating	Includes being bitten by oneself (e.g. ones tongue), by others, by animals, insects, jellyfish or reptiles, and anaphylactic shock post event
	8		Other specified piercing / penetrating force	
	9		Unspecified piercing / penetrating force	
3			**Other mechanical force**	
	1		Struck by explosive blast	Includes air pressure injuries and flying objects
	2		Contact with machinery	Includes recreational, industrial or farm machinery, or kitchen equipment (e.g. powered knife, blender, washing machine) or sewing machine
	8		Other specified mechanical force	
	9		Unspecified mechanical force	
4			**Thermal mechanism**	
	1		Heating	Includes contact with hot solid, liquid or gaseous substance or object, contact with fire or flame, or whole body heating e.g. sunstroke, or inhalation of smoke from burning object / substance (Excludes sunburn – use 98.2)
	2		Cooling	Includes natural or man-made cooled objects / substances, whole body or body part
	8		Other specified thermal mechanism	
	9		Unspecified thermal mechanism	
5			**Threat to breathing**	
	1		Mechanical threat to breathing	Includes hanging , strangling, compression to chest

				or airway, obstruction of airway by object or substance
	2		Drowning / near drowning	
	3		Confinement in an oxygen deficient place	
	8		Other specified threat to breathing	
	9		Unspecified threat to breathing	
6			**Exposure to chemical or other substance**	
	1		Poisoning by chemical or other substance	Includes solid substances (e.g. pills, tablets), liquids (e.g. medicines, alcohol, intravenous injections) or gases (e.g. car exhaust fumes, chemical dusts). Does not include inert solids (e.g. beads)
	2		Corrosion by chemical or other substance	Includes tissue damage due to chemical effects of strong acids, or alkalis etc
	8		Other specified effect of exposure to chemical or other substance	Includes swallowing batteries
	9		Unspecified effect of exposure to chemical or other substance	
7			**Physical over-exertion**	
	1		Acute over-exertion or over-extension	Includes twisting an ankle, or after lifting heavy weights
	8		Other specified physical over-exertion	Includes conditions of delayed or gradual onset, or due to cumulative effects e.g. running a marathon / rowing
	9		Unspecified physical over-exertion	
8			**Exposure to (effect of) weather, natural disaster or other force of nature**	
	1		Exposure to (effect of) precipitation	Includes storm, rain, sleet or snow, or hurricane, hail or flood
	2		Exposure to (effect of) wind	Includes tornado, windstorm, duststorm, blizzard
	3		Exposure to (effect of) earth or ocean movement	Includes earthquake, mudslide, avalanche, tidal wave
	4		Exposure to (effect of) eruption	Includes volcanic eruption, lava
	8		Exposure to (effect of) other specified natural force	Includes lightning
	9		Exposure to (effect of) unspecified natural force	
20			**Complications of health care**	
	1		Adverse effects related to drugs, medicaments, or biological substances	
	2		Foreign object left in body during surgical or medical care	
	3		Adverse incidents associated with medical devices in diagnostic or therapeutic use	
	4		Unintentional cut, puncture, perforation during surgical or medical care	
	5		Failure of sterile precaution during surgical or medical care	
	6		Abnormal reaction of the patient or later complication caused by surgical/ medical operations/ procedures without mention of misadventure at time of procedure	
	7		Non-administration of surgical or medical care	
	8		Other specified complication of healthcare	
	9		Unspecified complication of healthcare	
98			**Other specified mechanism of injury**	
	1		Contact with foreign body	Includes foreign body in eye, ear, nose, other

				orifice
	2		Exposure to electricity, radiation	Includes electrocution, sunlight (i.e. sunburn)
	3		Exposure to sound, vibration	
	4		Exposure to air pressure	
	5		Exposure to low gravity	
	6		Neglect, abandonment or lack of necessities of life	
	8		Other specified mechanisms of injury	
99			**Unspecified mechanism of injury**	
88			**Not an injury**	

Place of occurrence

Definition
Where the child was when the injury event started (not where the injury event ended)

Guide for use
- Place has two coding levels, the second being more detailed than the first.
- Not all places will require a second coding level
- In preference, always choose the category that refers to the larger environment, rather than a specific part of that environment (for example, if an injury occurred whilst in a swimming pool at a holiday park then code the place of occurrence as a Holiday park (10.5) rather than a swimming pool (5.3))
- If more than one injury is involved, select the place associated with the more severe injury. If the injuries are equally severe, or it is not known which is more severe, select the place that appears first in the code list
- In general places include their attached grounds, e.g. the Home includes, the garden, yard, shed, garage, path and driveway etc.

Code format
nn.nn

Source
ICECI module C4: Place of occurrence. (ICECI manual page 111) combined with P2: Place module for second level codes of the Home category (ICECI manual page 191)

Place of occurrence coding framework

1st level code	2nd level code	Place	Inclusions (and exclusions)
1		**Home**	Includes house, flat, weekend cottage, residential caravan, tent, boarding house, houseboat, motor home, mobile home, garage, garden, yard, driveway, playground / play equipment at the home, swimming pool at home, residence of a foster child
	01	Bathroom, toilet	
	02	Kitchen	*Added inclusions: utility room*
	03	Living room	*Added inclusions: lounge, sitting room, dining room, reception room, front room, back room, breakfast room*
	04	Bedroom	
	05	Playroom, family room	
	06	Home office	*Added inclusion: study*
	07	Classroom	
	08	Canteen, cafeteria	
	09	Balcony	
	10	Stairs	
	11	Elevator	
	12	Corridor	*Added inclusions: hall, landing, passage way*
	13	Lobby	*Added inclusions: porch, entrance way*
	14	Garden, yard	
	15	Garage	
	16	Driveway	
	17	Swimming pool	
	18	Tennis court	
	19	Other specified sporting facility	
	20	Playground	*Added inclusion of outdoor play equipment in the home, e.g. swing, slide, climbing frame etc*
	21	Private road	
	22	Private parking area	
	98	Other specified part of building or grounds	Includes roof, basement, *Added inclusions: shed, cellar, barn, conservatory, allotment*
	99	Unspecified part of building or grounds	
2		**Residential institution**	
	01	Home for the elderly	Place where generally healthy older people live and are cared for.
	02	Nursing home	Place of recovery from illness or injury, facility for those unable to care for themselves
	03	Prison	Police cell, jail, correctional centre, reformatory school
	04	Shelter for women and children suffering domestic violence	
	05	Military institution	Includes camps, base, training grounds, hospital, educational facilities
	08	Other specified residential institutions	Children’s home, orphanages, hospice
	09	Unspecified residential institution	
3		**Medical services area**	
	01	Hospital	
	02	Community clinic	Health centre, GP surgery building
	03	Health professionals office	Consultation room or examination room at a GP surgery
4		**School / educational area**	
	01	School or university	State schools, private schools, colleges, institutes of higher education, special schools, within the school building or grounds (but not sports area or playground – see below)
	02	Day care, pre-school	After school care, crèche
	03	Sports and athletics areas at school	
	04	Playground at school	

	05	Other specified area at school	
	06	Unspecified area at school	
5		**Sports and athletics area**	(not a swimming pool at home (use home) or sports facilities at schools (use school)
	01	Sports grounds (outdoor)	Football pitch, cricket ground, tennis court, running track etc
	02	Sports hall (indoor)	Tennis hall, fitness club, gymnasium, squash court
	03	Public swimming pool	
	04	Race track	Includes motor vehicle, motor bike, dog, horse or cycle track
	05	Equestrian facility	Pony club, riding school, (including a private stable / area, or a showring)
	06	Skating rink	Skate park, ice rink, roller rink, (but not roller-skating on the road – use road)
	07	Skiing or snowboarding area	Excludes water skiing – use body of water
	08	Other specific sports or athletics area	
	09	Unspecified sports or athletics area	
6		**Transport area: public highway**	
	01	Road	Street, dual carriageway, motorway, street parking area, lane
	02	Pavement	Pathway, footpath, designated walkway
	03	Cycleway	Cycle path, designated cycle lane marked on a road
	08	Other specified public highway	Ferry route
	09	Unspecified public highway	
7		**Transport area: other**	
	01	Public parking area	Car park whether free or commercial (not street parking – use road)
	03	Public transport facility	Bus terminal, underground station, railway station, airport, ferry terminal
	08	Other specified transport area	Includes pedestrian mall, railway line
	09	Unspecified transport area	
8		**Industrial or commercial area**	Building sites, demolition sites, factory, industrial plant, mine / quarry, ship / boat yard, other or unspecified
9		**Farm**	Place of primary production of crops, vegetables, nursery products, trees, fruits, animals or animal products for sale. Includes farm equipment buildings, barns, fields, land under cultivation. Excludes farmhouse (use home) or a farm based tourist part (use amusement park), allotment, other or unspecified
10		**Recreational area, cultural area or public building**	
	01	Public playground	Excludes play ground equipment at home (use home), or in school (use school)
	02	Amusement or theme park	Includes circus, zoo, fair ground, tourist farm
	03	Public park	Includes open spaces maintained by local authority, botanical gardens, recreation reserves, picnic areas, show ground, public square, country park
	04	Public building, non-cultural	Includes public hall, town hall, police station
	05	Holiday park, camp ground	Includes camp site, recreational caravan site, swimming pool at such a site
	06	Public building, religious	Includes cathedral, church, temple, parish hall, mosque, synagogue
	08	Other specified recreational or cultural area or public building	Includes museum, gallery, library, music hall, cinema, theatre, youth centre, stately home
	09	Unspecified recreational or cultural area or public building	
11		**Commercial area (non-recreational)**	
	01	Shop, store	Includes supermarket, shopping mall, bank, market, post office
	02	Commercial garage	Petrol station. Excludes private garage (use home)
	03	Office building	

	04	Café, hotel, restaurant	Includes bar, pub, dance club, night club, swimming pool of hotel, youth hostel
	08	Other specified commercial area	
	09	Unspecified commercial area	
12		**Countryside**	
	01	Area of still water	Pond, pool, farm reservoir
	02	Stream of water	River, stream, brook, canal, flooded area, dock
	03	Large area of water	Lake, sea, ocean, bay, estuary, reservoir
	04	Marsh, swamp	
	05	Beach, shore, or bank of a body of water	
	06	Forest	Includes paths, tracks and hiking trails
	07	Desert	Includes paths, tracks and hiking trails
	08	Other specified countryside	Includes mountains (if not forested), caves
	09	Unspecified countryside	
98		**Other specified place of occurrence**	
99		**Unspecified place of occurrence**	

Object / substance producing injury

Definition
The matter, material or object being involved in the injury event

Guide for use

- An object (e.g. a car, heater, knife) or substance (e.g. hot water, flames) conveys the mechanism of the injury
- Injuries are often the result of a sequence of events. Objects involved in the injury event can be broadly separated into the **Underlying object / substance** (i.e. that involved at the start of the injury event) and the **Direct object / substance** (i.e. that producing the actual physical harm)
- The underlying and direct object / substance may be the same, or may be separated by an intermediate object / substance.
- Several objects may produce different injuries during the same injury event.
- Up to three object / substance codes could be produced per injury event (one underlying, one direct, and one intermediate), coded in that order
- Object / substance can be coded up to three coding levels, the second and third being progressively more detailed.
- This manual describes codes to the second coding level only (except for food and drink where the need to specify hot drinks and alcohol warrants coding to the third coding level)
- In the ALSPAC questionnaires information on object / substance was only specifically and repeatedly requested for injuries related to burns / scalds and ingestions. **Therefore, this manual recommends coding of object / substance only for burns / scalds and ingestions. These should be recorded as a direct object / substance only.**
- If more than one injury occurs, select the object / substance that resulted in the most severe injury.
- If more than one injury occurs and the injuries are equally severe, or it is not known which is more severe, select the object / substances associated with the underlying and direct cause for the injury mentioned first

Examples
a) If a girl trips over a toy and falls against a fireguard, burning her hand, then the toy she trips over is the underlying object, and the fireguard is the direct object.
b) If a boy drinks bleach that has been placed in an old fruit juice bottle, then the bleach is both the underlying and the direct substance of injury

Code format
nn.nn (except for food / drink, coded to nn.nn.nn)

Source
ICECI module C3: object / substance producing injury (ICECI manual page 51)

Object / substance producing injury coding framework

1st level code	2nd level code	3rd level code	Object / substance	Inclusions (and exclusions)
1			**Land vehicle or means of land transport**	
	01		Person powered means of transport	Includes pedal cycle, bicycle (but not pram or buggy or stroller (use infant or child product)
	02		Animal powered means of transport	Includes animal drawn vehicle (e.g. horse and cart) or animal being ridden (e.g. horse)
	03		Motorised 2 or 3 wheeled vehicle	Includes motorcycles, moped, scooter
	04		Light transport vehicle with 4 or more wheels	Includes car, light truck, van, 4x4, jeep, pickup truck, minibus or school bus (if seats up to 10 people)
	05		Heavy transport vehicle with 4 or more wheels	Includes bus, coach, tractor-trailer, articulated lorry
	06		Rail vehicle	Includes tram, train, funicular, monorail
	07		Parts or components of a land vehicle	Includes doors, seat belts, airbags, tyres, batteries, windows, windshield, engine, interior of vehicle (e.g. dashboard, steering wheel), bicycle chain
	98		Other specified land vehicle	Includes cable car, ski lift, gondola, motorised wheelchair, small sized motorised vehicles for children, motor home
	99		Unspecified land vehicle	
2			**Mobile machinery / special purpose vehicle**	
	01		Mobile machinery / special purpose machinery mainly used in agriculture	Includes tractor, combine harvester, ride on lawnmower, fertiliser spreader, cultivator
	02		Mobile machinery / special purpose machinery mainly used in industry	Includes fork lift, mobile crane, battery powered airport passenger vehicle
	03		Mobile machinery / special purpose machinery mainly used in construction	Includes bulldozer, excavator, digger, road roller
	98		Other specified mobile machinery or special purpose vehicle	Includes ambulance, fire engine, race car, snowmobile, special all terrain or off road vehicle (includes quad bike, dirt bike)
	99		Unspecified mobile machinery or special purpose vehicle	
3			**Watercraft or means of water transport**	
	01		Powered (motorised) watercraft	Includes cargo ship, merchant ship, passenger ship, liner, fishing boat, ferry, motorised yacht, motorboat, powerboat, dinghy / row boat with outboard motor, jet-ski, houseboat, hovercraft, submarine, airboat
	02		Unpowered watercraft	Includes sailboat, canoe, kayak, row boat, surfboard, windsurfer
	03		Part / component of watercraft	Includes boarding plank, propeller, onboard machinery
	98		Other specified watercraft	
	99		Unspecified watercraft	
4			**Aircraft or means of air transport**	
	01		Powered aircraft	Includes helicopter, airship, ultralight aircraft, fixed wing aircraft, spacecraft
	02		Unpowered aircraft	Includes passenger balloon, parachute, hang-glider, glider,
	03		Part / component of aircraft	Includes boarding steps, machinery onboard aircraft, propeller
	98		Other specified aircraft	
	99		Unspecified aircraft	
5			**Furniture / Furnishings**	
	01		Bed, bedding, bedding	Includes mattress, bed base, bunk bed, special

			accessories	bed, orthopaedic bed, stretcher, hammock, air / camping mattress, sofa bed, futon, waterbed, pillow, bed linen, duvet, blanket, sleeping bag
	02		Chair, sofa	Includes upholstered chair, sofa, couch, hard chair, bench, rocking chair, folding chair, revolving chair, stool, ottoman, hassock, commode chair
	03		Table, stand, cupboard, shelf or partition	Includes rack, bookshelf, cabinet, cupboard, sideboard, chest of drawers, tall boy, dresser, dining table, kitchen table, coffee table, night table, bedside table, desk, workbench, television table, television stand, television cupboard, folding table, room divider or partition
	04		Decoration, decorating item	Includes rug, mat, loose carpet, curtains, roller blinds, Venetian blinds, shutters, window covering hardware (e.g. hook, rod, cord, ring), mirror, picture, picture frame, wall hanging, ornament, vase, statue, Christmas tree, holiday decorations (e.g. fairy lights, Christmas decorations)
	98		Other specified furniture / furnishing	
	99		Unspecified furniture / furnishing	
6			**Infant or child product**	
	01		Baby or child article	Includes pram, buggy, stroller, pushchair, baby walker, high chair, booster seat, baby or child car seat, cot, baby bed, playpen, baby gate or barrier, baby carrier (backpack), baby seat on a pedal cycle, baby bath, changing table, dummy, baby bottle, nappy, nappy fastener, rattle, teething ring
	02		Toy	Includes tricycle, ride on toy, toy vehicle, toy weapon (gun, knife, bow and arrow), art / craft kit, building / modelling kit, chemistry / science kit, board game or accessory or piece, toy sports equipment, ball, flying toy (e.g. Frisbee, kite), doll or accessory or part, soft toy, balloon, inflatable toy, marble, bead, play tent or tunnel or enclosure, toy box or chest
	03		Playground equipment	Includes tree house, play house, climbing frame, swing, slide, seesaw, flying fox (track glide), powered amusement ride (e.g. roller coaster, merry go round)
	98		Other specified infant or child product	
	99		Unspecified infant or child product	
7			**Appliance mainly used in household**	
	01		Cooking or kitchen appliance	Includes electric kettle, Electric frying pan, deep fryer, bread making machine, food processor, blender, juicer, powered knife, toaster, microwave oven, other electric cooking or food processing appliance (e.g. slow cooker, coffee maker, can opener), stove / hob / grill / oven / aga, BBQ / outdoor grill, dishwasher, refrigerator, freezer
	02		Cleaning or laundering appliance tool	Includes washing machine, clothes dryer, iron, clothes press, clothes line, drying frame / clothes horse, cleaning tool (e.g. broom, brush, mop), vacuum cleaner, other powered or unpowered cleaning tool
	03		Lighting appliance	Includes gas, oil or kerosene lamp, electric lamp, lampshade, battery torch, candle, candlestick
	04		Heating or cooling appliance	Includes electric or gas radiator / heater, kerosene heater, fan, domestic boiler, hot water system, solar hot water system, heated towel rail
	05		Sewing appliance or equipment	Includes sewing machine, scissors, pin, needle, other equipment
	06		Entertainment appliance	Includes television, video recorder / decoder / player, video camera, camera, camera or video accessory, sound equipment (e.g. hi-fi, stereo, speakers)
	98		Other specified household	Includes appliance cord, extension lead

			appliance	
	99		Unspecified household appliance	
8			**Utensil or container**	
	01		Cooking or food processing utensil	Includes non-electric kettle, knife, cooking pot / pan / saucepan / tin, pressure cooker, cutlery, food preparation utensil
	02		Crockery, kitchen container	Includes drinking glass, plate, bowl, dish, glass bottle or jar, container made of plastic, wood or clay
	03		Cleaning utensil or container	Includes bucket, pail, etc
	04		Food storage or related utensil or container	Includes tinned container, tin can, box or carton, grocery or shopping trolley or cart
	98		Other specified utensil or container	Includes rubbish bin, dustbin, wheelie bin, heavy box, bag or sac
	99		Unspecified utensil or container	
9			**Item mainly for personal use**	
	01		Clothes, footwear or related product	Includes belt, sash, button, other clothes fastener, shoe, sandal, slipper, boot, part of shoe, shirt, blouse, t-shirt, trousers, skirt, jacket, coat, outerwear, nightwear, underwear, socks, gloves, hat
	02		Clothing accessory or personal decoration item	Includes wristwatch, jewellery, scarf
	03		Personal grooming utensil	Includes hair dryer, curler, straightener, comb, hairbrush, razor, razorblade, electric shaver, toothbrush, hair clip
	04		Toiletries, cosmetics or related products	Includes cleaning agent for contact lenses, dental care products (e.g. toothpaste, mouthwash), cotton bud, soap, deodorant, hair colouring product, hair removal preparation, other hair product, nail polish, nail polish remover, body cream, facial cream, body powder (talcum powder), cosmetics, suntan protection cream, self-tan cream, essential oils (as in aromatherapy)
	05		Communication or related utensil or accessory	Includes telephone, mobile phone and accessories (e.g. charger), personal computer and accessories (e.g. printer, speakers, CDs), fax machine and accessories, typewriter correction fluid, pen, pencil, other stationary item (stapler, hole punch, letter opener, pencil sharpener)
	06		Arts and crafts supplies	Includes paints, chalks, crayons, glazes, canvases
	07		Personal aid	Includes glasses, sunglasses, contact lenses, wheelchair, cane, walking stick, walking frame, prosthetic limb, or eye, pacemaker, rubber bath mat
	08		Tobacco or related product	Includes cigarette, cigar, pipe, lighter, match, aids to quit smoking (including patch, gum), ashtray, pipe tobacco, chewing tobacco
	98		Other specified personal use item	Includes vaporiser, oil burner, condom, contraceptive device, sex aids, clock, umbrella, coins, hand held fan
	99		Unspecified personal use item	
10			**Equipment mainly used in sports or recreational activity**	
	01		Ball used in sport	Includes soft ball (e.g. tennis ball, squash ball, football), hard ball (e.g. golf ball, cricket ball, hockey ball, baseball)
	02		Hand held sports equipment	Include spear, javelin, bow & arrow, bat, hockey stick, racquet, ice pick
	03		Equipment / structure for playing sports and exercise	Includes net, rugby pole, net pole, goal post, trampoline, gymnastic equipment, sports mat, diving board or platform, moveable fitness equipment (e.g. dumbbell), fixed fitness equipment (e.g. stationary cycle
	04		Equipment with wheels or designed for movement in sport or recreation	Includes roller skates, roller blades, inline skates, skateboard, folding scooter, water ski, snow ski, snowboard, ice skate, sledge or toboggan, sleigh,
	05		Underwater diving equipment	Includes aqualung, diving belt, wetsuit, goggle,

				mask, flipper, snorkel
	98		Other specified equipment for sports / recreational activity	Includes personal protective equipment e.g. Mouth guard, knee pad, helmet
	99		Unspecified equipment for sports / recreational activity	
11			**Tool, machine, apparatus for work related activity**	
	01		Machinery or fixed plant tool	Includes machinery or tools for cutting, crushing, heating, cooling, lifting, or moving, Mains (gas, water, electricity, sewerage, hot water, steam) or tool, steam engine
	02		Powered hand tool / equipment	Includes drill, chainsaw, power saw, welding equipment / soldering iron, nail/glue gun, grinder / buffer / polisher / sander, powered garden tool, powered push lawnmower, Industrial vacuum cleaner
	03		Unpowered hand tool / equipment	Includes push lawnmower, hammer, mallet, chopping tool, cutting tool, digging tool, lifting tool, nail, screw, tack, nut
	04		Pressure based equipment	Includes gas cylinder, pressurised hose or pipe
	05		Other unpowered equipment	Includes ladder, scaffolding, helmet, earplugs, welding mask, personal protective equipment (e.g. gloves, mask), fire extinguisher
	98		Other specified tool, machine, apparatus for work related activity	
	99		Unspecified tool, machine, apparatus for work related activity	
12			**Weapon**	
	01		Sharp object	Includes spear, arrow, bolt, knife, sword, dagger, cutlass, machete, other
	02		Firearm or related object	Includes hand gun, rifle, shotgun, airgun, bullet, pellet, flare gun
	98		Other specified weapon	Includes club, cudgel, rod, electrical prod, stun gun, pepper spray, mace
	99		Unspecified weapon	
13			**Animal, plant or person**	
	01		Plant	Includes whole plant or part thereof (seed, fruit, thorn, branch, stick, root, leaves, flowers)
	02		Bird	
	03		Insect, invertebrate	Includes bee, wasp, ant, spider, tick, caterpillar, other
	04		Land mammal	Includes dog, cat, rat, guinea pig, mouse, pig, sheep, goat, cow, horse, monkey, marsupial, deer, other
	05		Marine mammal	Includes shark, fish, sea snake, jelly fish, coral, dolphin, sea lion, urchin, other
	06		Reptile or amphibian	Includes snake, lizard, frog, toad, crocodile alligator
	07		Person	Includes self, crowd of people, other specified person, unspecified person
	98		Other specified animal	
	99		Unspecified animal	
14			**Building, building component, or related fitting**	
	01		Building fitting	Includes flush toilet, pit latrine, bathtub, shower, fitted counter / worktop
	02		Door, window or related fitting	Includes door, door sill, window pane, window handle, window sill exterior shutters
	03		Floor or related fitting	Includes floors of any finish, i.e. includes carpet, tile, brick, wood, clay etc. Excludes loose carpet or rugs
	04		Wall or related fitting	Includes fireplace, built in BBQ, Brick / concrete / tiled / wood / other wall
	98		Other specified building or component of fitting	Includes swimming pool, hot tub, spa, fence, gate, stairs, steps, handrail, banister, electric sockets / switches / cable, air conditioning, water or gas pipes
	99		Unspecified building or	

			component of fitting	
15			**Ground surface or conformation**	
	01		Ground surface	Includes cliff, slope, ramp, ditch, pit, drain, other
	02		Body of water	Includes man made well, reservoir, dam, lake , puddle, swamp, marsh, beach, seashore, river, streams, sea, other.
	98		Other specified surface conformation	
	99		Unspecified surface conformation	
16			**Materials NEC**	
	01		Natural materials	Includes snow, ice, rock, stone, grass, wood (includes splinters), soil, sand, gravel, grain, sun, leaves, berries
	02		Manufactured / industrial materials	Includes artificial grass, bitumen, asphalt, brick, concrete, metal, china, ceramics, glass, frozen liquids, plastics, paper, cardboard
	98		Other specified materials	
	99		Unspecified materials	
17			**Fire, flame & smoke**	
	01		Fire & flame	Burning oils, gases, controlled fires (e.g. fire in fireplaces, campfire), uncontrolled fires (e.g. burning building, furniture, forest fire)
	02		Smoke	
	99		Unspecified	Includes cases where it is obvious that fire or flame caused the injury (e.g. burns), however the actual cause is not specified
18			**Hot objects / substances NEC**	
	01		Hot liquid	Includes hot tap water, boiling water (excludes hot drink – use food / drink)
	02		Hot gas / air	Steam, hot vapour, other
	98		Other specified hot objects / substances	Embers, test tube
	99		Unspecified hot objects / substances	
19			**Food, drink or related product**	
	01	05	Hot cooking oil or fat	
		10	Hot solid food	
		15	Hot drink	
		20	Cold solid food	
		25	Cold drink non-alcoholic	
		30	Cold drink alcoholic	Excludes methylated spirits
	98		Other specified food or drink	
	99		Unspecified food or drink	
20			**Pharmaceutical substance for human use (drug or medicine)**	
	01		Analgesic, antipyretic, anti-inflammatory	
	02		Antimicrobial, anti-infective, antibiotic	
	03		Cough and cold preparation	
	04		Asthma therapy	
	05		Antihistamine	
	06		Antidepressant	
	07		Sedative, hypnotic, antipsychotic	
	08		Anticonvulsant	
	09		Cardiovascular drug	
	10		Diuretic	
	11		Anticoagulant	
	12		Gastrointestinal preparation	Includes antacid, laxative, antidiarrhoeal
	13		Diagnostic agent	Includes radiographic agent, agent for urinanalysis
	14		Anti-neoplastic agent	
	15		Anaesthetic	
	16		Muscle relaxant	
	17		Narcotic antagonist	
	18		Ear, nose and throat preparation	
	19		Topical preparation	Includes head lice shampoo

	20		Vitamin or dietary supplement	
	21		Electrolyte or mineral	Includes calcium, fluoride, iron
	22		Vaccine, toxoid or serum	
	23		Hormone, contraceptive, hormone antagonist	
	24		‘Street’ or recreational drug	Includes amphetamines, cocaine, crack, ecstasy, heroin, LSD, marijuana
	98		Other specified pharmaceutical product	Includes nicotine replacement, diet aid
	99		Unspecified pharmaceutical product	
21			**Other non-pharmaceutical chemical substance**	
	01		Glue or adhesive	
	02		Fuel or solvent	
	03		Paint, or stripping agent	
	04		Pet product, pesticide or herbicide	Includes dog shampoo, flea powder, rat poison, weedkiller, ant killer, moth ball
	05		Cleaning agent	Includes detergent, dishwasher tablets, soaps, bleach, chorine
	06		Reactant used in chemical industry process	Includes battery acid
	98		Other specified non-pharmaceutical chemical substance	Includes motor vehicle exhaust gas, carbon monoxide, lead, mercury, plant food, fabric dye, leather dye, food dye, photographic products, traditional remedies, aromatherapy oils, fluorescent necklace fluid
	99		Unspecified chemical substance	
40			**Medical or surgical device**	
	01		General hospital or personal use device	Includes hypodermic syringe, thermometer, hoist
	02		General or plastic surgery device	
	03		Anaesthesiology device	
	04		Cardiovascular device	
	05		Ear, nose & throat device	
	06		Gastroenterology device	
	07		Neurological device	
	08		Obstetric or gynaecological device	
	09		Ophthalmic device	
	10		Orthopaedic device	
	11		Radiological device	
	12		Physical medicine device	
	98		Other specified device	
	99		Unspecified device	
98			**Other specified object or substance**	
	01		Law enforcement equipment	Includes handcuffs (excludes truncheon, use weapon)
	02		Public use item	Includes fire hydrant, telegraph pole, street light, overhead power line, pedal cycle rack, bus shelter
	03		Camping equipment	Includes tent, camping stove, propane lamp
	04		Fastening binding, or securing item	Includes rope, string, twine, wire, barbed wire, chain, elastic band
	05		Explosive or flammable object / substance	Includes fireworks, explosives
	98		Other specified object / substance	Includes high pressure jet, laser light, sharp object NEC, blunt object NEC, motor engine NEC, dry cell battery, disc battery, Battery NEC, animal cage, vomitus, excrement, blood, body NEC, plastic, rubbish, litter, padlock, key, magnet, tooth
99			**Unspecified object or substance**	

Part C: Coding the injury event using updated versions of the ALSPAC classification system

Date of injury

Definition
The date on which the injury event occurred

Guide for use
- The month and year should be recorded numerically, using two digits for the month, a forward slash, then four digits for the year

Example
'June 99' should be coded as 06/1999

Code format
mm/yyyy

Source
ALSPAC coding framework

Notes for analysis
- Convert digital month (mm) into 3 characters, e.g. Jan, mmm
- If parent reports 'approx May 2001' then code as May 2001
- If parent reports '? May 2001' then code as May 2001
- If parent report is unclear then use 444 for month and 4444 for year, e.g. if parent reports May 2001/2002 then code as May 4444, if parent reports May/Jun 2001 then code as 444 2001
- If parent reports 'don't know' or leaves blank then code as 555 for month and 5555 for year
- If parent reports just a month and no year then record as 3333. Can assume to be same year or the last time that month occurred within the last year if date questionnaire received correlates with this.
- If 'this year', 'last year', 'in the autumn', 'at Christmas', 'on holiday' or equivalent is the only information relating to the timing of the injury available, then discuss with statistician. If able to confidently decide on year, on basis of date of return of questionnaire then code appropriately, otherwise code as don't know.

Person / people with the child

Definition
The person or people with the child at the time the injury event started

Guide for use

- This set of codes has been designed primarily to identify whether or not this child had any supervision at the time of the injury event. It therefore seeks to identify adults or other children and their relationship (if any) to the child who becomes injured.
- The second use of this module is to provide the coding framework to identify the person involved when a child is injured by the actions of another person.
- One code should be entered per injured child for the person providing supervision and one code for the person involved in an injury caused by the actions of another person (where applicable)
- If the person completing the questionnaire has recorded 'me' or 'myself' code as 95. When the coded data is added to the main dataset this will be recoded according to the person completing the questionnaire.
- If the person completing the questionnaire has recorded 'self' code as 96. It may or may not be possible to recode this category at a later time.
- If accompanied by two or more specified adults, both of whom are relatives (e.g. mother and aunt), then code the most direct relative, e.g. code mother over aunt or grandmother, or code grandmother over aunt or other
- If mother and father both present, then code as mother if mother listed first, and father if father listed first, unless stepfather and mother, or stepmother and father, when list natural parent first.
- If accompanied by two or more people, one of whom is an adult and one is a child (e.g. Granny and sister) then code the adult, not the child
- If accompanied by two or more people, one of whom is a relative and one is not (e.g. brother and friend, or aunt and neighbour) then code the relative, not the friend
- If accompanied by two or more specified adults, neither of whom are relatives (e.g. teacher and classroom assistant) then code the most senior person with responsibility for the child
- If accompanied by a group of adults, or a group of adults and children, where at least one adult is specified, but does not fulfil any of the above categories, code as 98
- If accompanied by a group of adults, or a group of adults and children, where no adult is specified, code as 99

Broadly:
Parents recorded over Family over Friends
Specified adults recorded over unspecified adults

Code format
nn

Source
Updated ALSPAC coding framework

Coding framework for person / people with the child

Code	Includes
00	No one / alone / by himself / by herself
01	Mother / Mum (natural or step or adopted)
02	Father / Dad (natural or step or adopted)
03	Parent(s) unspecified
04	Sibling(s) / brother(s) / sister(s)
05	Other child(ren) NEC (i.e. no adults present) e.g. friends, classmates, pupils, mates
06	Grandparent(s)
07	Aunt / Uncle (s) / other adult relative / family NEC
08	Cousin(s) / other child relative
09	School staff (adults) (includes teacher, classroom assistant, playground assistant, dinner lady, whole school etc)
10	Designated carer (includes child minder, babysitter, social services, foster carer, au pair etc)
11	Stranger(s) / unknown person(s)
95	Me / Myself / I / us / partner / we
96	'Self'
97	Other specified adult(s) NEC (includes adult friends, but excludes strangers), with or without children also present e.g. family friend, coach, instructor, scout leader, brown owl, 'others', 'other people'
98	Unspecified adult(s) with or without children also present
99	Don't know / not known / left blank / not asked

Part of the body injured

Definition
The region of the child's body affected by the injury

Guide for use
- If more than one injury occurs, and all injuries occur in the same body region, select that body region
- If more than one injury occurs, and the injuries occur in different body regions, then consider the severity of injury. If it is obvious that one injury is more serious than the other (e.g. fell over, broke right forearm and grazed right knee), then select the part of the body affected by the more severe injury.
- If more than one injury occurs and the injuries occur in different body regions but the injuries are equally severe, or it is not known which is more severe, select 'multiple sites'

Code format
nn

Source
Updated ALSPAC coding framework

Coding framework for part of the body injured

Code	Includes
00	None
01	Upper arm, forearm, wrist (upper limb excluding hand, fingers or thumb)
02	Hand
03	Fingers, thumb
04	Thigh, leg, knee, hip (Lower limb excluding ankle, foot or toes)
05	Torso (including neck, chest, back, tummy, bottom, genital area 'between the legs', collar bone)
06	Face and head (includes mouth, lips, nose, eyebrow and ears, but excludes teeth and eyes)
07	Eye or Eyes (includes eyelid and 'black eye' but excludes 'cut above the eye (use 06))
08	Tooth or teeth
09	Multiple sites
10	Ankle
11	Foot, toes
99	Don't know / no body part recorded / not applicable (e.g. ingestion)

Outcome of injury event

Definition
The type of injury that the child sustains as a result of the injury event

Guide for use

- This coding framework helps to identify the type of injury sustained when the person completing the questionnaire has responded to the questions relating to 'Has he/she had any *other* accidents or injuries?'
- It allows the identification of injuries resulting in e.g. fractures or head injuries.
- There will be some overlap with mechanism of injury e.g. the recording of 'a cut' will be used both to identify the direct mechanism of injury, and the outcome of that injury.
- If more than one injury is sustained, select the more severe injury where this information is known. If the injuries are equally severe, or it is not known which is more severe, select the outcome of the injury that occurs first in the record

Code format
nn.nn

Source
New ALSPAC coding framework

Coding framework for outcome of injury event

1st level code	2nd level code	Outcome of injury event	Inclusions (and exclusions)
1		**Bony injury**	**Damage to the integrity of the bone, with or without skin trauma**
	01	Fracture	Break in any bone (specified or unspecified), or damage to the surface of the bone if not all the way through the bone e.g. greenstick fracture.
	02	Dislocation of a joint	Includes pulled elbow
2		**Skin trauma without bony injury**	**Damage to the continuity of the skin surface**
	01	Cut, laceration, gash, graze, wound, 'scrage'	Note; assume 2.01 if injury not specified but action included stitches, glue, plasters, dressings etc
	02	Burn, scald or blister	With or without mark to skin if recorded as burn or scald
	03	Sting or bite	
3		**Injury without skin trauma or bony injury**	
	01	Bruising, swelling, bump, lump, mark on skin,	Includes part of body being crushed (e.g. finger) if no skin trauma stated
	02	Over exertion / over stretching injury	Includes twisted ankle, sprains, strains, 'pulled' muscles, ligament injury, 'went over on foot', whiplash. Note; assume 3.02 if injury not specified but action included strapping or support
	03	Foreign body in orifice	Foreign body in any orifice
	04	Ingestion of foreign body or substance	
4		**Head injury**	
	01	Head injury with any loss of consciousness	Includes being 'knocked out'
	02	Head injury without any loss of consciousness	May include parental report of 'concussion', but if action included 'neuro obs' or 'admission, then consider if 4.01. Note for 'bump to head' use 3.01, for cut to head use 2.01
	99	Head injury with loss of consciousness unspecified	
5		**Eye injury**	
	01	Eye injury with consequent loss / impairment of vision	
	02	Eye injury without consequent loss / impairment of vision	
6		**Dental injury**	
7		**Other injury**	Any other injury NEC e.g. back pain, shoulder injury, nose bleed, 'hurt' or 'sore'part of body where no other detail given
8		**No visible injury**	Parent-reported 'None'
9		**Near drowning**	
99		**Not known / not specified**	Blank or inadequate information given, e.g. 'hit arm' or 'hurt hand'

Treatment given

Definition
The actions taken by the person or people who come into contact with the child as a consequence of the injury sustained

Guide for use

- This coding is intended to be used with answers to the question 'What did the person with him/her do?' (Options for completing this part of the questionnaire were "Nothing", "Treated him/her themselves", "Took to doctor", "Took to hospital" and "Other". If the person completing the questionnaire ticked the option "Other" they were asked to provide details of what was done.) **and** the question 'What treatment did the person with her/him give?
- A single code should be assigned to capture the action that suggests the severity of the injury, e.g. Admitted to hospital should be coded in preference to Taken to hospital. Similarly, Taken to doctor should be coded in preference to Phoned or discussed with doctor etc

Code format
nn

Source
Updated ALSPAC coding framework

Coding framework for treatment given

Code	Includes
01	None / nothing / no treatment required
02	Treated him/her themselves / first aid
03	Treated by / seen by primary care doctor or nurse
04	Treated by / seen by dentist
05	Treated by / seen by hospital doctor or nurse (i.e. secondary care or tertiary care)
06	Admitted to hospital for treatment
07	Taken to adult with responsibility (e.g. teacher, grandmother, social worker) and no other treatment specified
08	Taken to parents / taken home and no other treatment specified
09	Phoned or discussed with parents and no other treatment specified
10	Phoned or discussed with doctor / nurse / hospital / dentist and no other treatment specified
11	Other
99	Don't know / not answered / unclear

Part D: Appendices

Glossary

Adapted from ICECI coding manual (version 1.2, June 2004)

Abrading
Injury caused by scraping or wearing away with pressure or friction over the surface of the skin or other tissue (= rubbing)

Aircraft
Any device for transporting passengers or goods in the air

Amusement park
A commercially operated park with rides and other devices for entertainment and booths for the sale of food and drink

Being taken care of
Undergoing activities conducted by or at the direction of a health care professional or other care taker e.g. parent, relative includes health care activity, being carried or held, being bathed

Blunt force
Any external force that produces a change in the speed or direction of a moving object or that causes a stationary object to deform or move and that does not involve piercing or penetrating forces or machinery

Bus
A motor vehicle designed or adapted primarily for carrying 20 or more persons and requiring a special driver's licence. Excludes minibus and passenger van

Car (= automobile)
A four wheeled motor vehicle designed primarily for carrying up to 10 persons. Excludes passenger van

Commercial area
Location being used at the time primarily for business-related activities that are non-industrial, non-recreational, non-cultural and not public, including buildings and adjacent grounds

Construction area
Location being used at the time primarily for building or demolition including buildings and adjacent grounds

Contact with foreign object
Contact between human tissue and an object not belonging where it is found, e.g. grit in the eye, a bead in the ear

Cycleway
Part of the pubic highway designed, improved and customarily used for pedal cycle traffic

Direct mechanism
The mechanism that causes the actual physical harm

Drowning
Death following submersion or immersion and includes cases where death occurred after hospital admission

Fall / Falling
To descend or drop by force of gravity, i.e. a non-syncopal event not due to sustaining a violent blow, loss of consciousness, stroke or epileptic seizure. Includes falling on same level, falling from a height and falling on stairs etc.

Farm
Any place of primary production of at least one of the following products intended for sale: crops, vegetables, horticultural specialities, nursery products, trees, fruits, nuts, animals, animal products, including buildings and adjacent grounds

Home
Person's usual residence including adjacent grounds

Indoor / outdoor
Describes whether the person was inside a building or in the open air when the injury event started

Industrial area
Location designed primarily for, and being used at the time primarily for, manufacturing, mining, extraction and other industrial activities, including buildings, other structures, excavations and adjacent grounds

Infant or child product
An object or substance made especially for the care or amusement of children

Injury event
The incident leading to the injury

Mechanical force
A force that concerns machines, i.e. actions preformed with or worked by machinery

Mechanism of injury
Data element that describes the way in which the injury was sustained, i.e. how the person was hurt

Medical services area
Location designed primarily for and being used at the time primarily for, providing healthcare, including buildings and adjacent grounds

Motorcycle rider
Any person riding on a motorcycle or in a sidecar or trailer attached to such a vehicle

Near drowning
Survival after submersion or immersion

NEC
Not elsewhere classified

Parking area
A location open to the public as a matter of right or custom designed primarily for and being used for at the time primarily storing transport devices or vehicles

Part of building or grounds
Describes the specific part of a building or the adjacent grounds where the injured person was when the injury event started

Passenger
Any occupant of a transport vehicle or a pedestrian conveyance other than the driver or operator

Pedal cycle
A land transport vehicle operated solely by pedals includes bicycle, tricycle but excludes motorised bicycle or child's toy tricycle.

Pedal cyclist
Any person riding on a pedal cycle or in a sidecar or trailer attached to such a vehicle

Pedestrian
Any person travelling from one place to another involved in a transport injury event who was not at the time of the event, riding in or on a motor vehicle, pedal cycle, railway train, streetcar, animal or animal drawn vehicle, watercraft or aircraft. Includes person on foot or user of a pedestrian conveyance.

Pedestrian conveyance
Includes baby carriage, pram, ice-skates, in-line skates, roller skates, pushchair, scooter, skateboard, skis, sled, wheelchair

Piercing / penetrating force
A force that makes a hole in or through, that punctures or forces a way through or into human tissue

Place of occurrence
Describes where the person was when the injury event started

Private parking area
Location explicitly not open to the pubic designed primarily for, and being used at the time primarily for, storing transport devices or vehicles.

Public highway (= traffic way, street, road)
The entire width between the property lines (or other boundary lines) of land open to the public as a matter of right or custom for purposes of moving persons or property from one place to another

Public transport area
Location designed primarily for, and being used at the time primarily for, receiving and discharging passengers or cargo of public transport devices

Rail vehicle
Any device with or without cars coupled to it, designed for traffic on a railway (includes streetcars, diesel or electric train, funicular, monorail, subterranean or elevated)

School, educational area
Location designed primarily for, and being used at the time primarily for, education purposes, including buildings and adjacent grounds

Sports and athletics area
Location designed primarily for, and being used at the time primarily for, sports and exercise or athletics, including buildings and adjacent grounds

Thermal mechanism
Mechanism involving extreme heat or cold, from either natural or man-made sources

Transport area
Location designed primarily for, and being used at the time primarily for, conveying persons or goods from one place to another

Transport device
A device designed primarily for, and being used at the time primarily for, conveying persons or goods from one place to another

Underlying mechanism
The mechanism involved at the start of the injury event

References

- ICECI Coordination and Maintenance Group. International Classification of External Causes of Injuries (ICECI) (version 1.2). Adelaide: Consumer Safety Institute, Amsterdam and AIHW Injury Surveillance Unit, 2004.

- The Injury Database (IDB) Coding Manual (version 1.1). Amsterdam: Consumer Safety Institute, 2005.

- Nordic Medico-Statistical Committee. NOMESCO Classification of External Causes of Injury (version 3.1). Copenhagen: Nordic Medico-Statistical Committee, 1997.

APPENDIX 7: INDEPENDENT VARIABLES USED IN ANALYSIS OF RISK FACTORS

Each independent variable used in the analysis of risk factors for injury is described including its derivation, prevalence, and relationship to hospital attended injury, stratified by age and gender. Variables are described in four categories; child, family, home and environment.

Child variables

1) Gender
Variable name = Kz021
Variable definition = Sex
Coding: male=1, female=2, recoded to Kz021b: male=1, female=0
Prevalence: Male n=2902 (50.45%), Female n=2850 (49.54%), Missing n=0

Early primary:

	Gender		
AnySCI56	Female n (%)	Male n (%)	Total n (%)
No hospital attended injury	2564 (89.96)	2449 (84.39)	5013 (87.15)
Any hospital attended injury	286 (10.04)	453 (15.61)	739 (12.85)
Total	2850 (100.00)	2902 (100.00)	5752(100.00)

Pearson X^2=39.9101, p<0.001

Late primary:

	Gender		
AnySCI811	Female n (%)	Male n (%)	Total n (%)
No hospital attended injury	2208 (77.47)	2170 (74.78)	4378 (76.11)
Any hospital attended injury	642 (22.53)	732 (25.22)	1374 (23.89)
Total	2850 (100.00)	2902 (100.00)	5752(100.00)

Pearson X^2=5.7554, p=0.016

2) Hearing impairment

Early primary
Variable name = Km2061
Variable definition = Has your child been seen at the hearing assessment centre or by a specialist since their 4th Birthday?
Coding: Yes=1, No=0,
Prevalence: Yes=707 (12.3%), No=925 (16.1%). Missing=4120 (71.6%)

Recoding: As the majority of the missing category are likely to include parents who had a child that did not attend a hearing assessment centre, recode to combine no/missing (Km2061cat).
New Coding: No/missing=1, Yes=2
Prevalence: No/missing = 5054 (87.71%), Yes= 707 (12.29%)

	Km2061Cat		
AnySCI56	No n (%)	Yes n (%)	Total n (%)
No hospital attended injury	4408 (87.37)	605 (85.57)	5013 (87.15)
Any hospital attended injury	637 (12.63)	102 (14.43)	739 (12.85)
Total	5045 (100.00)	707 (100.00)	5752 (100.00)

Pearson X^2=1.7959, p=0.180

Late primary
Variable name = F7hs035
Variable definition = audiology assessment, where normal hearing = deficit of <20dBHL
Coding: normal hearing=1, bilateral hearing impairment (HI)=2, unilateral HI=3
Prevalence: normal hearing=4334 (75.35%), bilateral hearing impairment=100 (1.74%), unilateral hearing impairment=231 (4.02%). Missing n=1087 (18.90%)
Recoding into binary variable (hear7): normal hearing=0, any hearing impairment>20dBHL = 1
Prevalence: normal=5421 (94.25%), hearing impairment=331 (5.75%)

	Hear7		
AnySCI811	Normal n (%)	HI n (%)	Total n (%)
No hospital attended injury	4129 (76.17)	249 (75.23)	4378 (76.11)
Any hospital attended injury	1292 (23.83)	82 (24.77)	1374 (23.89)
Total	5421 (100.00)	331 (100.00)	5752 (100.00)

Pearson X^2=0.1517, p=0.697

3) Visual impairment
Early primary
Variable name = Km2071
Variable definition = Has your child ever been given glasses?
Coding: Yes=1, No=2
Prevalence: Yes=565 (9.82%), No=337 (5.86%), Missing=4850 (84.31%)
Recoding: Assuming that a carer may miss out this question if their child did not wear glasses recoded to (Km2071b): No/missing=0, Yes=1
Prevalence: No/missing=5187 (90.18%) Yes=565 (9.82%)

	KM2071b		
AnySCI56	No n (%)	Yes n (%)	Total n (%)
No hospital attended injury	4505 (86.85)	508 (89.91)	5013 (87.15)
Any hospital attended injury	682 (13.15)	57 (10.09)	739 (12.85)
Total	5187 (100.00)	565 (100.00)	5752 (100.00)

Pearson X^2=4.2601, p=0.039

Late primary
Variable name = F7vs010
Variable definition = Does your child wear glasses?
Coding: no=1, Yes in clinic=2, Yes not here=3, No longer=4
Recoded into binary variable (F7vs010b): No / no longer=1, yes (whether with child or not)=2
Prevalence: No / no longer=4408 (76.63%), yes (whether with child or not)=449 (7.81%), missing=895 (15.56%)

	F7vs010b		
AnySCI811	No n (%)	Yes n (%)	Total n (%)
No hospital attended injury	3328 (75.50)	346 (77.06)	3674 (75.64)
Any hospital attended injury	1080 (24.50)	103 (22.94)	1183 (24.36)
Total	4408 (100.00)	449 (100.00)	4857 (100.00)

Pearson X^2=0.5390, p=0.463

4) Coordination

Early primary
a)Variable name = kj519
Variable definition = Denver scores at 42 m - fine motor development score (range 0 to 34) - series of questions about abilities scored 0 (can't do), 1 (has done once or twice), 2 (can do), summed together.
Derived variable = fmotor42b
Derived variable definition = normal fine motor development (top 90%) of scores = 0, abnormal fine motor development (bottom 10% scores) = 1
Prevalence: normal=5060 (87.97%), abnormal=550 (9.56%), missing=142 (2.47%)

	Fmotor42b (fine motor development score, categorised)		
AnySCI56	Normal score (top 90%) n (%)	Abnormal score (bottom 10%) n (%)	Total n (%)
No hospital attended injury	4405 (87.06)	481 (87.45)	4886 (87.09)
Any hospital attended injury	655 (12.94)	69 (12.55)	724 (12.91)
Total	5060 (100.00)	550 (100.00)	5610 (100.00)

Pearson X^2=0.0703, p=0.791

b) Variable name = kj535
Variable definition = Denver scores at 42 m - gross motor development score (range 0 to 34) - series of questions about abilities scored 0 (can't do), 1 (has done once or twice), 2 (can do), summed together.
Derived variable = gmotor42b

Derived variable definition = normal gross motor development (top 90%) of scores = 0, abnormal gross motor development (bottom 10% scores) = 1
Prevalence: normal=5129 (89.17%), abnormal=484 (8.41%), missing=139 (2.42%)

	Gmotor42b (gross motor development score, categorised)		
AnySCI56	Normal score (top 90%) n (%)	Abnormal score (bottom 10%) n (%)	Total n (%)
No hospital attended injury	4457 (86.90)	432 (89.26)	4889 (87.10)
Any hospital attended injury	672 (13.10)	52 (10..74)	724 (12.90)
Total	5129 (100.00)	484 (100.00)	5613 (100.00)

Pearson X^2=2.1891, p=0.139

Late primary
Variable name = binary_dcd15 (derived by Raghu Lingam)
Variable definition = Derived developmental coordination disorder variable, where abnormal = the 15th centile with the lowest DCD scores.
Recoding: dcd8, No dcd at 8 years=0, Dcd present at 8 years=1
Prevalence: No dcd=4265 (74.15%), Dcd present =180 (3.13%), missing =1307 (22.72%)

	Dcd8 (Developmental coordination disorder at age 8 years, binary (15th centile))		
AnySCI56	No DCD n (%)	DCD present n (%)	Total n (%)
No hospital attended injury	3219 (75.47)	140 (77.78)	3359 (75.57)
Any hospital attended injury	1046 (24.53)	40 (22.22)	1086 (24.43)
Total	4265 (100.00)	180 (100.00)	4445 (100.00)

Pearson X^2=0.4961, p=0.481

5) Hyperactivity

Early primary
Variable name = Kq346b
Variable definition = Strengths and Difficulties Questionnaire (SDQ) Hyperactivity score at age 6years (prorated) – range 1-10
Derived variable = Hyper6Cat
Derived variable definition = categorised variable with 3 approximately even sized categories of ~1859 cases (5576/3): Low score (0-2), Medium score (3-4), and High score (>=5)
Prevalence: Low score = 2349 (40.84%), Medium score = 1663 (28.91%) and High score = 1564 (27.19%). Missing values=176 (3.06%)

	Hyper6Cat (hyperactivity score at age 6y, categorised)			
AnySCI56	Low n (%)	Medium n (%)	High n (%)	Total n (%)
No hospital attended injury	2079 (88.51)	1444 (86.83)	1329 (84.97)	4852 (87.02)
Any hospital attended injury	270 (11.49)	219 (13.17)	235 (15.03)	724 (12.98)
Total	2349 (100.00)	1663 (100.00)	1564 (100.00)	5576 (100.00)

Pearson X^2=10.4342, p=0.005

Hyperactivity is known to be commoner in boys, therefore possible interaction between hyperactivity and gender explored by repeating analysis, stratified by gender. The confidence intervals overlap for the high group (boys vs girls) and for the medium group (boys vs girls), suggesting no interactions

Late primary
For junior school-aged period, use ku706b (since relates to age 9y, i.e. mid junior school age period). Do not use kw6601b as originally discussed.

Variable name = ku706b
Variable definition = Strengths and Difficulties Questionnaire (SDQ) Hyperactivity score at age 9years (prorated) – range 1-10
Derived variable = Hyper9Cat
Derived variable definition = categorised variable with 3 approximately even sized categories of ~1823 cases (5469/3): Low score (0-1), Medium score (2-3), and High score (>=4)
Prevalence: Low score = 1773 (30.82%), Medium score =1875 (32.60%) and High score =1821 (31.66%). Missing values =283 (4.92%). Total n=5469 (100.00%)

	Hyper9Cat (hyperactivity score at age 9y, categorised)			
AnySCI81	Low n(%)	Medium n(%)	High n(%)	Total n (%)
No hospital attended injury	1360 (76.71)	1424 (75.95)	1363 (74.85)	4147 (75.83)
Any hospital attended injury	413 (23.29)	451 (24.05)	458 (25.15)	458 (24.17)
Total	1773 (100.00)	1875 (100.00)	1821 (100.00)	5469 (100.00)

Pearson X^2=1.7126, p=0.425

Hyperactivity is known to be commoner in boys, therefore possible interaction between hyperactivity and gender explored by repeating analysis, stratified by gender. The confidence intervals overlap for the high group (boys vs girls) and for the medium group (boys vs girls), suggesting no interactions

6) Psychological difficulties

Early primary
Variable name = Kq346c
Variable definition = Strengths and Difficulties Questionnaire (SDQ) Emotional symptoms score (prorated): Range 0-9
Derived variable: emot6Cat
Derived variable definition: Generate categorised variable with 3 categories of ~1859 cases (5578/3): No score = 0, Low score = 1-2, and High score = 3-9
Prevalence: No score = 1987 (34.54%), Low score = 2352 (%), and High score = 1239 (%). Missing values = 174 (3.03%). Total n=5752 (100.00%)

	Emot6Cat (emotional symptoms score at age 6y, categorised)			
AnySCI56	No score n(%)	Low n(%)	High n(%)	Total n (%)
No hospital attended injury	1726 (86.86)	2066 (87.84)	1062 (85.71)	4854 (87.02)
Any hospital attended injury	261 (13.14)	286 (12.16)	177 (14.29)	724 (12.98)
Total	1987 (100.00)	2352 (100.00)	1239 (100.00)	5578 (100.00)

Pearson X^2=3.3133, p=0.191

Emotional symptoms are known to be commoner in girls, therefore possible interaction between emotional symptoms and gender explored by repeating analysis, stratified by gender. The confidence intervals overlap for the high group (boys vs girls) and for the medium group (boys vs girls), suggesting no interactions

Late primary
Variable name = ku707b
Variable definition = Strengths and Difficulties Questionnaire (SDQ) Emotional symptoms score (prorated): Range 0-10
Derived variable = emot9Cat
Derived variable definition: Generate categorised variable with 3 categories of ~1819 cases (5456/3): where No score = 0, Low score = 1, and High score = 2-10 (NB skewed distribution towards low scores)
Prevalence: No score = 2101 (36.53%), Low score = 1344 (23.37%), and High score = 2011 (34.96%). Missing values = 296 (5.15%). Total = 5752 (100.00%)

	Emot9Cat (emotional symptoms score at age 9y, categorised)			
AnySCI811	No score n(%)	Low n(%)	High n(%)	Total n (%)
No hospital attended injury	1631 (77.63)	1021 (75.97)	1488 (73.99)	4140 (75.88)
Any hospital attended injury	470 (22.37)	323 (24.03)	523 (26.01)	1316 (24.12)
Total	2101 (100.00)	1344 (100.00)	2011 (100.00)	5456 (100.00)

Pearson X^2=7.4322, p=0.024

Emotional symptoms are known to be commoner in girls, therefore possible interaction between emotional symptoms and gender explored by repeating analysis, stratified by gender. The confidence intervals overlap for the high group (boys vs girls) and for the medium group (boys vs girls), suggesting no interactions

7) Conduct problems

Early primary
Variable name = kq346d
Variable definition = Strengths and Difficulties Questionnaire (SDQ) Conduct problems score (prorated) at 6 years: Range 0-10
Derived variable = cond6Cat
Derived variable definition = Categorised variable with 4 approximately evenly sized categories ~1396 cases (5585/4). No score = 0, Low score = 1, Medium score = 2, High score = 3-10
Prevalence: No score = 1560 (27.12%), Low score = 1511 (26.27%), Medium score = 1257 (21.85%), High score = 1257 (21.85%). Missing values = 167 (2.90%). Total = 5752 (100.00%)

	Cond6Cat (conduct problems score at age 6y, categorised)				
AnySCI56	No Score n(%)	Low n (%)	Medium n (%)	High n(%)	Total n (%)
No hospital attended injury	1379 (88.40)	1319 (87.29)	1100 (87.51)	1062 (84.49)	4860 (87.02)
Any hospital attended injury	181 (11.60)	192 (12.71)	157 (12.49)	195 (15.51)	725 (12.98)
Total	1560 (100.00)	1511 (100.00)	1257 (100.00)	1257 (100.00)	5585 (100.00)

Pearson X^2=10.1275, p=0.018

Conduct problems are known to be commoner in boys, therefore possible interaction between conduct problems and gender explored by repeating analysis, stratified by gender. The confidence intervals overlap for the high group (boys vs girls) and for the medium group (boys vs girls), suggesting no interactions

Late primary
Variable name = ku708b
Variable definition = Strengths and Difficulties Questionnaire (SDQ) Conduct problems score (prorated) at 9 years: Range 0-9
Derived variable = cond9Cat
Derived variable definition = Categorised variable with 4 approximately evenly sized groups ~1367 cases (5467/4). No score = 0, Low score = 1, Medium score = 2, High score = 3-10
Prevalence: No score = 2112 (36.72%), Low score = 1543 (26.83%), Medium score = 927 (16.12%), High score = 885 (15.39%). Missing values = 285 (4.95%). Total = 5752 (100.00%)

	Cond9Cat (conduct problems score at age 9y, categorised)				
AnySCI811	No Score n(%)	Low n (%)	Medium n(%)	High n(%)	Total n (%)
No hospital attended injury	1630 (77.18)	1173 (76.02)	702 (75.73)	643 (72.66)	4148 (75.87)
Any hospital attended injury	482 (22.82)	370 (23.98)	225 (24.27)	242 (27.34)	1319 (24.13)
Total	2112 (100.00)	1543 (100.00)	927 (100.00)	885 (100.00)	5467 (100.00)

Pearson X^2=6.9993, p=0.072

Conduct problems are known to be commoner in boys, therefore possible interaction between conduct problems and gender explored by repeating analysis, stratified by gender. The confidence intervals overlap for the high group (boys vs girls) and for the medium group (boys vs girls), suggesting no interactions

8) Total behaviour problems

Early primary
Variable name = Kq346f
Variable definition = Strengths and Difficulties Questionnaire (SDQ) Total behaviour problems score (prorated) at 6yrs. Range 0-31
Derived variable = Total6Cat
Derived variable definition = Categorised variable with 3 approximately evenly sized categories of ~1857 cases (5570/3). Low = 0-4, Medium = 5-8, High = 9-31
Prevalence: Low (0) = 1739 (30.23%), Medium (1) = 1975 (34.34%), High (2) =1856 (32.27%), Missing values = 182 (3.16%). Total = 5752 (100.00%)

	Total6Cat (total behaviour problems score at age 6y, categorised)			
Anysci56	Low n(%)	Medium n (%)	High n(%)	Total n (%)
No hospital attended injury	1542 (88.67)	1730 (87.81)	1574 (84.81)	4846 (87.00)
Any hospital attended injury	197 (11.33)	245 (12.41)	282 (15.19)	724 (13.00)
Total	1739 (100.00)	1975 (100.00)	1856 (100.00)	5570 (100.00)

Pearson X^2=12.8153, p=0.002

Behaviour problems are known to be commoner in boys, therefore possible interaction between total behaviour problems and gender explored by repeating analysis, stratified by gender. The confidence intervals overlap for the high group (boys vs girls) and for the medium group (boys vs girls), suggesting no interactions

Late primary
Variable name = ku710b
Variable definition = Strengths and Difficulties Questionnaire (SDQ) Total behaviour problems score (prorated) at 9yrs: Range 0-33

Derived variable = Total9Cat
Derived variable definition = Categorised variable with 3 approximately evenly sized groups of ~1817 cases (5452/3). Low = 0-4, Medium = 5-8, High = 9-31
Prevalence: Low (0) = 2142 (37.24%), Medium (1) = 1798 (31.26%), High (2) = 1512 (26.29%), Missing values = 300 (5.22%). Total = 5752 (100.00%)

	Total9Cat (total behaviour problems score at age 9y, categorised)			
Anysci811	Low n(%)	Medium n (%)	High n(%)	Total n (%)
No hospital attended injury	1673 (78.10)	1361 (75.70)	1102 (72.88)	4136 (75.86)
Any hospital attended injury	469 (21.90)	437 (24.30)	410 (27.12)	1316 (24.14)
Total	2142 (100.00)	1798 (100.00)	1512 (100.00)	5452 (100.00)

Pearson X^2=13.2349, p=0.001

Behaviour problems are known to be commoner in boys, therefore possible interaction between total behaviour problems and gender explored by repeating analysis, stratified by gender. The confidence intervals overlap for the high group (boys vs girls) and for the medium group (boys vs girls), suggesting no interactions

9) Learning difficulties

Early primary
Variable name = Kp1220
Variable definition = child has been identified as having learning problems
Coding: Yes = 1, No = 2
Prevalence: Yes = 480 (8.34%), No = 5233 (90.98%), Missing = 39 (0.68%). Total = 5752 (100.00)
Recoded variable = kp1220b
Recoded variable definition: Recoded so that Learning problems = 1 and no learning problems = 0
Prevalence: Yes = 480 (8.34%), No = 5233 (90.98%), Missing = 39 (0.68%). Total = 5752 (100.00)

	Kp1220b (child has been identified as having learning problems		
AnySCI56	No learning problems n (%)	Learning problems n (%)	Total n (%)
No hospital attended injury	4574 (87.41)	404 (84.17)	4978 (87.13)
Any hospital attended injury	659 (12.59)	76 (15.83)	735 (12.87)
Total	5233 (100.00)	480 (100.00)	5713 (100.00)

Pearson X^2=4.1177, p=0.042

Late primary
Variable name = F8ws115
Variable definition = Categorical Total IQ, Weschler Intelligence Scales for Children, continuous variable of IQ scores from WISC at Focus at 8 clinic; max 151, min 45, mean 106
Coding: Exceptionally low = <70, Low = 70-79, Low average = 80-89, Average = 90-109, High average = 110-119, High = 120-129, Exceptionally high >=130
Prevalence: Exceptionally low (1) = 50 (0.87%), Low (2) = 197 (3.42%), Low average (3) = 468 (8.14%), Average (4) = 2051 (35.66%), High average (5) = 1009 (17.54%), High (6) = 506 (8.80%), Exceptionally high (7) = 463 (8.05%). Missing = 1008 (17.52%). Total = 5752 (100.00%)
Recoded variable: learndiff8
Recoded variable definition: binary variable, where top 75% of IQ scores (IQ>97) = 0 and bottom 25% IQ scores (IQ<=97) = 1
Prevalence: Top 75% = 3337 (58.01%), Bottom 25% = 1407 (24.46%), missing = 1008 (17.52%)

	Learndiff8 (WISC score at age 8y, binary)		
AnySCI811	Top 75% scores n (%)	Bottom 25% scores n(%)	Total n (%)
No hospital attended injury	2522 (75.58)	1067 (75.84)	3589 (75.65)
Any hospital attended injury	815 (24.42)	340 (24.16)	1155 (24.35)
Total	3337 (100.00)	1407 (100.00)	4744 (100.00)

Pearson X^2=0.0358, p=0.850

Noted that the bottom 25% of IQ scores contains n=50 children with an IQ<=70 (severe learning difficulties category). These children are likely to have different risk profiles for injury than other children within the bottom 25% IQ scores. Previous chi square tests both including and excluding the children with IQ<=70 showed no statistically significant association with hospital attended injury (i.e. not greater than could have occurred by chance).

10) Previous injury

Early primary
Variable name = Anysci34
Variable definition = Any hospital attended injury aged 3/4yrs, derived from kp questionnaire; kp4601=1 | kp4611=1 | kp4621=1 | kp4631=1 | kp4641=1 | kp4651=1 | kp4661=1)
Coding: Yes = 1, No/missing = 0
Prevalence: Yes = 277 (10.03%), No/missing = 5175 (89.97%)

	Anysci34		
AnySCI56	No hospital attended injury n (%)	Yes, any hospital attended injury n (%)	Total n (%)
No hospital attended injury	4604 (88.97)	409 (70.88)	5013 (87.15)
Any hospital attended injury	571 (11.03)	168 (29.12)	739 (12.85)
Total	5175 (100.00)	577 (100.00)	5752 (100.00)

Pearson X^2=151.5899, p=0.000

Late primary
Variable name = Anysci56
Variable definition = any hospital attended injury reported aged 5/6 years
Coding: Yes = 1, No = 0
Prevalence: Yes = 739 (12.83%), No = 5013 (87.15%)

	Anysci56		
AnySCI811	No hospital attended injury n (%)	Any hospital attended injury at 65m / 78m n (%)	Total n (%)
No hospital attended injury	3875 (77.30)	503 (68.06)	4378 (76.11)
Any hospital attended injury	1138 (22.70)	236 (31.94)	1374 (23.89)
Total	5013 (100.00)	739 (100.00)	5752 (100.00)

Pearson X^2=30.2054, p=0.000

Family variables

1) Maternal age at child's birth
Variable name = mz028b
Variable definition = Maternal age at child's birth (years), continuous data with normal distribution on histogram, mean age = 29.45 years (sd=4.40), min=16 and max=44
Recoded variable = mz028bCat2
Recoded variable definition = categorised into 5 year age groups; <=20 years = 1, 21-25 years = 2, 26-30 years = 3, 31-35 years = 4, >=36 years = 5
Prevalence: <=20 years = 130 (2.26%), 21-25 years = 889 (15.46%), 26-30 years n = 2489 (43.27%), 31-35 years = 1727 (30.02%), >=36 years = 517 (8.99%) Missing = 0.

Early primary

	Mz028bCat2 (Mothers age, categorised)					
AnySCI56	<=20 years n (%)	21-25 years n(%)	26-30 years n(%)	31-35 years n(%)	>=36 years n(%)	Total n(%)
No hospital attended injury	110 (84.62)	778 (87.51)	2162 (86.86)	1518 (87.90)	445 (86.07)	5013 (87.15)
Any hospital attended injury	20 (15.38)	111 (12.49)	327 (13.14)	209 (12.10)	72 (13.93)	739 (12.85)
Total	130 (100.00)	889 (100.00)	2489 (100.00)	1727 (100.00)	517 (100.00)	5752 (100.00)

Pearson X^2=2.4334, p=0.657

Late primary

	Mz028bCat2 (Mothers age, categorised)					
AnySCI811	<=20 years n (%)	21-25 years n(%)	26-30 years n(%)	31-35 years n(%)	>=36 years n(%)	Total n(%)
No hospital attended injury	92 (70.77)	667 (75.03)	1889 (75.89)	1327 (76.84)	403 (77.95)	4378 (76.11)
Any hospital attended injury	38 (29.23)	222 (24.97)	600 (24.11)	400 (23.16)	114 (22.05)	1374 (23.89)
Total	130 (100.00)	889 (100.00)	2489 (100.00)	1727 (100.00)	517 (100.00)	5752 (100.00)

Pearson X^2=4.1422, p=0.387

2) Family size
a) Younger siblings

Early primary

Variable name = kq635
Variable definition = number of younger siblings when child aged 6 years
Recoded variable = SibsYCat
Recoded variable definition = number of younger siblings at age 6y, categorised.
Coding: None = 0, One = 1, Two or more = 2
Prevalence: None = 2811 (48.87%), One = 2264 (39.36%), Two or more = 543 (9.44%), Missing = 134 (2.33%).

	SibsYCat (number younger siblings at 6y)			
AnySCI56	None n (%)	One n (%)	Two or more n (%)	Total n (%)
No hospital attended injury	2415 (85.91)	1986 (87.72)	491 (90.42)	4892 (87.08)
Any hospital attended injury	396 (14.09)	278 (12.28)	52 (9.58)	726 (12.92)
Total	2811 (100.00)	2264 (100.00)	543 (100.00)	5618 (100.00)

Pearson X^2=9.6259, p=0.008

Late primary

Variable name = ku624 and ku625
Variable definition = number of younger brothers and number of younger sisters, when child aged 9 years, respectively
Recoded variable = SibsYCat2
Recoded variable definition = number of younger siblings at age 9y, categorised
Coding: None = 0, one = 1, two or more = 2
Prevalence: None = 2667 (46.37%), one = 2173 (37.78%), two or more = 681 (11.84%), missing = 231 (4.02%).

	SibsYCat2 (number younger siblings at 9y)			
AnySCI811	None n (%)	One n (%)	Two or more n (%)	Total n (%)
No hospital attended injury	2034 (76.27)	1650 (75.93)	509 (74.74)	4193 (75.95)
Any hospital attended injury	633 (23.73)	523 (24.07)	172 (25.26)	1328 (24.05)
Total	2667 (100.00)	2173 (100.00)	681 (100.00)	5521 (100.00)

Pearson X^2=0.6887, p=0.709

b) Older siblings

Early primary

Variable name = kq632
Variable definition = number of older siblings at age 6 years
Recoded variable = SibsOCat
Recoded variable definition = number of older siblings at age 6 years, categorised
Coding: None = 0, One = 1, Two or more = 2
Prevalence: None = 2650 (46.07%), One = 2107 (36.63%), Two or more = 861 (14.97%), Missing = 134 (2.33%)

	SibsOCat (number of older siblings at 6 years)			
AnySCI56	None n (%)	One n (%)	Two or more n (%)	Total n (%)
No hospital attended injury	2339 (88.26)	1826 (86.66)	727 (84.44)	4892 (87.08)
Any hospital attended injury	311 (11.74)	281 (13.34)	134 (15.56)	726 (12.92)
Total	2650 (100.00)	2107 (100.00)	861 (100.00)	5618 (100.00)

Pearson X^2=8.9730, p=0.011

Late primary

Variable name = ku621 and ku622
Variable definition = number of older brothers and number of older sisters respectively
Recoded variable = SibsOCat2
Recoded variable definition = number of older siblings at age 9 years, categorised
Coding: None = 0, One = 1, Two or more = 2
Prevalence: None = 2691 (46.78%), One = 2058 (35.78%), Two or more = 772 (13.42%), missing = 231 (4.02%)

	SibsOCat2 (number of older siblings at 9 years)			
AnySCI811	None n (%)	One n (%)	Two or more n (%)	Total n (%)
No hospital attended injury	2041 (75.85)	1562 (75.90)	590 (76.42)	4193 (75.95)
Any hospital attended injury	650 (24.15)	496 (24.10)	182 (23.58)	1328 (24.05)
Total	2691 (100.00)	2058 (100.00)	772 (100.00)	5521 (100.00)

Pearson X^2=0.1143, p=0.944

c) Total number siblings

Early primary

Variable name = kq637
Variable definition = total number of siblings
Recoded variable = sibsTCat
Recoded variable definition = total number of siblings at age 6 years, categorised
Coding: None = 0, One = 1, Two = 2, Three or more = 3
Prevalence: None = 590 (10.26%), One = 3157 (54.89%), Two = 1432 (24.90%), Three or more = 439 (7.63%), Missing = 134 (2.33)

	SibsTCat (Total number of other siblings at age 6y)				
AnySCI56	None n (%)	One n (%)	Two n (%)	Three or more N (%)	Total n (%)
No hospital attended injury	514 (87.12)	2750 (87.11)	1248 (87.15)	380 (86.56)	4892 (87.08)
Any hospital attended injury	76 (12.88)	407 (12.89)	184 (12.85)	59 (13.44)	726 (12.92)
Total	590 (100.00)	3157 (100.00)	1432 (100.00)	439 (100.00)	5618 (100.00)

Pearson X^2=0.1147, p=0.990

Late primary

Variable name = ku624, ku625, ku621, ku622, ku627 & ku628
Variable definition = Number of younger brothers, number of younger sisters, number of older brothers, number of older sisters, number of twin brothers, number of twin sisters, respectively
Recoded variable = sibsTCat2
Recoded variable definition = total number of siblings at age 9 years, categorised
Coding: None = 0, One = 1, Two = 2, three or more = 3
Prevalence: None = 547 (9.91%), One = 3043 (55.12%), Two = 1452 (26.30%), three or more = 479 (8.68%), missing = 231

	SibsTCat2 (Total number of other siblings at age 9y)				
AnySCI811	None n (%)	One n (%)	Two n (%)	Three or more N (%)	Total n (%)
No hospital attended injury	401 (73.31)	2336 (76.77)	1102 (75.90)	354 (73.90)	4193 (75.95)
Any hospital attended injury	146 (26.69)	707 (23.23)	350 (24.10)	125 (26.10)	1328 (24.05)
Total	547 (100.00)	3043 (100.00)	1452 (100.00)	479 (100.00)	5521 (100.00)

Pearson X^2=4.2987, p=0.231

3) Maternal marital status

Early primary

Variable name = j370
Variable definition = maternal marital status at age 47m
Coding: never married = 1, widowed = 2, divorced = 3, separated = 4, married once = 5, married 2/3 times = 6
Recoded variable = Mmarital4
Recoded variable definition = maternal marital status at age 47m, categorised

Coding: married (combined categorise 5&6) =0, not married (combined categories 1-4) = 1
Prevalence: married = 4735 (82.32%), not married = 827 (14.38%), missing = 190 (3.30%)

	Mmarital4 (Mothers marital status at 47m)		
AnySCI56	Married (0) n (%)	Not married (1) n (%)	Total n (%)
No hospital attended injury	4138 (87.39)	711 (85.97)	4849 (87.18)
Any hospital attended injury	597 (12.61)	116 (14.03)	713 (12.82)
Total	4735 (100.00)	827 (100.00)	5562 (100.00)

Pearson X^2=1.2673, p=0.260

Late primary

Variable name = m3040
Variable definition = maternal marital status at age 7years
Coding: never married = 1, widowed = 2, divorced = 3, separated = 4, married once = 5, married 2 times = 6, married 3 times = 7
Recoded variable = Mmarital7
Recoded variable definition = maternal marital status at age 7years
Coding: married (combined 5-7) = 0, not married (combined 1-4) = 1
Prevalence: married = 4643 (80.72%), not married = 931 (16.19%), missing = 178 (3.09%)

	Mmarital7 (Mothers marital status at 7 years)		
AnySCI811	Married (0) n (%)	Not married (1) n (%)	Total n (%)
No hospital attended injury	3544 (76.33)	694 (74.54)	4238 (76.03)
Any hospital attended injury	1099 (23.67)	237 (25.46)	1336 (23.97)
Total	4643 (100.00)	931 (100.00)	5574 (100.00)

Pearson X^2=1.3581, p=0.244

4) Presence of a partner in household

Early primary

Variable name = m3100
Variable definition = mother currently lives with husband or partner
Recoded variable = Partner7
Recoded variable definition = mother living with husband/partner at child age 7
Coding: Yes = 1, No = 2
Prevalence: Yes = 5052 (87.83%), No = 505 (8.78%), missing = 195 (3.39%)

	Partner7 (mother living with husband/partner at child age 7)		
AnySCI56	Yes (0) n (%)	No (1) n (%)	Total n (%)
No hospital attended injury	4405 (87.19)	442 (87.52)	4847 (87.22)
Any hospital attended injury	647 (12.81)	63 (12.48)	710 (12.78)
Total	5052 (100.00)	505 (100.00)	5557 (100.00)

Pearson X^2=0.0453, p=0.831

Late primary

Variable name = p3000 & p3001
Variable definition = mother has partner or husband & mother's husband / partner lives with her, respectively
Recoded variable = partner9
Recoded variable definition = mother living with husband/ partner at child aged 9y
Coding: Yes = 1 (if p3001=Yes), and No = 2 (if p3001= No, or if p3000 indicated no partner/husband and p3001 subsequently missing, assume that these should be partner9=No as well)
Prevalence: Yes = 4877 (84.79%), No = 562 (9.77), missing = 313 (5.44%)

	Partner9 (mother living with husband/partner at child age 9)		
AnySCI81	Yes (0) n (%)	No (1) n (%)	Total n (%)
No hospital attended injury	3717 (76.21)	412 (73.31)	4129 (75.91)
Any hospital attended injury	1160 (23.79)	150 (26.69)	1310 (24.09)
Total	4877 (100.00)	562 (100.00)	5439 (100.00)

Pearson X^2=2.3263, p=0.127

5) Mothers reported general health

Early primary

Variable name = l3000
Variable definition = Maternal self reported general health at child aged 6y
Coding: fit and well = 1, mostly well and healthy = 2, often unwell = 3, hardly ever feel well = 4
Recoded variable = Mhealth6
Recoded variable definition = Maternal self reported general health at child aged 6y, binary
Coding: well / mostly well (combined 1-2) = 0, unwell / often unwell (combined 3-4) = 1

Prevalence: well / mostly well = 5248 (91.24%), unwell / often unwell = 328 (5.70%) missing = 176 (3.06%)

	Mhealth6 (Mothers self reported general health, age 6y)		
AnySCI56	Well / mostly well n (%)	Unwell / often unwell n (%)	Total n (%)
No hospital attended injury	4588 (87.42)	272 (82.93)	4860 (87.16)
Any hospital attended injury	660 (12.58)	56 (17.07)	716 (12.84)
Total	5248 (100.00)	328 (100.00)	5576 (100.00)

Pearson X^2=5.5780, p=0.018

Late primary
Variable name = p1000
Variable definition = Maternal self reported general health when child aged 9y
Coding: fit and well = 1, mostly well and healthy = 2, often unwell = 3, hardly ever feel well = 4
Recoded variable = Mhealth9
Recoded variable definition = Maternal self reported general health at child aged 9y, binary
Coding: well / mostly well (combined 1-2) = 0, unwell / often unwell (combined 3-4) = 1
Prevalence: well / mostly well = 5199 (90.39%), unwell / often unwell = 252 (4.38%), missing = 301 (5.23%)

	Mhealth9 (Mothers self reported general health, age 9y)		
AnySCI811	Well / mostly well n (%)	Unwell / often unwell n (%)	Total n (%)
No hospital attended injury	3948 (75.94)	193 (76.59)	4141 (75.97)
Any hospital attended injury	1251 (24.06)	59 (23.41)	1310 (24.03)
Total	5199 (100.00)	252 (100.00)	5451 (100.00)

Pearson X^2=0.0556, p=0.814

6) Mothers self reported alcohol consumption

Early primary

Variable name = k6190
Variable definition = Maternal self reported alcohol consumption at child aged 61m
Recoded variable = Alcohol5
Recoded variable definition = Mothers reported alcohol consumption, age 5, categorised
Coding: Never / less than once a week = 0, At least once per week = 1, 1-2 units nearly every day or more = 2

Prevalence: Never / less than once a week = 2500 (43.46%), At least once per week = 2115 (36.77%), 1-2 units nearly every day or more = 959 (16.67%), Missing n=178 (3.09%)

	Alcohol5 (Mothers reported alcohol consumption, age 5, categorised)			
AnySCI56	Never / <1x wkly n (%)	At least 1x /wk n (%)	1-2u most days or more (2) n (%)	Total n (%)
No hospital attended injury	2186 (87.44)	1837 (86.86)	839 (87.49)	4862 (87.23)
Any hospital attended injury	314 (12.56)	278 (13.14)	120 (12.51)	712 (12.77)
Total	2500 (100.00)	2115 (100.00)	959 (100.00)	5574 (100.00)

Pearson X^2=0.4215, p=0.810

Late primary

Variable name = m6100
Variable definition = Maternal self reported alcohol consumption 'mother drank alcohol in the last week' Y/N
Recoded variable = Alcohol9
Recoded variable definition = Mothers drank alcohol in last week, child aged 9y, binary
Coding: No = 0, Yes = 1
Prevalence: No = 1410 (24.51%), Yes = 4107 (71.40%), missing = 235 (4.09%)

	Alcohol9 (Mothers drank alcohol in last week, child aged 9y, binary)		
AnySCI811	No (0) n (%)	Yes (1) n (%)	Total n (%)
No hospital attended injury	1078 (76.45)	3116 (75.87)	4194 (76.02)
Any hospital attended injury	332 (23.55)	991 (24.13)	1323 (23.98)
Total	1410 (100.00)	4107 (100.00)	5517 (100.00)

Pearson X^2=0.1960, p=0.658

7) Mothers self reported anxiety

Early primary

Variable name = l3010
Variable definition = Mothers self reported anxiety in the past year, asked at age 6y
Recoded variable = Anxiety6
Recoded variable definition = Mothers reported anxiety in past year, child aged 6y, binary
Coding: No = 0, Yes = 1

Prevalence: No = 4410 (76.67%), Yes = 1150 (19.99%), missing = 192 (3.34%).

	Anxiety6 (Mothers reported anxiety in past year, child aged 6y, binary)		
AnySCI56	No (0) n (%)	Yes (1) n (%)	Total n (%)
No hospital attended injury	3853 (87.37)	994 (86.43)	4847 (87.18)
Any hospital attended injury	557 (12.63)	156 (13.57)	713 (12.82)
Total	4410 (100.00)	1150 (100.00)	5560 (100.00)

Pearson X^2=0.7130, p=0.398

Late primary

Variable name = p1010
Variable definition = Mothers self reported anxiety in past 3 years, asked at age 9y
Recoded variable = Anxiety9
Recoded variable definition = Mothers reported anxiety in past 3 years, child aged 9y, binary
Coding: No = 0, Yes = 1
Prevalence: No = 4030 (70.06%), Yes = 1365 (23.73%), missing = 357 (6.21%).

	Anxiety9 (Mothers reported anxiety in past 3 years, child aged 9y, binary)		
AnySCI811	No (0) n (%)	Yes (1) n (%)	Total n (%)
No hospital attended injury	3074 (76.28)	1022 (74.87)	4096 (75.92)
Any hospital attended injury	956 (23.72)	343 (25.13)	1299 (24.08)
Total	4030 (100.00)	1365 (100.00)	5395 (100.00)

Pearson X^2=1.1028, p=0.294

8) Mothers self reported depression

Early primary

Variable name = l3011
Variable definition = Mothers self reported depression in the past year, asked at age 6y
Recoded variable = Depr6
Recoded variable definition = Mothers reported depression in past year, child aged 6y, binary
Coding: No = 0, Yes = 1
Prevalence: No = 4362 (75.83%), Yes = 1197 (20.81%), missing = 193 (3.36%).

	Depr6 (Mothers reported depression in past year, child aged 6y, binary)		
AnySCI56	No (0) n (%)	Yes (1) n (%)	Total n (%)
No hospital attended injury	3817 (87.51)	1033 (86.30)	4850 (87.25)
Any hospital attended injury	545 (12.49)	164 (13.70)	709 (12.75)
Total	4362 (100.00)	1197 (100.00)	5559 (100.00)

Pearson X^2=1.229, p=0.268

Late primary

Variable name = p1011
Variable definition = Mothers self reported depression in the past year, asked at age 9y
Recoded variable = Depr9
Recoded variable definition = Mothers reported depression in past 3yr, child aged 9y, binary
Coding: No = 0, Yes = 1
Prevalence: No = 4071 (70.78%), Yes = 1343 (23.35%), missing = 338 (5.88%).

	Depr9 (Mothers reported depression in past 3yr, binary)		
AnySCI811	No (0) n (%)	Yes (1) n (%)	Total n (%)
No hospital attended injury	3118 (76.59)	993 (73.94)	4111 (75.93)
Any hospital attended injury	953 (23.41)	350 (26.06)	1303 (24.07)
Total	4071 (100.00)	1343 (100.00)	5414 (100.00)

Pearson X^2=3.8852, p=0.049

9) Maternal education

Early primary

Variable name = k6280-95
Variable definition = 15 questions coded 1=Yes if any of these qualifications were gained by when the child was aged 5 yrs.
Recoded variable = edqual5bin
Recoded variable definition = Mothers highest educational qualification when child aged 5y, binary
Coding: ‘O’ level or more = 0, Less than ‘O’ level = 1
Prevalence: ‘O’ level or more = 4580 (79.62%), Less than ‘O’ level = 1158 (20.13%), missing = 14 (0.24%)

	Edqual5bin (Mothers highest educational qualification when child aged 5y, binary)		
AnySCI56	'O' level or more n (%)	Less than 'O' level n (%)	Total n (%)
No hospital attended injury	3982 (86.94)	1018 (87.91)	5000 (87.14)
Any hospital attended injury	598 (13.06)	140 (12.09)	738 (12.86)
Total	4580 (100.00)	1158 (100.00)	5738 (100.00)

Pearson X^2=0.7791, p=0.380

Late primary

Variable name = n4000-15
Variable definition = 15 questions (none to university degree, including vocational qualifications) coded 1=Yes if any of these qualifications were gained by when the child was aged 9 yrs.
Recoded variable = edqual9bin
Recoded variable definition = Mothers highest educational qualification when child aged 9y, binary
Coding: 'O' level or more = 0, Less than 'O' level = 1
Prevalence: 'O' level or more = 4502 (78.27%), Less than 'O' level = 1239 (21.54%), missing = 11 (0.19%)

	Edqual9bin (Mothers highest educational qualification when child aged 9y, binary)		
AnySCI811	'O' level or more n (%)	Less than 'O' level n (%)	Total n (%)
No hospital attended injury	3397 (75.46)	970 (78.29)	4367 (76.07)
Any hospital attended injury	1105 (24.54)	269 (21.71)	1374 (23.93)
Total	4502 (100.00)	1239 (100.00)	5741 (100.00)

Pearson X^2=4.2852, p=0.038

10) Paternal social class

Variable name = c765
Variable definition = paternal social class
Recoded variable = sclasspat
Recoded variable definition = paternal social class, categorised
Coding: Non-manual (classes i, ii, iiinm) = 0, Manual (classes iiim, iv, v, armed forces) = 1
Prevalence: non-manual = 3359 (58.40%) and manual = 1909 (33.19%), missing = 484 (8.41%)

Early primary

	sclasspat (paternal social class, categorised)		
AnySCI56	Non-manual (0) n (%)	Manual (1) n (%)	Total n (%)
No hospital attended injury	2946 (87.70)	1645 (86.17)	4591 (87.15)
Any hospital attended injury	413 (12.30)	264 (13.83)	677 (12.85)
Total	3359 (100.00)	1909 (100.00)	5268 (100.00)

Pearson X^2=2.5572, p=0.110

Late primary

	sclasspat (paternal social class, categorised)		
AnySCI811	Non-manual (0) n (%)	Manual (1) n (%)	Total n (%)
No hospital attended injury	2572 (76.57)	1430 (74.91)	4002 (75.97)
Any hospital attended injury	787 (23.43)	479 (25.09)	1266 (24.03)
Total	3359 (100.00)	1909 (100.00)	5268 (100.00)

Pearson X^2=1.8418, p=0.175

11) Mothers life events

Early primary

Variable name = l4000-l4044
Variable definition = Mothers self report of 44 life events occurring in previous year, at child age 6y
Coding: For each of the 44 life events respondents could answer Yes, affected me a lot (1), Yes affected me moderately (2), Yes affected me a little (3), Yes but did not affect me (4) and No did not occur (5).
Recoded variable = Life6cat
Recoded variable definition = Each life event recoded to Yes occurred (1) or No did not occur (0), then all added together to make life events score at CH aged 6. Score categorised into 3 fairly evenly sized groups
Coding: Low score (0-3) = 0, medium score (4-6) = 1, and high score (7-19) = 2
Prevalence: Low score = 2455 (42.68%), medium score = 1580 (27.47%) and high score = 1002 (17.42%), missing = 715 (12.43%)

	Life6cat (Mothers life events score in previous year, CH aged 6, categorised)			
AnySCI56	Low (score 0-3) n (%)	Medium (score 4-6) n (%)	High (score >7) n (%)	Total n (%)
No hospital attended injury	2161 (88.02)	1374 (86.96)	860 (85.83)	4395 (87.25)
Any hospital attended injury	294 (11.98)	206 (13.04)	142 (14.17)	642 (12.75)
Total	2455 (100.00)	1580 (100.00)	1002 (100.00)	5037 (100.00)

Pearson X^2=3.2627, p=0.196

Late primary

Variable name = p2000-p2044
Variable definition = Mothers self report of 44 life events occurring in previous 3 years, at child age 9y
Coding: For each of the 44 life events respondents could answer Yes, affected me a lot (1), Yes affected me moderately (2), Yes affected me a little (3), Yes but did not affect me (4) and No did not occur (5)
Recoded variable = Life9cat
Recoded variable definition = Each life event recoded to Yes occurred (1) and No did not occur (0), then all added together to make life events score for child at age 9. Score categorised into 3 fairly evenly sized groups as life9cat
Coding: Low score (0-3) = 0, medium score (4-6) = 1, and high score (7-24) = 2
Prevalence: Low score = 1788 (31.08%), medium score = 1625 (28.25%) and high score = 1246 (21.66%), missing = 1093 (19.00%)

	Life9cat (Mothers life events score in previous year, CH aged 9, categorised)			
AnySCI811	Low (score) (0) n (%)	Medium (score) (1) n (%)	High (score) (2) n (%)	Total n (%)
No hospital attended injury	1406 (78.64)	1243 (76.49)	881 (70.71)	3530 (75.77)
Any hospital attended injury	382 (21.36)	382 (23.51)	365 (29.29)	1129 (24.23)
Total	1788 (100.00)	1625 (100.00)	1246 (100.00)	4659 (100.00)

Pearson X^2=25.8582, p=0.000

Home variables

1) Mothers feelings about home (use k5140 at age 5y (got) and m2130 at age 7y (got))

Early primary

Variable name = k5140
Variable definition = Mothers satisfaction with the home at child aged 5y
Coding: 4 level scale; Satisfied, fairly satisfied, dissatisfied, very dissatisfied
Recoded variable name = home5
Recoded variable definition = Mothers satisfaction with the home, child aged 5y, binary
Coding: Satisfied / fairly satisfied = 0, Dissatisfied / very dissatisfied = 1
Prevalence: Satisfied / fairly satisfied = 5297 (92.09%), Dissatisfied / very dissatisfied = 279 (4.85%). Missing = 176 (3.06%)

	Home5 (mothers satisfaction with the home, child aged 5y, binary)		
AnySCI56	Satisfied n (%)	Dissatisfied n (%)	Total n (%)
No hospital attended injury	4623 (87.28)	241 (86.38)	4864 (87.23)
Any hospital attended injury	674 (12.72)	38 (13.62)	712 (12.77)
Total	5297 (100.00)	279 (100.00)	5576 (100.00)

Pearson X^2=0.1910, p=0.662

Late primary

Variable name = m2130
Variable definition = Mothers satisfaction with the home at child aged 7y
Coding: 4 level scale; Satisfied, fairly satisfied, dissatisfied, very dissatisfied
Recoded variable name = home7
Recoded variable definition = Mothers satisfaction with the home, child aged 7y, binary
Coding: Satisfied / fairly satisfied = 0, Dissatisfied / very dissatisfied = 1
Prevalence: Satisfied / fairly satisfied = 5371 (93.38%), Dissatisfied / very dissatisfied = 187 (3.25%). Missing = 194 (3.37%)

	Home7 (mothers satisfaction with the home, child aged 7y, binary)		
AnySCI811	Satisfied (0) n (%)	Dissatisfied (1) n (%)	Total n (%)
No hospital attended injury	4098 (76.30)	131 (70.05)	4229 (76.09)
Any hospital attended injury	1273 (23.70)	56 (29.95)	1329 (23.91)
Total	5371 (100.00)	187 (100.00)	5558 (100.00)

Pearson X^2=3.8738, p=0.049

2) Mothers reported problems with the home

Early primary

Variable name = k5210, k5211 k5212
Variable definition = poorly fitting windows/doors, ventilation and noise between rooms are a problem for mother or family respectively (at child aged 5y)
Recoded variable name = hprobs5b
Recoded variable definition = Recoded each variable into 0=no problem or no opinion, 1=minor prob, 2=serious prob, then added all together to produce overall score and categorised into low score group and high score group
Coding: Low score (0-1) = 0, High score (2-6) = 1
Prevalence: Low score = 4988 (86.72%), High score = 561 (9.75%), missing = 203 (3.53%)

	Hprobs5b (Home problems score, child aged 5y, binary)		
AnySCI56	Low score n (%)	High score n (%)	Total n (%)
No hospital attended injury	4374 (87.69)	468 (83.42)	4842 (87.26)
Any hospital attended injury	614 (12.31)	93 (16.58)	707 (12.74)
Total	4988 (100.00)	561 (100.00)	5549 (100.00)

Pearson X^2=8.2624, p=0.004

Late primary

Variable name = m2200 m2201 and m2202
Variable definition = poorly fitting windows/doors, ventilation and noise between rooms are a problem for mother or family respectively (at child age 7y)
Recoded variable name = hprobs7b
Recoded variable definition = Recoded each variable into 0=no problem or no opinion, 1=minor prob, 2=serious prob, then added all together to produce overall score and categorised into low score group and high score group
Coding: No problems (score 0) = 0, Yes, home problems (score 1-6) = 1
Prevalence: No problems = 3611 (62.78%), Yes = 1931 (33.57%). Missing = 210 (3.65%)

	Hprobs7b (Home problems score, child aged 7, binary)		
AnySCI81	No (score 0) n (%)	Yes (score 1-6) n (%)	Total n (%)
No hospital attended injury	2777 (76.90)	1441 (74.62)	4218 (76.11)
Any hospital attended injury	834 (23.10)	490 (25.38)	1324 (23.89)
Total	3611 (100.00)	1931 (100.00)	5542 (100.00)

Pearson X^2=3.5951, p=0.058

3) Mothers reporting of damp and water problems in the home

Early primary

Variable name = k5110, k5130, k5131
Variable definition = home has problems with damp / condensation / mould, roof leaks, water gets into house other than through roof respectively (reported when child 5y)
Recoded variable name = Wethome5
Recoded variable definition = Recoded each variable into 0=no problem or not applicable, 1=yes, problem reported, then added together to produce overall score, categorised into none, low or high damp/water problems score
Coding: None (score 0) =0, Low (score 1) =1, High (score 2-3) =2
Prevalence: None = 2825 (49.11%), Low = 1993 (34.65%), High = 676 (11.75%). Missing = 258 (4.49%).

	Wethome5 (Water entry into home, age 5, categorised)			
AnySCI56	None (score 0) n (%)	Low (score 1) n (%)	High (score 2-3) n (%)	Total n (%)
No hospital attended injury	2473 (87.54)	1742 (87.41)	577 (85.36)	4792 (87.22)
Any hospital attended injury	352 (12.46)	251 (12.59)	99 (14.64)	702 (12.78)
Total	2825 (100.00)	1993 (100.00)	676 (100.00)	5494 (100.00)

Pearson X^2=2.4307, p=0.297

Late primary

Variable name = m2110 m2120 m2121
Variable definition = home has problems with damp / condensation / mould, roof leaks, water gets into house other than through roof respectively (reported when child aged 7y
Recoded variable name = Wethome7
Recoded variable definition = Recoded each variable into 0=no problem or not applicable, 1=yes, problem reported, then added together to produce overall score, categorised into none, low or high damp/water problems score
Coding: None (score 0) = 0, Low (score 1) = 1, High (score 2-3) =2
Prevalence: None = 2728 (47.43%), Low = 1919 (33.36%), High = 744 (12.93%). Missing = 361 (6.28%).

	Wethome7 (Water entry into home, age 7, categorised)			
AnySCI811	No (score 0) n (%)	Low (score 1) n (%)	High (score 2-3) n (%)	Total n (%)
No hospital attended injury	2068 (75.81)	1477 (76.97)	550 (73.92)	4095 (75.96)
Any hospital attended injury	660 (24.19)	442 (23.03)	194 (26.08)	1296 (24.04)
Total	2728 (100.00)	1919 (100.00)	744 (100.00)	5391 (100.00)

Pearson X^2=2.7889, p=0.248

4) Mother reported home invaded by pests

Variable name = m3410 (rats), m3411 (mice), m3414 (cockroaches)
Variable definition = Mother reports home invaded by pests. Only collected at 7y so used for both anysci56 and anysci811 outcomes. Other pests reported included dogs, cats, pigeons, ants and woodlice. Rats, mice and cockroaches suggest greater disrepair / lack of maintenance / uncleanliness than other pests, therefore pests score limited to these three pests
Recoded variable name = pestworst
Recoded variable definition = Recoded into 0=no, not at all, 1=yes, occasionally and 2=yes frequently, then added together to create pests score and recoded into binary variable
Coding: No (score 0) = 0, Yes (score 1 or more) =1
Prevalence: No = 4686 (81.43%), Yes = 678 (11.79%). Missing = 390 (6.78%)

Early primary

	Pestworst (Home/garden invaded by rats, mice or cockroaches)		
AnySCI56	No (score 0) n (%)	Yes (score 1-3) n (%)	Total n (%)
No hospital attended injury	4096 (87.45)	580 (85.55)	4676 (87.21)
Any hospital attended injury	588 (12.55)	98 (14.45)	686 (12.79)
Total	4684 (100.00)	678 (100.00)	5362 (100.00)

Pearson X^2=1.9182, p=0.166

Late primary

	Pestworst (Home/garden invaded by rats, mice or cockroaches)		
AnySCI811	No (score 0) n (%)	Yes (score 1-3) n (%)	Total n (%)
No hospital attended injury	3572 (76.26)	505 (74.48)	4077 (76.04)
Any hospital attended injury	1112 (23.74)	173 (25.52)	1285 (23.96)
Total	4684 (100.00)	678 (100.00)	5362 (100.00)

Pearson X^2=1.0250, p=0.311

5) Crowding

Early primary

Variable name = m3000 m3001 and m3002, m2070
Variable definition = number of adults >18 years, number of adults aged 16-18 years and number of children in household respectively, number of living/sleeping rooms in home (i.e. excludes kitchen and bathrooms), collected at age 7y
Recoded variable name = Crowd7cat
Recoded variable definition = Calculated the average number of persons per room (living/sleeping rooms) per household. Large number of responses missing from question relating to number of adults aged 16-18. Assumed these were missing values, and therefore recoded to 0 (m3001b). Total number of persons (persons7) = m3000 + m3001b + 3002. Number of rooms for sleeping/living excluding kitchen = m2070. Average number of persons per room (crowd7) = persons7/m2070. Histogram suggests fairly normal distribution.
Coding: <=1 person per room = 0, >1 person per room = 1
Prevalence: <=1 person per room = 4958 (86.20%), >1 person per room = 485 (8.43%), missing = 309 (5.37%)

	Crowd7cat (Av no. of persons per room)		
AnySCI56	<=1 person/rm n (%)	>1 person/rm n (%)	Total n (%)
No hospital attended injury	4339 (87.52)	411 (84.74)	4750 (87.27)
Any hospital attended injury	619 (12.48)	74 (15.26)	693 (12.73)
Total	4958 (100.00)	485 (100.00)	5443 (100.00)

Pearson X^2=3.0571, p=0.080

Late primary

Variable name = q3000 q3001 and q3002, q2080
Variable definition = number of adults >18 years, number of adults aged 16-18 years and number of children in household respectively, number of living/sleeping rooms in home (i.e. excludes kitchen and bathrooms), collected at age 10y
Recoded variable name = crowd10cat
Recoded variable definition = Calculated the average number of persons per room (living/sleeping rooms) per household. Large number of responses missing from question relating to number of adults aged 16-18. Assumed these were missing values, and therefore recoded to 0 (q3001b). Total number of persons (persons7) = q3000 + q3001b + q3002. Number of rooms for sleeping/living excluding kitchen = q2080. Average number of persons per room (crowd7) = persons7/m2070. Histogram suggests fairly normal distribution.
Coding: <=1 person per room = 0, >1 person per room = 1
Prevalence: <=1 person per room = 4768 (82.89%), >1 person per room = 355 (6.17%), missing = 629 (10.94%)

	Crowd10cat (Av no. of persons per room)		
AnySCI811	<=1 person/rm (0) n (%)	>1 person/rm (1) n (%)	Total n (%)
No hospital attended injury	3623 (75.99)	270 (76.06)	3893 (75.99)
Any hospital attended injury	1145 (24.01)	85 (23.94)	1230 (24.01)
Total	4768 (100.00)	355 (100.00)	5123 (100.00)

Pearson X^2=0.0009, p=0.976

6) Basic home facilities

Early primary

Variable name = k5080, k5081, k5082, k5062
Variable definition = Basic home facilities relate to maternal reporting of the sole use of running hot water (k5080) a bath (k5081) or shower (k5082), and an indoor flushing toilet (k5062) when child aged 5y. Additional variable in this section (sole use of a garden or yard (k5083) excluded since lack of sole use of a garden or yard is not very discriminating for lack of basic facilities in Bristol since residents may live in e.g. a flat without a garden or yard in both the most affluent and the most disadvantaged wards. Bath and shower combined into a single variable indicating sole use of bathing facilities. Hot water, bathing facilities and flushing toilet recoded into binary variables (0=yes, 1=no), added together and recoded into combined variable (basics5):
Recoded variable name = basic5
Recoded variable definition = presence of basic home facilities at aged 5y, comprising sole use of hot water, bathing facilities and indoor flushing toilet
Coding: Yes (score 0) = 0, No (any missing) =1
Prevalence: Yes = 5384 (93.60%), No = 86 (1.50%), Missing = 282 (4.90%)

	Basics5 (home has sole use of running hot water, bathing facilities and indoor flushing toilet, child aged 5)		
AnySCI56	Yes (0) n (%)	No (1) n (%)	Total n (%)
No hospital attended injury	4699 (87.28)	74 (86.05)	4773 (87.26)
Any hospital attended injury	685 (12.72)	12 (13.95)	697 (12.74)
Total	5384 (100.00)	86 (100.00)	5470 (100.00)

Pearson X^2=0.1153, p=0.734

Late primary

Variable name = m2080, m2081, m2082, m2083, m2062
Variable definition = Basic home facilities relate to maternal reporting of the sole use of running hot water (m2080) a bath (m2081) or shower (m2082), and an indoor flushing toilet (m2062) when child aged 7y. Additional variable in this section (sole use of a garden or yard (m2083) excluded since lack of sole use of a garden or yard is not very discriminating for lack of basic facilities in Bristol since residents may live in e.g. a flat

without a garden or yard in both the most affluent and the most disadvantaged wards.
Bath and shower combined into a single variable indicating sole use of bathing facilities.
Hot water, bathing facilities and flushing toilet recoded into binary variables (0=yes, 1=no), added together and recoded into combined variable (basics7)
Recoded variable name = basics7
Recoded variable definition = presence of basic home facilities at aged 7y, comprising sole use of hot water, bathing facilities and indoor flushing toilet
Coding: Yes (score 0) = 0, No (any missing) =1
Prevalence: Yes = 5362 (93.22%), No = 73 (1.27%), Missing = 317 (6.51%)

	Basics7 (home has sole use of running hot water, bathing facilities and flushing toilet, age 7)		
AnySCI811	Yes (0) n (%)	No (1) n (%)	Total n (%)
No hospital attended injury	4073 (75.96)	58 (79.45)	4131 (76.01)
Any hospital attended injury	1289 (24.04)	15 (20.55)	1304 (23.99)
Total	5362 (100.00)	73 (100.00)	5435 (100.00)

Pearson X^2=0.4815, p=0.488

7) Mothers home ownership status
Note: prior analysis indicated that living in privately rented accommodation compared to either owner-occupier, or council rented accommodation, was associated with increased risk of injury

Early primary

Variable name = k5010
Variable definition = Mothers home ownership status when child aged 61m
Recoded variable = rent5
Recoded variable definition = mother lives in privately rented accommodation when child aged 5y
Coding: No (Not living in private rented accommodation) = 0, Yes (Living in private rented accommodation) = 1
Prevalence: No = 5369 (93.34%), Yes = 197 (3.42%), missing = 186 (3.23%)

	Rent5 (Mother living in private rented accommodation, at child aged 5y)		
AnySCI56	No n (%)	Yes n (%)	Total n (%)
No hospital attended injury	4680 (87.17)	176 (89.34)	4856 (87.24)
Any hospital attended injury	689 (12.83)	21 (10.66)	710 (12.76)
Total	5369 (100.00)	197 (100.00)	5566 (100.00)

Pearson X^2=0.8063, p=0.369

Late primary

Variable name = m2010
Variable definition = Mothers home ownership status when child aged 7y
Recoded variable = rent7
Recoded variable definition = mother lives in privately rented accommodation when child aged 7y
Coding: No (Not living in private rented accommodation) = 0, Yes (Living in private rented accommodation) = 1
Prevalence: No = 5396 (93.81%), Yes = 172 (2.99%), missing = 184 (3.20%)

	rent7 (Mother living in private rented accommodation, at child aged 7y)		
AnySCI811	Owned / mortgaged (0) n (%)	Rented / other (1) n (%)	Total n (%)
No hospital attended injury	4119 (76.33)	118 (68.60)	4237 (76.10)
Any hospital attended injury	1277 (23.67)	54 (31.40)	1331 (23.90)
Total	5396 (100.00)	172 (100.00)	5568 (100.00)

Pearson X^2=5.4750, p=0.019

8) Number of house moves

Early primary

Variable name = k5001
Variable definition = Number of house moves at child aged 61m: continuous variable range 0-10 moves
Recoded variable = moves5b
Recoded variable definition = number of house moves at child aged 61m, categorised
Coding: None = 0, One or more = 1
Prevalence: None = 3781 (65.73%), One or more = 1617 (28.11%), Missing = 354 (6.15%)

	Moves5b (number of house moves at child aged 61m, categorised)		
AnySCI56	None n (%)	One or more n (%)	Total n (%)
No hospital attended injury	3294 (87.12)	1414 (87.45)	4708 (87.22)
Any hospital attended injury	487 (12.88)	203 (12.55)	690 (12.78)
Total	3781 (100.00)	1617 (100.00)	5398 (100.00)

Pearson X^2=0.1080, p=0.724

Late primary
Variable name = m2001
Variable definition = Number of house moves when child aged 7y
Recoded variable = moves7b
Recoded variable definition = number of house moves at child aged 7y, categorised
Coding: None = 0, One or more = 1
Prevalence: None = 4075 (70.84%), One or more = 1351 (23.49%), Missing = 326 (5.67%)

	Moves7b (number of house moves at child aged 7y, categorised)		
AnySCI811	None n (%)	One or more n (%)	Total n (%)
No hospital attended injury	3126 (76.71)	994 (73.58)	4120 (75.93)
Any hospital attended injury	949 (23.29)	357 (26.42)	1306 (24.07)
Total	4075 (100.00)	1351 (100.00)	5426 (100.00)

Pearson X^2=5.4616, p=0.019

9) Mothers reported financial difficulty

Early primary

Variable name = k6200-6208
Variable definition = Mothers reported financial difficulty when child aged 61m. Variables included mother reported financial difficulty to afford food, clothing, heating, rent/mortgage, things for child, educational costs, medical costs, and child care costs respectively
Coding: Each item coded very difficult (1), fairly difficult (2), slightly difficult (3), not difficult (4). Heating and rent/mortgage costs had additional code ‘paid by social security’ (5).
Recoded variable = money5
Recoded variable definition = Recoded into 0=no difficulty, 1=slight, 2=fairly/very/social security, then added together to get financial difficulty score (finance5) and categorise into money5
Coding: None (score 0) =0, Low (score 1-4) = 1, High (score 5-16) = 2
Prevalence: None = 1909 (33.19%), Low = 1533 (26.65%), High = 1009 (17.54%), Missing = 1301 (22.62%).

	Money5 (Mother reported financial difficulties score, age 5, categorised)			
AnySCI56	None (0) n (%)	Low (1) n (%)	High (2) n (%)	Total n (%)
No hospital attended injury	1664 (87.17)	1334 (87.02)	872 (86.42)	3870 (86.95)
Any hospital attended injury	245 (1.83)	199 (12.98)	137 (13.58)	581 (13.05)
Total	1909 (100.00)	1533 (100.00)	1009 (100.00)	4451 (100.00)

Pearson X^2=0.3326, p=0.847

Late primary

Variable name = m5170-5178
Variable definition = Mothers reported financial difficulty when child aged 85m. Variables included mother reported financial difficulty to afford food, clothing, heating, rent/mortgage, things for child, educational costs, medical costs, and child care costs respectively
Coding: Each item coded very difficult (1), fairly difficult (2), slightly difficult (3), not difficult (4) or not paid by me (5).
Recoded variable = money7
Recoded variable definition = Recoded into 0=no difficulty, 1=slight, 2=fairly/very difficult. 'Not paid by me' recoded to missing as do not know who pays this money. Scores then added together to get financial difficulty score (finance7) and categorised into money7
Coding: No money difficulties (score 0) = 0, Low (score 1-4) = 1, High (score 5-16) = 2
Prevalence: No money difficulties = 1306 (22.71%), Low = 593 (10.31%), High = 359 (6.24%), Missing = 3494 (60.74%).

	Money7 (Mother reported financial difficulties score, age 7, categorised)			
AnySCI811	None (0) n (%)	Low (1) n (%)	High (2) n (%)	Total n (%)
No hospital attended injury	1012 (77.49)	431 (72.68)	260 (72.42)	1703 (75.42)
Any hospital attended injury	294 (22.51)	162 (27.32)	99 (27.58)	555 (24.58)
Total	1306 (100.00)	593 (100.00)	359 (100.00)	2258 (100.00)

Pearson X^2=7.1527, p=0.028

Environmental factors

1) Deprivation of area of residence

Variable name = IMD
Variable definition = Index of multiple deprivation 2000. Index applied based on postcode of residence when child aged 5yrs.
Recoded variable name = Qimd
Recoded variable definition = for complete outcome dataset (i.e. parents/carers completing all four questionnaires during primary school period), IMD of postcode at aged 5 split into 5 approximately even sized groups (quintiles)
Coding: Quintile 1 (most affluent) = 1, quintile 2 = 2, quintile 3= 3, quintile 4 =4, quintile 5 (most deprived) =5
Prevalence: Quintile 1 (most affluent) = 1110 (19.30%), quintile 2 = 1069 (18.50%), quintile 3 = 1115 (19.38%), quintile 4 = 1080 (18.78%), quintile 5 (most deprived) = 1072 (18.64%). Missing = 306 (5.32%).

Qimd used for both early primary and late primary outcomes, as Qimd for postcode at age 11 not available at time of analysis

Early primary

	Qimd (quintile of deprivation of area of residence at age 5 years, complete outcome dataset only)					
AnySCI56	Quintile 1 n (%)	Quintile 2 n(%)	Quintile 3 n(%)	Quintile 4 n(%)	Quintile 5 n(%)	Total n(%)
No hospital attended injury	982 (88.47)	934 (87.37)	962 (86.28)	922 (85.37)	942 (87.87)	4742 (87.07)
Any hospital attended injury	128 (11.53)	135 (12.63)	153 (13.72)	158 (14.63)	130 (12.13)	704 (12.93)
Total	1110 (100)	1069 (100)	1115 (100)	1080 (100)	1072 (100)	5446 (100)

Pearson X^2=6.0222, p=0.197

Late primary

	Qimd (quintile of deprivation of area of residence at age 5 years, complete outcome dataset only)					
AnySCI811	Quintile 1 n (%)	Quintile 2 n(%)	Quintile 3 n(%)	Quintile 4 n(%)	Quintile 5 n(%)	Total n(%)
No hospital attended injury	867 (78.11)	817 (76.43)	861 (77.22)	800 (74.07)	812 (75.75)	4157 (76.33)
Any hospital attended injury	243 (21.89)	252 (23.57)	254 (22.78)	280 (25.93)	260 (24.25)	1289 (23.67)
Total	1110 (100)	1069 (100)	1115 (100)	1080 (100)	1072 (100)	5446 (100)

Pearson X^2=5.6810, p=0.224

2) Mother thinks neighbourhood is a good place to live

Early primary

Variable name = k7020
Variable definition = mothers opinion on whether neighbourhood is a good place to live, child aged 5y
Recoded variable name = K7020Cat
Recoded variable definition = mothers opinion on whether neighbourhood is a good place to live, categorised
Coding: Very good = 1, Fairly good = 2, Not very good or not good = 3
Prevalence: Very good = 3036 (52.78%), Fairly good = 2380 (41.38%), Not very good or not good = 157 (2.73%). Missing = 179 (3.11%).

	K7020Cat (Neighbourhood is a good place to live, child aged 5y)			
AnySCI56	Very good n (%)	Fairly good n (%)	Not very good / not good n (%)	Total n (%)
No hospital attended injury	2669 (87.91)	2059 (86.51)	134 (85.35)	4862 (87.24)
Any hospital attended injury	367 (12.09)	321 (13.49)	23 (14.65)	711 (12.76)
Total	3036 (100.00)	2380 (100.00)	157 (100.00)	5573 (100.00)

Pearson X^2=2.8658, p=0.239

Late primary

Variable name = m2250
Variable definition = mothers opinion on whether neighbourhood is a good place to live, child aged 7y
Recoded variable name = M2250Cat
Recoded variable definition = mothers opinion on whether neighbourhood is a good place to live, categorised
Coding: Very good = 1, Fairly good = 2, Not very good or not good = 3
Prevalence: Very good = 3296 (57.30%), Fairly good = 2155 (37.47%), Not very good or not good = 123 (2.14%). Missing = 178 (3.09%).

	M2250Cat (Neighbourhood is a good place to live, child aged 7y)			
AnySCI811	Very good n (%)	Fairly good n (%)	Not very good / not good n (%)	Total n (%)
No hospital attended injury	2537 (76.97)	1614 (74.90)	90 (73.17)	4241 (76.09)
Any hospital attended injury	759 (23.03)	541 (25.10)	33 (26.83)	1333 (23.91)
Total	3296 (100.00)	2155 (100.00)	123 (100.00)	5574 (100.00)

Pearson X^2=3.6751, p=0.159

3) Neighbourhood problems score

Early primary

Variable name = k5213, k5214, k5215, k5216 k5217, k5218, k5219, k5220
Variable definition = Mothers perceptions of neighbourhood: Problems with noise from homes, noise from street, problems with dumped litter, dog dirt, vandalism, burglary, mugging, youths respectively. Reported when child aged 5y
Recoded variable name = Nbprobs5
Recoded variable definition = Neighbourhood problems score. Recoded each variable into 0=no problem or no opinion, 1=minor prob, 2=serious prob, then added all together to produce overall score, then categorised into low, medium or high score.

Coding: Low (score 0-1) = 0, medium (score 2-4) = 1, high (score 5-16) = 2
Prevalence: Low = 2273 (39.52%), Medium = 2193 (38.13%), High = 1074 (18.67%).
Missing = 212 (3.69%).

	Nbprobs5 (neighbourhood problems score aged 5, categorised)			
AnySCI56	Low n (%)	Medium n (%)	High n (%)	Total n (%)
No hospital attended injury	1994 (87.73)	1913 (87.23)	926 (86.22)	4833 (87.24)
Any hospital attended injury	279 (12.27)	280 (12.77)	148 (13.78)	707 (12.76)
Total	2273 (100.00)	2193 (100.00)	1074 (100.00)	5540 (100.00)

Pearson X^2=1.4855, p=0.476

Late primary

Variable name = m2203, m2204, m2205, m2206, m2207, m2208, m2209, m2210
Variable definition = Mothers perceptions of neighbourhood: Problems with noise from homes, noise from street, problems with dumped litter, dog dirt, vandalism, burglary, mugging, youths respectively. Reported when child aged 7y
Recoded variable name = Nbprobs7
Recoded variable definition = Neighbourhood problems score. Recoded each variable into 0=no problem or no opinion, 1=minor prob, 2=serious prob, then added all together to produce overall score, then categorised into low, medium or high score.
Coding: Low (score 0-1) = 0, medium (score 2-4) = 1, high (score 5-16) = 2
Prevalence: Low = 2575 (44.77%), Medium = 2068 (35.95%), High = 896 (15.58%).
Missing = 213 (3.70%).

	Nbprobs7 (neighbourhood problems score aged 7, categorised)			
AnySCI81	Low n (%)	Medium n (%)	High n (%)	Total n (%)
No hospital attended injury	1982 (76.97)	1564 (75.63)	669 (74.67)	4215 (76.10)
Any hospital attended injury	593 (23.03)	504 (24.37)	227 (25.33)	1324 (23.90)
Total	2575 (100.00_	2068 (100.00)	896 (100.00)	5539 (100.00)

Pearson X^2=2.3403, p=0.310

4) Mothers perception of traffic load on street

Variable name = k7030
Variable definition = Mothers perception of traffic load on street at child's age 5y
Coding: 4 categories; Hardly any, Not heavy, Quite heavy, Very heavy
Recoded variable name = traffic
Recoded variable definition = Mothers perception of traffic load on street, at child aged 5y, binary

Coding: Hardly any/not heavy = 0, Quite/very heavy = 1
Prevalence: Hardly any/not heavy = 4401 (76.51%), Quite/very heavy = 1168 (20.31%). Missing = 183 (3.18%)

Variable not repeated in late primary period, therefore same variable used for early and late primary analyses

Early primary

AnySCI56	Not heavy (0) n (%)	Heavy (1) n (%)	Total n (%)
No hospital attended injury	3849 (87.46)	1009 (86.39)	4858 (87.23)
Any hospital attended injury	552 (12.54)	159 (13.61)	711 (12.77)
Total	4401 (100.00)	1168 (100.00)	5569 (100.00)

Pearson X^2=0.9496, p=0.330

Late primary

AnySCI811	Not heavy (0) n (%)	Heavy (1) n (%)	Total n (%)
No hospital attended injury	3366 (76.48)	876 (75.00)	4242 (76.17)
Any hospital attended injury	1035 (23.52)	292 (25.00)	1327 (23.83)
Total	4401 (100.00)	1168 (100.00)	5569 (100.00)

Pearson X^2=1.1179, p=0.290

5) Mothers social support

Early primary

Variable name = k8020, k8021, k8022, k8023, k8024, k8025, k8026, k8027, k8028, k8029
Variable definition = mother has no one to share feelings with, mothers partner provides emotional support, mother can share experiences with other mothers, mother feels neighbours would help in times of difficulty, mother worried partner might leave, mother has someone to share happiness about child with, partner will take over if mother tired, mother's family will help if in financial difficulty, mothers friends would help if in financial difficulty, Mother feels state would support financially, respectively
Coding: exactly how I feel (1), often how I feel (2), sometimes how I feel (3), never feel (4), no partner (7)
Recoded variable name = Socsup5cat
Recoded variable definition = Variables recoded: k8020 and k8024 recoded (1=0), (2=1), (3=2), (4=3) and all other variables recoded (1=3), (2=2), (3=1), (4=0). Also k8022 and k8026 coded (7=0) and k8024 coded (7=3). Social support score when child age 5 created by adding together recoded k8020-k8029 and then categorised
Coding: Low (score 1-17) = 2, medium (score 18-22) = 1, high (score 23-30)= 0

Prevalence: Low = 1692 (29.42%), medium = 1972 (34.28%), high = 1710 (29.73%), missing = 378 (6.57%)

	Socsup5cat (social support score at CH aged 5y, categorised)			
AnySCI56	High (0) n (%)	Medium (1) n (%)	Low (2) n (%)	Total n (%)
No hospital attended injury	1511 (88.36)	1697 (86.05)	1475 (87.17)	4683 (87.14)
Any hospital attended injury	199 (11.64)	275 (13.95)	217 (12.83)	691 (12.86)
Total	1710 (100.00)	1972 (100.00)	1692 (100.00)	5374 (100.00)

Pearson X^2=4.3556, p=0.113

Late primary

Variable name = p4020, p4021, p4022, p4023, p4024, p4025, p4026, p4027, p4028, p4029
Variable definition = mother has no one to share feelings with, mothers partner provides emotional support, mother can share experiences with other mothers, mother feels neighbours would help in times of difficulty, mother worried partner might leave, mother has someone to share happiness about child with, partner will take over if mother tired, mother's family will help if in financial difficulty, mothers friends would help if in financial difficulty, Mother feels state would support financially, respectively
Coding: exactly how I feel (1), often how I feel (2), sometimes how I feel (3), never feel (4), no partner (7)
Recoded variable name = Socsup9cat
Recoded variable definition = Variables recoded: p4020 and p4024 recoded (1=0), (2=1), (3=2), (4=3) and all other variables recoded (1=3), (2=2), (3=1), (4=0). Also p4022 and p4026 coded (7=0) and p4024 coded (7=3). Social support score at child aged 9 created by adding together recoded p4020-p4029 and then categorised
Coding: Low (score 1-17) = 2, medium (score 18-22) = 1, high (score 23-30) = 0
Prevalence: Low = 1675 (29.12%), medium = 1836 (31.92%), high = 1698 (29.52%), missing = 543 (9.44%)

	Socsup9cat (social support score at CH aged 5y, categorised)			
AnySCI81	High (0) n (%)	Medium (1) n (%)	Low (2) n (%)	Total n (%)
No hospital attended injury	1313 (77.33)	1382 (75.27)	1257 (75.04)	3952 (75.87)
Any hospital attended injury	385 (22.67)	454 (24.73)	418 (24.96)	1257 (24.13)
Total	1698 (100.00)	1936 (100.00)	1675 (100.00)	5209 (100.00)

Pearson X^2=2.9481, p=0.229

6) Mothers social networks

Early primary

Variable name = k8000, k8001, k8002, k8003, k8004, k8005, k8006, k8007, k8008, k8009
Variable definition = mother or partners relatives seen two or more times per year, number of friends mother has, mother belongs to close circle of friends, number of people including partner that mother can talk to, number of people who talk to mother, number of people with whom mother can discuss important decisions, number of people mother can borrow £100 from, number of people who would help if mother in trouble, number of times mother got together with friends in last month, number of times mother got together with relatives in last month
Coding: k8002: Yes=1, no=2, all other variables: none=1, 1=2, 2-4=3, >4=4
Recoded variable name = socnet5bin
Recoded variable definition = variables recoded: k8002 (1=2) (2=1), and all other variables recoded (1=0), (2=1), (3=2), (4=3). Social networks score when child aged 5 created by adding together recoded k8000-k8009 and then categorised into binary variable
Coding: Not high score (score 1-25) = 0, and high score (score 26-30) = 1
Prevalence: High score = 1560 (27.12%), Not high score = 3862 (67.14%), missing = 330 (5.74)

	Socnet5bin (mothers social networks score, child aged 5y, binary)		
AnySCI56	Not High (0) n (%)	High (1) n (%)	Total n (%)
No hospital attended injury	3345 (86.61)	1380 (88.46)	4725 (87.14)
Any hospital attended injury	517 (13.39)	180 (11.54)	697 (12.86)
Total	3862 (100.00)	1560 (100.00)	5422 (100.00)

Pearson X^2=3.3888, p=0.066

Late primary

Variable name = p4000, p4001, p4002, p4003, p4004, p4005, p4006, p4007, p4008, p4009
Variable definition = mother or partners relatives seen two or more times per year, number of friends mother has, mother belongs to close circle of friends, number of people including partner that mother can talk to, number of people who talk to mother, number of people with whom mother can discuss important decisions, number of people mother can borrow £100 from, number of people who would help if mother in trouble, number of times mother got together with friends in last month, number of times mother got together with relatives in last month
Coding: p4002: Yes=1, no=2, all other variables: none=1, 1=2, 2-4=3, >4=4
Recoded variable name = socnet9bin

Recoded variable definition = variables recoded: k8002 (1=2) (2=1), and all other variables recoded (1=0), (2=1), (3=2), (4=3). Social networks score when child aged 9 created by adding together recoded p4000-p4009 and then categorised into binary variable
Coding: Not high score (score 1-25) = 0, and high score (score 26-30) = 1
Prevalence: High score = 1511 (26.27%), Not high score = 3766 (65.47%), missing = 475 (8.26)

	Socnet9bin (social networks score, child aged 9y, binary)		
AnySCI81	Not high (0) n (%)	High (1) n (%)	Total n (%)
No hospital attended injury	2870 (76.21)	1128 (74.65)	3998 (75.76)
Any hospital attended injury	896 (23.79)	383 (25.35)	1279 (24.24)
Total	3766 (100.00)	1511 (100.00)	5277 (100.00)

Pearson X^2=1.4211, p=0.233

7) Mothers relationship with neighbours

Early primary

Variable name = K7000, K7010
Variable definition = Neighbour visits Mother's home, Mother visits Neighbour's home respectively at age 5y. (Close contact between members of a community is one component of high social capital.)
Coding: never (1), rarely (2), sometimes (3), often (4), almost daily (5)
Recoded variable name = nvisits5b
Recoded variable definition = K7000 and k7010 added together to create new variable nvisits5 (neighbour visits, at age 5), divided into low and high scores
Coding: low score (2-6) = 0, high score (7-10) = 1
Prevalence: low = 4208 (73.16%), high = 1356 (23.57%), missing n=188 (3.27%)

	Nvisits5b (neighbour visits mother and vice versa, child aged 5y, binary)		
AnySCI56	Low score n (%)	High score n (%)	Total n (%)
No hospital attended injury	3662 (87.02)	1192 (87.91)	4854 (87.24)
Any hospital attended injury	546 (12.98)	164 (12.09)	710 (12.76)
Total	4208 (100.00)	1356 (100.00)	5564 (100.00)

Pearson X^2=0.7148, p=0.398

Late primary

Variable name = m2230, m2240
Variable definition = Neighbour visits Mother's home, Mother visits neighbour's home, respectively, at child aged 7 years
Coding: never (1), rarely (2), sometimes (3), often (4), almost daily (5)
Recoded variable name = nvisits7b
Recoded variable definition m2230 and m2240 added together to create new variable nvisits7 (neighbour visits, at age 7), divided into low and high scores
Coding: low score (2-6) = 0, high score (7-10) = 1
Prevalence: low score = 4221 (73.38%) and high score = 1345 (23.38%), missing = 186 (3.23%)

AnySCI811	Low score n (%)	High score n (%)	Total n (%)
No hospital attended injury	3243 (76.83)	991 (73.68)	4234 (76.07)
Any hospital attended injury	978 (23.17)	354 (26.32)	1332 (23.93)
Total	4221 (100.00)	1345 (100.00)	5566 (100.00)

Pearson X^2=5.5591, p=0.018

8) Neighbours care for children

Early primary

Variable name = K7002
Variable definition = Neighbour looks after Mother's children at child aged 5 years
Coding: never (1), rarely (2), sometimes (3), often (4), almost every day (5)
Recoded variable name = ncares5
Recoded variable definition = Neighbour cares for mothers children, child aged 5y, binary
Coding: no/rarely = 0, sometimes / often = 1
Prevalence: no/rarely = 3294 (57.27%), sometimes / often = 2258 (39.26%), missing = 200 (3.48%)

	Ncares5 (neighbour cares for mothers children, age 5y, binary)		
AnySCI56	No / rarely n (%)	Sometimes / often n (%)	Total n (%)
No hospital attended injury	2869 (87.10)	1976 (87.51)	4845 (87.27)
Any hospital attended injury	425 (12.90)	282 (12.49)	707 (12.73)
Total	3294 (100.00)	2258 (100.00)	5552 (100.00)

Pearson X^2=0.2059, p=0.650

Late primary

Variable name = m2232
Variable definition = Neighbour looks after Mother's children at child aged 7 years
Coding: never (1), rarely (2), sometimes (3), often (4), almost every day (5)
Recoded variable name = ncares7
Recoded variable definition = neighbour cares for mothers children, age 7y, binary
Coding: no/rarely = 0, sometimes / often = 1
Prevalence: no/rarely = 3060 (53.20%), sometimes / often = 2502 (43.50%), missing = 190 (3.30%)

	Ncares7 (neighbour cares for mothers children, age 7y, binary)		
AnySCI811	No / rarely (0) n (%)	Sometimes / often (1) n (%)	Total n (%)
No hospital attended injury	2330 (76.14)	1902 (76.02)	4232 (76.09)
Any hospital attended injury	730 (23.86)	600 (23.98)	1330 (23.91)
Total	3060 (100.00)	2502 (100.00)	5562 (100.00)

Pearson X^2=0.011, p=0.914

Note: A number of school variables were excluded from further analysis due to a) large amount of missing data (number shown in brackets) and b) the missing data was socially patterned (trend seen when 'missingness' cross tabulated with Qimd) and therefore would have introduced bias
Excluded variables:

- Teacher reported weight of traffic on school street (missing = 3327)
- Index of disadvantage of schools pupils (prorated) (missing = 3447)
- Percentage of pupils with concerning home circumstances (missing = 3372)
- Percentage of pupils eligible for free school meals (missing = 3579)

APPENDIX 8: PUBLISHED SYSTEMATIC REVIEW

Unintentional injuries in school-aged children and adolescents; lessons from a systematic review of cohort studies

Mytton J, Towner E, Brussoni M and Gray S

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Unintentional injuries in school-aged children and adolescents: lessons from a systematic review of cohort studies

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► Additional tables and boxes are published online only at http://injuryprevention.bmj.com/content/vol15/issue2

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ABSTRACT

Objectives: To critically synthesise current knowledge of the patterns of injuries and risk factors for injury in school-aged children, to summarise the evidence and support effective child injury prevention initiatives.

Design: Systematic review.

Selection criteria and methods: Prospective cohort studies reporting unintentional injuries in healthy children aged 5–18 years were identified by searching 15 electronic databases and additional grey literature sources. A narrative synthesis was conducted of papers meeting quality criteria, with risk factors analysed at individual, family and environmental levels. Limitations of existing evidence were considered.

Results: 44 papers from 18 different cohort studies met the inclusion criteria. There were broad and consistent patterns of injury across time and place. Male sex, psychological, behavioural and risk-taking behaviour problems, having a large number of siblings, and a young mother were all associated with increased injury occurrence across more than one cohort and setting.

Conclusions: Descriptive epidemiology and risk factors for injury were derived from prospective cohort studies, but few studies used the full potential of their design. Opportunities to use repeated measures to assess temporal changes in injury occurrence, and the exploration of risk factors, particularly those related to the child's environment, have rarely been undertaken. Few studies were conducted in low/middle-income countries where the burden of injury is greatest. These findings should be considered when planning future research and prevention initiatives.

Childhood injury continues to be an international public health problem. More than 875 000 children die each year as a result of injury, with 95% of child deaths occurring to children in low/middle-income countries. For every child who dies, many more receive injuries resulting in disability and discomfort. Non-fatal injuries affect the lives of 10–30 million children and adolescents each year.[1] Reducing this substantially preventable burden requires the collation and interpretation of existing data on childhood injury to contribute to hypothesis generation and intervention development.[2 3]

The development and implementation of effective intervention programmes requires a knowledge of risk and protective factors for childhood injury. These factors can be explored at a number of different levels: an individual level, a family level and the level of the environment in which the child lives. There are differences in injury occurrence between countries, and between groups within countries, thus understanding the factors beyond the individual child are important for identifying risks in different settings and populations.[3] Reports of injury occurrence and risk factors for injury are derived from a variety of study designs including case–control, cohort and population registry follow-up studies. The primary advantage of prospective cohort studies over other study designs is the collection of information on the circumstances surrounding the injury and individual characteristics of children, before the occurrence of injury. This temporal relationship reduces the potential for recall bias that threatens the validity of case–control study findings, and is often absent from population registry follow-up studies. Prospective cohort studies reporting injury in children are therefore more likely to be valid than other study designs as a means of examining prevalence and associated risk factors.

Systematic reviews have a well-established methodology that overcomes the biases in traditional methods of reviewing the literature.[4 5] This paper presents the findings of a systematic review of child cohort studies reporting unintentional injury in school-aged children. It summarises the knowledge and gaps in injury epidemiology, exploring risk factors for injury at individual, family and environmental levels, and identifies methodological issues that may be of relevance for planning future cohort studies.

METHODS

Inclusion and exclusion criteria

Inclusion criteria for studies were: (*a*) the study design was a prospective cohort, longitudinal or follow-up study in which healthy children up to 18 years old were recruited through personal or parental consent; (*b*) outcomes were unintentional physical injuries sustained between the ages of 5 and 18 years. Studies were excluded if: (*a*) they used population-based or record-based cohorts, where no active recruitment to the study occurred; (*b*) children were either selectively recruited because of a specific diagnosis, disability or injury, or undertook an activity that placed them at increased risk of injury, eg, competitive sports; (*c*) if the study only collected outcomes related to psychological or psychiatric injuries. No language or date restrictions were applied.

Search process

Electronic databases were searched using a search strategy developed in Medline through an iterative manner to achieve optimum sensitivity, while retaining practical specificity. The strategy explored the three concept areas of children/young people, injuries, and cohort studies using a combination of text and thesaurus terms (supplementary electronic data; box 1). The strategy was adapted and applied to 14 databases (supplementary electronic data; box 2). Searches took place in January and February 2006. Using reference management software where possible, duplicate references and ineligible studies were excluded on the basis of their design, recruitment, population, or study outcomes (where specified in sufficient detail). The full texts of remaining references were obtained, and further ineligible studies were excluded using the same criteria.

Grey literature sources included the bibliographies of included studies; authors of potentially eligible studies were contacted to confirm eligibility, and, if eligible, to request details of further published and unpublished work, departmental or institutional reports or additional unpublished data; a Medline author search (1966 to 2006) was undertaken for further publications by the lead author of included studies; an internet search for websites relating to known child cohorts was conducted to identify contacts and search publication lists for papers and reports of injury outcomes.

Data extraction

A data extraction form was developed and piloted on five papers by three authors (JM, ET, MB) and modified accordingly. Independent dual data extraction (JM and either ET or MB) was undertaken from all included studies on the number and description of study participants, study design, methods and outcomes recorded. Reviewers were not blinded to the names of journals, the authors or institutions, or the results when extracting data on study methods. Data were compared and differences resolved through discussion or clarification with the author where possible.

To assess study quality, each included paper was critically appraised using questions adapted from CASP (Critical Appraisal Skills Programme "12 questions to help you make sense of a cohort study").[6] These published quality criteria were adapted by excluding one question relating to local application of evidence, since local relevance was not applicable to an international review of the literature. The two authors extracting data undertook the quality assessments. These were collated, and discrepancies were resolved by discussion. A judgement on the overall quality of the study was made after discussion, and an author-designed quality rating was assigned, where A = sound methodology and clear reporting, B = minor methodological or reporting concerns (but not to the extent that the validity of the reported results was questioned), and C = significant methodological or reporting concerns such that serious doubt was placed on the validity of the reported results. Studies given a C quality rating were not considered suitable for inclusion in the synthesis of the review.

Data analysis

Synthesis was achieved through a two-stage narrative process: firstly, a within-study review of papers reporting specific cohort studies, to determine the contribution of that cohort study to the research field and to report consistency of findings between papers reporting that study; secondly, through a between-study review, to summarise the findings identified across different cohort studies, to identify differences and possible reasons for those differences between studies, and to identify gaps in the knowledge base.[5] Differences between groups were reported as odds ratios (ORs) or relative risk (RR) where reported, and as p values where no OR or RR was given. Differences were considered important if they were greater than could have occurred by chance (ie, 95% CIs did not include OR = 1.00 or RR = 1.00, or p values were <0.05). Subgroups specified a priori for the between-study review included the age of the child (age 5–11 years designated "primary" school age, and age 12–18 years designated "post-primary" school age), economic status of the country of study (high-income countries versus middle/low-income countries, as defined by the World Bank[7]), and date of study (studies before 1980 versus those recruited since 1980). Meta-analysis of results of cohort studies was considered inappropriate because of the potential problems associated with unrecognised confounding in observational study designs and the heterogeneity of the studies identified.[8 9]

RESULTS

Forty-four papers from 18 different cohorts met the inclusion criteria and had data available for analysis (fig 1, table 1). Attempts were made to contact authors or study directors; nine contacts responded. No unpublished papers were identified. Five cohorts recruited infants at birth, and the remaining 13 studies recruited older children. Fourteen were based in high-income countries (UK, New Zealand, USA and Canada), and four were from middle/low-income countries (Thailand,[10] Taiwan[11] and

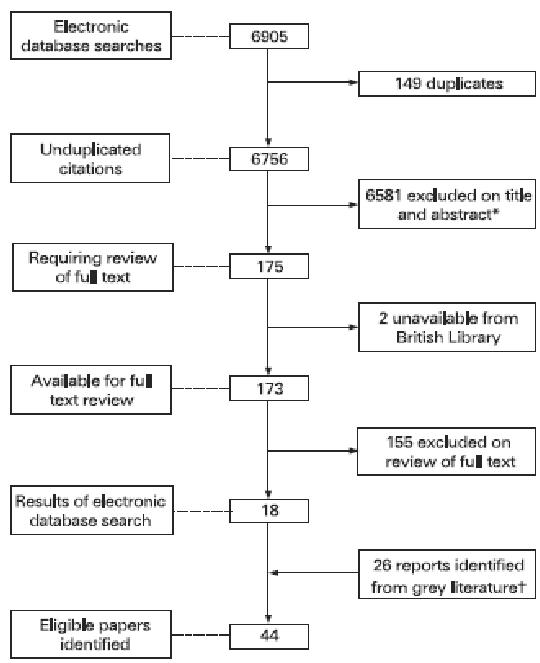

Figure 1 Flow chart of identified eligible studies. Note: 43 of the papers have data for descriptive epidemiology and 27 papers have data for analysis of risk/protective factors. *Key words and indexing terms were also used to identify ineligible papers where these were available. †The majority of grey literature papers were identified by contacting the author of an included study or by performing an electronic database search for further publications by the author of an included study.

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Table 1 Cohort studies included in systematic review

Name of cohort study, country*, first year of recruitment	Location†	Aim and selection criteria of primary study, age at recruitment to primary study	Number recruited/ number eligible (%)‡	First author, year, (quality rating)	Aim of paper, selection criteria (number of children studied) and duration of follow-up from recruitment (% of those recruited followed-up)
Cohort from Baise, China (M), 2002	Baise City, Guangxi Zhuang Autonomous Region (U)	Aim: to describe patterns of non-fatal unintentional injuries. Selection: adolescents from 36 randomly selected classes in 9 randomly selected schools. Age at recruitment: 11–18 years	1840/1855 (99)	Chen, 2005[13] (A)	Aim: as primary study. Selection: children aged 11–18 years (n = 1840). Follow-up: 1 year (99.2%)
				Chen, 2005[14] (A)	Aim: as primary study plus investigation of the association of psychological symptoms with injury. Selection: children aged 13–18 years (n = 1474). Follow-up: 1 year (95.2%)
Cohort from Maanshan, China (M), 2001	Maanshan city (U)	Aim: to study the incidence of injuries and the relationship with behaviour problems. Selection: cluster sampling from years 1–5 in 3 primary schools. Age at recruitment: 6–12 years	2005/NS (nk)	Peng, 2003[12] (B)	Aim: as primary study. Selection: as primary study (n = 1983). Follow-up: 1 year (98.9%)
Cohort from Kaohsiung, Taiwan (M), 1995	Kaohsiung city (U)	Aim: to study the incidence of non-fatal school-related injuries over one academic year. Selection: adolescents aged 13–15 years (grades 7, 8 and 9) attending 6 randomly selected schools. Age at recruitment: 13–15 years	13335/NS (nk)	Yang, 1998[11] (B)	Aim: as primary study. Selection: as primary study (n = 13335). Follow-up: 1 academic year (nk)
West of Scotland 11–16 Study, UK (H), 1994	Central Clydeside (U)	Aim: to study teenage health and the factors that influence it. Selection: pupils entering 43 randomly selected post-primary schools from randomly selected classes in 135 primary schools. Age at recruitment: 11 years	2586/2793 (93)	West, 2004[30] (A)	Aim: to test the hypothesis of equalisation in health between childhood and adolescence. Selection: participants who were surveyed at recruitment (age 11), 13 and 15 years (n = 2196). Follow-up: 5 years (11 years, 93%; 13 years, 84.9%; 15 years, 78.6%)
National Longitudinal Survey of Children & Youth, Canada (H), 1994	Nationwide (M)	Aim: to follow the development and well-being of children from birth to early adulthood. Selection: a random probability sample of residential households with children aged 0–11 years. Age at recruitment: 0–11 years	22831/NS (nk)	Soubhi, 2004[34] (B)	Aim: to study the relationship between child, family and neighbourhood characteristics on medically attended injuries. Selection: children aged 4–11 years living in 10261 households responding to cycle 2 of the study (n = 5357). Follow-up: 1 year (63.3%)
				Soubhi, 2004[66] (B)	Aim: to study the relationships between injury, behaviour, parenting, family functioning and neighbourhood characteristics. Selection: children aged 4–11 years living in 10261 households responding to cycle 2 of the study (n = 5357). Follow-up: 1 year (63.3%)
Add Health Study, USA (H), 1994.	Nationwide (M)	Aim: to study a nationally representative sample of public and private school students. Selection: clustered sampling of 145 middle junior and high schools. Age at recruitment: 11/12–17/18 years	90118/e118576 (76)	Hammig, 2001[36] (B)	Aim: to identify behaviours associated with injuries among boys who fight. Selection: boys involved in fights in past 12 months (n = 1314) from a random sample of cohort participants. Follow-up: 1 academic year (100%)
Cohort from Kamphaeng Phet Province Vaccination Study, Thailand (M), 1991	Kamphaeng Phet Province (R)	Aim: to study the efficacy of an inactivated hepatitis A vaccine. Selection: children attending 148 largest community primary schools in the study province. Age at recruitment: school entry to 16 years	40119/130000 (31)	Kozik, 1999[39] (B)	Aim: to describe mortality and self-reported injury morbidity in a cohort of schoolchildren. Selection: a randomly selected subset of 20% of the cohort, chosen for sequential serological tests as part of the vaccine trial (n = 6378). Follow-up: 2 years (81.0%)
Adolescent Injury Control Study, USA (H), 1990	Allegheny County, Pittsburgh, Pennsylvania (U)	Aim: to investigate the incidence and risk factors for adolescent injuries. Selection: 7th–9th grade students in one school district. Age at recruitment: 12–16 years	1245/1400 (89)	Anderson, 1994[37] (A)	Aim: to examine the patterns of socioeconomic status and injury morbidity. Selection: as primary study (n = 1245). Follow-up: 2 years (89.0%)
Cohort from Eastern Shore, Maryland, USA (H), 1986	3 counties on Eastern Shore, Maryland, Baltimore (M)	Aim: to investigate factors associated with use of tobacco, drugs and alcohol, and early unprotected sexual intercourse among rural youth. Selection: all 8th grade students in three counties. Age at recruitment: 12–14 years	758/1930 (39.3)	Alexander, 1992[35] (B)	Aim: to study behavioural risk factors for medically attended injuries. Selection: as primary study + having completed data from both parent and child (n = 632). Follow-up: 2 years (72.0%)
Carolina Longitudinal Study, USA (H), 1981	Carolina (M)	Aim: to study social development. Selection: students in two bi-racial school districts in either the 4th grade (9–10 years) or 7th grade (12–13 years). Age at recruitment: 9/10 and 12/13 years	695/e993 (70)	Cobb, 1995[38] (B)	Aim: to study the relationships between child factors and socioeconomic status and injury/"close calls" (near accidents). Selection: sub-sample of students responding to questions on injury and "close calls" during interviews (n = 271). Follow-up: to 12th grade (~2–7 years) (39.0%)

Continued

Table 1 Continued

Name of cohort study, country*, first year of recruitment	Location†	Aim and selection criteria of primary study, age at recruitment to primary study	Number recruited/ number eligible (%)‡	First author, year, (quality rating)	Aim of paper, selection criteria (number of children studied) and duration of follow-up from recruitment (% of those recruited followed-up)
Christchurch Child Development Study, New Zealand (H), 1977	Christchurch (U)	Aim: to examine the social, environmental and other risk factors related to child morbidity and explore factors related to health service use, family functioning and well-being. Selection: all hospital births in the urban region of Christchurch, New Zealand between period 15 April 1977 and 5 August 1977. Age at recruitment: birth	1265/1310 (96.4)	Horwood, 1989[31] (B)	Aim: to describe participant's medical history at 5–10 years of age. Selection: all children traceable, with data up to 10 years (n = 1079). Follow-up: 10 years (84.3%)
				Fergusson, 1995[46] (B)	Aim: to study relationship between antisocial behaviour in adolescence and injury. Selection: respondents from cohort with complete data (n = 954). Follow-up: 16 years (75.4%)
				McKinley, 2002[55] (B)	Aim: to study the effect of mild head injury before age 10 on children in mid to late childhood. Selection: respondents from cohort with data available. (n = 939). Follow-up: 13 years (74.2%)
Cohort from Seattle, USA (H), 1975	Seattle, Washington, (nk)	Aim: to study the relationship between injury and risk-taking behaviour or stressful life events. Selection: all 7th grade boys enrolled in physical education at one middle school. Age at recruitment: 12–13 years	138/150 (92)	Padilla, 1976[16] (C)	Aim: as primary study. Selection: as primary study. Follow-up: 5 months (68.7%)
Dunedin Multidisciplinary Child Development Study, New Zealand (H), 1975	Dunedin metropolitan area, Otago (U)	Aim: to study the health and development of children and adolescents, the influences and events contributing to morbidity and health behaviour. Selection: all surviving infants born at Dunedin's maternity hospital between 1 April 1972 and 31 March 1973, whose mothers resided in the metropolitan area during pregnancy and were still living in the province of Otago when children were age 3. Age at recruitment: 3 years	1037/1139 (91)	Langley, 1981[17] (B)	Aim: to describe injuries experienced by children aged 6–7 years. Selection: all traceable 7-year-olds from the original cohort plus those eligible and added to the cohort (n = 1072). Follow-up: 4 years (92.4%)
				Langley, 1985[18] (B)	Aim: to describe injuries experienced by children aged 8–9 years. Selection: all 9-year-olds from the original cohort assessed at the research centre. (n = 818). Follow-up: 6 years (78.9%)
				Langley, 1987[19] (B)	Aim: to describe injuries experienced by children aged 10–11 years. Selection: all traceable 11-year-olds from the original cohort who agreed to take part (n = 925). Follow-up: 8 years (89.2%)
				Langley, 1987[43] (A)	Aim: to study the relationship between child and family variables to childhood injuries. Selection: all traceable children with data for the period 7–11 years (n = 781). Follow-up: 8 years (75.3%)
				Chalmers, 1989[20] (B)	Aim: to describe injuries experienced by children aged 12–13 years. Selection: all traceable children completing questionnaires at the research centre (n = 738). Follow-up: 10 years (71.2%)
				Lodge, 1990[21] (B)	Aim: to describe injuries experienced by children aged 14–15 years. Selection: all traceable children completing questionnaires at the research centre (n = 849). Follow-up: 12 years (81.9%)
				Begg, 1990[40] (B)	Aim: to describe the road crash experiences of children aged 14–15 years. Selection: all traceable children completing questionnaires at the research centre (n = 848). Follow-up: 12 years (81.8%)
				Begg, 1991[41] (B)	Aim: to study injuries sustained in bicycle crashes in children aged 14–15 years. Selection: all traceable children completing questionnaires at the research centre (n = 848). Follow-up: 12 years (81.8%)
				Begg, 1992[33] (B)	Aim: to study injuries sustained in motor vehicle crashes in children aged 14–15 years. Selection: all traceable children completing questionnaires at the research centre (n = 848). Follow-up: 12 years (81.8%)
				Jones, 2002[48] (B)	Aim: to describe the proportion of children remaining fracture-free up to the age of 18 years. Selection: all children providing injury information at each stage of follow-up (n = variable, 739 to 984). Follow-up: 15 years (71.3–84.5%)
				Jones, 2004[59] (B)	Aim: to study child risk factors for fractures in cohort members. Selection: poorly specified. (n = 675–853). Follow-up: 15 years (65.1–82.3%)

Continued

Table 1 Continued

Name of cohort study, country*, first year of recruitment	Location†	Aim and selection criteria of primary study, age at recruitment to primary study	Number recruited/ number eligible (%)‡	First author, year, (quality rating)	Aim of paper, selection criteria (number of children studied) and duration of follow-up from recruitment (% of those recruited followed-up)
Cohort from South Wales, UK (H), 1972	Two "industrial towns" in South Wales, (U)	Aim: to study the effects of milk supplementation on child growth to 5 years. Selection: consecutive births in two community hospitals. Twins, premature infants, and those receiving supplements excluded. Age at recruitment: birth	1163/1288 (90.3)	Davidson, 1987[46] (B)	Aim: to study the relationship between maternal personality and injury in children. Selection: participants of original cohort with complete data (n = 831). Follow-up: 8 years (71.5%)
				Davidson, 1988[22] (B for injury reporting, C for analysis)	Aim: to study the relationship between child behaviour and injury. Selection: all children remaining in the study at 5 years of age (n = 951). Follow-up: 8 years (81.8%)
Child Health & Education Study (CHES), UK (H), 1970	Nationwide (England, Scotland, Wales and Northern Ireland) (M)	Aim: to study the circumstances, health, education and social development of children through to adulthood. Selection all children born between 5–11 April 1970, alive and living in England, Wales or Scotland in 1975. Age at recruitment: birth	CHES: 16004/NS (nk). BCS70: 17196/ NS (~95)	Bijur, 1988[34] (A)	Aim: to study the relationship between behaviour and injury. Selection: children with data at both 5 and 10 years, who were singleton births, had an English speaking mother of British ancestry, no suspicion of child abuse as the cause of the injuries (or in care), and mother present at the 5-year-old interview (n = 10394). Follow-up: 10 years (64.9%)
				Bijur, 1988[38] (B)	Aim: to study the relationship between preschool injuries and injuries in the school-aged period. Selection: as Bijur[34] (n = 10394). Follow-up: 10 years (64.9%)
				Bijur, 1988[40] (B)	Aim: to study the relationship between family and child factors and injury. Selection: as Bijur[34] (n = 10394). Follow-up: 10 years (64.9%)
				Bijur, 1990[42] (B)	Aim: to study the sequelae of mild head injury in children. Selection: as Bijur[34] (n = 10394). Follow-up: 10 years (nk)
				Beattie, 1999[23] (B)	Aim: to describe injuries requiring medical attention in Scottish teenagers. Selection: all teenagers in the cohort traced as resident in Scotland in 1986/7 (n = 958). Follow-up: 16 years (68.0%)
Cambridge Study of Delinquent Development, England, UK (H), 1961	London (U)	Aim: to study offending and antisocial behaviour in London males. Selection: all boys aged 8–9 years (born 1951–4), on the registers of 6 state primary schools and one special school, within a 1-mile radius of the research office in a working class area of South London. Age at recruitment: 8–9 years	411/411 (100)	West, 1977[25] (B)	Aim: to describe the lifestyles of youths at age 18. Selection: all traceable from primary study (n = 389). Follow-up: 10 years (94.6%)
				Shepherd, 2002[26] (A)	Aim: to study the relationship between offending, health and injury. Selection: all traceable from primary study (n = 387). Follow-up: 10 years (94.2%)
				Shepherd, 2004[27] (B)	Aim: to study the relationship between childhood characteristics, teenage delinquency, injury and illness at 16–18. Selection: all traceable from primary study (n = 378). Follow-up: 26 years (94.6%)

Continued

Table 1 Continued

Name of cohort study, country*, first year of recruitment	Location†	Aim and selection criteria of primary study, age at recruitment to primary study	Number recruited/number eligible (%)‡	First author, year, (quality rating)	Aim of paper, selection criteria (number of children studied) and duration of follow-up from recruitment (% of those recruited followed-up)
National Child Development Study (NCDS), UK (H), 1958	Nationwide (England, Scotland and Wales), (M)	Aim: to monitor the social, economic, educational and health circumstances of all children in England, Scotland and Wales. Selection: all children living in England, Scotland and Wales who were born in the week 3–9 March 1958. Age at recruitment: birth	17418/e17957 (97)	Peckham, 1973[38] (B)	Aim: to describe the preliminary findings at age 11 years. Selection: all children from the cohort alive and living in England, Scotland or Wales (n = "more than 15 000"). Follow-up: 11 years (nk)
				Peckham, 1976[39] (B)	Aim: to describe development, illnesses, school absence, social conditions and educational progress at age 16 years. Selection: all children from the cohort traced through educational authority school registers in 1974, and agreeing to participate (n = 15245). Follow-up: 16 years (87.5%)
				Pless, 1989[40] (B)	Aim: to study factors that may affect the risk of having a traffic injury. Selection: all children from the cohort alive and living in England, Scotland or Wales (n = 13 653 at 11 years, n = 11 507 at 16 years). Follow-up: 16 years (78.4% at 11 years, 66.1% at 16 years)
				Bijur, 1991[44] (B)	Aim: to study the relationship between parent–adolescent conflict and injury. Selection: children from the cohort whose British, English-speaking mother responded to questionnaire, with >50% data complete and had data on injury episode at age 16 and 23 years (n = 8231). Follow-up: 23 years (47.3%)
				Cumberland, 2004[41] (B)	Aim: to study the relationship between colour vision deficiency, education and injury. Selection: unclear. Assumed to be participants from the original birth cohort that had colour vision assessed at age 11 years using the Ishihara test (n = 12534). Follow-up: 33 years (72.0%)
				Rahi, 2006[42] (B)	Aim: to study the relationship between amblyopia and educational, health and social outcomes. Selection: participants from the cohort at age 16, excluding those with bilateral visual loss, unilateral visual loss inconsistent with amblyopia or known eye disease (n = 8861). Follow-up: 33 years (50.9%)
Newcastle Thousand Families Study, UK (H), 1947	Newcastle upon Tyne, England, (U)	Aim: to describe disease and disablement in a representative sample of the city's children. Selection: infants born to mothers resident in Newcastle from 1 May to 30 June 1947. Age at recruitment: birth	1142/NS (nk)	Miller, 1974[6] (B)	Aim: to describe growth, injury, disease, social adaptation and educational attainment of children in relationship to family life and the environment of Newcastle families. Selection: all members of the cohort still enrolled at the ages of 5–15 years (n = 763). Follow-up: 15 years (66.8%)

*High (H), middle (M) or low (L) income country.
†Urban (U), rural (R) or mixed (M).
‡e, estimated; NS, not specified; nk, not known.
¶A, B or C (see Methods).

China[12–14]). Four cohorts used a nationally representative sampling method, while the remainder sampled particular geographical areas (often urban). The oldest cohort study was recruited in the UK in 1947,[15] and the most recent in China in 2002.[13] The quality of the included papers was generally satisfactory, with only one paper given a C rating.[16]

Descriptive epidemiology of injuries

Of papers describing injuries, 15 reported primary school-aged children, 18 post-primary school-aged children and nine described injuries across both age periods. The text below provides an overview of the descriptive injury results, and the tables and figures provide details from specific studies. The range of outcomes reported by individual papers is summarised in table S1 (supplementary electronic data). The average proportion of the cohort sustaining both any injury and multiple injuries varied markedly, largely because of differences in injury and outcome definitions. All papers reporting any injury or multiple injuries by gender found that injuries were more common in boys than girls, with the difference appearing to widen in the post-primary school-age group (table 2). Only nine cohorts reported the ethnic group of the children or their mothers.

Type and mechanism of injury

The New Zealand Dunedin Multidisciplinary Child Development Study (DMCDS)[17–21] described injuries occurring between the ages of 6 and 15 years, in greater detail than any other study. The changing patterns of injuries with age are illustrated in fig 2, and these findings were consistent with those from four papers from older UK cohorts[15 22–24] with respect to fractures, and by a paper from a middle-income country with respect to lacerations and sprains/strains.[10] The latter paper reported that 12% of injuries were near-drownings. Only two other cohorts reported near-drowning cases; both were older UK studies with rates of $\leqslant$3%.[24 25]

Four papers from three cohorts (UK, New Zealand and China) reported the proportion of injuries affecting different parts of the body.[13 20 21 23] Upper limbs were affected in 32–36% of injury events reported, lower limbs in 29–39% of events, and the head or face in 19–23% of injury events. One Taiwanese cohort[11] found that rates of upper limb injuries were double those affecting the lower limb. Falls were the most often reported mechanism of injury, followed by injuries involving sharp and blunt objects, although the proportions of the latter two categories vary considerably between papers because of different definitions. Injuries sustained during sports participation were rarely specified[21 26] (table S2).

Location of injury event

The location of the reported injury event changed as the children aged. The home became less important as more injuries occurred in school and leisure areas. This is shown clearly in the DMCDS cohort[17–21] (fig 3). Even at home, injuries became increasingly likely to occur outside, eg, in the garden, yard, driveway or path.[18 20 21] Injuries on the road peaked at 8–9 years in the DMCDS, but never formed a large proportion of injury locations. Two UK cohorts[27–30] and one from China[13] reported similar locations for children of post-primary school age, despite varying in geographical setting and date of recruitment (1969–2005). One older UK cohort[15] and one cohort from the USA[26] both found a greater proportion of injuries occurring in the road environment (table S3).

Table 2 Proportion of boys and girls sustaining any injury or multiple injuries during the period of follow-up

Cohort, country (period of data collection)	Age of child (years)	Proportion (%) of cohort sustaining injury: Any injury, Boys	Any injury, Girls	More than one injury, Boys	More than one injury, Girls
Primary school age					
Cohort from South Wales, UK (1977–1980)	5–8[22]	37.2	26.3	12.5	7.1
1970 British Birth Cohort Study, UK (1975–1980)	5–10[47]	49	34.8	43.9	31.4
1958 British Birth Cohort, UK (1966–1969)	8–11[40]	4.1	2.1		
Post-primary school age					
Cohort from Baise City, China (2002–2003)	11–18[13]	34.8	30.3	12.2	8.3
	13–18[14]	32.6	27.4		
West of Scotland 11–16 study, UK (1994–1998)	13[30]	39.2	28.1		
	15[30]	58.0	40.1		
Carolina Longitudinal Study, USA (1981–1986)	14–18[26]	53.1	39.0		
1970 British Birth Cohort Study, UK (1980–1986)	10–16[23]	52	33		
1958 British Birth Cohort, UK (1969–1974)	12–16[40]	6.6	3.5		
	12–16[44]	25.3	11.4	5.3	1.5
	11–16[41]	30.6	17.3		
Combined primary and post-primary school age					
Cohort from Kampaeng Phet Province Vaccination Study, Thailand (1991–1993)	School entry to 16[10]	70.8	60.2	37.9	27.2
Cohort from Maanshan, China (2001–2002)	7–13[12]	32.1	29.1	9.7	8.4

Note: 1958 British Birth Cohort Study paper by Pless *et al*[40] reported road traffic injuries only.

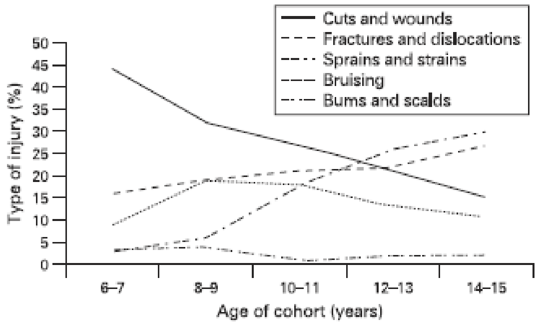

Figure 2 Percentage of types of injury sustained between 6 and 15 years in the Dunedin Multidisciplinary Child Development Cohort. Compiled from data from five papers.[17–21]

Figure 3 Change in location of injury event in the Dunedin Multidisciplinary Child Development Study cohort. Compiled from data from five papers.[17–21]

Severity and consequences of injury

Comparison of severity of reported injuries was difficult because of the number of methods used to categorise severity of injuries. Seven papers reporting healthcare service use as a proxy for severity often defined an injury as one requiring medical attention. Reported injuries were more likely to have required either primary care (7–33%) or outpatient/emergency room care (13–65%) than hospital admission (<10%) (table S4).[15 17–21 31] Only one cohort stated the proportion of reported injuries receiving care outside of health service settings, with 70% of injuries being managed by the child or their carer, 27% managed by a primary care doctor, and 4% admitted to hospital.[13 14] The Abbreviated Injury Scale score was used in five papers[18–21 23] from two cohort studies (New Zealand and UK) and suggested that, as children became older, the injuries they sustained were likely to be less severe (table S5). Two cohorts used duration of time away from school as a proxy for injury severity and suggested that between 4.0%[32] and 7.2% of children missed more than a week from school as a consequence of their injury.[13]

Three cohorts reported fatal injuries. In the New Zealand DMCDS[19 33] cohort and a US cohort,[26] unintentional fatal injuries were due to road traffic incidents. In the cohort from Thailand,[10] 0.05% of the cohort (n = 20) died from unintentional injury over 2 years of follow-up, 13 (65%) due to road traffic crashes, and six (30%) due to drowning. Only two cohorts reported any short-term or long-term consequences of the injuries sustained. In one UK study,[15] 0.5% (n = 3) received long-term severe disabilities. In the New Zealand DMCDS, 70% of the injuries reported at 12–13 years resulted in some limitation of activities from the day after the injury.[20] Most were of short duration, but 20% lasted longer than 1 month and 1% (n = 8) resulted in a permanent disability. Similar findings emerged 2 years later when this assessment was repeated.[21]

Risk factors for injury

Twenty-seven papers from 15 cohorts reported some analysis of risk factors for injury (tables 3 and S6).

Child factors

Male sex was a significant risk factor for injury across a range of geographical settings (China, USA, New Zealand, UK and Canada) and periods of time (1958–2002).[10 13 22 34 35] In contrast with the descriptive data reported, the two papers that analysed injury risk by age of the child found either no differences greater than chance[36] or more injuries in younger children.[13] Four US cohorts[26 35–37] reported no statistically significant differences in injury occurrence between different ethnic groups, in contrast with one study from China[13] that found more injuries in minority ethnic groups. Only one paper reported a history of injury as a risk factor for future injury, finding increased risk greater than expected by chance.[38]

Risk factors related to the physical development of the child were not consistently found to be associated with injury, although cohorts rarely analysed identical factors. Being taller and heavier than their peers was an independent risk factor for fractures in children from New Zealand,[39] while post-primary school UK boys were more likely to sustain road traffic injuries if of short stature.[40] The latter study also reported increased risk of traffic injuries with sensory deficit (unspecified), in contrast with papers reporting no increased risk of any injury associated with colour vision deficit[41] or amblyopia.[42] Studies exploring the impact of poor coordination or motor development found little evidence of independent increased risk in cohorts from both the UK[40] and New Zealand.[43]

Learning ability was not associated with risk of injury in the two studies reporting this variable.[40 43] Children with psychological difficulties were consistently found to have increased risks across both geographical setting (UK and China) and time (1958, 2001 and 2002).[12 14 40] Hyperactivity was an independent risk factor in two UK cohorts,[40 44] but not in a Canadian study.[34] Behavioural difficulties (such as antisocial or aggressive behaviours) were reported in 10 different cohorts, with authors reporting increased risk in both primary school-aged children[12 24 38 45] and post-primary school-aged children,[26 28 29 36 44] and across time and place. A smaller number of papers did not report increased risk of injury with behavioural difficulties.[34 35 43 46] Risk-taking behaviour was consistently associated with injury greater than expected by chance generally[26 28] and for specific risk behaviours including daily smoking,[39] lifetime marijuana use[35] and recent alcohol use.[35 44]

Family factors

Living in a family with many siblings was associated with increased risk of injury greater than chance in three UK cohorts,[24 28 38 45 47] in contrast with a New Zealand cohort of primary school-aged children[43] and an adolescent cohort from China.[13 14] A relatively young mother at the time of the child's birth was independently associated with injury risk in cohorts from both the UK (where "young" was defined as 20–24 years)[38] and China (where "young" was defined as under 22 years).[12]

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Table 3 Individual, family and environmental risk factors associated with unintentional injury greater than by chance

Risk factor category	Cohort (country) author, year	Outcome variable	Exposure variable: Comparison group	Exposure variable: Reference group	Effect estimate (95% CI)
Individual risk factors					
Sex	NLSCY (Canada), Soubhi 2004[18]	Risk of any injury 4–11 years	Boys	Girls	OR = 1.56 (1.35 to 1.85)
	Baise City, (China) Chen, 2005[6]	Risk of any injury aged 11–18 years	Boys	Girls	OR = 1.25 (1.02 to 1.53)
	Eastern Shore, (USA) Alexander, 1992[22]	Risk of injury whilst in 9th grade (~14–15 years)	Boys	Girls	OR = 1.96 (1.26 to 3.04)
	South Wales, (UK) Davidson, 1988[39]	Risk of injury at 5–8 years	Boys	Girls	RR = 1.52 (1.23 to 1.88)
	Kamphaeng Phet Province (Thailand), Kozik, 1999[30]	Risk of having a motor vehicle crash while enrolled in school	Boys	Girls	RR = 1.4 (1.2 to 1.6)
Age	Baise City, (China) Chen, 2005[6]	Risk of any injury	11–13-year-olds	17–18-year-olds	OR = 1.51 (1.00 to 2.26)
			14–15-year-olds	17–18-year-olds	OR = 2.94 (1.96 to 4.42)
Ethnicity	Baise City, (China) Chen, 2005[6]	Risk of any injury aged 11–18 years	Students from minority ethnic groups	Students from one of the main ethnic groups	OR = 1.67 (1.05 to 2.66)
Growth	DMCDS, (NZ) Jones, 2004[26]	Risk of any fracture 5–18 years	Children with a standard deviation increase in mean weight	Mean weight at age 3	RR = 1.14 (1.03 to 1.27)*
			Children with a standard deviation increase in mean height	Mean height at age 3	RR = 1.13 (1.01 to 1.23)*
			Children with a standard deviation increase in mean weight	Weight at ages 5–18 years	RR = 1.15 (1.03 to 1.28)*
			Children with a standard deviation increase in mean height	Height at ages 5–18 years	RR = 1.13 (1.02 to 1.24)*
		Risk of prepubertal fractures	Children with a standard deviation increase in mean birth length	Mean birth length	RR = 1.28 (1.04 to 1.58)*
			Children with a standard deviation increase in BMI	BMI aged 5–18 years	RR = 1.24 (1.02 to 1.52)*
Sensory deficit	NCDS, (UK) Pless, 1989[52]	Risk of road traffic injuries at 7–11 years	Boys with sensory deficit	Boys without sensory deficit	OR = 1.54 (1.1 to 2.1) (Girls had CI crossing 1.0)
	NCDS, (UK) Rahi, 2006[53]	Risk of injury at 7–11 years	Children with resolved amblyopia (Note: small numbers)	Children with normal vision	OR = 0.33 (0.12 to 0.89)
Coordination/motor skills	NCDS, (UK) Pless, 1989[52]	Risk of road traffic injuries at 7–11 years	Girls with poor gross motor control	Girls with normal gross motor control	OR = 1.68 (1.1 to 2.6) (Boys had CI crossing 1.0)
	Eastern Shore, (US) Alexander, 1992[22]	Risk of injury when in 10th grade	Children playing 1–3 team sports in previous 12 months	Children not playing team sports in previous 12 months	OR = 1.66 (1.11 to 2.57)
	CSDD, (UK) Shepherd, 2002[46]	Risk of injury at 16–18 years	Boys with "low" heart rate at 16–18 years (rate unspecified)	Boys without low heart rate	OR = 1.72 (1.14 to 2.60)
Concentration and attention	NCDS, (UK) Pless, 1989[52]	Risk of road traffic injuries at 7–11 years	"Fidgety" boys (parental report)	Boys not considered "fidgety"	OR = 1.67 (1.2 to 2.4) (Girls had CI crossing 1.0)
Psychological difficulties	South Wales, (UK) Davidson, 1988[39]	Risk of injury at 5–8 years	Children with marked fears	Children without marked fears	RR = 1.95 (1.35 to 2.83)
	NCDS, (UK) Pless, 1989[52]	Risk of road traffic injuries at age 7 years	"Sensitive" boys (parental report)	Boys not reported "sensitive"	OR = 1.38 (1.1 to 1.8) (Girls had CI crossing 1.0)
			"Maladjusted" girls (parental report)	Girls not reported "maladjusted"	OR = 1.8 (NS)
	Maanshan City, (China) Peng, 2003[34]	Risk of injury at age 7–13 years	Neurotic behaviour (parental report)	Child not reported neurotic	RR = 1.96 (1.36 to 2.82)
	Baise City, (China) Chen, 2005[6]	Risk of injury at 13–18 years	Self-reported somatisation	Children with low somatisation score	OR = 2.00 (1.52 to 2.63)†
			Self-reported obsessive-compulsiveness	Children with low obsessive-compulsiveness score	OR = 2.10 (1.71 to 2.58)†
			Self-reported anxiety	Children with low anxiety score	OR = 2.08 (1.62 to 2.66)†
			Self-reported depression	Children with low depression score	OR = 2.00 (1.59 to 2.51)†
			Self-reported interpersonal-sensitivity	Children with low interpersonal-sensitivity score	OR = 1.66 (1.34 to 2.06)†
			Self-reported psychoticism	Children with low psychoticism score	OR = 1.60 (1.26 to 2.03)†

Continued

Table 3 Continued

Risk factor category	Cohort (country) author, year	Outcome variable	Exposure variable: Comparison group	Exposure variable: Reference group	Effect estimate (95% CI)
Behavioural difficulties	Maanshan City, (China) Peng, 2003[34]	Risk of injury at age 7–13 years	Parent-reported antisocial behaviour	Children without antisocial behaviour	RR = 2.04 (1.37 to 3.01)
	Add Health study, (USA) Hammig, 2001[16]	Risk of injuring self between 11–18 years	Self-reported group fighting 3+ times in past 12 months	No group fighting or group fighting 1–2 times	OR = 1.97 (1.1 to 3.5)
			Self-reported fighting with a stranger in past 12 months	No fighting with strangers	OR = 2.01 (1.3 to 3.1)
		Risk of injuring others when aged 11–18 years	Self-reported group fighting 1–2 times in past 12 months	No group fighting	OR = 2.51 (1.8 to 3.5)
			Self-reported group fighting 3+ times in past 12 months	No group fighting or group fighting 1–2 times	OR = 5.67 (3.2 to 10.0)
			Self-reported fighting with a stranger in past 12 months	No fighting with strangers	OR = 1.69 (1.2 to 2.4)
			Self-reported use of a weapon	No weapon use	OR = 2.24 (1.4 to 3.7)
	CSDD, (UK) Shepherd, 2002[46]	Risk of injury at 16–18 years	Boys who were antisocial (teacher report)	Boys not reported to be antisocial	OR = 1.93 (NS)
		Risk of injury in an assault at 16–18 years	Boys who engaged in troublesome behaviour (teacher report)	Boys who did not engage in troublesome behaviour	OR = 4.36 (2.01 to 9.46)
	South Wales, (UK) Davidson, 1988[39]	Risk of injury at 5–8 years	Children with discipline problems	Children without discipline problems	RR = 1.29 (1.04 to 1.60)
Personal risk-taking behaviour	CSDD, (UK) Shepherd, 2002[46]	Risk of injury at 16–18 years	Boys who engaged in "daring" behaviour (parent report)	Boys who did not engage in "daring" behaviour	OR = 3.20 (1.49 to 6.90)
	DMCDS, (NZ) Jones, 2004[36]	Risk of fracture	Personal daily smoking in teenagers	Not smoking, or occasional smoking	RR = 1.43 (1.05 to 1.95)
	Eastern Shore, (US) Alexander, 1992[22]	Risk of injury while in 9th grade (~14–15 years)	Self-report of lifetime marijuana use 1–5 times	Not having taken marijuana	OR = 2.03 (1.11 to 3.71)‡
		Risk of injury while in 10th grade (~15–16 years)	Self-report of alcohol use on 1–2 days in previous 30 days	No alcohol use in previous 30 days	OR = 1.69 (1.05 to 2.71)‡
			Self-report of alcohol use on 3 or more days in previous 30 days	No alcohol use in previous 30 days	OR = 1.74 (1.07 to 2.84)‡
Employment	Eastern Shore, (US) Alexander, 1992[22]	Risk of injury while in 9th grade (~14–15 years)	Self-report of working ≥11 h/week	Working none or less than 11 h/week	OR = 2.37 (1.26 to 4.45)
Previous injuries	CHES, (UK) Bijur, 1988[42]	Risk of injuries at 5–10 years	Children having 3 or more injuries before 5 years of age	Children having no injuries before the age of 5 years	RR = 5.9 (4.4 to 8.8)
		Risk of injuries requiring hospitalisation at 5–10 years	Children admitted to hospital 1 or more times for injuries before 5 years of age	Children not admitted to hospital for injuries before 5 years of age	RR = 2.5 (2.0 to 3.3)
Family risk factors					
Family size	CHES, (UK) Bijur, 1988[44]	Risk of injuries requiring hospitalisation at 5–10 years	Children living in a household with 4 or more children	Children living in a household with 1–3 children	OR = 1.91 (1.16 to 3.12)¶
	South Wales, (UK) Davidson, 1987[40]	Risk of injury at 5–8 years	Children living in household with 1–2 children	Children living in household with more than 2 children	RR = 0.58 (0.38 to 0.89)
	CSDD, (UK) Shepherd, 2002[46]	Risk of injury in an assault at 16–18 years	Children living in a large family at 8–10 years	Children not living in a large family at 8–10 years	OR = 2.89 (1.33 to 6.26)
Young maternal age	Maanshan City, (China) Peng, 2003[34]	Risk of injury at 7–13 years	Having a mother aged 22 years or younger at birth of study child	Having a mother older than 22 years at birth of study child	RR = 2.25 (1.04 to 4.72)
Parent figure	NCDS, (UK) Pless, 1989[52]	Risk of road traffic injuries at 12–16 years	Boys not living with natural mother at age 11	Boys living with natural mother	OR = 1.98 (1.1 to 3.5)
Family income	CSDD, (UK) Shepherd, 2002[46]	Risk of being injured in an assault at age 16–18 years	Children from families with low incomes	Children from families not on low incomes	OR = 3.09 (1.42 to 6.70)
	Baise City, (China) Chen, 2005a[13]	Risk of injury at 12–19 years	Adolescents from family in middle income band	Adolescents from family in lowest income band	OR = 1.42 (1.11 to 1.81)
Parental education	Maanshan City, (China) Peng, 2003[34]	Risk of injury at 7–13 years	Child's mother had "high" level of education (unspecified)	Child's mother did not have "high" level of education	RR = 1.23 (1.07 to 1.33)

Continued

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Table 3 Continued

Risk factor category	Cohort (country) author, year	Outcome variable	Exposure variable: Comparison group	Exposure variable: Reference group	Effect estimate (95% CI)
Parenting ability and activity	NLSCY (Canada), Soubhi 2004[18]	Risk of injury at 4–11 years	Children with below average consistency of parenting	Children with average or above average consistency of parenting	OR = 1.43 (1.22 to 1.68)§
	Maanshan City, (China) Peng, 2003[14]	Risk of injury at 7–13 years	Children with poor injury-prevention activity at home	Children with adequate or good injury-prevention activity at home	RR = 1.33 (1.03 to 1.71)
			Children whose parents accompanied them to school	Children who were unaccompanied to school	RR = 0.71 (0.06 to 0.87)
Family dysfunction	NCDS, (UK) Pless, 1989[53]	Risk of road traffic injury at age 7–11 years	Boys who appeared to be "scruffy and underfed" (teacher report) at age 7 years	Boys who were not "scruffy and underfed"	OR = 1.69 (1.1 to 2.7)
			Boys who had ever been in care of social services	Boys never taken into care of social services	OR = 1.64 (1.1 to 2.9)
			Girls from homes with "family problems"	Girls from homes without "family problem"	OR = 2.00 (1.3 to 3.1)
			Boys who were "fidgety" and in care of local authority	Boys not "fidgety" or in care of local authority	OR = 1.8 (NS)
		Risk of road traffic injury at age 12–16 years	Boys who appeared to be "scruffy and underfed" (teacher report) at age 11	Boys who were not "scruffy and underfed"	OR = 1.99 (1.1 to 3.4)
			Boys who had ever been in care of social services	Boys never taken into care of social services	OR = 2.22 (1.3 to 3.7)
			Girls from homes with "family problems"	Girls from homes without "family problems"	OR = 1.64 (1.1 to 2.4)
			Girls who were "fidgety" and living in a crowded home	Girls not "fidgety" or in crowded home	OR = 1.56 (NS)
Environmental risk factors					
Physical home environment	NCDS, (UK) Pless, 1989[53]	Risk of road traffic injury at age 7 years	Boys living in homes lacking basic amenities	Boys living in homes with basic amenities	OR = 1.37 (1.1 to 1.8)

"Greater than by chance" indicates studies where 95% CIs do not contain OR = 1.00 or RR = 1.00, or where p values are <0.05.
*Adjusted for sex and age.
†Adjusted for sex, age and ethnicity.
‡Adjusted for sex, race and parents educational level.
¶Adjusted for family socioeconomic status, family income, housing quality, maternal mental health, maternal education, maternal employment, family structure, child aggression, child independence and child overactivity.
§Adjusted for socioeconomic status, the number of people in the household, caregiver's physical and mental health, and a history of injury.
BMI, body mass index; CHES, Child Health and Education Study; CSDD, Cambridge Study of Delinquent Development; DMCDS, Dunedin Multidisciplinary Child Development Study; NCDS, National Child Development Study; NLSCY, National Longitudinal Study of Children and Youth; NS, not stated.

Living without either one or both of the natural parents varied from increasing injury risk[40] to decreasing the risk[15] to making no difference.[14 43]

None of the measures of socioeconomic status (SES) of the child's family were consistent in associations with injury risk. Cohorts from UK and New Zealand showed no significant differences in injury rates between families of different social class as determined by parental occupation.[23 43 48] When income was used as an indicator of SES, higher rates of injury were associated with either lower incomes[28] or middle band incomes,[13] or no association with poverty was found,[36] and increased risk of injury was reported in families with lower[13] or higher[12] parental education or was not associated with parental education.[35] The West of Scotland cohort study[30] examined adolescent injury risk using four measures of SES. Unpublished data indicated no significant association with injury for burn injuries or road traffic injuries, but a significant trend for assault injuries in boys (increased injuries in lower SES groups), and a reverse gradient for sports injuries in girls (increased injuries in higher SES groups).

Poor maternal mental health was associated with increased risk of injuries in primary school-aged children in two UK cohorts,[15 45] but not in New Zealand.[43] Consistent parenting (defined using the McMaster Family Assessment Device)[34] and parental injury-prevention measures (such as the safe keeping of poisons and sharp or hot objects)[12] reduced injuries greater than by chance, while the effect of parental supervision was inconclusive.[15 35] Indicators of poor family functioning were associated with traffic injuries in one UK cohort,[40] but no association between family relationships, family adversity or family dysfunction and child injury were identified in two cohorts from New Zealand.[43 46]

Environmental factors

Only one cohort reported the influence of a poor physical home environment, with increased risk of traffic injuries in boys living in homes lacking basic amenities.[40] Frequent house moves in adolescence were associated with injury in a UK cohort[44] but not in primary school children from New Zealand.[43] Three cohorts studied the wider environment; a Canadian study[34] explored neighbourhood disadvantage using an index of factors, while one UK study[23] and one US[37] cohort explored measures of regional disadvantage. None were able to identify an independent association greater than could have occurred by chance.

DISCUSSION

Principal findings

The pattern and circumstances of injuries change as children progress from 5 to 18 years; in general, there is a widening difference in injury occurrence rates between boys and girls, an increase in the frequency of injuries with an apparent reduction in the severity of injuries, and a tendency for injuries to occur in sports and leisure locations. Falls are consistently the primary mechanism of injury, but the type of injury changes with age from cuts and lacerations to sprains and fractures. We were unable to identify patterns relating to the consequences of injury because of very limited reporting.

Most analyses of risk factors were at the individual level (23/27 papers), a smaller number explored family factors (19/27), and very few considered the wider environment (6/27). Male gender, relatively high weight or height, psychological difficulties, behavioural problems, risk-taking behaviour, having a large number of siblings, having older siblings, and having a younger mother were all associated with an increased risk of subsequent injury across more than one cohort and setting. The risk factors related to the individual child often reflect the child increasing their exposure to injury risk situations, or may result in injury from placing themselves in injury risk situations where they lack the developmental or judgement skills to prevent injury. Having older siblings may be a risk factor because carers perceive that older siblings will supervise younger children, when in practice the younger children try to copy their older brothers and sisters. Younger mothers, compared with average age or older mothers, may be less aware of the risks a child will encounter as they develop and grow. Understanding such factors helps to indicate groups and situations where interventions should be considered and the effectiveness of such interventions assessed. Factors not often explored or inconsistently associated with injury risk included a history of injury, having a sensory deficit, poor learning ability, attention, parental health or parenting ability, family dysfunction, SES and the wider environment of the child.

Methodological issues

This review focused on evidence from prospective cohort studies, enabling a wide range of injury events of variable severity to be reported. A consequence of this decision was that very few child deaths from injury were included in the risk factor analysis. Collating data from case–control studies where cases were children who had died from injury might have yielded different results and gained further insight into preventing these severest of injuries. Such research is warranted.

More papers were identified through grey literature searching than from electronic databases, which was often due to the absence of an indexing term relating to the study design. Randomised controlled trials often have their study design indexed by electronic databases, but this review suggests that other study designs, such as cohort studies, are not routinely indexed. Systematic review methodology increasingly considers the inclusion of non-trial and observational evidence to support the development of policy and the implementation of interventions. Hence all study designs require adequate indexing to allow identification. All the included papers were in English, except for one in Mandarin,[12] and no unpublished papers were identified, although one author did provide additional unpublished data.[30] The predominance of papers in English is not unexpected, since the expense and infrastructure required to conduct cohort studies is likely to have limited them to high-income countries. In this review, four studies were identified from low/middle-income countries, and three of these reported in English. Positive reporting bias was common, with authors stating that they collected or analysed data but they only published selected results, and this risks overestimation of the effects of the reported factors. A further eight papers were identified[49–56] that met the inclusion criteria except for reporting data for children younger or older than the 5–18 age group. Despite attempts to contact authors, data limited to the age period of interest were not available, and these papers were excluded. The absence of these data may have influenced the findings and conclusions drawn.

Heterogeneity existed between included studies with respect to date of study, setting, participants, methodology, and classification systems for measuring risk factors or assessing injury severity. The variety of methods used to classify injury severity reflects the previous lack of widely accepted classification systems. Authors used different definitions of "an injury", although most defined an injury as that requiring medical

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What is already known on this topic

- Childhood unintentional injury is a leading cause of preventable disability and death.
- Prospective cohort studies have the potential to provide data on the occurrence and risk factors for injury.

What this study adds

- Some patterns of injury occurrence and risk factors are consistent across different populations and settings.
- Cohort studies have rarely undertaken repeated measures of injury occurrence to illustrate temporal trends.
- Risk factors related to the family and the environment of the child are likely to be important but under-researched.

attention. Older studies tended to record only the more severe (eg, hospitalised) injuries. The quality of the included papers was generally satisfactory. Only one paper[16] was completely excluded from the synthesis because of selective reporting and inability to obtain complete data. However, authors rarely reported comparisons of recruited and non-recruited children, or those lost to follow-up compared with those retained. Loss to follow-up was reported in 71% of papers, and varied between 0.8%[13] and 52.7%.[44] The modal period of follow-up was 1–2 years but varied between 9 months[11] and 15 years.[15]

Methods for synthesising data from observational studies are still being developed, but the risks of unrecognised confounding when calculating statistical estimates of effect are well reported.[8 9 57] The narrative synthesis used in this review has attempted to be a transparent and objective method to summarise the literature identified. Detailed inclusion of cohort studies that are reported in multiple publications (eg, the DMCDS cohort and the National Child Development Study) risks over-weighting their findings, but not including all publications would lose valuable data. The DMCDS was the only cohort providing in-depth sequential reporting of type and circumstances of injury in an increasingly ageing cohort, thereby illustrating changing patterns of risk. Individuals within clusters are more similar than individuals between clusters, limiting the ability to generalise findings outside of the cluster. Only four of the 18 cohorts identified children using a nationwide sampling frame. The remainder were based in geographical areas that will have had some element of clustering effects. The majority of studies came from high-income countries where risk factors may differ from those in middle/low-income countries. It is possible that further studies from low/middle-income countries may have been identified if additional non-English databases had been included in the search strategy.

This review has attempted to be robust in the methodology used and transparent in reporting, in an attempt to provide an unbiased overview of the evidence available. Even so, methodological decisions made along the way have been based on judgement and opinion, and are therefore not immune to criticism. In addition, the findings of this review need to be considered in the context of epidemiological reports of injury in school-aged children that have arisen from other study designs, and the changing social contexts and experiences of children and adolescents. Children engaged in competitive sport were excluded from this review, yet their risks of injury are well recognised. Understanding of these risks and the effectiveness of interventions to prevent such injuries warrant further study.

IMPLICATIONS AND FUTURE RESEARCH

This review has identified a number of gaps that should be considered when planning future research. Cohort studies are expensive and challenging study designs to deliver. Existing studies should maximise the potential of the design by undertaking repeated measures of injury and risk factor occurrence, and following-up children over extended periods of time. The association between low SES and increased risk of injury occurrence failed to be consistently replicated in this review, yet is known to exist from descriptive epidemiology. Comparisons of risk analyses by severity of injury and environmental disadvantage were complicated by the use of variable definitions. The use of internationally recognised classifications of SES, severity of injury and measures of neighbourhood disadvantage would greatly enhance the ability to compare results from different studies. It is possible that real associations between risk factors and injuries may only exist at specific levels of injury severity or for particular definitions of injury and this warrants further exploration. The paucity of studies reporting the impact of the physical home environment and neighbourhoods on injury occurrence suggested that either positive reporting bias or publication bias was obscuring this research, or that it remains to be undertaken. New cohort studies should be considered in low/middle-income countries where the vast majority of child injury occurs. Where established, such studies should be supported by experienced study teams in high-income countries. Risk factors that are consistently associated with injury across international boundaries may be particularly valuable for targeting groups or situations when designing targeted prevention initiatives.

CONCLUSIONS

This review has attempted to summarise our knowledge of unintentional injury in school-aged children that is available from cohort studies. It has shown broad and consistent patterns of injury across time and geographical location, and identified a limited number of factors consistently associated with the increased risk of injury in this age group. The use of repeated measures over time within cohort studies has been rarely used to monitor changing patterns of injury with age, and that follow-up has often been limited to 2 years or less. Individual child factors cannot account for all inter-country variation in injury occurrence, and therefore further research is needed to explore environmental and societal factors associated with increased injury risk, particularly in middle/low-income countries.

This review has also demonstrated the enduring value of cohort studies as a methodology to describe injury occurrence and to assess risk factors for injury. Such patterns are important for the generation of hypotheses of causation and to inform the targeting and development of new interventions to reduce the unnecessary burden of unintentional childhood injury.

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