The epidemiology of injuries among children and young people, and the impact of maternal mental illness on child injury risk

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Abstract

Background

Preventing injuries among children and young people is a priority in England and worldwide; with injuries a leading cause of death, ill health and disability in children, and resulting in substantial costs to health services and society. Understanding the burden of injuries is important for health service planning and the prioritisation of preventative interventions to those at greatest risk. Despite this, estimating injury burden in England remains a challenge due to fragmented data collection systems and no national surveillance system. The recent linkage of a large primary care research database, the Clinical Practice Research Datalink (CPRD), to hospitalisation and mortality data, offers a new opportunity to study the epidemiology of injuries and provide more complete estimates of injury incidence.

Mental illnesses are the commonest morbidity women experience during pregnancy and the postnatal period, and are associated with several child health outcomes. The impact of maternal mental illnesses on the occurrence of childhood injuries is underexplored; with existing studies giving mixed findings, focusing upon depression alone and relying on maternal reporting of injury occurrences. Existing studies suggesting an association between maternal perinatal depression and childhood injuries have not considered the role of ongoing maternal depression after the postnatal period, and whether observed associations could be explained by biases in the reporting of injuries by mothers, or the recording of injuries by clinicians.

Methods

Three large routinely-collected datasets from England, the CPRD, Hospital Episode Statistics (HES), and Office for National Statistics (ONS) mortality data, were used to conduct a series of studies.

1. The epidemiology of injuries among children and young people. A cohort of 1,928,681 individuals aged 0-24 years old from England who had linked CPRD, HES and ONS mortality data was used to describe the epidemiology of three common injuries (poisonings, fractures, burns). Time-based algorithms were developed to identify incident injury events, distinguishing between repeat records for the same injury, and those for a new event. Injury incidence rates and adjusted incidence rate ratios (aIRR) were estimated by age, sex, calendar year and socioeconomic deprivation. The recording of injury mechanisms and intent were examined for the three data sources.

2. Maternal mental illnesses during pregnancy and the child's first five years of life. A cohort of 207,048 mother-child pairs from England who had linked CPRD and HES data, with children born 1998-2013, was used to define episodes of maternal depression and/or anxiety (termed 'depression/anxiety') using diagnostic, prescription and hospitalisation records. Incidence rates of maternal depression/anxiety were described over the child's first five years of life.

3. Maternal perinatal depression and injuries in children aged 0-4 years old. A cohort study of 207,048 mother-child pairs compared incidence rates and adjusted incidence rate ratios of child poisonings, fractures, and burns among children whose mothers had experienced perinatal depression with those who had not. To assess how the association between perinatal depression and child injury was affected by subsequent exposure to maternal depression, adjusted incidence rate ratios were compared for mothers whose depression continued beyond or recurred after the postnatal period, with mothers in whom it did not. Analyses were repeated for a group of serious injuries where injury ascertainment was more likely to be complete.

4. Association between episodes of maternal depression/anxiety and rates of child injuries. Two analyses, a traditional cohort analysis (a between person design) and a self-controlled case series (SCCS) analysis (a within person design where individuals act as their own controls), were used to compare incidence rates of child injuries during episodes of maternal depression/anxiety with periods when mothers had no evidence of depression/anxiety in their medical record. These two methods were compared as they account for confounding by different means.

Results

1. The epidemiology of injuries among children and young people. For the period 2001-2011, incidence rates of poisonings, fractures and burns were 41.9 per 10,000 person-years (PY) (95%CI 41.3-42.5), 185.5 (95%CI 184.6-186.4) and 34.6 (95%CI 34.2-35.0), respectively among the cohort of 0-24 year olds. Of the injury events identified in linked CPRD-HES-ONS mortality data, 18,065 (51%) poisonings, 117,102 (75%) fractures, and 26,276 (91%) burns were only recorded in primary care data (CPRD). Injury mechanism and intent recording was high within hospitalisation and mortality data (80-100%), but low in primary care data (2-4% of burns and fractures).

Age patterns of injury incidence varied by injury type, with peaks at age 2 (69.4/10,000 PY) and 18 (76.0/10,000 PY) for poisonings, age 13 for fractures (310.1/10,000 PY) and age 1 for burns (113.1/10,000 PY). Over time, fracture incidence rates increased, whereas poisoning rates increased only among 15-24 year olds and burns incidence reduced. Poisoning and burn incidence rates increased with deprivation, with the steepest socioeconomic gradient between most and least deprived quintiles for poisonings (aIRR 2.20, 95%CI 2.07-2.34).

2. Maternal mental illnesses during pregnancy and the child's first five years of life. 4,210 (2.0%) mothers had antenatal depression, 20,486 (9.9%) had postnatal depression, and 7,413 (3.6%) had both. Between the child's birth and fifth birthday, 54,702 (26.4%) children were exposed to one or more episode of maternal depression/anxiety, with incidence rates of maternal depression, depression with anxiety and anxiety alone 6.92/100 PY (95%CI 6.86-6.98), 1.30 (95%CI 1.27-1.33) and 1.83 (95%CI 1.80-1.86), respectively.

3. Maternal perinatal depression and injuries in children aged 0-4 years old. Among 207,048 children, 2,614 poisonings, 6,088 fractures and 4,201 burns occurred during follow-up. Children whose mothers had perinatal depression had higher injury rates than children who were unexposed, with associations strongest for poisonings. Compared to those unexposed, poisoning rates were 74% higher among children exposed to antenatal depression (aIRR 1.74, 95%CI 1.39-2.18), 55% higher for postnatal depression (aIRR 1.55, 95%CI 1.39-1.72) and 89% higher for children exposed to both (aIRR 1.89, 95%CI 1.61-2.23). Children also exposed to maternal depression when aged

1-4 years old tended to have higher poisoning, fracture and burn rates than children only exposed to perinatal depression. Significant associations persisted when analyses were restricted to serious fractures and burns.

4. Association between episodes of maternal depression/anxiety and rates of child injuries. In the traditional cohort analysis, child poisoning rates were increased during episodes of maternal depression (aIRR 1.52, 95%CI 1.31-1.76), depression with anxiety (aIRR 2.30, 95%CI 1.93-2.75) and anxiety alone (aIRR 1.63, 95%CI 1.09-2.43). Similarly, rates of burns (aIRR 1.53, 95%CI 1.29-1.81) and fractures (aIRR 1.24, 95%CI 1.06-1.44) were greatest during episodes of maternal depression with anxiety. No association was seen between maternal depression/anxiety and serious child injuries.

The study populations for the SCCS analyses consisted of 2,502, 5,836, 4,051 and 909 children who had experienced a poisoning, fracture, burn or serious injury, respectively. For children who experienced a poisoning or burn, poisoning (aIRR 1.48, 95%CI 1.19-1.85) and burn (aIRR 1.29, 95%CI 1.07-1.55) rates were only increased during periods when the mother had depression compared to periods when the mother had no evidence of depression/anxiety in their medical record. No significant differences in fracture or serious injury rates were seen during depression/anxiety episodes compared to unexposed periods.

Conclusion and implications

It is essential to use linked primary care, hospitalisation and mortality data to estimate injury burden, as many injury events are only captured within a single data source. Linked routinely-collected data may offer an affordable mechanism for injury surveillance; although is limited by poor recording of injury mechanism and intent within primary care data. Differing injury patterns according to age and injury type reflect differences in underlying injury mechanisms, highlighting the importance of tailored preventative interventions across the life course. Inequalities in injury occurrences support the targeting of preventative interventions to those living in the most deprived areas. Future work includes extending this research to other injury types and incorporating emergency department data when this becomes available.

Approximately 1 in 4 children were exposed to maternal depression/anxiety between birth and their fifth birthday, highlighting maternal depression/anxiety as a common exposure of childhood. The studies presented in this thesis suggest maternal depression is a modifiable risk factor for childhood injuries. The consistent finding of higher poisoning and burn rates during maternal depression episodes, in both the traditional cohort and SCCS analyses, mean associations are unlikely to be fully explained by residual confounding. The lack of association between maternal depression with anxiety episodes and child injuries in the SCCS analysis may relate to confounding variables being controlled for in the SCCS analysis that could not be controlled for in the traditional cohort analysis, but may also relate to study power and the chronicity of depression with anxiety episodes.

The significant associations between perinatal depression and child injuries highlights the importance of screening mothers for perinatal depression and ensuring they receive appropriate treatment and support. Clinicians working with young families, such as general practitioners and health visitors need to be aware of the increased injury rates among children of depressed mothers. These clinicians can refer families to support groups (e.g. parenting groups), for home safety advice and to equipment schemes where these are available. In addition, pharmacists and prescribers should consider providing advice about safe medication storage and disposal to mothers being managed for depression/anxiety. Future research could include; qualitative studies exploring mothers' perceptions on child injury prevention, managing a mental illness and the support they would find beneficial, and work to assess associations between serious mental illnesses (e.g. schizophrenia and bipolar disorder) and child injuries.

List of publications and conference presentations

Peer reviewed papers

Baker R, Tata LJ, Kendrick D, Orton E. Identification of incident poisoning, fracture and burn events using linked primary care, secondary care and mortality data from England: implications for research and surveillance. Injury Prevention. 2016. 22(1):59-67. Doi: 10.1136/injuryprev-2015-041561. Published online July 2015.

Baker R, Orton E, Tata LJ and Kendrick D. The epidemiology of poisonings, fractures and burns among 0-24 year olds in England using linked health and mortality data. European Journal of Public Health. Doi:10.1093/eurpub/ckw064. Published online May 2016.

Baker R, Tata LJ, Kendrick D, Burch T, Kennedy M, and Orton E. Differing patterns in thermal injury incidence and hospitalisations among 0-4 year old children from England. Burns. Doi:10.1016/j.burns.2016.05.007. Published online June 2016.

Baker R, Kendrick D, Tata LJ and Orton E. Association between maternal depression and anxiety episodes and rates of childhood injuries: a cohort study from England. Injury Prevention. In press.

Conference presentations and published abstracts

Annual Conference of the Society for Academic Primary Care.

- Oral presentation, July 2015. "The use of linked health and mortality data to inform injury prevention strategies".

European Congress of Epidemiology.

- Poster presentation, June 2015. Abstract published: *Baker R, Tata LJ, Orton E, and Kendrick D. The use of linked health and mortality data to inform injury prevention*

strategies. In 'Healthy Living: The European Congress of Epidemiology, 2015'. European Journal of Epidemiology. 2015; 30:854.

Public Health England, Applied Epidemiology Scientific Meeting.

- Oral presentation, March 2015. "The utility of linked primary care, secondary care and mortality data for injury surveillance".

Public Health Science Conference.

- Poster presentation, November 2014. Abstract published: *Baker R, Orton E, Tata LJ, and Kendrick D. Measurement of the incidence of poisonings, fractures and burns in children and young people with linked primary and secondary care data: a population-based cohort study. The Lancet. 2014; 384, S19.*
- Poster presentation, November 2015. Abstract published: *Baker R, Orton E, Kendrick D and Tata, LJ. Maternal depression in the 5 years after childbirth among women with and without perinatal depression: a population-based cohort study. The Lancet. 2015; 386:S22.*
- Poster presentation, November 2015. Abstract published: *Baker R, Tata LJ, Orton E and Kendrick, D. Maternal depression and risk of injuries in children aged 0-4 years: a population-based cohort study. The Lancet. 2015; 386:S21.*

Safety 2016 World Conference.

- Oral presentation, Finland September 2016. Abstract published: *Baker R, Orton E, Kendrick D, and Tata LJ. Association of maternal depression and anxiety with children's injury risk: a prospective cohort. Injury Prevention. 2016; 22(Suppl 2): A28.*
- Oral presentation, Finland September 2016. Abstract published: *Baker R, Orton E, Kendrick D, and Tata LJ. Child poisoning risk during maternal depression and anxiety episodes: self-controlled case series. Injury Prevention. 2016; 22(Suppl 2): A87-88.*

Society of Reproductive and Infant Psychology.

- Oral presentation, September 2015. Abstract published: *Baker R, Orton E, Kendrick D and Tata LJ. Persistence of maternal depressive episodes in the 5 years after childbirth among women with and without antenatal and postnatal depression. Journal of Reproductive and Infant Psychology. 2015; 33(3):E5.*

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List of abbreviations

95%CI: 95% confidence interval

aIRR: Adjusted incidence rate ratio

ALSPAC: Avon Longitudinal Study of Parents and Children

AN: Antenatal

BNF: British National Formulary

CAMHS: Child and adolescent mental health services

CCG: Clinical Commissioning Group

CES-D: Center for Epidemiologic Studies Depression Scale

CPRD: Clinical Practice Research Datalink

CRD: Current Registration Date

DSM: Diagnostic Statistical Manual of Mental Disorders

DALYs: Disability adjusted life years

ED: Emergency department

EPDS: Edinburgh Postnatal Depression Scale

FCE: Finished Consultant Episode

GDP: Gross domestic product

GP: General Practitioner

HADS: Hospital Anxiety and Depression Scale

HASS/LASS: Home and Leisure Accident Surveillance System

HES: Hospital Episode Statistics

HR: Hazard ratio

IMD: Index of multiple deprivation

ICD: International classification of diseases

IQR: Interquartile range

LCD: Last collection date

LRT: Likelihood ratio test

MBL: Mother-baby link

MHRA: Medicines and Healthcare products Regulatory Agency

NHS: National Health Service

NICE: National Institute for Health and Care Excellence

ONS: Office for National Statistics

OPCS-4: Office of Population Census and Surveys version 4

OR: Odds ratio

PHQ: Patient Health Questionnaire

PN: Postnatal

PY: Person-years

QOF: Quality Outcomes Framework

RR: Rate ratio

SCCS: Self-controlled case series

THIN: The Health Improvement Network

TOD: Transfer out date

UK: United Kingdom

US: United States

Chapter 1: Introduction

This chapter provides an overview of background literature relating to injuries among children and young people. The first section describes why injuries continue to be an important public health problem both globally and in the United Kingdom (UK), the epidemiology of injuries in the UK, and existing literature on risk factors for injuries among children and young people. The second part of this chapter describes the epidemiology of maternal mental illnesses and existing literature describing the relationship between maternal mental illnesses and child injury risk.

1.1 Defining children and young people

Within this thesis, children and young people have been defined as those aged 0-24 years old in order to correspond to a national target in England on injury prevention published within the Department of Health's Public Health Outcomes Framework(1). Preschool children are defined as those aged 0-4 years old.

1.2 Defining injuries

A commonly used definition of an injury is "the physical damage that results when a human body is suddenly subjected to energy in amounts that exceed the threshold of physiologic tolerance, or else the result of a lack of one or more vital elements, such as oxygen"(2). This energy can be mechanical, thermal, chemical or radiated(3); therefore encompassing a broad range of injury types, mechanisms and severities, from mild cuts and bruises to severe trauma leading to death. An important distinction that is made in both research and practice is whether an injury is unintentional (e.g. falls, road traffic incidents) or the result of intentional harm (e.g. self-harm, non-accidental injury). The focus of this thesis is primarily on unintentional injuries among children and young people; although consideration will be given to the identification of intentional injuries within the data sources used and in the interpretation of the study findings.

1.3 The public health importance of injuries among children and young people

1.3.1 A sizeable global and national problem

Injuries are a significant cause of morbidity and mortality both within the UK and globally. In 2013, the Global Burden of Disease study estimated that 973 million people sustained an injury requiring medical attention and 4.8 million people died from an injury across the world(4). Injuries account for 10.1% of the global burden of disease and disproportionately affect the young and the poorest(3, 4). Among children and young people aged 5-19 years, injuries continue to be one of the two leading causes of death globally; becoming an increasingly important cause of death in younger age groups as death rates from infectious diseases have fallen(3). Inequalities in the burden of injuries are stark, both between, and within countries. For example, in 2013 males aged 0-14 from Central Sub-Saharan Africa had a nearly 14 times higher rate of Disability Adjusted Life Years (DALYs) from injury than those living in Western Europe(4); reflecting both the higher number of years of life lost and the higher number of years lived with disability from injury. Among children and young people, about 90% of injury deaths are from unintentional causes, with road traffic incidents, drownings, falls, poisonings and fire-related burns important causes of injury death(3). While the health of children and young people living in the UK has dramatically improved over the last century, injuries continue to account for 31-48% of child deaths(5) and are an important cause of pain, suffering and disability. For each injury death it is estimated that approximately 151 children are admitted to hospital, 1,947 attend emergency departments (ED), and many more are seen in primary care or managed at home(6).

1.3.2 A costly problem to individuals, health services and society

Injuries lead to considerable costs to individuals, families, health services and nations as a whole. Road traffic incidents alone have been estimated to cost about 2% of the Gross Domestic Product (GDP) of high income countries and 5% of the GDP of low-income countries(7). Estimates from England suggest that ED costs are a minimum of £9 million per year for childhood injuries, and that total hospital costs are between £16 million and £87 million for severe childhood injuries leading to admission(8). Costs are particularly high for certain severe injuries requiring long-term medical care or leading to disability.

For example, severe traumatic brain injury is estimated to cost the UK society between £640 million and £2.24 billion in healthcare, social care, welfare costs, and productivity losses(8). Estimates of the acute treatment costs of burns vary widely; from £1,850 to treat a minor hot drink scald, to £173,000 to treat a serious bathwater scald requiring intensive care admission(9, 10). What is clear is that injuries lead to substantial health and societal costs; costs which could be reduced through the implementation of preventative interventions. Data from the United States (US) suggests that for every US dollar spent on certain safety interventions, money is saved; $77 for every dollar spent on childproof cigarette lighters, $42 for every dollar spent on child safety seats for children aged 0-4, $48 for every dollar on bicycle helmets, and $18 for every dollar spent on smoke alarms(11).

1.3.3 A preventable problem

During the first 50 years of the 20th century the prevalent perception was that injuries were inevitable, random and unavoidable(12). Indeed, the term 'accident', although generally no longer used by those working within injury prevention, is a common term in the English language, carrying the implication that events are 'unexpected', 'by chance' or 'unforeseeable'. Over time, injuries have increasingly been recognised as preventable. In 1949, John E Gordon recognised that patterns of injury varied over time, seasons and population demographics, suggesting that similar to other diseases, injuries could be explained by factors related to the host, the agent and the environment(12). In the 1960s considerable progress was made in the field of injury prevention, particularly as a result of the work by William Haddon, an engineer and public health physician from the US(12, 13). Haddon developed a model, the 'Haddon Matrix', to conceptualise injury events according to two dimensions; host, agent and environmental factors influencing injury; and pre-event, event and post-event phases of injury (Table 1-1)(14). This model, initially applied to road traffic incidents, but later also applied to other injury types, enabled the identification of a number of environmental (e.g. road lighting, road surfaces, speed limits) and engineering modifications (e.g. seat belts, shatterproof glass, collapsible steering columns) that could reduce both the occurrence and severity of injury, rather than focusing upon individual behaviours alone (e.g. driver behaviour)(13).

Table 1-1: The Haddon Matrix, example for road traffic incidents(14)

	Host	Agent	Environment
Pre-event	• Education and safety (e.g. driver training) • Attitudes and risk taking (e.g. enforcement to prevent drink driving)	• Vehicle maintenance (lighting, braking, handling)	• Road design, surface, layout • Speed limits • Street lighting
Event	• Driver behaviour (risk-taking, use of seat belt, alcohol use, speeding)	• Seat belt • Child car seats • Design of vehicle (e.g. crumple zone)	• Weather, road surface
Post-event	• Access to first-aid, early medical care	• Ease of access to car occupants • Fire risk	• Rescue facilities • Availability and distance to trauma care

Since the development of the Haddon matrix, several other approaches to injury prevention, aiming to tackle both structural and behavioural risk factors for injury, have been introduced (Table 1-2). The "3 Es" (education, engineering, enforcement) is one of the most widely used mnemonics of injury prevention; referring to changes that can be made to address behavioural, environmental and wider social/political factors affecting injury risk. These approaches are used together to try and prevent injury occurrences happening (primary prevention) and to minimise the harm of events if they do occur (secondary prevention).

Table 1-2: Approaches to injury prevention

Approaches to injury prevention	
Primary, secondary and tertiary prevention	***Primary prevention:*** aims to prevent an injury occurrence, through using preventative measures, e.g. the use of a stair gate to prevent falls. ***Secondary prevention:*** aims at reducing the risk of injury once an event has occurred. ***Tertiary prevention:*** aims at reducing the harms once an injury event has occurred. This includes ensuring effective treatment is provided and where needed rehabilitation is given to maximise function and health outcomes.
The Es	***Education:*** addresses individual behavioural risk factors through providing individuals with information and/or training about injury risks and what can be done to prevent them, e.g. road safety training for school aged children. ***Engineering / Environment:*** addresses the physical environment, the design of products and the use of safety devices, e.g. modifying consumer products to make them safer such as thermostatic mixing valves. ***Enforcement:*** involves using legislation or standards to make the environment safer (e.g. consumer product safety) and to minimise risky behaviours (e.g. prevent drink driving, promote seat belt use).

The large declines in injury deaths over the last twenty to thirty years, seen in the US(13, 15), UK(16) and many other countries(4, 17, 18), are largely a result of planned and coordinated injury prevention initiatives, the development of surveillance systems to monitor the patterns and trends in injury occurrences(19), improvements in trauma care(20, 21) and wider policy and legislative changes(19). Indeed, since the early work by Haddon, numerous studies have identified effective interventions to prevent a range of injury types and mechanisms(22-25)(Table 1-3). The World Health Organisation highlights injury prevention as a priority worldwide, with a need for multi-sectoral action and integration of injury prevention into national and local policies(26).

Table 1-3: Examples of evidence-based measures to reduce important causes of injury and death

	Measures to prevent injuries(22-25)
Road traffic incidents	• Creation and enforcement of laws on speeding, drink driving, motorcycle helmets, seat-belts, use of child seats • Promoting use of safety devices, e.g. cycle helmets • Development of safer road infrastructure (e.g. traffic calming, reduced speed limits, cycle paths, street lighting, road crossings)
Burns	• Smoke alarms • Reduction in hot water temperatures, hot water mixing valves
Drowning	• Barriers to prevent access to water • Training in swimming, water safety education • Use of personal floatation devices
Falls	• Window guards • Stair gates • Modifying playground surfaces, reducing height of playground equipment • Protective sports equipment
Poisonings	• Child resistant packaging • Reduced quantities of medications in packets • Reducing use of toxic products
Other	• Parent education and training programmes • Home safety education and provision of safety equipment

Adapted from: World Health Organisation (2014). Injuries and Violence. The Facts.

1.3.4 Injury prevention: a priority for the UK

Within the UK, injuries are recognised as an issue of importance across multiple disciplines and policy areas (e.g. education, transport, health, the environment). In 1999, the UK government published a White Paper 'Saving Lives: Our Healthier Nation' which included an aim to reduce serious injuries and deaths by 2010(27). Subsequently, in 2004 the government published the document 'Every Child Matters' which established 'staying safe' as one of five priorities for child health and wellbeing(28). In 2008, both preventing injury hospital admissions and reducing deaths from road traffic incidents

among children and young people were included in a set of national indicators for local authorities (national indicators 48 and 70); introduced following the publication of the Local Government White Paper 'Strong and Prosperous Communities'(29). In 2010, the Marmot review 'Fair Society, Healthy Lives' highlighted childhood injuries, particularly those occurring on the roads, as an important source of inequality between the most and least deprived groups in England(30). More recently, the 2012 Chief Medical Officer report highlighted the considerable cost and burden of childhood injuries, advocating for a shift to prevention, early intervention and a life course approach to improve child outcomes(8). In 2013, reducing injury-related hospital admissions among children and young people aged 0 to 24 years old was established as an indicator in the Public Health Outcomes framework(1). Since October 2015, as part of the changes introduced by the 2010 White Paper 'Healthy lives, healthy people', local authorities have become responsible for the commissioning of health visiting and targeted support services (e.g. for teenage mothers) for children aged 0-5 years, with reducing child accidents highlighted as a 'high impact' area for these services. While considerable progress has been made in the reduction of injury deaths in the UK, injuries are still recognised as an important cause of preventable death, cost and disability, with notable inequalities between the richest and poorest persisting.

1.4 The epidemiology of injuries among children and young people in the United Kingdom

1.4.1 Defining and classifying injuries in practice and research

Defining an injury is by no means straight forward, with many different ways to describe and classify injuries, all of which lead to discussion and debate(31-35). In practice, operational definitions of injuries used within research, policy and injury prevention programmes depend upon the context in which injuries are being discussed and the data that are available. Common ways of classifying injuries include by anatomical site, injury type, mechanism, intent, severity, location and according to health service use (Table 1-4). These ways of classifying injuries commonly overlap or are used in conjunction with each other. For example, a deep cut of the scalp resulting from a fall in the playground could be classified by anatomical site (e.g. head injury), by type (e.g. open wound), by mechanism (e.g. a fall), or by intent (e.g. unintentional injury). Each of these ways to classify injuries has strengths and limitations. For example, classifying

injuries according to mechanism (e.g. road traffic accidents, falls) aligns most closely with public health approaches to injury prevention. Comparatively, classifying injuries by intent has strong ties to child protection and criminal justice issues, and so is of greater importance for particular injury types and ages of children. Defining injury severity is important when comparing injury occurrences, risk factors or outcomes between different populations or groups where injury ascertainment may differ (e.g. different hospital admission thresholds).

Table 1-4: Classification of injuries

Classification	Examples
Anatomy	• head injury, spinal injury
Type	• fracture, open wound, laceration
Mechanism	• road traffic accident, bite, fall
Intent	• unintentional, intentional (self-harm, assault)
Severity	• fatal/non-fatal, Injury Severity Score, Abbreviated Injury Scale, length of hospital stay
Location	• work, school, playground, roads (e.g. STATS19 police data on injuries occurring on the road)
Service use	• hospitalised, medically-attended injuries

Adapted from Cummings et al (1995)(34)

Within health services, the most common classification system used to define injuries is the International Classification of Diseases version 10 (ICD-10), a hierarchical medical classification system produced by the World Health Organisation which to some extent combines the classifications in Table 1-4. Within this classification system, injuries are primarily described according to anatomical site, injury type and mechanism in chapters XIX and XX (Table 1-5). Yet, even defining injuries according to ICD-10 is open to debate. For example, chapters XIX and XX include injuries resulting from medical and surgical care, which many argue should be excluded from operational definitions of injuries due to the different aetiology and preventative interventions required for these events(31). Some also argue that chapters XIX and XX exclude some potential injury codes that lie outside of these chapters (e.g. psychological injuries)(36). These complexities with defining injuries can affect the comparability of study findings, and lead to inconsistencies in epidemiological findings.

Table 1-5: Describing injuries using ICD-10

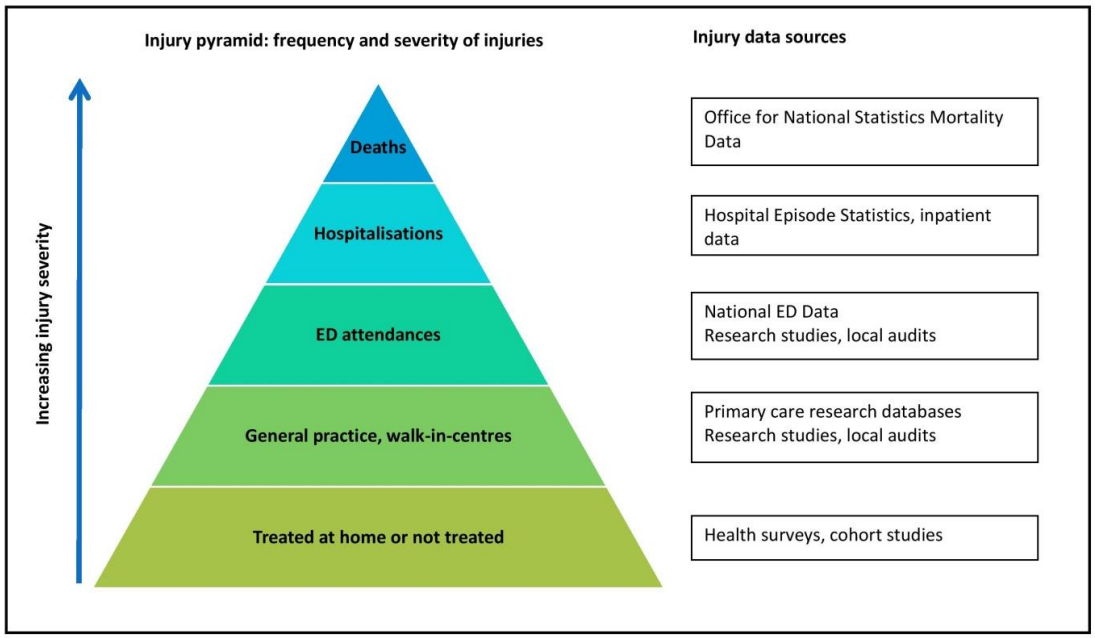
ICD-10 Chapter	Description of information given within the chapter	Example injuries
XIX "Injury, poisoning and certain other consequences of external causes" S00-T98	Describes injuries according to anatomical site (e.g. injuries to head, injuries to thorax) and the type of injury sustained (e.g. laceration, open wound, fracture)	• Superficial injury • Open wound • Fracture • Dislocation, sprain and strain • Injuries of nerves • Injuries of blood vessels • Crushing injuries
XX "External causes of morbidity and mortality" V01-Y98	Describes the mechanism and/or intent of an injury.	• Transport accidents (rail, road) • Falls • Drowning and submersion • Smoke, fire, flames • Suffocation, foreign bodies • Intentional self-harm • Assault

1.4.2 The injury pyramid and overview of UK injury data and surveillance

The epidemiology of injuries is commonly conceptualised as an injury pyramid representing the relative frequency and severity of injury events. For every child that dies from an injury there are many more admitted to hospital, managed within EDs or at home where no medical treatment is sought(3) (Figure 1-1).

It is difficult to estimate the true burden of childhood injuries within the UK, due to both the fragmented data collection systems and the large burden of injuries that do not come to medical attention. Within the UK, data on injury occurrence primarily come from the yearly publication of mortality data by the Office for National Statistics (ONS) and publication of hospital admissions data from Hospital Episode Statistics (HES)(37). In addition there are specialist databases capturing certain injuries, such as burns (International Burn Injury Database(38)), trauma (The Trauma Audit & Research Network(39)) and road traffic incidents (STATS19 system)(40).

Figure 1-1: The injury pyramid and available UK data sources on injuries



Source: Adapted from Peden et al (2008)(3) and Currie et al (1996)(41)

In recent years, national ED data has started to be published as part of HES. This however is still a developing dataset not yet used for injury surveillance; with a need to both improve geographical coverage and data quality(42). Prior to 2002, comprehensive ED data on injury occurrences were available from two linked surveillance programmes, the Home Accident Surveillance System and the Leisure Accident Surveillance System (HASS/LASS)(43). These surveillance systems collected data on injuries occurring in the home or related to leisure from a sample of 16-18 hospitals in the UK, using these data to produce national estimates of the injury burden. These surveillance programmes finished over 10 years ago, and since that time data on injuries seen in ED have predominantly come from published research studies.

A summary of the available data and key published studies describing the mortality and morbidity from injuries in children and young people in the UK is described in Sections 1.4.2.1 and 1.4.2.2, respectively. Detail of the literature search conducted is included in Appendix 1.

1.4.2.1 Injury mortality

Until recently, injuries were the leading cause of death among children and young people in the UK(5). Publically available data from the ONS show that in 2012 there were 6,230 deaths among children and young people aged 0-24 living in England and Wales, of which 1,428 (23%) were from injuries (ICD-10 codes V01-Y98) (Table 1-6). Among 1-14 year olds, neoplasms were the leading cause of death in 2012, whereas among those aged 15-24, injuries remained the leading cause of death, accounting for over 50% of all deaths in this age group.

Table 1-6: Leading causes of death among children and young people in England and Wales, 2012

Age (years)	Number of deaths, all causes	Leading cause of death according to age	Second leading cause of death according to age	Deaths resulting from external causes* Frequency (%)
Under 1	3,040	Congenital malformations, deformations and chromosomal abnormalities	Sudden infant deaths/ deaths due to unknown causes	51 (1.7%)
1-4	476	Neoplasms	External causes of morbidity and mortality	69 (14.5%)
5-9	278	Neoplasms	External causes of morbidity and mortality	38 (13.7%)
10-14	300	Neoplasms	External causes of morbidity and mortality	75 (25%)
15-19	815	External causes of morbidity and mortality	Neoplasms	420 (51.5%)
20-24	1,321	External causes of morbidity and mortality	Neoplasms	775 (58.7%)

Source: Office for National Statistics, 2012

**External causes of morbidity and mortality ICD-10 V01-Y98*

Eleven studies published between 1995 and 2016 provide evidence on injury mortality rates and trends (Table 1-7), with the most recently published study by Hardelid *et al* (2013) demonstrating a significant reduction in injury deaths among children aged 0-18 over a 30 year time period from 1980 to 2010(16). Declines in injury deaths have principally been due to a decline in unintentional injury deaths; linked to increased use of safety measures such as traffic calming, cycle helmets and smoke alarms(44); improvements in medical care(45); and less exposure to traffic as a pedestrian as children use cars rather than walk(46). Road traffic injuries (pedestrian and non-pedestrian) have consistently been identified as the leading mechanism of injury death in children and young people over the age of 1 year, accounting for about 40-50% of all injury deaths(5, 47). Injury related deaths are uncommon in children aged less than 1,

but importantly it has been estimated that about a quarter of all deaths from assault/homicide in childhood occur in this age group(47).

The key strength of studies that use routine mortality data is that within the UK the universal process of death registration and certification means that ascertainment of injury related deaths is likely to be near-complete. However, studies focusing on injury deaths alone only provide a snapshot of the burden of injuries, reflecting certain types of very severe injury, and can be limited by not having access to data on important risk factors for injuries (e.g. socioeconomic deprivation(16)).

Table 1-7: Epidemiological studies published between 1995 and 2016 from the UK on injury mortality among children and young people

Study	Study Design	Study Population	Outcome measure	Key Findings
Roberts and Power (1996) (48)	Descriptive analysis of all deaths from injuries in England and Wales 1979-1992	0-15 year old children who died from an injury or poisoning	Death rates over time and according to socioeconomic deprivation. Deaths from unintentional and intentional injuries coded with ICD-9	• Death rates from injuries were higher among those from more deprived socioeconomic groups (24.2/100,000 in social class I compared to 84.7/100,000 in social class V). • Inequalities widened over time, with those from higher social classes showing a greater reduction in mortality rates from injury between 1979-83 and 1989-92. • Motor vehicle accidents / pedestrian / cycle accidents constituted 44% of all child deaths from injury in 1989-92.
Roberts *et al* (1996) (45)	Major Trauma Outcomes Study, cohort study 1989-1995	0-24 year olds admitted to a participating hospital for 3 or more days, admitted to ICU or died from injuries.	Case fatality over time and according to age. Severe injuries, injury severity score of ≥16, admitted for ≥3 days or died from an injury	• Decline in estimated odds of death after major trauma between 1989 and 1995 for each age group (0-4, 5-14, 15-24). Authors suggest improvement in medical care of patients admitted with major traumas. • Authors adjusted for injury severity and age.
DiGuiseppi *et al* (1997) (46)	Ecological study, 1985-1992	0-14 year old children, England and Wales	Death rate trends Deaths from all unintentional injuries coded with ICD-9, and according to mechanism	• Decline in unintentional injury death rates by 34% between 1985 and 1992. • Higher mortality rates for males than females. • Pedestrian injuries leading mechanism of death • 37% decline in pedestrian injury deaths between 1985 and 1992 • Reduced injury mortality associated with reductions in walking and cycling.
Roberts (1997)(49)	Descriptive analysis deaths, 1985-1992	0-15 year old children, England and Wales	Death rates Deaths from unintentional and intentional injuries coded with ICD-9	• Children in social class V 4.6 times more likely to suffer from an injury death than those from social class I • Death rate social class I: 34.8/100,000 for 8 year period • Death rate social class V: 160.6/100,000 for 8 year period • Steepest socioeconomic gradients for fire related deaths and pedestrian deaths
DiGuiseppi *et al* (1998) (50)	Descriptive analysis deaths, 1985-1995	15-19 year old young people, England and Wales	Death rates Deaths from unintentional injuries and transport injuries (motorcyclist, pedestrian, cyclist, car occupant) coded using ICD-9	• 7,954 deaths from unintentional injuries among 15-19 year old between 1985-1995, of which 6,073 (76%) were transport injuries • Mortality rates from all unintentional injuries declined by 32% between 1985 and 1995. • Reductions in mortality largely due to reductions in transport related deaths. • Males accounted for 79% of deaths from unintentional injury.

Table 1-7 continued

Study	Study Design	Study Population	Outcome measure	Key Findings
Morrison *et al* (1999) (51)	Descriptive analysis deaths, 1981-1995	0-14 year olds, Scotland	Death rates Unintentional and intentional injuries as defined by ICD-9 (E800-E999)	• Death rates from injury declined by 58% from 1981 to 1995 • Death rate 7.4/100,000 in 1993-1995 • Those from most deprived groups had a two-fold higher death rate. No evidence of a reduction in inequality over time.
Edwards *et al* (2006) (52)	Descriptive study, using routine mortality data, 1979-2003	0-15 year old children living in England and Wales	Mortality rates from injuries at three time periods (1979-83, 1989-92, 2001-3) Injuries included all unintentional and intentional injury deaths, defined by ICD-9 (E800-E999) and ICD-10 (V01-Y98)	• Mortality rates reduced over 20 year time period. • Mortality rate 4.0 deaths per 100,000 (95%CI 3.8-4.2) in 2001-2003. • Steep socioeconomic gradient in deaths. Death rate 5.0/100,000 (95%CI 4.3-5.8) among NS-SEC group 7 (routine occupations) compared to 1.9/100,000 (1.6-2.4) in NS-SEC group 1 (higher managerial/professional occupations). • Commonest cause of death: pedestrians injured in transport accident accounting for 205 (18%) of the 1,163 deaths observed between 2001-2003
Pearson and Stone (2009) (53)	Descriptive study using routine mortality data, 2002-2006	0-14 year old children living in Scotland	Mortality rates, unintentional and intentional injuries, (ICD-10 V01-Y98)	• Mortality rate 4.3 per 100,000 • Road traffic accidents and homicide/assault leading causes of injury deaths. • Leading mechanisms of death varied with age. E.g. children aged 1-4 years old, leading causes: fire, assault, suffocation. Children 5-14, leading causes: pedestrian and non-pedestrian traffic injuries • Mortality rates from homicide highest in infants <1 years old.
Pearson *et al* (2009)(54)	Descriptive study using routine mortality data, 1982-2006	0-14 year old children living in Scotland	Mortality rates, unintentional and intentional injuries as defined by ICD-9 (E800-E999) and ICD-10 (V01-Y98)	• Males more likely to die from injuries in all ages except infancy. • Mortality rate 11.3/100,000 for males compared to 6.6/100,000 for females • Extent of gender difference varied by injury mechanism. Greatest gender difference for poisonings, falls, suicides. • Only injury mechanism that did not show male excess, fires.

***NS-SEC**: National Statistics Socioeconomic Classification*

Table 1-7 continued

Study	Study Design	Study Population	Outcome measure	Key Findings
Siegler *et al* (2010)(55)	Descriptive study using routine mortality data, 2001-2003	Children aged 28 days to 15 years old, England and Wales	Mortality rates, unintentional and intentional injuries coded using ICD-10 (V01-Y98)	• Overall mortality rate, 3.3 per 100,000 • Death rate from injury 4.5 times greater in children from NS-SEC group 7 (routine occupations) compared to those from higher managerial or professional classes (NS-SEC group I) • Steepest socioeconomic gradients for fire, pedestrian and suffocation accidents. • Widest inequalities for children who died between 28 days and 1 year of age.
Hardelid *et al* (2013) (16)	Descriptive analysis of all deaths from injuries in the UK 1980-2010	28 days-18 years old children who had died from an injury	Death rates from injuries for England, Scotland, Wales and Northern Ireland. Death rates over time, according to age and sex. Unintentional and intentional injuries as defined by ICD-9 (E800-E999) and ICD-10 (V01-Y89)	• Mortality rates declined between 1980 and 2010 across all four UK countries. • Mortality rates varied by country of UK; lowest seen in England. For example, mortality rates for 10-18 year old males (2006-2010) were 11.5/100,000 for England, 19.4/100,000 for Scotland, 15.9/100,000 for Wales, and 20.9/100,000 for Northern Ireland. • Transport accidents were the leading cause of injury deaths. • Authors did not have access to socioeconomic deprivation data.

***NS-SEC**: National Statistics Socioeconomic Classification*

1.4.2.2 Injury morbidity

The burden of non-fatal injuries is considerably more difficult to quantify than the burden of fatal injuries. Nationally published injury hospital admission rates for 2012/13 were 10.4 per 1000 for 0-14 year olds, and 13.1 per 1000 for 15-24 year olds living in England; with falls and intentional self-harm the leading injury mechanisms for 0-14 and 15-24 year olds respectively(56, 57)(Table 1-8).

Table 1-8: Leading mechanisms of hospital admission among children and young people (0-24 years old) in 2012-2013, England

Age (years)	Number of finished consultant episodes (FCE)# for external causes of injury*	Leading mechanism (% of injury FCEs for age group)	Second leading mechanism (% of injury FCEs for age group)	Third leading mechanism (% of injury FCEs for age group)
Under 1	8,881	Falls (48.4%)	Inanimate mechanical forces (11.6%)	Heat and hot substances (7.3%)
1-4	37,753	Falls (40.5%)	Inanimate mechanical forces (24.9%)	Poisoning (12.5%)
5-9	26,256	Falls (49.6%)	Inanimate mechanical forces (21.9%)	Transport accidents (9.8%)
10-14	30,493	Falls (35.5%)	Intentional self-harm (15.3%)	Inanimate mechanical forces (14.5%)
15-19	51,049	Intentional self-harm (32.4%)	Falls (14.8%)	Inanimate mechanical forces (11.9%)
20-24	56,364	Intentional self-harm (27.2%)	Falls (15.8%)	Inanimate mechanical forces (13.9%)

Source: Hospital Episode Statistics, England 2012-2013

#Finished consultant episodes (FCE) are a standard measure used within English hospital admissions data, defined as a period of care under a consultant or allied healthcare professional within an NHS Trust. A patient can have more than one FCE recorded for a single hospital admission.

**Excluding complications of medical and surgical care*

Table 1-9 summarises studies published between 1995 and 2016 describing the epidemiology of injuries among children and young people in the UK, according to the data source used to identify injury occurrences.

Studies have estimated injury hospital admission and ED attendance rates as between 13.4(58) and 16.6(59) per 1000 per year, and 138(60) and 215(59) per 1000 per year respectively. Differences in ED and hospitalisation rates between studies are likely to reflect differences in methods used and populations studied (e.g. age group,

geographical area, deprivation level). Recognised limitations with using hospital data in injury research include; the identification of an appropriate denominator to calculate rates(17, 34), the introduction of biases associated with hospital supply (e.g. hospital admissions policies(61)) and demand factors (e.g. travel distance(62)), and problems distinguishing between attendances and re-attendances for the same injury event(35). For example, Lyons *et al* demonstrated that 15% of all ED attendances for injuries were re-attendances for the same injury event(62), meaning a failure to remove these re-attendances could lead to substantial overestimation of injury rates, potentially affecting certain injury types (e.g. severe burns requiring multiple operative procedures), or patient groups (e.g. those living near ED) more than others. In addition, most data on patterns of injuries seen within EDs come from individual hospital sites, with results not generalisable to the rest of the UK (60, 62-64).

Many existing studies describing the epidemiology of childhood injuries rely on mortality or hospital data sources, which only capture a small proportion of injuries. Four studies using self-reported, or parent-reported data on injury occurrence demonstrate the high proportion of children sustaining injuries that are not captured within health service data(41, 65-67). Using a cross-sectional survey of 4,710 school children, Currie *at al* found that 94.5% reported sustaining one or more injury in the last 12 months, with only 41.9% having sought medical attention(41). Similarly, Warrington *et al*, using data from a large cohort study of 11,466 0-6 month infants, found 2,554 had sustained one or more fall, of which 162 were taken to hospital and 18 were admitted(65). These studies demonstrate the huge scale of injuries not captured within health service data, but are limited by potentially excluding the most severe injuries (i.e. those resulting in death or disability), can lack diagnostic specificity(65) and are potentially subject to reporting biases(17).

Another way that researchers have attempted to capture the spectrum of injuries is through using multiple data sources to describe injury patterns for defined geographical populations(59, 68). For example, Walsh *et al* (1996) describe ED attendances, hospital admissions and deaths from injury for the 0-15 year old resident population of Newcastle upon Tyne, as 215 per 1000, 17 per 1000 and 0.11 per 1000, respectively(59). While providing helpful data on patterns of injury for a local area, these findings are unlikely to be generalisable to the UK population, and the authors could not link data

sources together meaning they were unable to estimate injury incidence or identify children appearing across multiple data sources.

In recent years, there has been an increasing use of large primary care research databases in injury epidemiology(69-74). For example, Cooper *et al* (2004) used the Clinical Practice Research Datalink (CPRD) to estimate the incidence of fractures among children aged 0-18 according to age, sex and fracture site(71). While correspondence from secondary care should be coded in patients' primary care records, it is possible that the study by Cooper *et al* may still underestimate the number of fracture events and therefore incidence, if fracture events are not thoroughly recorded in patients' primary care records.

Although a number of studies have described patterns of fatal and non-fatal child injuries within the UK, there is still a need to build a more complete picture of the epidemiology of childhood injuries, to ensure, where possible injury events are thoroughly ascertained across the severity spectrum, and biases associated with hospital data are minimised.

Table 1-9: Epidemiological studies from the UK published between 1995 and 2016 on injury morbidity among children and young people, hospital admissions

Study	Study design	Study population	Outcome measure	Key findings	Comments
Hospital Admissions					
Hippisley-Cox *et al* (2002)(75)	Cross-sectional study, 1992-1997	0-14 year old children living in the Trent region of England.	Hospital admission rates for all injuries, long bone fractures, long bone fractures requiring an operation.	• Admission rates varied by deprivation and child age. • Higher rates of hospital admission for all injuries and more severe injuries with increasing deprivation. Gradients more marked in 0-4 year olds compared to 5-14 year olds. • Socioeconomic gradient between most and least deprived groups varied by injury mechanism (pedestrian injuries aIRR 3.65, 95%CI 2.94-4.54; burns aIRR 3.49, 95%CI 2.81-4.34; poisonings aIRR 2.98, 95%CI2.65-3.34) • Falls commonest injury mechanism.	• Long bone fractures requiring admission/operative procedure used as marker of serious injuries.
Edwards *et al* (2008) (58)	Descriptive study using Hospital Episode Statistics, 1999-2004	0-15 year old children living in England	Hospital admission rates for serious injuries (e.g. fracture neck of femur, intracranial injury)	• Hospital admission rate for all injuries 13.4 per 1000 (95%CI 13.37-13.44). • Hospital admission rate for serious injuries 15.8 per 100,000 (95%CI 15.5-16.2) • Falls accounted for 38% of all admissions. • Socioeconomic gradient in hospital admissions for 'severe' injuries.	• Used serious injuries definition to take account of confounding due to hospital admission supply/demand issues

Table 1-9 continued: emergency department attendances

Study	Study design	Study population	Outcome measure	Key findings	Comments
ED attendances					
Lyons *et al* (1995) (62)	Descriptive study of ED attendances, 1993	0-14 year old children living in West Glamorgan County, Wales	ED attendance rates	• ED attendance rate 182/1000 (having excluded repeat attendances for same injury) • 85% of all ED attendances were for new injuries • Distance from home inversely related with total number of injury attendances, but not related to fracture attendances.	• Repeat attendances for the same injury were excluded. • Fractures were used as a more severe injury type.
Laing and Logan (1999) (60)	Descriptive study of ED attendances, 1992-1993	0-14 year old children who resided in study area who attended 1 of 4 ED departments in London	ED attendance rates	• ED attendance rate 138.2/1000. • Attendance rates higher for boys than girls. • Falls most common injury mechanism. • 33% higher rate of ED attendance among most deprived wards compared to least deprived wards.	• Case ascertainment of all cases in geographical area? • Potential numerator-denominator mismatch.
Gorman *et al* (1999) (63)	Descriptive study of ED attendances, 1995-1996	Single hospital, Livingston, Scotland	ED attendance rates	• 0-4 year olds: 213.8/1000 (female), 266.4/1000 (male) • 10-14 years olds: 432.5/1000 • 15-19 year olds 434.0/1000	• Attempted to identify injuries for a specific population using postcode information
MacInnes and Stone (2008) (64)	Descriptive study of ED attendances, 1997-2001	0-7 year old children, single hospital Glasgow	ED attendance rates	• Injury rate of 144/1000 • Rate highest among those aged 12-35 months and consistently higher for boys than girls. • Patterns and types of injuries varied with age. • Home most common location of injury.	• Difficulty identifying denominator for hospital catchment area.
Hughes *et al* (2014)(76)	Descriptive study of ED attendances, experimental HES dataset of ED attendances, 2010-2011	0-14 year old children, all of England	Proportions of ED attendances according to age, sex, socioeconomic quintile, calendar time	• Odds of burns peaked at age 1, and odds of poisonings peaked at age 1-2 • Increased odds of most types of injury amongst most deprived quintile (road traffic incidents, assault) but a reduced odds compared to the most affluent of sports injuries • Variation in attendances by day of the week and season	• No rates of ED attendances were reported • Experimental dataset, poor coding and geographical coverage in some areas • Limitations with how injuries are coded/grouped in ED

ED: *Emergency Department*

Table 1-9 continued: surveys and self-reported data

Study	Study design	Study population	Outcome measure	Key findings	Comments
Surveys / self-reported data					
Currie *et al* (1996) (41)	Cross-sectional survey, 1994	11,13 and 15 year old school children, Scotland	Frequency of self-reported injuries	• 94.5% of children reported sustaining an injury in past 12 months, 41.9% requiring medical attention. • Bruises, cuts and sprains most commonly reported injuries.	• Self-reported injuries over 12 months – may be underreporting / recall biases.
Warrington *et al* (2001) (65)	ALSPAC cohort study, children born between 1991 and 1992 in Bristol	0-18 month children	Frequency of parental reported falls and burns in child	• Falls: 2,554 (22%) of children had one or more fall. 162 taken to hospital and 18 were admitted. • Burns: 166 (1.5%) had a burn or scald. 15 attended hospital. 1 required a skin graft.	• Parental recall of injuries, reporting biases? • No clinical detail of injuries sustained. • Captures medically and non-medically attended injuries.
Lalloo *et al* (2003)(66)	Cross-sectional study. Health Survey for England, 1997	4-15 year olds	Frequency of self-reported (or parent reported) major injuries requiring medical attention in last 6 months Frequency of self-reported minor injuries causing pain or discomfort for more than 24 hours occurring in last 4 weeks	• 11.8% of children reported a major accident in the last 6 months • 9.5% reported a minor accident in the last 4 weeks • Both major and minor injuries more common among boys and among older children	• No significant association found with social class • More minor injuries reported in higher social classes – differences in reporting of events?
Pearce *et al* (2012) (67)	UK Millennium Cohort Study, children born 2000-2002	9 month – 3 year olds	Parent reported injury requiring medical attention occurring between 9 months old and 3 years old	• 22% of children injured at home between 9 months and 3 years old • 14% injured somewhere outside of the home	

ALSPAC: *Avon Longitudinal Study of Parents and Children*

Table 1-9 continued: primary care data, and use of multiple data sources

Study	Study design	Study population	Outcome measure	Key findings	Comments
Primary care data					
Cooper *et al* (2004) (71)	Cohort study using CPRD primary care database, 1988-1998	0-18 year olds	Incidence of fractures	• Incidence rate 133/10,000 person years • Fractures more common males • Incidence peaked at 14 years old males, 11 years old females • Geographical variation in incidence of fractures by region of UK	• May not capture all fractures if those seen in secondary care are poorly recorded.
Orton *et al* (2014) (77)	Cohort study using THIN primary care database, 1990-2009	0-4 year old children	Incidence of fractures, poisonings and burns.	• Fracture incidence: 75.7/10,000 person years • Poisoning incidence: 37.1/10,000 person years • Burn incidence: 57.8/10,000 person years • Significantly higher rates of injuries with increased socioeconomic deprivation.	• May not capture all injuries if those seen in secondary care are poorly recorded.
Multiple data sources					
Walsh *et al* (1996) (59)	Descriptive study of ED attendances, hospital admissions and deaths from injury, 1990	0-15 year old children, Newcastle upon Tyne	Death, hospital admission and ED attendance rates	• For a resident population of 54,400 children, there were six deaths, 904 admissions and 11,682 ED attendances. • Falls were the leading causes of hospital admissions and ED attendances. • Death rate, 0.11 per 1000 • Hospital admission rate, all injuries 16.6 per 1000 • ED attendance rate 214.9 per 1000	• Used injury severity scores
Graham *et al* (2005) (68)	Descriptive study using hospital and deaths data, patient questionnaire used in ED, 1999-2000	0-13 year old children admitted to a single District General Hospital in Scotland	Hospital admission rates by age. Proportion of admissions according to mechanism and calendar month.	• 10,697 patients seen in ED for injuries, 1,282 hospital admissions, 1 death due to choking in time period. • Admission rate of 3.5 children under 5 per day. • Admission rate of 2.1 children aged 5-13 per day. • Most common injury mechanism was falls.	• Very low response rate to questionnaire (12%). • No population based rates. • Potential numerator-denominator mismatch. • Single hospital site, small numbers.

THIN: *The Health Improvement Network, a large primary care research database.* ***CPRD:*** *Clinical Practice Research Datalink*

1.5 Risk factors for injuries among children and young people

A large number of risk factors have been identified for childhood injuries. These factors are often interrelated, reflecting the complex interactions and dynamics between individual children, their families and the environment in which they live. A summary of key risk factors is described below.

1.5.1 Child risk factors

1.5.1.1 Age

Patterns of injury vary considerably by age, both in terms of the frequency and the types of injuries that children sustain(64, 78-80). Age-related patterns of injury largely relate to child development, and how children's cognitive and physical changes interact with the environment(79). For example, injuries among preschool children most commonly occur in the home(64, 81), with falls, foreign body ingestions, poisonings and burns common in this age group(81). As children become older, they gain increasing independence, participate in different activities and play, and take a greater responsibility for their own safety(79). This is reflected in the locations where injuries occur; more commonly at school, during leisure (e.g. playgrounds, sports) or on the road (e.g. pedestrian and cyclist injuries)(78).

1.5.1.2 Sex

Existing studies have consistently shown males to have higher injury rates than females(79, 80), in all but a few cases (e.g. self-harm is higher among adolescent females(82, 83)). The magnitude of the difference between males and females has been shown to vary by injury type(79), age(78) and injury severity(78, 80, 84). A number of factors have been suggested to explain this sex difference; including different rates of physical and cognitive development in young children, differences in behaviour (e.g. risk taking), exposures (e.g. types of play and sports) and levels of caregiver supervision(79, 85).

1.5.1.3 Ethnicity

There is mixed evidence about the association between ethnicity and injury risk(78-80), potentially reflecting differences in study populations, whether socioeconomic factors

were adjusted for, and what measures of injury occurrence were used. A systematic review by Pearson *et al* concluded that there was weak to moderate evidence that burns, poisonings and falls were higher amongst ethnic minority groups(80). Additionally there is some evidence from the Health Survey for England(86) and an ecological study from England(87) to suggest lower fracture rates amongst ethnic minority and South Asian groups, respectively.

1.5.1.4 Behaviour

Child behavioural and personality traits have been extensively studied as risk factors for injury(88). Hyperactivity and behavioural difficulties have been associated with an increased risk of injuries among school aged children(78), with pedestrian and cyclist injuries(80), and with poisonings(80). Additionally, specific disorders such as oppositional defiant disorder(89) and attention deficit hyperactivity disorder(89) have been associated with an increased injury risk. Researchers suggest behavioural difficulties may increase injury risk as a result of increased exposure to hazards (e.g. risk taking, exploratory behaviour) and/or a reduction in the child's ability to respond appropriately to hazards (e.g. impulsive, disobedient)(88). Among adolescents, risk behaviours such as alcohol consumption have been associated with an increased frequency of injuries and injury complications(90).

1.5.1.5 Other child factors

Children who have had a previous injury have been shown to be at increased risk of a subsequent injury(91, 92). There is some evidence that certain conditions, such as sensory impairments(78, 93), epilepsy(94) and disabilities(95) increase the risk of injury. For example, a recent systematic review and meta-analysis found that children with a physical disability had a 2.39 fold increased odds of injury (pooled odds ratio (OR) 2.39, 95%CI 1.43-4.00) compared to those with no disability, and those with a cognitive disability had a 77% higher odds of injury (pooled OR 1.77, 95%CI 1.49-2.11)(95). For fractures, specific genetic conditions (e.g. osteogenesis imperfecta)(96), chronic diseases(96-98) and medications affecting bone metabolism and structure (e.g. steroids(99), anticonvulsants(96, 98)) can increase fracture risk(100).

1.5.2 Family risk factors

1.5.2.1 Socioeconomic deprivation

Socioeconomic deprivation is by no means a simple concept and is related to a wide range of other potential injury risk factors, including single parenthood, housing quality, neighbourhood factors (e.g. safe playgrounds, traffic), use of safety equipment, and household size. Within the literature a range of socioeconomic measures have been used, including parental occupation, parental unemployment, car ownership, social welfare benefits, parental education and area-based measures (e.g. Townsend score)(79, 80). While there are some differences in findings according to the measure of socioeconomic deprivation used(80), in general, socioeconomic deprivation has consistently been shown to be a risk factor for injury among children; with those from the most deprived families having higher death rates(45, 58), rates of serious injury(75) and rates of a number of injury types (e.g. falls, burns, poisonings)(77, 84, 101). There is some evidence to suggest that socioeconomic inequalities differ by child age(80), injury type(69, 77) and have narrowed over time(77).

1.5.2.2 Parental characteristics and behaviours

Younger maternal age has consistently been associated with increased injury risk(69, 78, 102). For example, a large cohort study of 800,192 children from Sweden found that children of teenage mothers (aged 12-17 years) had a 40% higher risk of unintentional injuries compared to the children of mothers aged 33-55 years (adjusted hazard ratio (HR) 1.4, 95%CI 1.2-1.6)(102). Additionally a number of other maternal factors have been associated with children's injury risk including substance misuse(80, 103, 104), certain personality traits (e.g. reduced conscientiousness(85), neuroticism(85)), and maternal stress(105). The literature concerning maternal mental illness as a risk factor for child injury is described in Section 1.7.

1.5.2.3 Family structure

There are a number of studies demonstrating that family composition affects injury risk(80). Single parenthood(80, 103, 106, 107), a higher number of children in the household(78, 108, 109), being part of a step-family(107) and having more older siblings(78, 108) have been associated with increased injury risk. For example, Nathens *et al* demonstrated a progressive increase in the odds of child injury with a greater

number of older siblings, with children who had 3 or more older siblings having a 69% higher odds of injury than those with no siblings (adjusted odds ratio (aOR) 1.69, 95%CI 1.44-1.97)(109). This may be explained by reduced parental supervision due to more children being in the household, activities or games children play through having older siblings, and older children being responsible for supervising younger siblings(109). Work by Morrongiello *et al* suggests that older siblings supervise younger siblings for as much as 11% of the time, with increased sibling supervision associated with higher mean numbers of parent reported minor and moderate child injuries(110).

1.5.2.4 Parenting practices and child supervision

Caregiver supervision and parenting practices, particularly among preschool children, have consistently been shown to influence injury risk(85). Child risk taking behaviours, minor and medically attended injury occurrences, have been associated with lower levels of caregiver supervision, less frequent checking on unsupervised children, and less proximal supervision(85, 111). For example, in a case-cross over study by Schnitzer *et al* (2014), children were more likely to be beyond reach and out of view at the time an injury occurred compared to a control period 1 hour before (OR 2.9, 95%CI 1.8-4.9)(111). A review by Morrongiello (2005) highlights that there is a dynamic interaction between the nature and extent of caregiver supervision and other child (e.g. child sex, age, temperament, behaviour) and environmental factors (e.g. use safety equipment). For example, a study by Schwebel *et al* demonstrated that the risk of injury among children with hyperactivity or behavioural difficulties is moderated through positive parenting, highlighting the interrelationship between the child's individual risk factors and parental behaviours(112).

1.5.2.5 Other factors

Adverse life events (e.g. domestic violence, parental separation, recent bereavement, moving house)(107, 113, 114) and low social support(114) have been associated with increased risk of child injuries.

1.5.3 Community and environmental risk factors

The risk of injury is related to a number of environmental factors, both within the home and at community or neighbourhood levels. Among preschool children, injuries most commonly occur within the home(115), with injury risk affected by the quality of

housing, the presence of hazards and parental safety behaviours. For example, in a multi-centre case-control study, Kendrick *et al* demonstrated that compared to controls, parents of children who had a stairway fall were more likely to; not have a stair gate (aOR 2.50, 95%CI 1.90-3.29), not close the stair gate (aOR 3.09, 95%CI 2.39-4.00), not have carpeted stairs (aOR 1.52, 95%CI 1.09-2.10), and not have a landing part-way up the stairs (aOR 1.34, 95%CI 1.08-1.65)(116). Other structural risk factors for child falls include; the use of bunk beds(84), absence of window bars(84), the use of child walkers(84) (increasing stairway falls) and having rugs or carpets not firmly fixed to the floor(117). The delivery of home safety interventions has been associated with improved safety behaviours, with some evidence of reductions in child injury rates(118); demonstrating that changes to the home environment can reduce injury risk in young children.

Injury rates have been found to be higher in urban, low income areas(119-121) and among those living in rented(84, 120) or older houses(84). Several studies have used multilevel analysis to examine the differing effects of individual, family and neighbourhood characteristics on injury risk(103, 120, 121), concluding that much of the neighbourhood variation in injury rates is explained by child and family factors that can cluster together in geographical areas (e.g. deprivation, unemployment, younger parents, substance misuse)(103, 120).

Environmental risk factors for injury are most clearly seen for road traffic incidents; affected by the traffic volume on the road(122), the road type (greater risk on main roads than urban roads)(123), the presence of street lighting(122), the speed limit of the road(123, 124) and the use of traffic calming(122). For example, a time-series analysis by Grundy *et al* evaluated the effect of introducing 20mph speed limits in London and demonstrated a 50.2% reduction in deaths and serious injuries from road traffic incidents among children aged 0-15 following the reduction in speed limit (percentage reduction 50.2%, 95%CI 37.2-63.2)(124). Children have been shown to have a greater risk of pedestrian injuries when living on through roads, roads without parking, and when there are no play areas(123). Factors affecting the occurrence and severity of playground falls include the height of play equipment and the nature of the undersurface(84, 125).

Geographical variation by region of the UK has been demonstrated(71, 126); potentially reflecting differences in socioeconomic deprivation and injury prevention initiatives. Injury rates vary according to the season of the year, with an increase in fractures during March to August (longer daytime hours, good weather)(71), compared to other injury types, such as falls and burns which are more common in autumn and winter(127).

1.6 The importance and epidemiology of maternal mental illnesses

There is much concern about the burden of mental illnesses both within the UK and internationally(128, 129). Mental illnesses are the leading cause of years lived in disability worldwide, with depression alone ranked as the fourth leading cause of overall disease burden(128). In 2010, mental disorders and substance misuse accounted for 183.9 million DALYs(128); more than the global burden of HIV/AIDs, tuberculosis, diabetes or transport injuries together. Mental disorders commonly commence during childhood or early adulthood, are recurrent, and potentially have lifelong impacts(129, 130). It is estimated that one in five adults experience a common mental disorder such as depression or anxiety each year(131), and that a third of people will experience one of these disorders across their lifetime(131). Costs of mental illnesses are high; estimated as £105 billion in England in 2009-2010 (including health and social care costs, loss of output and human costs)(132).

1.6.1 The importance of maternal mental illnesses

Particular attention is given to maternal mental illness, as it is the commonest morbidity women experience during pregnancy and the postnatal period(133), remains the leading cause of maternal mortality in the UK (i.e. from suicide)(134), and has been associated with a number of negative child outcomes(135). Changes in mental health symptoms after delivery are common, with an estimated 50-85% of women experiencing 'baby blues'; transient symptoms of anxiety, low mood, irritability and tearfulness that usually resolve spontaneously by day 10 postnatally(136). During pregnancy and the postnatal period, depression and anxiety are the commonest mental illnesses, with an estimated 10-20% of women affected(133). For women with pre-existing mental disorders (e.g. bipolar disorder, schizophrenia), pregnancy and the postnatal period require particular consideration in terms of the continuation or cessation of medications during pregnancy

and ensuring the wellbeing of both mother and child(137). The importance of prompt identification and management of maternal mental illnesses is highlighted by both the National Institute for Health and Care Excellence (NICE)(138), and a recent report about identification of perinatal mental illness in primary care(139).

1.6.2 Identification and diagnosis of mental illnesses in research and practice

Formal diagnoses of mental illnesses are made based upon the presence of a clinically recognisable set of symptoms associated with distress, disability or significant risk(140), meeting the requirements of classification systems such as ICD-10 or The Diagnostic and Statistical Manual of Mental Disorders (DSM). For example, for a formal diagnosis of depression to be made using ICD-10, at least four out of ten depressive symptoms (e.g. low mood, loss of energy, loss of interest/pleasure) need to be present at a sufficient severity for most of every day for at least two weeks(141). There are a large number of validated screening and diagnostic tools that are used in clinical practice and research to aid in the identification of depression and anxiety. Examples include the Edinburgh Postnatal Depression Scale (EPDS), Center for Epidemiologic Studies Depression Scale (CES-D), and the Beck Depression Inventory (BDI). Those with a high score on these scales should be followed up with a more in depth assessment to make a diagnosis of depression in clinical practice, as not all those identified as experiencing symptoms of depression/anxiety using these tools will meet the criteria for a formal diagnosis(142).

1.6.3 The epidemiology of maternal mental illnesses

1.6.3.1 Depression

Depression is a mental health problem characterised by low mood, decreased sense of pleasure, and in some cases physical symptoms such as fatigue, disturbed sleep and loss of appetite(143, 144). Depression is a heterogeneous diagnosis, with the number and severity of symptoms varying. In severe cases, psychotic symptoms can be present. Symptoms of depression and anxiety are common throughout adulthood, with the most recent Adult Psychiatric Survey in England estimating that 12.5% of men and 19.7% of women have symptoms of anxiety and/or depression; although not all of a level to warrant diagnosis and/or treatment(145).

The term ‘perinatal depression’ encompasses depressive episodes occurring during pregnancy and the first 12 months after delivery(136). Meta-analyses have estimated

the point prevalence of perinatal depression as between 6.5-12.9%(146-148), with considerable variation between individual studies as a result of the instruments used to detect depression, differences in study populations and the timing at which depressive symptoms were assessed(146-148). A systematic review of studies from high income countries estimated the point prevalence of major depressive disorders (those of severity and duration to satisfy formal diagnostic criteria such as DSM) as 4.9% in the second trimester of pregnancy, 5.7% at 2 months postpartum and 5.6% at six months postpartum(146). When both minor (e.g. those with low level depressive symptoms) and major cases of depression were included, the prevalence of depression in the second trimester increased to 8.5%, and 12.9% at three months postpartum(146).

Less attention has been given to episodes of maternal depression occurring after the perinatal period. A large cohort study using UK primary care data demonstrated that by the time children reached the age of 4 years old, 24% of mothers had experienced at least one episode of depression(149). National survey data from Canada found that 12% of children aged less than 12 years old are exposed to a parental mental disorder, with 5.1% exposed to a parental mood or anxiety disorder(150).

Within the general population, the median duration of a depressive episode is about 3 months, with between 10% and 30% of affected people having ongoing symptoms at 1-2 years(151, 152). Similar to this, most episodes of postnatal depression spontaneously resolve within two to six months(153). Persistent symptoms lasting beyond the first year after delivery are estimated to occur in about 30% of women(133).

1.6.3.2 Anxiety

Anxiety disorders are a group of conditions that share common features of excessive worry, fear, and anxiety that lead to distress and dysfunction(144), including conditions such as generalized anxiety disorder, social anxiety disorder, phobias and panic disorder(154). Within the general population, the prevalence of all anxiety disorders is estimated to be about 5%(145), with an estimated one third of the population experiencing an anxiety disorder during their lifetime(130). Compared to depression, considerably less research has been carried out describing the epidemiology of maternal anxiety disorders. A systematic review by Ross and McLean estimated the prevalence of maternal generalized anxiety disorder as between 4.4% and 8.2% in the postpartum

period, compared to 3% in the general population, with the included studies assessing anxiety symptoms between 8 weeks and 6 months postpartum(155). Using a large cohort of mothers from England, Heron *et al* estimated the prevalence of anxiety symptoms, identified using the Crown-Crisp experiential index (a self-reported validated inventory), as 14.6% at 18 weeks gestation and 8% at 8 months postnatally, with two-thirds of women reporting anxiety symptoms during pregnancy also reporting anxiety symptoms postnatally(156). In a study using UK primary care data, prevalence estimates of perinatal anxiety were much lower than the study by Heron *et al*, with an estimated 2.6% of mothers having prenatal anxiety and 3.7% of mothers having postnatal anxiety(157). Depression and anxiety commonly coexist with between 10% and 50% of women with anxiety symptoms also having depressive symptoms(133, 136).

1.6.3.3 Serious mental illnesses

Very little is known about the prevalence of severe mental illnesses during the perinatal period or the early years of a child's life(137). The two main serious mental illnesses considered in this thesis are bipolar disorder and schizophrenia.

Bipolar disorder, originally called manic depression, is a serious mental illness characterised by recurrent episodes of depression and elated mood (mania or hypomania)(158). Symptom onset frequently occurs in adolescence and the early 20s(159), although diagnosis can be delayed for many years depending upon clinical presentation, and the need to exclude other diagnoses (e.g. major depression, schizophrenia, substance misuse)(160). The lifetime prevalence of bipolar disorder is estimated at approximately 1%; similar in men and women. The clinical course of bipolar disorder varies between patients, from infrequent episodes over many years, to multiple episodes per year. A review of the natural history of bipolar disorder by Angst *et al* estimated a median length of bipolar episodes as between 3 and 6 months, with patients having, on average less than one episode per year (average of 0.37-0.66 episodes per year)(159). It is well established that women with pre-existing bipolar disorder are at increased risk of relapsing during the perinatal period(136), and that there is a close relationship between the occurrence of puerperal psychosis (a sudden onset mental illness with psychotic symptoms following childbirth) and bipolar disorder.

Schizophrenia is a long term mental disorder characterised by a disintegration of the process of thinking, of contact with reality (e.g. hallucinations, delusions), and of emotional responsiveness(161-163). Onset peaks in early adulthood (15-24 years) with males tending to have a younger onset(161). About half of those who develop schizophrenia have an acute onset of symptoms, with the other half having a long prodrome and gradual change in function(162). From systematic reviews, point prevalence is estimated to be about 4.6 per 1000 people, with no significant difference in prevalence between males and females(162, 163). The course of schizophrenia varies; with about 50% of individuals having an undulating course with relapses and remissions of symptoms, and a third having chronic unremitting symptoms(162). Only a small minority recover completely. There are limited data on how pregnancy and the postnatal period affect symptoms of schizophrenia, with the clinical course varying between individuals(137). It is estimated that approximately 50% of women with schizophrenia become mothers(164), with discontinuation of psychotropic medication potentially increasing the risk of relapse of symptoms during pregnancy and the postpartum period(137, 165). Careful planning before and during pregnancy are required, alongside careful consideration about the continuation of medication and support required for the mother and wider family(137).

1.7 Associations between maternal mental illnesses and childhood injuries

Poor maternal mental health during pregnancy and the early years of a child's life is recognised to have short and long term health, psychological, behavioural and emotional impacts on the child(135, 166). Less is known about the impact of maternal mental illnesses on child injury risk or child safety. Published studies were identified through searching the Medline, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase, Allied and Complementary Medicine Database (AMED), PsychINFO and British Nursing Index (BNI) databases using MeSH and free word search terms for 'children', 'injuries', 'mothers/caregivers' and 'mental illnesses' (see Appendix 2 for search terms). Additional studies were identified through reference lists of published papers. No restrictions were placed on year of publication, but studies had to be published in English. Identified studies fell into two main categories, those assessing the impact of maternal mental health on safety practices, and those assessing the impact on

specific injury outcomes (e.g. medically attended injuries, poisonings, fractures). These groups of studies are discussed in turn.

1.7.1 Association between maternal mental illnesses and safety practices

Table 1-10 summarises the key findings of published studies describing the association between maternal mental illnesses and carer safety practices, with all but one study focusing on maternal depression(167). Most of these studies assessed the presence of maternal depressive symptoms, measured using screening tools such as the CES-D(168-172), EPDS(173) or Patient Health Questionnaire (PHQ)(174). Only one study used a diagnostic interview defining mild and severe depression according to DSM(114). In all but two of the studies focusing on maternal depression(114, 171), an association with lower uptake of safety practices has been observed.

Two of the earliest studies, by McLennen and Kotelchuck (2000) and Leiferman (2002), both used longitudinal survey data from the US, finding that mothers who scored 16 or more on the CES-D at both time-points of the survey were less likely to report use of child car seats(168, 169) (Table 1-10). In addition, McLennen and Kotelchuck found women depressed at one or both time points were 21-25% less likely to use electrical socket covers compared to mothers who were not depressed(168). Both of these studies used a large weighted sample, representative of the US population, but relied upon maternal reporting of safety practices.

There is some evidence that the degree to which maternal depression affects home safety practices depends on symptom severity(174) and the persistence of depressive symptoms(169, 170). Conners-Burrow *et al* (2013) used the PHQ-2 to categorise women as having 'high-level' or 'low-level' depressive symptoms(174). While women with any level of depressive symptoms had worse uptake of safety practices, there was a stronger association among women with higher level symptoms. For example, the odds of poisoning hazards being accessible was 77% higher amongst mothers with low-level depressive symptoms compared to mothers who were not depressed (aOR 1.77, 95%CI 1.23-2.56), whereas the odds was 2.71 times higher for mothers with high-level depressive symptoms (aOR 2.71, 95%CI 1.45-5.08)(174). Both Chung *et al* (2004) and Leiferman (2002) found that an association between maternal depressive symptoms and safety practices was only present among those women with persistent depressive

symptoms, measured at two(169) or three(170) time points. This is one potential explanation for the lack of association between maternal depressive symptoms and home safety practices seen by Mulvaney and Kendrick (2005), which measured depressive symptoms at a single time point(171).

The other study which found no association between maternal depression and safety behaviours is a cross-sectional study by Rhodes and Iwashyna (2007), which was carried out in a single ED department(114). This study used a diagnosis of depression (based on DSM) rather than depressive symptoms as the exposure, non-randomly sampled individuals, and had a population mainly comprised of African Americans (95%). These factors may explain the differing finding to other studies, but in addition the authors measured social support and domestic violence, finding that it was these variables, not depression, that were associated with poorer safety practices.

A limitation common to all of the existing studies is a reliance on parent reported safety behaviours, a potential source of bias if there are differences in reporting between those with and without mental health symptoms. Two studies supplemented parent reports with a home visit(167, 174), but neither of these studies included direct observations of behaviours, and mothers knew when the health professional/researcher was going to visit, potentially affecting findings (e.g. mothers tidy away hazards). There is some evidence to suggest that safety behaviours are poorly correlated with injury outcomes(175), and so while maternal depressive symptoms may be associated with lower uptake of safety practices, it cannot be concluded that these children will have more injuries.

Table 1-10: Existing literature assessing the association between maternal mental illnesses and the implementation of safety practices

Study	Study design	Study Population	Exposure	Outcome measure(s)	Results	Comments
Glik et al 1992 (167)	Cross-sectional	230 mothers of children aged 0-4 Columbia, South Carolina	7 item stress scale	• Checklist of safety hazards assessed by health worker at home visit.	• Inconsistent relationship between maternal stress and home safety practices. Not included in adjusted model of risk factors.	• No direct observation of safety behaviours. Mothers knew the date of home visit, so may have changed practices.
McLennan and Kotelchuck 2000 (168)	Prospective cohort	7,537 women US. Data from the 1988 National Maternal and Infant Health Survey and 1991 Longitudinal Follow-up Survey	Depression at one or both time-points, measured using the CES-D	• Car seat and electrical socket cover usage. • Availability of syrup of Ipecac.	• Electrical socket cover and car seat usage were significantly lower among women who had depressive symptoms at one or both time points of the study follow-up. E.g. car seat use aOR 0.69, 95%CI 0.55-0.88 when mother depressed at both time points.	• Large survey, weighted to US population so potentially generalizable. • Use of longitudinal data is a strength. • Relies on self-reported measures of home safety practices.
Leiferman 2002 (169)	Prospective cohort	7,537 women US. Data from the 1988 National Maternal and Infant Health Survey and 1991 Longitudinal Follow-up Survey	Depression at one or both time-points, measured using the CES-D	• Car seat usage, reported by mother	• Car seat usage was not associated with depressive symptoms measured at one time point (aOR 1.14, 95%CI 0.95-1.36) • Car seat usage was only associated with depressive symptoms when mother depressed at both time points (aOR 1.36, 95%CI 1.04-1.78)	• Large survey, weighted to US population so potentially generalizable. • Use of longitudinal data is a strength. • Relies on self-reported measures of home safety practices.
Chung et al 2004 (170)	Prospective cohort	778 women Philadelphia, predominantly low income African American women	Depression measured at three time-points using the CES-D	• Smoke alarm in house. • Use of back to sleep position.	• Women with persistent depression at all 3 time points were 72% less likely to have a smoke alarm (aOR 0.28, 95%CI 0.11-0.70) and 44% less likely to use the back to sleep position (aOR 0.56, 95%CI 0.35-0.91) • Use of safety practices was only lower among those with persistent depression	• Lack of generalisability • Self-reported safety practices

CES-D: *Center for Epidemiologic Studies Depression Scale.* ***aOR:*** *adjusted odds ratio.* ***95%CI:*** *95% confidence interval.* ***US:*** *United States*

Table 1-10 continued

Study	Study design	Study Population	Exposure	Outcome measure(s)	Results	Comments
Mulvaney and Kendrick 2006 (171)	Prospective cohort, from control group of a RCT	452 women Nottingham, UK. Deprived communities.	Depression measured at a single time point using the CES-D	Safety practices assessed 3 months after depressive symptoms.	• No association between maternal depressive symptoms and any home safety practices. For example: • Fireguards (unadj OR 1.16, 95%CI 0.78-1.73) • Window catches (unadj OR 0.73, 95%CI 0.47-1.14) • Smoke alarms (unadj OR 1.08, 95%CI 0.61-1.91)	• Study population were recruited from the control group of an injury prevention trial- affect awareness of safety behaviours? • Depression assessed at single time point. Lack of association explained by not identifying women with chronic depression?
McLearn et al 2006 (172)	Prospective cohort	3412 women US, 'Healthy Steps for Young Children' prospective clinical trial	Depression measured at two time points (2-4 months and 30-33 months) using the CES-D	Safety behaviours reported by parents at 30-33 months: • Car seat use • Electrical outlet covers • Safety latches on cupboards • Lowered hot water heater temperature	• Depressive symptoms at 2-4 months were associated with a 35% reduced odds of using a car seat (aOR 0.65, 95%CI 0.45-0.94) and 30% odds of lowering hot water temperature (aOR 0.70, 95%CI 0.57-0.86) at 30-33 months. • Depressive symptoms at 30-33 months were associated with a 39% reduced odds of using electrical outlet covers (aOR 0.61, 95%CI 0.46-0.82) and a 28% reduced odds of using safety catches on cupboards (aOR 0.72, 95%CI 0.59-0.88).	• Cross-sectional analysis of depressive symptoms at 30-33 months and safety behaviours. Safety behaviour reporting affected by maternal mental health symptoms?
Rhodes and Iwashyna 2007 (114)	Cross-sectional	1,116 parents US. Predominantly African American.	Mild and severe depression assessed via interview, according to DSM-IV	• Gun ownership • Smoke alarms • Unsecured poisons • Inconstant seatbelt use • Smoke free home	• No association between depression and safety behaviours. • Likelihood of having a 'safe home': any depression: aOR 0.74 (0.53-1.03). Mild depression: aOR 0.86 (0.57-1.29). Severe depression: aOR 0.98 (0.42-2.32)	• Cross-sectional study • Self-reported data on safety behaviours • Not a random sample.

CES-D: *Center for Epidemiologic Studies Depression Scale.* ***DSM-IV:*** *Diagnostic and Statistical Manual of Mental Disorders, fourth edition.* ***RCT:*** *Randomised control trial.* ***aOR:*** *adjusted odds ratio.* ***95%CI:*** *95% confidence interval*

Table 1-10 continued

Study	Study design	Study Population	Exposure	Outcome measure(s)	Results	Comments
Conners-Burrow et al 2013 (174)	Cross-sectional	978 caregivers US. Parents enrolled in the 'Head Start' programme, low income families with 3-5 year old children, predominantly African American	PHQ-2, completed on a home visit Categorised women as having 'high-level', 'low-level' or no depressive symptoms	• Vehicle safety • Second hand smoking • Fire safety • Poison accessibility • Access to dangerous objects in the home • Lack of supervision • Violence exposure	• Both low and high levels of depressive symptoms associated with all safety practices except fire safety. • Stronger association with poorer safety practices and those with higher-level symptoms of depression. E.g. poison accessibility, aOR 1.77 (95%CI 1.23-2.56) for low-level, compared to aOR 2.71 (95%CI 1.45-5.08) for the high-level symptom group	• Home safety practices were assessed at a home visit, any bias in assessment of safety practices by clinicians? • Multiple statistical tests conducted, chance of type 1 error
Balbierz et al 2015 (173)	Cross-sectional	945 mothers from a trial study population New York, US	EPDS at 3 months after delivery	• Back to sleep position • Use of car seat • Working smoke alarm	• Mothers who were depressed were significantly less likely to engage in safety practices compared to mothers who were not depressed. • Back to sleep: aOR 0.37, 95%CI 0.22-0.61 • Car seat: aOR 0.44, 95%CI 0.25-0.79 • Smoke alarm: aOR 0.26, 95%CI 0.12-0.56	• Racially/ethnically diverse population from New York. Generalisability? • Self-reported safety behaviours, bias?
Morrissey 2016(176)	Prospective cohort, repeated surveys	10,700 preschool children from the Early Childhood Longitudinal Study. Birth Cohort, nationally representative sample, US	CES-D at 9 months after delivery. Mothers classified as having moderate-severe depression if scored ≥9 on CES-D	• Gun ownership and storage • Car seat use • Child sat in back of car • Working smoke alarm	• Mothers with mod-severe depression 2% less likely to make child always sit in back of vehicle than mothers without mod-severe depression (β -0.02, p<0.001) • Mothers with mod-severe depression 3% less likely have working smoke detector (β -0.032, p<0.01) • No significant association and gun ownership, safe storage of a gun, or car seat use	• Loss to follow-up, non-response • Multiple analyses, some of which were cross-sectional • Self-reported exposure and outcome data by mother. Social desirability biases.

CES-D: *Center for Epidemiologic Studies Depression Scale.* ***PHQ:*** *Patient Health Questionnaire.* ***EPDS:*** *Edinburgh postnatal depression scale.* ***RCT:*** *Randomised control trial.* ***aOR:*** *adjusted odds ratio.* ***95%CI:*** *95% confidence interval*

1.7.2 Association between maternal mental illnesses and child injury outcomes

Several studies have assessed the effect of maternal mental illnesses on child injury risk, as shown in Table 1-11, with most having focused on maternal depression. Existing studies give mixed results about the association between maternal mental illness and child injury risk, with a number of studies finding no significant association(74, 103, 105, 113, 177-180). Positive associations have however been demonstrated in both preschool(107, 181-184) and school age children(185-187), and across a number of different countries (e.g. US, UK, India, Vietnam, Ethiopia, Peru), with the magnitude of effect varying considerably across studies. These differences in study findings reflect the use of different study populations (e.g. child ages, countries), definitions of mental illness (e.g. different scales, severities and timing), injury outcomes (e.g. parent reported, medically-attended, specific injury types), and confounders that have been adjusted for. Of note, most existing studies have measured mental health symptoms, rather than formal diagnoses of mental disorders (e.g. using DSM or ICD-10).

1.7.2.1.1 Maternal depression and child injuries

One of the earliest studies to demonstrate an association between maternal psychiatric disorders (of which most cases were depression) and child injuries is a study by Brown and Davidson (1978) which used a cohort of 211 mothers from South London who had been asked about psychiatric symptoms and childhood injuries requiring medical attention in the past year(188). Child injury rates were related to both maternal psychiatric disorder and socioeconomic deprivation; highest in working class mothers with a psychiatric disorder (17.2 injuries per 100 children per year) and lowest in children of middle class mothers without a psychiatric disorder (1.5 injuries per 100 children per year). Interestingly, this study sought to establish the dates of onset and recovery from a psychiatric disorder, demonstrating injury rates to be elevated during periods when the mother had active psychiatric symptoms (20.7/100) compared to periods when the mother didn't have symptoms (4.8/100). While this study is limited by a cross-sectional design, a lack of adjustment for potential confounders, and potential inaccuracies in the recall of both psychiatric symptom onset and the occurrence of child injuries, no subsequent studies have attempted to describe child injury rates in relation to the onset and timing of maternal psychiatric symptoms.

Some of the most comprehensive findings on the association between maternal depression and child injuries come from longitudinal cohort studies carried out in the UK(103, 107) and US(182, 183). In 2000, O'Connor *et al* used a cohort of 10,431 families from England, reporting an association between maternal depression measured at 21 months after birth, and the occurrence of burns/scalds (aOR 1.29, 95%CI 1.01-1.64), and 2 or more accidents when the child was aged 15 to 24 months (aOR 1.39, 95%CI 1.16-1.66)(107). Similarly, Phelan *et al* (2007) studied 1,106 mother-child pairs from the US National Longitudinal Study of Youth, demonstrating a 4% increase in the odds of a medically attended injury for every 1 point increase in maternal depressive symptoms on the CES-D (aOR 1.04, 95%CI 1.01-1.08)(182). This study found that children of mothers with persistent depressive symptoms (elevated symptoms at two time points) had a two-fold higher odds of injury (aOR 2.10, 95%CI 1.19-3.72) than children whose mothers weren't depressed at either time point(182). In 2008, Schwebel and Brezausek assessed whether the severity of depressive symptoms (classified as moderate or severe based on the CES-D score) influenced child injury risk using a cohort of 1,364 mothers from the US(183). Child injury risk was only elevated among children whose mothers had severe levels of depressive symptoms. These findings are similar to the studies of safety behaviours (Section 1.7.1), suggesting greater depression severity and chronicity may have a greater influence on injury outcomes and safety behaviours.

In 2008, Reading *et al* used a longitudinal cohort of 14,062 children, finding that significant unadjusted associations between maternal depression and 'all accidents' (Rate Ratio (RR) 1.31, 95%CI 1.23-1.39) and 'medically attended accidents' (RR 1.23, 95%CI 1.12-1.36) were no longer significant in multivariate models; indicating that the effect of maternal depression was explained by other variables included in the model (e.g. adverse life events)(103). Similar to this, adjustment for adverse life events and maternal punitiveness led there to be no significant association between maternal depression and traumatic brain injury in a study by McKinlay *et al*(113); highlighting that differences in study findings may in part reflect which other variables have been adjusted for within multivariable models.

In all of the longitudinal cohort studies described above, injuries were reported retrospectively by the mother over the previous 3-6 (183) or 12 months(107, 182). While some studies have suggested good parental recall of injuries, Cummings *et al* (2005) demonstrated that parent injury recall decreases over time, with the tendency to over

represent major or more recent injury events(189). Whether there are any differences in the recall of child injuries between mothers with and without depression is unknown, but could be a source of bias. For example, within the study by O'Connor *et al*(107), high maternal education (e.g. university degree) was associated with a 42% higher odds of children sustaining 2 or more accidents (aOR 1.42, 1.14-1.77); potentially reflecting more accurate reporting of injury events among more educated mothers rather than a true increased injury risk.

Several studies have used medical records to identify child injury events(69, 70, 73, 74, 104, 113, 180, 190), such as the studies by Watson and Kemper (1995) and Braun *et al* (2005) where mothers and children were recruited from individual hospitals or medical centres, with child medical records used to identify subsequent child injury events(104, 180). While the use of medical records to identify injury events is a strength of these studies, injuries seen in other cities or hospitals were not captured and study findings are not generalisable to other populations (e.g. studies used low income urban populations(104, 180), predominantly Hispanic(104)). More recently, the use of large population-based research databases and registries have given large study populations and results potentially generalisable to the wider population. For example, several studies have been carried out using a cohort of mother-child pairs from a UK primary care research database(69, 70, 73, 74). Orton *et al* found that children aged 0-4 years who had sustained a poisoning or thermal injury had a 50% (aOR 1.50, 95%CI 1.29-1.75) and 22% (aOR 1.22, 95%CI 1.08-1.39), respectively, greater odds of exposure to maternal perinatal depression than controls who had not sustained a poisoning or burn(69). In contrast, no association was found between maternal perinatal depression and fractures (aOR 1.06, 95%CI 0.93-1.20)(69), indicating that maternal depression may only increase the risk of certain injury types. Subsequent studies using the same dataset, found an association between maternal perinatal depression and medicinal poisonings(73), but no association with non-medicinal poisonings (e.g. due to household products, paints)(73), long-bone fractures(74) or scalds(70). These differences in findings could reflect true differences in the impact of maternal depression on different injury types, also seen in two other studies(102, 191). Another potential explanation could be that there are differences in the ascertainment of injury events within routine health data; either as a result of how data are coded or as a result of differences in health seeking behaviour by mothers. For example, most fractures are likely to be seen by

health services whereas there may be greater variation in health seeking behaviour for minor burns or poisonings, which could be affected by the mother's mental wellbeing.

Study findings have also differed according to the injury outcome measured. A study of 812 school aged children from the US found that maternal depressive symptoms were only associated with medically attended injuries, but not with minor injuries(187). Additionally some studies suggest that maternal mental illness is associated with repeated child injuries(104, 190).

1.7.2.1.2 Other mental illnesses

Few studies have focused on mental illnesses other than depression. Four studies included measures of anxiety(185), neuroticism(177) or stress(105, 192). Davidson *et al* (1987) found children of mothers who had a low neuroticism score on the Eysenck Personality Inventory had significantly fewer injuries than children whose mothers had medium to high scores on this inventory (RR 0.67, 95%CI 0.48-0.93)(177). However, once child sex and child management disorders were adjusted for, this association was no longer significant. Similarly, Harris and Kotch (1994) found higher levels of maternal stress were associated with the occurrence of child injury in bivariate analyses, but was no longer significant in an adjusted multivariable model(105). The study by Damashek *et al* focused upon the occurrence of minor injuries, with the use of a severity scale (the Minor Injury Severity Scale) to identify a more severe group of minor injuries(192). This study demonstrated a significant association between maternal stress and any minor injury, but no significant association between maternal stress and severe injuries. It is plausible that maternal anxiety and/or stress may affect both the reporting of injury occurrences and health seeking behaviour. This highlights the need to consider measures of injury severity within future studies.

No studies were identified that have specifically examined the association between severe mental illnesses, such as bipolar disorder and schizophrenia, and unintentional child injuries. Several studies have identified women with psychiatric disorders, either through clinical interviews(188, 193) or health records(102), but have not separated out the effects of different mental disorders. For example, Ekéus *et al* used national registry data on over 800,000 children aged 0-7 years from Sweden(102). Crude rates of hospitalised injuries were 37% higher amongst children whose mothers had a psychiatric

disorder (injury rate 80.1/1000) compared to those who did not (injury rate 58.4/1000); but it is not known which mental disorders mothers had. This paucity of evidence on more severe mental illnesses is likely to be due to the large sample sizes required to study these rare disorders. Identified published literature on severe mental illnesses tends to be cases series or studies focusing on the risks of non-accidental injury and deaths from unnatural causes, rather than unintentional injuries(194-196).

Table 1-11: Existing literature on the associations between maternal mental illnesses and childhood injuries

Study	Study Design	Study Population	Exposure	Outcome measure	Results	Comments
Husband and Hinton, 1972 (197)	Case series	24 children, Fulham Hospital, England	Maternal report of a psychiatric disorder	Recurrent accidents (2 or more) in the past 12 months, seen in ED	• Of the 24 children who had recurrent accidents, one third (n=8) had a parent with a psychiatric disorder	• No control group • No adjustment for confounders • Small sample size
Brown and Davidson, 1978 (188)	Cross-sectional	211 women with children aged 0-16 South London, UK	Psychiatric symptoms in last year, clinician assessed likely date of onset	Maternal reported child accidents, fractures, cuts, burns, choking, electrocutions	• Rate of child injury when mother classified as 'psychiatrically disturbed' (20.7/100 children per year), compared to 4.8/100 in the weeks before/after onset of psychiatric symptoms. This compares to an injury rate of 5.4/100 children per year in women with no psychiatric disorder. • Rates of injury were highest in children of mothers who were both working class and had a psychiatric disorder or borderline psychiatric disorder (19.2/100 children per year)	• Most women had depression. • No adjustment for potential confounders • Recall of when psychiatric symptoms occurred and when children were injured. • Assessed injury risk in time before symptom onset • Potential interaction by socioeconomic deprivation
Beautrais *et al*, 1981 (198)	Cohort	1262 children born 1977 New Zealand	Maternal use of antidepressants and/or tranquilisers	Maternal reporting of any poisoning and medically attended poisonings between 0-2 years, and 2-3 years	• Children whose mothers were using tranquilisers and/or antidepressants had a significantly higher incidence of poisonings (29.8/100) compared to children whose mothers were not prescribed these medications (17.2/100) ($p<0.01$)	• Use of diaries and medical records to verify injury occurrences • No measure of maternal depression. Due to increased exposure to medications? • No adjustment for socioeconomic deprivation
Davidson *et al*, 1987 (177)	Cohort	831 children aged 0-4 Wales	Neurotism, Eysenck Personality Inventory	Injuries seen in EDs, identified from medical records	• Mothers who had a low score for neurotism had children who had significantly fewer injuries (RR 0.67, 95%CI 0.48-0.93) • No longer a significant association between neurotism and child injury when child management disorders and sex were adjusted for	• Medical records used to identify injury events • No measure of injury severity so could not account for differences in health service use

***ED:** Emergency department; **RR:** Rate ratio*

Table 1-11 continued

Study	Study Design	Study Population	Exposure	Outcome measure	Results	Comments
Langley *et al*, 1987 (178)	Cohort study	781 children New Zealand, children born between 1972-1973	Maternal mental health, measured using 'The Malaise Inventory'	Maternal report of injuries requiring medical attention in past 2 years	• No significant relationship between numbers of child injuries and mean scores of mothers on Malaise Inventory. Mean score Malaise Inventory: No injuries=1.8; 1 injury=2.0, 2 injuries=1.8; 3 or more injuries=2.4 (p=0.14).	• Loss to follow-up bias • Potential recall and reporting biases
Weissman *et al*, 1989 (179)	Matched cohort	220 children aged 6-23 months, 91 exposed to parental depression	Clinically diagnosed depression with Research Diagnostic Criteria	Parent reported occurrence of head injury	• 5.9% of children whose parent(s) had depression had a head injury, compared to 1.5% of children whose parents were not depressed. Not statistically significant.	• Could have one or both parents with depression, 40% were depressed fathers • Small study • No adjustment for confounders • Recall or reporting biases
Harris and Kotch, 1994 (105)	Prospective cohort	367 children aged 0-12 months North & South Carolina, US	Maternal depression, CES-D. Maternal stress, 'Everyday Stressors Index' Measured at 6-8 weeks after delivery and 1 year	Parent reporting of an injury at 1 year (yes or no)	• Higher mean depression scores reported at 1 year among mothers whose children had an injury in the past year (mean=16.18) compared to mothers whose child had not had an injury (mean=13.58) (p=0.013). • Higher mean stress scores at 1 year among mothers whose child had an injury (mean=20.74) compared to mothers of children that had not had an injury (mean=17.78) (p=0.005). • Depression and stress not included in the adjusted regression model (only family conflict, number of siblings and maternal employment were included).	• Mainly non-white, unmarried, unemployed, low income women • Not generalizable to general population • Cross-sectional data used at 1 year. Potential for reverse causality. Children who have had injuries make mothers more stressed/depressed. Differences in reporting.
Watson and Kemper, 1995 (180)	Prospective cohort	202 children aged 0-4 Teaching hospital, US	Maternal depression, 8 item Rand screening instrument	ED visits for injury, average follow-up after mother completed screening 12.9 months	• Mothers screened +ve depression (n=49): 17% of their children attended ED for an injury. Mothers screened -ve depression (n=94): 22% of their children attended ED for an injury. No significant difference.	• Urban, ethnically diverse, low-income population • Poor completion of screening questions (143/202 completed questions) • Single clinic

***CES-D**: Center for Epidemiologic Studies Depression Scale. US: United States.*

Table 1-11 continued

Study	Study Design	Study Population	Exposure	Outcome measure	Results	Comments
Russell 1998 (190)	Prospective cohort	4,287 children 26-48 months, US	Maternal depression, CES-D	Health provider records used to identify number of injury events	• Mean depression score higher in mothers of children who sustained repeat injuries (mean=10.21) compared to mothers of children who sustained one injury (mean=8.08) or no injury (mean=8.39), p=0.0006	• No adjustment for potential confounders • Excluded some ethnic groups
Bradbury *et al*, 1999 (185)	Prospective cohort	295 children 5-11 years old US	Maternal anxiety, depression, emotional control. Mental Health Index	Parent reported medically attended injuries in past 12 months. Measured 12 months after baseline questionnaire.	• Maternal anxiety significant in adjusted model. For every unit increase in the log of the anxiety score, there was a 0.779 increase in the number of medically attended injuries (p<0.05), after adjustment for other child and family variables • Maternal depression and emotional control were not included in final model	• Population predominantly white, middle-upper class 2 parent families • Association with maternal anxiety could relate to reporting of injuries / use of health services
O'Connor *et al*, 2000 (107)	Prospective cohort	10,431 children 0-24 months, ALSPAC study, UK	Maternal depression, EPDS when child 21 months old	Parent reported medically attended injuries, when child aged 15-24 months	• Burns/scalds: OR 1.29, 95%CI 1.01-1.64 • Burns/scalds requiring hospitalisation: OR 1.11, 95%CI 0.56-2.19 • 2 or more accidents: OR 1.39, 95%CI 1.16-1.66	• Parental recall of injuries
Ekéus *et al*, 2003 (102)	Prospective cohort study	800,190 children 0-7 years old, born 1987-1993 Sweden	Parents discharged from hospital with a diagnosis of a psychiatric disorder or substance misuse	Hospital admissions for injury, in particular falls, poisonings, burns, foreign bodies, violence, child abuse	• Injuries were more common among children of parents treated for a psychiatric disorder or substance misuse • E.g. rate of poisonings 17.5/1000 in children whose mother had psychiatric disorder compared to 8.8/1000 among mothers without a psychiatric disorder • E.g. rate of all accidents 80.1/1000 in children whose mother had psychiatric disorder compared to 58.4/1000 among mothers without a psychiatric disorder • Rates also higher among fathers with a diagnosed psychiatric disorder	• Swedish national registry data • Main aim of study was to assess relationship between single parenthood and injury – so no adjusted results are available for maternal mental health • Psychiatric disorders identified from discharge records, so may exclude mothers diagnosed with a psychiatric disorder in the community (i.e. outpatient clinics, primary care)

CES-D: *Center for Epidemiologic Studies Depression Scale.* ***EPDS:*** *Edinburgh postnatal depression scale.* ***OR:*** *odds ratio.* ***ALSPAC****: Avon Longitudinal Study of Parents and Children.*

Table 1-11 continued

Study	Study Design	Study Population	Exposure	Outcome measure	Results	Comments
Ramsay *et al*, 2003 (193)	Case-control study	207 children aged 0-4 presenting to an ED department 1998-99 Scotland	Mental and physical wellbeing, SF-12	Cases were children who had sustained a fall, poisoning, burn or fingertip injury Matched controls recruited from immunisation register	• No significant difference in mean mental wellbeing scores between mothers of cases (mean= 48.44, standard deviation=10.54) and controls (mean=50.21, standard deviation=8.36).	• Health visitors collecting data from parents not blinded to status of case or control • Recall bias • Cannot establish temporal relationship between mental wellbeing and injury occurrence • Only looked at 4 injury types – controls may have sustained other injuries in same period
Braun *et al*, 2005 (104)	Retrospective cohort	817 children aged 0-36 months US	Caregiver mental illness, recorded on standard assessment form at 'well child visits'	Medical chart review, number of injuries reported to hospital or community medical centres	• 11.3% of children injured more than once had a caregiver with a mental illness; compared to 4.2% of those injured once and 4.5% of those never injured (p=0.06).	• Validity and reliability of mental illness assessment at well child visits • Urban low-income population • Will not capture injuries seen at another hospital • No adjustment for potential confounders
Damashek *et al*, 2005 (192)	Cross-sectional	151 children aged either 15-18 months or 33-36 months	Composite score of maternal stress, psychopathy and depression	Minor injuries reported biweekly by mother for 6 months	• Maternal stress significant predictor of child injuries (β=-0.32, p=0.003), so increasing scores of maternal stress predicted a lower child injury rate. • No significant association between maternal psychopathy and child injury (β=0.11, p>0.05)	• Predominantly white middle-upper class study population • Used a measure of severity 'Minor Injury Severity Scale'
Minkovitz *et al*, 2005 (199)	Prospective cohort	3,419 children aged 0-33 months	Maternal depression, CES-D. Measured at two time points	Parent reported injuries in past 12 months, reported when child aged 30-33 months	• Injuries reported at 30-33 months were associated with depressive symptoms at 2-4 months (aOR 1.35, 95%CI 1.03-1.76)	• Women who were depressed at 2-4 months were less likely to complete follow-up data.

CES-D: *Center for Epidemiologic Studies Depression Scale.* ***SF-12:*** *12 item Short Form Survey.* ***OR:*** *odds ratio.*

Table 1-11 continued

Study	Study Design	Study Population	Exposure	Outcome measure	Results	Comments
Howe *et al*, 2006 (181)	Cross-sectional	8,061 children 6-17 months India, Peru, Vietnam, Ethiopia	Probable cases of common mental disorders, SRQ-20	Parent reported injuries (burn left scar, broken bone, serious fall, near death due to injury)	• Children with caregivers who had a common mental disorder had an approximate two-fold higher injury risk. E.g. for Ethiopia aOR 1.77 (95%CI 1.15-2.73) for burns, aOR 1.98 (95%CI 1.13-2.47) for fractures and aOR 2.44 (95%CI 1.49-4.01) for serious falls. • Results similar between countries in direction and magnitude, e.g. burns aORs ranged between 1.45-2.16, fractures aOR 1.98-3.67, falls aOR 1.74-4.20	• Not nationally representative samples • Anxiety and depression cannot be distinguished from each other using SRQ-20. Reference period of the SRQ-20 is 30 days, so will not accurately represent long term mental health symptoms. • Cross-sectional
Phelan *et al*, 2007 (182)	Prospective cohort	1,106 children aged 0-6 years, US	Maternal depression, CES-D	Parent reported medically attended injuries in past 12 months	• Injury risk increased 4% for every 1-point increase in depressive symptoms on CES-D (aOR 1.04, 95%CI 1.01, 1.08) • Children of mothers depressed in both 1992 and 1994 (persistent depression) had a two-fold increased injury risk (aOR 2.10, 95%CI 1.19-3.72) • Child externalizing behaviour was not a significant mediator of the relationship between maternal depression and child injury risk • Significant interaction maternal depression and child sex: boys aOR 1.10, 95%CI 1.04-1.16; girls aOR 0.97, 95%CI 0.90-1.04.	• Parent reported injuries • Loss to follow-up bias • Not generalizable to US / other populations
Reading *et al*, 2008 (103)	Prospective cohort	14,062 children aged 0-4 ALSPAC study Avon, UK	Maternal depression, EPDS	Parent reported accidents, and accidents requiring medical attention	• Maternal depression associated with 'all accidents' (RR 1.31, 95%CI 1.23-1.39) and medically attended accidents (RR 1.23, 95%CI 1.12-1.36) when adjusted only for child age, sex and time at risk. • Maternal depression was not however significant in final adjusted models.	• Study suggests associations between maternal depression and child injury may be explained by other variables included in multivariate model (e.g. child behaviour, adverse life events)

CES-D: *Center for Epidemiologic Studies Depression Scale.* ***EPDS:*** *Edinburgh postnatal depression scale.* ***OR:*** *odds ratio.* ***RR****: Rate ratio.* ***SRQ-20****: Self-reporting Questionnaire.* ***ALSPAC****: Avon Longitudinal Study of Parents and Children.*

Table 1-11 continued

Study	Study Design	Study Population	Exposure	Outcome measure	Results	Comments
Schwebel and Brezausek, 2008 (183)	Prospective cohort	1,364 children aged 0-6 US	Maternal depression, CES-D	Parent reported medically attended injuries, reported 3-6 monthly	• Severe (CES-D score ≥16) (IRR 2.89, 95%CI 1.79-4.66) but not moderate (CES-D score 8-15) depression (IRR 1.07, 0.97-1.60) increased injury risk • Chronic severe depression did not increase risk of subsequent injury between the ages of 3 and 6 years (IRR 1.25, 95%CI 0.98-1.92).	
McKinlay *et al*, 2009 (113)		1,265 children aged 0-15, born in 1977 New Zealand	Maternal depression, Levine-Pilowsky depression inventory	Traumatic brain injury, identified from parental interviews, diaries and medical records	• Increase in risk of traumatic brain injury among those whose mothers had higher depressive symptom score in unadjusted model, e.g. those with score ≥9 HR 1.49, 95%CI 1.0-2.3). Depression was not however significant and so not included in an adjusted model.	• Adverse life events, level of maternal punitiveness were significant in the adjusted model. • Long time between collection of data, exposures may have changed
Karazsia and van Dulmen, 2010 (187)	Prospective cohort	812 children in 4^{th}-6^{th} grades at school (ages 8-12 years old) US	Maternal depression, CES-D assessed when child in 3^{rd} grade	Parent reported minor injuries, 'close calls' and medically attended injuries	• Maternal depression only associated with medically attended injuries – not with minor injuries or close calls. • Risk of medically attended injury increased by 1.04 for every unit increase in the CES-D score (IRR 1.04, 95%CI 1.02-1.06).	• Parental recall • Different findings according to injury severity
Schwebel *et al*, 2011 (186)	Cross-sectional	4,745 fifth grade students (10-12 years old) US	Parent mental distress, Brief Symptom Inventory 18	Parent reported medically attended injuries in past 12 months	• Parental mental distress associated with increased injury odds (aOR 1.19, 95%CI 1.08-1.32)	• Mental distress scale assessed symptoms over the past 7 days. How well does this relate to symptoms over the 12 months that injury occurrences are assessed? • No longitudinal data, study cross-sectional

CES-D: *Center for Epidemiologic Studies Depression Scale.* ***OR:*** *odds ratio.*

Table 1-11 continued

Study	Study Design	Study Population	Exposure	Outcome measure	Results	Comments
Myhre *et al*, 2012 (184)	Prospective cohort	26,087 children 0-36 months Norway	Psychological distress at 18months, SCL-8	Hospital-attended injury between age 18 and 36 months, reported by parent	• Maternal psychological distress associated with increased odds of hospital-attended injury in adjusted multivariable model, (aOR 1.09 95%CI 1.03, 1.16)	• Low response rate (42.7%), potential response bias • Injury recall by parents
Orton *et al*, 2012 (69)	Nested case-control studies	180,064 children aged 0-4 born 1988-2004, from which cases and controls selected UK, THIN (primary care data)	Perinatal depression, primary care record for depression during pregnancy or 6 months after birth	Primary care record for thermal injuries, fractures and poisonings	• Perinatal depression associated with increased odds of thermal injuries (aOR 1.22, 95%CI 1.08-1.39) and poisonings (aOR 1.50, 95%CI 1.29-1.75) • Perinatal depression was not associated with the odds of fractures (aOR 1.06, 95%CI 0.93-1.20)	• Completeness of injury recording in primary care (e.g. may not capture all ED attendances or hospital admissions) • Bias in recording of injuries by GPs? • Underreporting of maternal depressive symptoms, will only capture those women who present to doctor
Tyrrell *et al*, 2012 (73)				Primary care records for poisonings – classified as medicinal or non-medicinal	• Perinatal depression only associated with medicinal poisonings in fully adjusted model (aOR 1.54, 95%CI 1.26-1.88). • Maternal depression not significant in fully adjusted model for non-medicinal poisonings so not included. Unadjusted OR 1.46, 95%CI 1.06-2.01.	
Shah *et al*, 2013 (70)				Primary care records for scalds	• Perinatal depression and scalds: unadjusted OR 1.34, 95%CI 1.06-1.70. Maternal depression not included in fully adjusted model as not significant.	
Baker *et al*, 2015 (74)				Primary care records for long-bone fractures	• No association between perinatal depression and long-bone fractures (unadjusted OR 1.12, 95%CI 0.95-1.32). Maternal depression not included in fully adjusted model.	
Yamaoka *et al*, 2015 (191)	Cross-sectional	9,707 children 3-4 months old Japan	Postnatal depression, EPDS	Parent report of an unintentional injury occurring between birth and 4 months	• Increased odds of some injury types among children whose mothers had postnatal depression; any injury (aOR 1.59, 95%CI 1.24-2.04); falls (aOR 1.43, 95%CI 1.03-1.97). • No significant association between postnatal depression and near drowning (aOR 1.55, 95%CI 0.79-3.04)	• Responder bias, parents chose to participate • Parent reported injuries-recall bias? • Cross-sectional survey, cannot assess temporal relationship

SL-8: *Symptoms Check List.* ***OR:*** *odds ratio.* ***THIN:*** *The Health Improvement Network.* ***EPDS:*** *Edinburgh postnatal depression scale.*

1.7.3 Potential explanations for an association between maternal mental illnesses and childhood injuries

Maternal mental illnesses have a wide range of effects on the mother, child and wider family. There are a number of potential explanations for a possible association between maternal mental illnesses and childhood injuries.

1.7.3.1.1 Maternal mental illness affecting supervision and parenting practices

Maternal mental illnesses have been shown to affect mother-child interactions, the formation of secure attachments and the quality of parenting(135). The nature of depressive symptoms (e.g. low mood, fatigue, poor concentration) may affect the mother's responsiveness to infant cues, ability to respond to environment, and lead to difficulties appreciating the child's perspectives and feelings(135, 200). A systematic review and meta-analysis by Lovejoy *et al* (2000) examined three aspects of parenting practices; negative (e.g. irritability, distress, anger), positive (e.g. energy, enthusiasm, interest) and the level of engagement(200). The review found that maternal depression affected all of these parenting practices to some degree, but the greatest impact was on negative parenting practices, meaning that maternal depression was more commonly associated with more irritable and hostile parenting practices(200). Mothers with depressive symptoms have also been found to use more coercive parenting techniques and harsher discipline(170, 172). For example, Chung *et al* found that women with persistent depressive symptoms were nearly two times more likely to use corporal punishment than women with no depressive symptoms (aOR 1.90, 95%CI 1.08-3.34)(170). Additionally depressive symptoms such as poor concentration and fatigue could affect maternal supervision. A study by Phelan *et al* found that mothers of children aged 0-3 years old who had elevated depressive symptoms reported more time supervising children, but a lower proportion of time in intense supervision(201).

1.7.3.1.2 Maternal depression affecting caregiver practices

Several studies have shown that maternal depression affects parenting behaviours, with maternal depression associated with an increased use of EDs, reduced use of preventative services (e.g. vaccinations), and earlier cessation of breast feeding(166, 199, 202, 203). A cohort study by McLearn *et al* found that mothers with depression were less likely to play with their child (aOR 0.72, 95%CI 0.58-0.89), talk to their child

(aOR 0.58, 95%CI 0.42-0.80), follow consistent routines (aOR 0.79, 95%CI 0.64-0.97), and limit television viewing (aOR 0.76, 95%CI 0.62-0.94)(172). As described in Section 1.7.1, maternal depression has been associated with reductions in home safety practices, which could increase child injury risk.

1.7.3.1.3 Maternal mental illness affecting child behaviour

Maternal depression has been associated with a number of internalising (e.g. emotional, social behaviours, depression) and externalizing (e.g. ADHD, oppositional defiant disorder, conduct disorder) child disorders(135), which could lead the child to have an elevated injury risk. For example, Phelan *et al* found that maternal depressive symptoms were associated with an increased odds of child externalising behaviours in males (aOR 1.08, 1.04-1.13)(182). Using a large cohort from England, Hanington *et al* found children exposed to maternal postnatal depression had a 74% higher odds of conduct disorders (aOR 1.74, 95%CI 1.33-2.52) and a 75% higher odds of emotional difficulties (aOR 1.75, 95%CI 1.36-2.52) at 42 months of age than children whose mothers had not had postnatal depression(204).

1.7.3.1.4 Impact on other family members

The mother's mental wellbeing influences not only the child, but the wider family dynamics within the home(200). Maternal depression has been associated with increased conflict between parents, marital breakdown and domestic violence(135); with the pathway between maternal depression and these relational difficulties potentially complex (e.g. marital conflict may lead to depressive symptoms, but for others the occurrence of maternal depression may increase marital conflict). A qualitative study of men whose partners had postnatal depression, reported men can feel overwhelmed, isolated and frustrated by their partner's depression(205). Additionally, there is some evidence to suggest that men whose partners are depressed, are more likely to have psychological difficulties themselves (e.g. anxiety, depression, alcohol misuse)(206, 207). While there is considerably less literature examining the impact of paternal depression on child outcomes, paternal depression has been shown to increase negative parenting behaviours(208), reduce positive parenting behaviours(208) and increase child behavioural problems(135, 209). A meta-analysis describing the associations between maternal and paternal depression and child outcomes, found that maternal depression had a greater impact on child behaviour

among young children, whereas the converse was true for fathers, with paternal depression exerting a greater effect as children became older(210). The level of support and/or child care provided by the father could influence the impact of maternal depression on child injury risk, and similarly could influence the mother's recognition and coping strategies to manage her symptoms.

1.7.3.1.5 Maternal psychological wellbeing and child maltreatment

Child maltreatment, including abuse and neglect, is an important issue to consider when examining the association between maternal mental illness and childhood injuries. Non-accidental injuries are more common among children aged 2 years or younger, with the perpetrator often a family member or parent(211). Recurrent injuries could be a sign of physical abuse, but could also indicate neglect, with injuries resulting from poor supervision and an inadequate home environment to meet the child's needs(212, 213). Child maltreatment is recognised to result from the interaction of a number of risk factors, many of which overlap with risk factors for unintentional injuries, including; child medical conditions, younger maternal age, low socioeconomic status, social isolation and lack of support, substance misuse, family composition (e.g. step parents), and parental stress and/or adverse life events(211, 213).

Parents who maltreat children have consistently been found to have a higher incidence of mental disorders(211, 212). Using linked health and child protection data from Australia, O'Donnell *et al* found the occurrence of child maltreatment allegations were significantly increased amongst mothers with substance misuse (aHR 2.08, 95%CI 1.63-2.65), schizophrenia and other psychoses (aHR 3.26, 95%CI 2.83-3.75) and depression and neurotic disorders (aHR 1.99, 95%CI 1.76-2.24), compared to mothers without these disorders(214). In the rare cases of infanticide, the prevalence of maternal severe mood disorders and psychoses are very high, with some studies finding all mothers to have a mental disorder(136). Maternal mental illnesses reduce mother-child bonding, attachment and understanding of the child's needs; features seen in cases of child maltreatment. Thoughts about harming their child have been shown to be more common among mothers who have depressive symptoms(215). For instance, Jennings *et al* (1999) found that 41% of mothers with major depression had unwanted thoughts of harming their child compared to 7% of non-depressed mothers(215).

1.8 Summary of existing literature and identified gaps in literature

1.8.1 Epidemiological data on injuries among children and young people

Injuries are an important preventable cause of morbidity, hospitalisation and health inequality among children and young people in England(77, 115, 216, 217). Understanding the burden of injuries is important for health service planning and the prioritisation of preventative interventions to those at greatest risk. Despite this, estimating injury burden in England remains a challenge due to fragmented data collection systems and no national surveillance system. Most existing injury studies have relied on single data sources(16, 62, 64), such as ED or hospitalisation data, and so underestimate injury burden as injuries seen in primary care or minor injury units are not captured. In recent years longitudinal primary care research databases have increasingly been used to study the epidemiology of injuries. As many injuries first present to secondary care, relying on primary care data alone could lead to under ascertainment of injury cases. The recent linkage of a primary care research database, the Clinical Practice Research Datalink, to hospitalisation and mortality data, offers a new potential to build a more complete picture of the epidemiology of injuries in England, and consider whether these linked data could offer a new and affordable method for injury surveillance in England. At the time of commencing this PhD, there were no studies that had used these three linked data sources to describe the epidemiology of injuries among children and young people. It is the ability to use these linked data sources that will be taken advantage of within this PhD.

1.8.2 Maternal mental illness as a risk factor for child injury

Maternal mental illnesses are a common exposure during childhood and have been associated with a number of negative child developmental, behavioural and emotional outcomes. Maternal mental illnesses affect parenting behaviours, mother-child interactions, child behaviour and parental safety practices. Therefore there are a number of plausible mechanisms through which maternal mental illnesses could affect child injury risk. While several studies have considered the impact of maternal mental illness on the risk of childhood injuries, most have focused on maternal depression and

study findings have been mixed. There are several key limitations / gaps in the existing evidence base:

The first relates to the ascertainment of injury events. Both injuries reported by the mother and those identified in health data can potentially introduce bias. Differences in study findings according to injury type could reflect true differences in risk, but may reflect differences in ascertainment. There is a need to include measures of injury severity within future studies to take account of differences in reporting, healthcare use and hospital admission thresholds between mothers with and without mental illnesses.

Secondly, most existing studies have identified mothers with depression using symptom screening tools. In many cases these tools ask about symptoms in limited time windows beforehand (e.g. in the past 7 days, in the past month), which may not accurately reflect the mother's ongoing symptoms over the months and years that studies subsequently measure the occurrence of injuries. There is a need for longitudinal data on both maternal depression and childhood injuries to consider how injury events relate to the onset and timing of depression episodes. In particular, observed associations between perinatal depression and childhood injuries could be explained by ongoing exposure to maternal depression during the child's early years, rather than specifically being related to the presence of perinatal depression.

Thirdly, an important reason for differences between study findings relates to which potential confounding variables have been adjusted for. In some studies, the association between maternal mental illness and child injury was explained by other factors. Consideration of which confounding variables should be adjusted for and other methods (e.g. self-controlled case series) to take account of confounding are important for future studies.

Finally, to date there have been few studies considering the impact of mental illnesses other than depression on child injury risk (e.g. anxiety, serious mental illnesses), most likely related to the large sample sizes required to study these rarer outcomes. Despite comorbid depression and anxiety being common, no studies have considered whether the two conditions together exert a greater effect than depression alone.

Chapter 2: Outline of thesis and aim and objectives

2.1 Outline of thesis

This thesis is divided into three parts. The first part focuses on defining injuries among children and young people, in order to both describe the epidemiology of injuries in England and to define injury outcomes for subsequent studies. Three linked data sources (primary care, hospitalisation and mortality data) have been used to identify incident injury events, with consideration given as to how injuries are recorded in these data sources. This work uses a study population of 0-24 year old children and young people, to correspond with the ages of children included in a national injury indicator from the Public Health Outcomes Framework(1).

The second part of this thesis focuses on defining maternal depression and/or anxiety episodes, occurring during pregnancy and the first five years of the child's life. As maternal depression and anxiety are commonly comorbid, episodes will be defined as depression, anxiety or both. For the purposes of this thesis, the term 'depression/anxiety' is used to refer to episodes of depression and/or anxiety. Preschool children (aged 0-4 years) are the focus of the second and third parts of this thesis, as this is the age when injuries most commonly occur within the home and the mother's mental health may have the greatest effect on injury risk.

The third section of this thesis focuses upon describing associations between maternal mental illnesses and injuries among preschool children, aiming to address two questions. Firstly, a study is carried out assessing whether perinatal depression is a risk factor for child injuries and whether associations seen in previous studies are explained by ongoing exposure to maternal depression after the perinatal period. Secondly, a study is carried out to assess associations between maternal depression/anxiety and child injuries, with maternal depression/anxiety episodes used as a time-varying exposure to take account of the changing nature of depression/anxiety symptoms over

time (e.g. relapses, remission). Two analytical methods are compared, a traditional cohort analysis and a self-controlled case series analysis, to consider the impact of using different analytical methods to take account of confounding.

2.2 Justification for choice of injury outcomes

For this thesis it was necessary to select some specific injury outcomes, as it was beyond the scope of this PhD to estimate overall injury incidence due to the complexities of using three linked data sources to define incident events. Three injury types were chosen (poisonings, fractures and burns), as these are three of the commonest injuries of childhood and adolescence(71, 218) and have been highlighted as priorities for prevention among children aged less than 5 years old in England(216). In addition, severe burns are an important cause of disability, can lead to multiple operative procedures and result in substantial healthcare costs(9, 10). Fractures were additionally selected as they are an injury type where ascertainment of injury events is more likely to be complete as most fractures will be seen by health services, and in addition there is a greater possibility of defining a group of serious fractures (e.g. according to anatomical site of fracture).

2.3 Aim and objectives

Part 1: To describe the epidemiology of injuries among children and young people aged 0-24 years old living in England through the use of linked health and mortality data sources.

- To estimate the incidence of three common childhood injuries (poisonings, fractures, burns) through developing methods to define incident injury events across linked primary care, hospitalisation and mortality data.

- To describe the recording of injury mechanism (how the injury occurred) and injury intent (e.g. intentional) within primary care, hospitalisation and mortality data from England.

- To describe the incidence of poisonings, fractures and burns among children and young people by age, sex, socioeconomic deprivation and calendar year.

- To describe patterns in the incidence of serious poisonings, fractures and burns by age, sex, socioeconomic deprivation and calendar year.

Part 2: To define exposure to maternal depression/anxiety during pregnancy, the postnatal period and the child's first five years of life.

- To define episodes of medically attended maternal depression/anxiety using linked primary care and hospitalisation data.

- To estimate the incidence of maternal depression/anxiety in the first five years of a child's life.

- To describe the incidence of maternal depression/anxiety when the child is aged 1-4 years old in relation to whether the mother had antenatal and/or postnatal depression.

Part 3: To investigate the association between maternal mental illnesses and childhood injuries.

- To assess the association between maternal perinatal depression and the incidence of child poisonings, fractures, burns and serious injuries in the child's first five years of life.

- To assess whether an association between maternal perinatal depression and childhood injuries is explained by ongoing/subsequent exposure to maternal depression when the child is aged 1-4 years old.

- To examine the relationship between the occurrence of maternal depression/anxiety episodes and the incidence of childhood injuries during the child's first five years of life.

- To compare the rates of childhood injuries between periods when the mother is recorded as having depression/anxiety and periods when the mother has no medical record of depression/anxiety using the self-controlled case series method.

Chapter 3: Description of data sources

The potential to link primary care data with other data sources provides new opportunities to study the epidemiology of injuries (Section 1.8.1), and understand related patterns of health service use. It is this potential to link data sources that will be taken advantage of within this PhD, with three linked data sources being used; the Clinical Practice Research Datalink, Hospital Episode Statistics and Office for National Statistics mortality data. This chapter describes each of these data sources and the rationale for using them for the studies described within this thesis.

3.1 The Clinical Practice Research Datalink

The CPRD is a longitudinal primary care research database, consisting of the anonymised primary care records of over 15 million patients registered across 678 participating UK general practices, representing approximately 7% of the UK population(219, 220). Within the UK general practitioners (GPs) have a central role in managing the health of individuals and families registered with their practice, maintaining a longitudinal health record over the course of patients' lives, including recording face-to-face primary care consultations, referrals to other health services, and communication from secondary and tertiary health services (e.g. EDs, inpatient admissions, outpatient appointments).

The CPRD, initially established in 1987, is jointly funded by National Health Service (NHS) National Institute for Health Research and the Medicines and Healthcare products Regulatory Agency (MHRA). It was renamed from the 'General Practice Research Database' to the CPRD in 2012, to reflect the development of a data linkage model, where data extracted from participating general practices can be linked to HES, ONS mortality, socioeconomic deprivation and registry (e.g. cancer) data(219, 221).

Participation in the CPRD is on a voluntary basis, with practices signing up to submit data and adhere to certain quality standards(222). General practices that agree to participate in the CPRD are required to use the Vision Clinical software programme, to allow the automatic collection of patient data from the practice. The extracted data are organised within the CPRD by general practice in a relational database consisting of 9 data files per

practice that are predominantly linked using a unique patient identifier (Table 3-1). Within the CPRD, participating general practices are recorded as being in one of 10 English geographical regions, Scotland, Wales or Northern Ireland.

Medical diagnoses, symptoms, examination findings, and administrative details are recorded using Read codes, an alpha-numeric hierarchical clinical coding system used in UK primary care since 1985(223). Information from secondary and tertiary care (e.g. ED attendances, hospitalisations, and specialist unit admissions) should also be recorded in the primary care record, with previous studies showing high levels (about 90%) of transcription of diagnostic information from hospital discharge records and outpatient clinic letters into the electronic primary care record(224, 225). Data held in the CPRD undergoes extensive quality control and validity checks prior to release. At a practice level, data are assessed across a number of key areas in order to determine an up to standard (UTS) date, from which the data are considered to be of research standard. At a patient level, a data quality flag is used to indicate whether a patient's record is of an acceptable standard for research.

Table 3-1: Structure of the Clinical Practice Research Datalink

CPRD File	Description of data contained in file
Practice file	Practice identifier. Region of UK. Date when practice data met the CPRD data quality standard. Date of last data collection from practice.
Patient file	Sex, year and month of birth, household unique identifier ('famnum'). Registration details (date of current registration, date left practice, death date). Patient data quality flag.
Clinical file	Medical diagnoses and symptoms coded using Read codes. Event date.
Referral file	Details of referrals, including specialty, referral date, referral urgency. Reason for referral coded using Read codes.
Test file	Event date, test as coded by Read codes. Values and results. Normal ranges for tests.
Therapy file	Prescriptions issued by the practice coded using Multilex prescription codes for drug substance/product. British National Formulary (BNF) code for medication. Numbers of days/packs prescribed.
Immunisation file	Details of immunisations, coded using CPRD Medical code. Event date, type of immunisation, method of administration, immunisation batch number.
Consultation file	Consultation identifier. Date and type of consultation. Duration of consultation. Staff identifier.
Staff file	Staff identifier. Staff role and gender.
Additional clinical details file	Data entered into the computerised medical record in a standard format, e.g. for the recording of smoking status, 6 week baby check, alcohol consumption, test results.

3.2 Hospital Episode Statistics

HES is an administrative data source from England that contains records of hospital admissions and outpatient appointments paid for by the NHS, with the primary purpose of enabling hospitals to receive payment for the activity they undertake. Each time a patient is admitted to hospital or requires hospital care (e.g. outpatient appointment) a standard set of data are collected. HES inpatient data are widely used at both national and local levels to support service planning, monitoring of trends in hospital activity, and evaluation of changes in service configuration or health policy. Inpatient and outpatient HES data have been linked to the CPRD, but for the studies described within this thesis, only inpatient hospitalisation data were available to the author at the time the studies were conducted. In recent years, national ED data has been published as part of HES. This however is still a developing dataset that is yet to achieve full geographical coverage of all EDs in England and continues to have some data quality issues (e.g. consistency of coding between ED departments)(42). This ED dataset is yet to be linked to the CPRD and so could not be used as part of the studies carried out within this thesis.

The HES inpatient dataset contains all emergency and elective hospital admissions, of any duration, to NHS hospitals in England, including admissions of private patients to NHS hospitals, and care paid for by the NHS but delivered by independent or private treatment centres(37). It includes inpatient admissions for rehabilitation, psychiatry and to other specialist units (e.g. burns units) if funded by the NHS. These inpatient admissions are organised into hospitalisations (also known as spells) and finished consultant episodes (defined as a period of care under a consultant or allied healthcare professional within an NHS Trust). This means that for one hospitalisation, there can be multiple episodes of care if the patient was managed by multiple consultants during that hospital stay. Clinical information concerning diagnoses, complications and comorbidities are recorded in HES using ICD-10 codes. Each episode of care can have up to 20 diagnoses and 24 procedures to allow thorough coding of complex admissions. Interventions and procedures are coded using the Office of Population Census and Surveys version 4 (OPCS-4) coding system. The structure and content of the HES files supplied by CPRD are outlined in Table 3-2. Predominantly, these data are organised into hospitalisations and episodes of care linked using unique hospitalisation (spell),

episode and patient identifiers, with additional detailed files for maternity and critical care.

Table 3-2: Structure of Hospital Episode Statistics data

HES File	Description of data contained in file	
Patient file	Unique CPRD patient and practice identifiers that allow linkage of HES to CPRD. HES identifier.	
Hospitalisations file	Patient identifier. Spell number. Admission and discharge dates. Admission and discharge methods. Duration of hospitalisation.	
Episodes file	Patient, episode and spell identifiers. Start and end dates of the episode of care. Episode duration. Episode type. Main specialty. Consultant code.	
Diagnoses files	*By episode*	Patient, episode and spell identifiers. ICD-10 code for diagnoses.
	By hospitalisation	Patient and spell identifiers. ICD-10 code for diagnoses.
	Primary diagnosis hospitalisation	Patient and spell identifiers. ICD-10 code for primary diagnosis for hospitalisation.
Procedure file	Patient, episode and spell identifiers. Event date. Procedure coded with OPCS-4. Procedure order variable.	
Augmented care and critical care files	Patient, episode and spell identifiers. Type of critical care admission. Admission/discharge dates from critical care. Days of cardiovascular, respiratory, gastrointestinal, renal, neurological support.	
Maternity file	Patient, episode and spell identifiers. Number of babies. Well baby check. Sex of child. Delivery method. Length of gestation. Antenatal and postnatal days of stay.	

3.3 Office for National Statistics Mortality data

The ONS mortality dataset contains details of both cause and date of death, taken from the individual's death certificate, for all deaths registered in England and Wales. When a death occurs, a doctor completes a death certificate recording an underlying cause of death (the condition leading directly to death), and any contributory causes of death (other diseases or conditions which may or may not have directly led to death). In most cases deaths are registered within 5 days. When a case is referred to the coroner (e.g. in sudden infant deaths, violent or unexplained deaths), registration and therefore inclusion in the ONS mortality dataset can be delayed for several months while a cause of death is established. This means a small number of deaths may be missing from the ONS mortality dataset at the end of the coverage period as a result of late registration. Causes of death are recorded using the International Classification of Diseases; with ICD-9 used in England until 2000 and full transfer to ICD-10 from 2001.

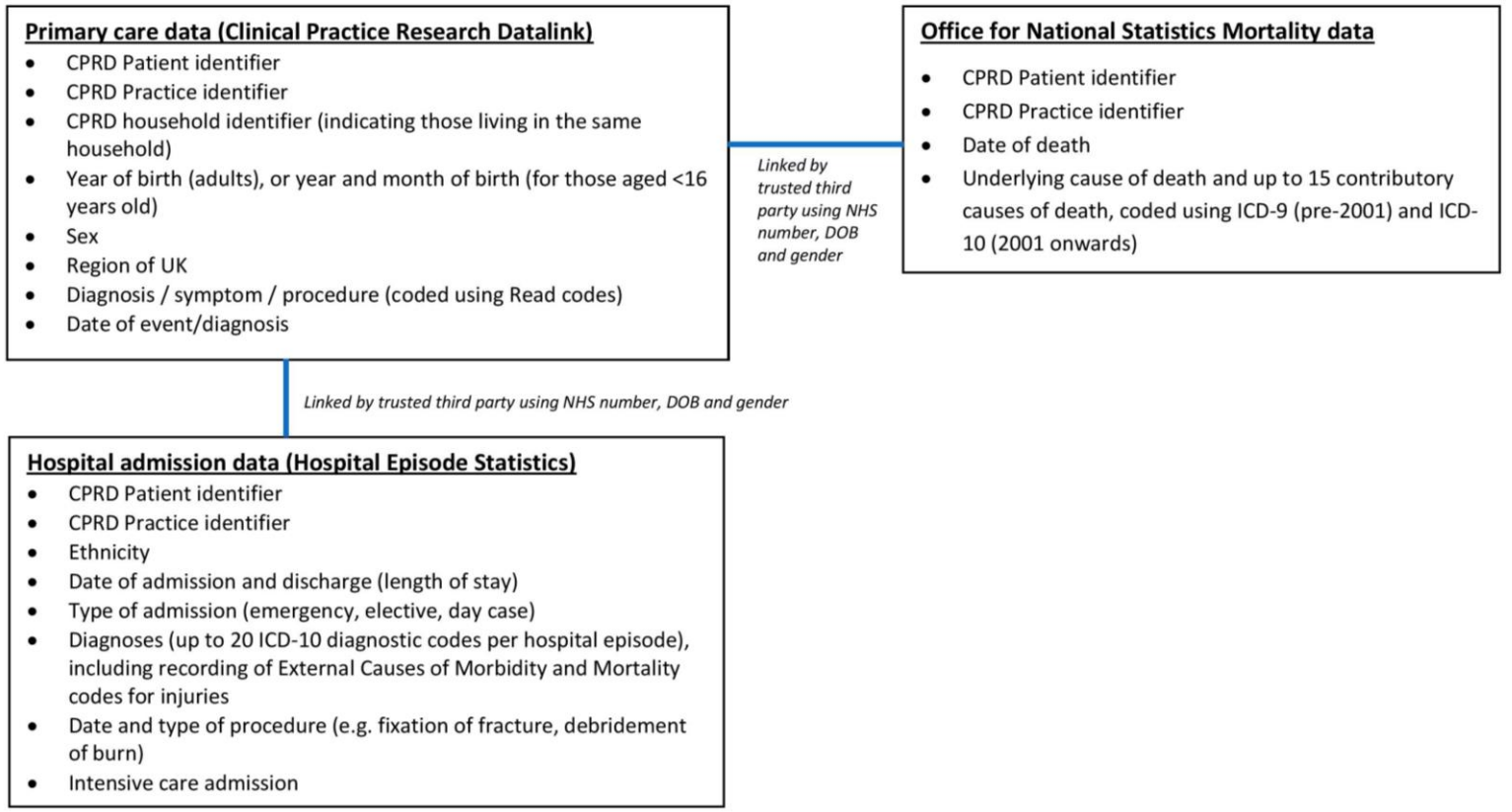
3.4 Linkage of data sources

HES and ONS mortality data are linked to the CPRD by a trusted third party (the Health and Social Care Information Centre) prior to data being anonymised, using the patient's NHS number, sex and date of birth. These linked data are available for a subset of English practices participating in the CPRD (398 of the 684 (58%) UK CPRD practices in March 2014) that have consented for patient-level data to be linked to other data sources. Additionally, for practices that have agreed to data linkage, the patient's postcode of residence is used to provide data on the Index of Multiple Deprivation, an area based measure of socioeconomic deprivation (described further in Section 4.2.4).

Linked data are supplied by the CPRD following study approval by the MHRA Independent Scientific Advisory Committee (Section 3.7), with the CPRD providing eligibility files to researchers to enable identification of patients eligible for linkage of their primary care record to these other data sources.

Figure 3-1 illustrates the linked datasets used within this thesis and the key information they contain.

Figure 3-1: Key information contained within the CPRD, HES and ONS mortality datasets



**CPRD, HES and ONS mortality data have been linked by a trusted third party using the patient's NHS number, sex and date of birth. Following linkage, patient and practice data are anonymised, with patients and practices given unique identifiers within the CPRD database.*

3.5 Justification for use of the CPRD and linked data

The CPRD has a number of key strengths which make it a valuable research tool.

The UK health system and representativeness of CPRD database

Within the UK, healthcare is available free at the point of access through the NHS, with about 98% of the resident population registered with a GP(226). While the CPRD is yet to have complete coverage of the UK population, both the CPRD, and the population with linked CPRD-HES data have been shown to be broadly representative of the resident population in terms of age and sex(220, 227), making study findings potentially generalisable to the UK population. Additionally, a strength of using UK health data is that the private medical sector is small (e.g. in 2011 public spending accounted for 82.8% of all health spending in the UK(228)); predominantly providing access to elective procedures and investigations(228) and often being used in conjunction with the NHS (i.e. to avoid NHS waiting lists for elective procedures). While some follow-up care for injuries could be provided by the private medical sector (e.g. physiotherapy), emergency care, such as ambulance services and EDs are almost exclusively delivered by the NHS(228), and so estimates of injury incidence are unlikely to be substantially underestimated as a result of injuries being seen within the private medical sector.

Availability, size and cost of the data

The electronic health data contained in the CPRD are readily available and inexpensive to use (compared to collecting new data), without the need to wait for data to accrue over time. In addition, the large population size allows the study of rare exposures and outcomes; useful for this PhD due to the low rates of some injury outcomes (e.g. serious injuries).

The CPRD contains data on a wide range of demographic, medical and lifestyle factors which allows the assessment of child (e.g. age, sex), maternal (e.g. alcohol misuse, maternal age) and household (e.g. numbers of children in the household, socioeconomic deprivation) risk factors for injuries. In particular, the ability to link the primary care records of mothers to their children allows the study of maternal risk factors for child injury, as utilised within this thesis.

The data held in the CPRD undergo a number of quality assessments to ensure data are of research standard. Several studies have demonstrated high specificity and positive predictive values for diagnoses made in the primary care record compared with a gold standard (e.g. hospital data, community survey data), including hip fractures, schizophrenia, anxiety and depression(224, 229-231). For example, John *et al* compared diagnoses of common mental disorders (depression and anxiety) with data from a community survey (using a 5 item Mental Health Inventory) demonstrating high specificity (96%) and positive predictive values (76%) of diagnoses of depression and/or anxiety recorded in the primary care record(232).

Longitudinal health record

Common methodological challenges in injury research include difficulties in identifying all injury cases (e.g. hospital-based studies will exclude minor injuries or those resulting in death without admission), defining denominator populations (e.g. difficult to define hospital catchment areas), and difficulties in distinguishing recurrent injury events from re-attendances for the same injury occurrence. The CPRD contains longitudinal health records for individual children, allowing identification of repeated injury events requiring medical attention and clear identification of follow-up time per child.

Prospectively recorded data

Data held within the CPRD are for the most part recorded prospectively which minimises recall biases. Existing studies assessing associations between maternal depression and child injuries have mostly relied upon maternal reporting of child injuries (e.g. in the last year) and depressive symptoms(182, 183)(Section 1.7.2); potentially introducing recall and social desirability biases which could affect study findings. Through the use of routine health data, recall and social desirability biases may be minimised.

The ability to link data sources

As injuries are seen in a range of health settings, existing injury studies tend to focus on one part of the injury pyramid, such as deaths(16, 52, 53) or hospitalisations(58, 75). Through using linked primary care, hospitalisation and mortality data, the ascertainment of injury occurrences should be improved, allowing more complete estimates of injury incidence.

3.6 Limitations of the CPRD and linked data

Data completeness

Data held within the CPRD are primarily collected for clinical and administrative purposes as part of routine clinical practice, meaning that not all information of use to researchers is accurately captured. Data can be missing for a number of reasons. Firstly, some data that would be of interest within this thesis are not routinely captured in primary care, and so cannot be explored. The main examples of this are measures of home hazards, home safety practices, social support, child behaviour and parental supervision; factors which could be potential confounders and/or mediators in a relationship between maternal mental illness and child injury risk. Secondly, data can be missing as a result of patients not presenting to their doctor. This is particularly the case for those with mild symptoms of mental illness and less severe injuries which can be managed at home. Thirdly, data on lifestyle measures such as smoking and alcohol intake are more commonly recorded amongst those with high healthcare use (e.g. women of childbearing age, those on chronic disease registers)(233). As a result, these data may be 'missing not at random'.

The Read code hierarchy includes many codes that range from broad (e.g. fracture not otherwise specified) to highly specific (e.g. fracture of first metacarpal bone). Only coded data can be routinely extracted from the CPRD and so the amount of information that can be gained depends on coding practices, and how much information is contained within free text (observations and notes typed into the medical record by the health professional) rather than being coded. For example, a GP may prescribe a medication, but enter into the free text the indication for the medication and any instructions given to the patient.

General practitioners receive information from secondary care, with this information needing to be manually entered in the primary care electronic record. As a result, the accuracy and completeness of data entered will depend on coding practices within each general practice. This is particularly an issue for injuries, as many events will be seen in EDs or lead to hospitalisation. Linked hospitalisation and mortality data will be used for the studies within this thesis, but unfortunately linked ED data are yet to be available, and so there may remain some under-ascertainment of injury events. It is possible that the validity and completeness of injury recording in the CPRD may vary by injury severity

(e.g. more specific diagnostic information communicated to GPs about injuries resulting in hospitalisation compared to those only seen in ED(234)) and injury type (e.g. better recording of injuries such as self-harm where there are concerns for the young person's safety).

Geographical representativeness

General practices both participate in the CPRD and agree for data linkage to HES and ONS mortality data on a voluntary basis. There is some underrepresentation of practices from the North East, East Midlands and Yorkshire and The Humber within CPRD-HES linked data(227); reflecting regional variation in the uptake of the Vision clinical software system required for participation in the CPRD. Additionally, in some regions numbers of practices with linked data are relatively small and so are unlikely to be representative of all practices in that region (e.g. by practice size, urban/rural location, socioeconomic deprivation)(220).

Duration of follow-up

The CPRD contains a subset of UK general practices and currently cannot continue follow-up of individuals when they change practice. The duration of follow-up data may vary between patient groups (e.g. by socioeconomic deprivation, by disease status), and will require consideration when designing and interpreting studies carried out using the CPRD.

3.7 Ethical approval

The studies contained within this thesis were approved by the MHRA Independent Scientific Advisory Committee in December 2013 (protocol 13-199R, studies of the epidemiology of injuries) and February 2014 (protocol 14_025, studies of the association between maternal mental illnesses and child injuries).

3.8 Data extraction and management

All data extraction, management and analyses were carried out by the author using Stata 13 MP4 (StataCorp. 2013. *Stata Statistical Software: Release 13*. College Station, TX: StataCorp LP).

Part 1: The epidemiology of injuries among children and young people aged 0-24 living in England using linked health and mortality data sources

Chapter 4: Identification and epidemiology of incident injury events using linked health and mortality data

This chapter describes a method developed to identify incident poisoning, fracture and burn events in linked primary care, hospitalisation and mortality data, and goes on to describe the epidemiology of these three injury types by child characteristics, socioeconomic deprivation and over time. In addition, the recording of injury mechanism and intent within these linked data, and definitions of serious injuries are considered.

4.1 Objectives

- To estimate the incidence of three common childhood injuries (poisonings, fractures, burns) through developing methods to define incident injury events across linked primary care, hospitalisation and mortality data.
- To describe the recording of injury mechanism (how the injury occurred) and injury intent (e.g. intentional) within primary care, hospitalisation and mortality data from England.
- To describe the incidence of poisonings, fractures and burns among children and young people by age, sex, socioeconomic deprivation and calendar year.
- To describe patterns in the incidence of serious poisonings, fractures and burns by age, sex, socioeconomic deprivation and calendar year.

4.2 Methods

4.2.1 The study population

The study population consisted of an open cohort of children and young people aged 0-24 years old who were registered with general practices actively submitting data to the CPRD, who also had linked HES and ONS mortality data, and were at risk of an injury

between the 1st of January 2001 and the 31st of December 2011. These dates were selected as they corresponded to the time period for which linked HES and ONS mortality data were available when the cohort was extracted (December 2013), and the period from which ONS mortality data were coded using ICD-10. Children and young people were defined as those aged 0-24 years old in order to correspond with the definition used within the Department of Health's Public Health Outcomes Framework injury indicators(56) and so provide data of relevance to local public health teams. As HES data are only available for England, patients registered at general practices in Scotland, Wales and Northern Ireland were excluded.

4.2.2 Estimating the date of birth of study participants

As part of ensuring CPRD data are anonymised, patients' exact dates of birth are not extracted from general practices; with the month and year of birth supplied for those aged less than 16 years old, and only the year of birth provided for those aged 16 or more. For the purposes of this study a date of birth was approximated for each study participant. For children aged less than 16 years old, the day of birth was approximated to the 15th of the month. If the patient was registered at the general practice in the same month but before the 15th, the date of birth was back-dated to the general practice registration date. For those aged 16 and over, the date of birth was approximated as the 1st of July in the year of birth. This was back-dated to their registration date if they were registered prior to the 1st of July but within the same year. Whilst this will still include inaccuracies in the dates of birth, it ensures that for those children who do have early life injuries recorded that these are captured in the study.

4.2.3 Defining patient follow-up time

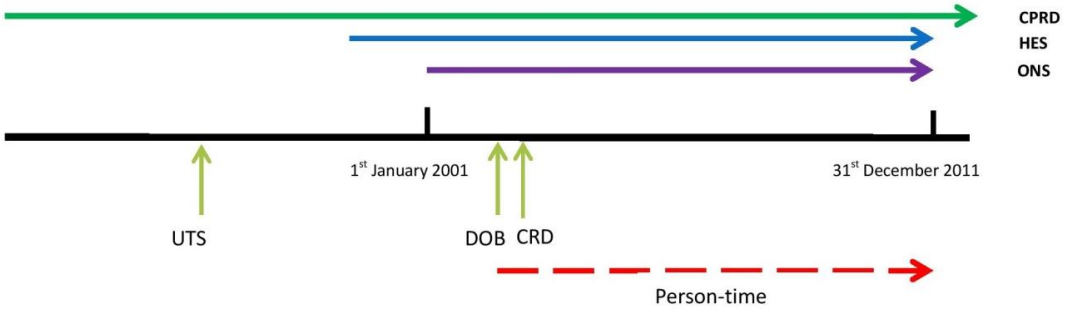
For each subject, the entry date to the study was the most recent date of: their date of birth, the general practice registration date, the date the practice met CPRD data quality standards (up-to standard variable), or the start of the study period (1st January 2001). Patients left the cohort at the earliest date of: the 31st December 2011, when the child/young person died, reached the age of 25, changed general practice or when the practice stopped participating in the CPRD. This was thus an open cohort where subjects could enter and exit the cohort at different time points or ages within this study period. Several scenarios are shown in Figure 4-1 to illustrate how person-time has been defined using these dates.

Figure 4-1: Defining person-time, some scenarios

CPRD: Clinical Practice Research Datalink
HES: Hospital Episode Statistics, linked data available from 1st April 1997
ONS: Office for National Statistics mortality data, linked data coded using ICD-10 available from 1st January 2001
UTS: Up to standard date (date practice reaches CPRD research standard)
DOB: Date of birth
CRD: Current registration date at general practice
TOD: Transfer out date (e.g. date patient changed general practice)

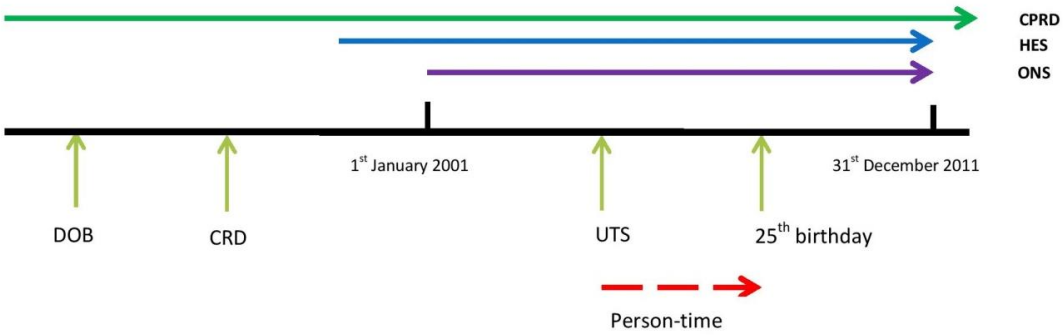
Scenario 1

Child born after 1st January 2001, and registered shortly afterwards with a general practice. Remained at practice until the end of the study period (31st December 2011). Start of follow-up= CRD. End of follow-up=end of study period.



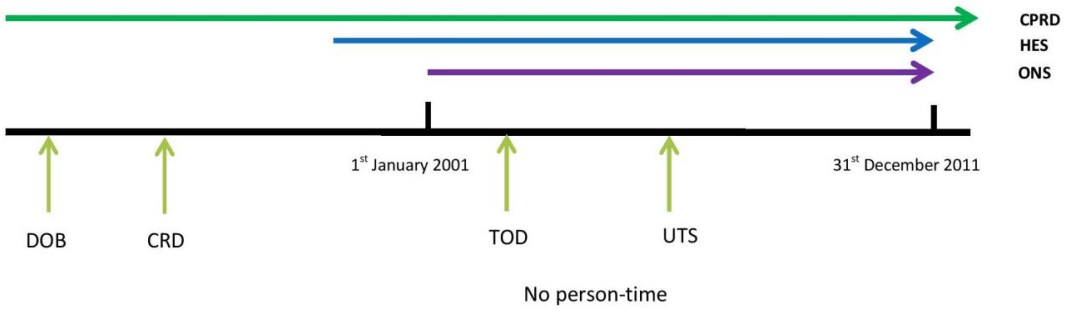
Scenario 2

Child born before the start of HES and ONS data coverage. General practice did not reach research standard (UTS) until part way through study time period. Start of follow-up=UTS. End of follow-up =25th birthday.



Scenario 3

Patient transferred out of the general practice (TOD) prior to the practice reaching research standard (UTS). The patient contributes no person-years of follow up time and is therefore excluded from the study.



4.2.4 Defining patient covariates

4.2.4.1 Socioeconomic deprivation

Socioeconomic deprivation was measured using quintiles of the Index of Multiple Deprivation (IMD) 2010, an area based measure of deprivation based on the lower super output area of residence (homogenous areas in England where approximately 1,500 people live)(235). These quintiles provide an indication of the relative level of deprivation of individuals within the study population compared to the rest of the population of England. The IMD is a composite score based upon 38 indicators covering income, employment, health, education, crime, access to services and the living environment(235).

4.2.4.2 Ethnicity

Prior to 2006, ethnicity data were not routinely recorded within UK general practice, with less than 30% of patients having their ethnicity recorded(236). Since 2006 the recording of ethnicity data has been incentivised as part of the Quality and Outcomes Framework (QOF), a pay for performance scheme operating in primary care, which has led to a notable increase in the recording of ethnicity data after 2008(236). To maximise the identification of a patient's ethnic group, data from both the CPRD and HES were used, assigning an ethnic group using the following principles:

- Where patients only had their ethnicity recorded once, in either CPRD or HES, this ethnic category was used.
- An ethnic group was assigned if the patient had two or more matching ethnicity records recorded in either CPRD or across CPRD and HES.
- The most recently recorded ethnic group was assigned if the patient had multiple non-matching CPRD records and no record of ethnicity in HES. As ethnicity recording has improved over time with additional Read codes added to correspond to the 2001 Census, the most recently recorded ethnicity was taken as the most appropriate to use.
- For the small proportion of patients with mismatching HES and CPRD records (1.6% of study cohort), the CPRD ethnicity record was used.

Study participants were assigned one of five ethnic groups, based on the 2001 Census classification (White; Mixed; Asian or Asian British; Black or Black British; Chinese or Other).

4.2.4.2.1 Region

Geographical regions were based on Strategic Health Authority areas, organisations that coordinated NHS care at a regional level until April 2013. Data supplied by the CPRD are still classified by these 10 English regions (e.g. East Midlands, North West).

4.3 Defining incident injury events

4.3.1 Definitions of injury outcomes

Three injury outcomes were selected, poisonings, fractures and burns, as they are three of the commonest injuries of childhood and adolescence(71, 218), and have been highlighted as priorities for prevention among children aged less than 5 years old in England(216). The definitions of these injuries were based on ICD-10 codes, as shown in Table 4-1.

Table 4-1: Definitions of fractures, poisonings and burns

	ICD-10 codes	Description	Exclusions
Fractures	S02, S12, S22, S32, S42, S52, S62, S72, S82, S92, T02, T08, T10, T12, T14.2	All fractures occurring at any anatomical site, including greenstick fractures.	Pathological fractures (e.g. due to malignancy, bone disorders), birth fractures
Burns, scalds and corrosions	T20-T32, X10-X19, X00-X09	Superficial and full thickness burns. Scalds. Corrosions. Abrasion burns. Thermal injuries (contact with heat, hot substances, fires)	
Poisoning	T36-T50, T51-T65, X40-X49, X60-69, X85-90, Y10-Y19	Medicinal and non-medicinal poisoning events, including poisonings with alcohol, chemicals, gases.	Food poisoning, iatrogenic poisonings

All injury records were extracted from CPRD, HES and ONS mortality data for poisonings, fractures and burns. A comprehensive Read code list that had been mapped to ICD-10 (to enable comparability with HES and ONS mortality data) was used to extract injury records from the CPRD (Read code list shown in Appendix 3). This list of injury Read codes was developed using Stata version 13.0, based upon the principles outlined by

Davé and Peterson(237) using a combination of search terms of the Read code description and the Read code hierarchy, to identify appropriate codes for inclusion.

Injury diagnoses were extracted from HES inpatient data using an ICD-10 code list for each injury type. In addition, an OPCS-4 code list, referring to any procedures that indicated a poisoning, fracture or burn (e.g. primary open reduction of fracture, debridement of burnt skin) was used to extract injury treatment procedures from HES. Relevant OPCS-4 codes were identified using the OPCS-4 hierarchy of codes and free word searches of the code descriptors. Several non-specific procedure codes were identified for skin grafts and bone fixations that could be used following an injury, but also could be used for other diagnoses. These codes were included in the Read and OPCS-4 code lists, but were later removed as part of a sensitivity analysis (Section 4.5.2.3).

To identify children and young people who died from an injury, a list of patient identifiers for the study population and an injury ICD-10 code list were sent to the CPRD, who then supplied death records for those children recorded to have died from an injury (either underlying or a contributory cause of death). As the primary cause of injury death is recorded in England using External Cause codes (ICD-10 V01-Y98), all causes of death recorded per child were examined in order to identify fracture, poisoning or burn events. For example, the primary cause of death could be a transport accident, but if a child was recorded as having sustained multiple fractures, they would be classified as a fracture case in this study.

4.3.2 Identifying incident injuries within linked CPRD, HES and ONS mortality data

To identify incident poisoning, fracture and burn events for each child or young person, it was necessary to distinguish between records for follow-up care and those indicating new events. Two main steps were taken to do this; firstly excluding codes for ineligible and non-incident events (Figure 4-2), and secondly using a time-based algorithm to exclude repeat codes for the same injury event. The aim was to count incident injury events as opposed to individually injured sites, such that if a child sustained multiple injuries of the same type (e.g. multiple fractures at different sites), this was only counted once.

4.3.2.1 Exclusion of codes referring to non-incident injuries

Codes referring to complications of injury and past injury events were excluded:

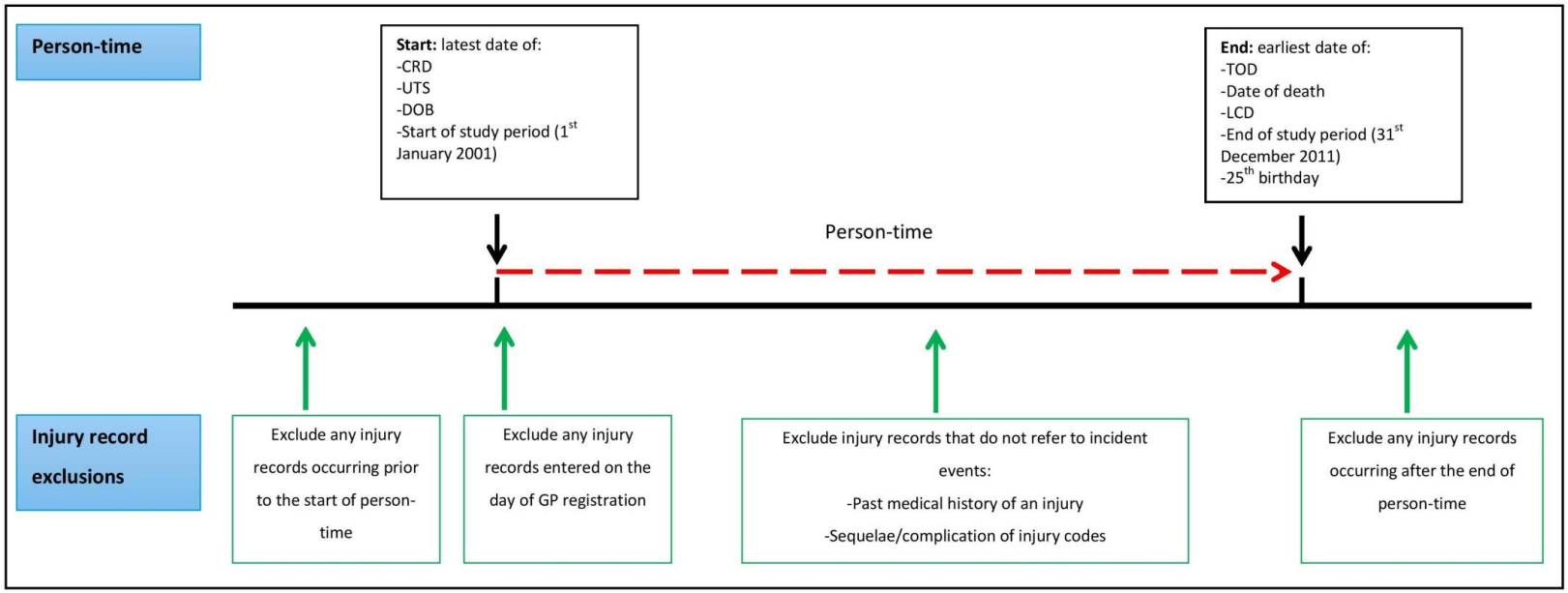
- ***Past injury/sequelae codes.*** Codes referring to a past medical history or sequelae of an injury (e.g. malunion of a fracture) were excluded as they were unlikely to refer to a new injury event.

- ***Secondary procedure codes.*** Read and OPCS-4 procedure codes referring to removal of fixation devices (e.g. 'Removal of fixation from fracture of orbit') and secondary operations (e.g. 'Secondary open reduction of intraarticular fracture of bone') were excluded.

- ***History of injury codes.*** There are a number of Read codes that refer to '*history of injury'*, (e.g. 14G9.00 H/O: fracture). While these codes may refer to past events, it is difficult to determine how they are used in clinical practice (e.g. the code could be used to refer to a burn that happened 1 week ago). The frequency of these codes following general practice registration was examined (Appendix 4). The overall frequency of these codes was low and only a small spike in these codes was observed following registration. Therefore, 'history of injury' codes were only excluded if recorded within two weeks of general practice registration. A sensitivity analysis was carried out, excluding these, and other non-specific injury codes (Section 4.5.2.3).

- ***Injury codes recorded after general practice registration.*** Injury Read codes recorded upon practice registration or shortly after registration may refer to the patient's past medical history. Following examination of the distribution of injury Read codes entered in the medical record after practice registration (Appendix 5), only injury codes entered in the medical record on the same day as registration were excluded. This was because a spike in injury codes appeared only on the day of registration, and with acute events such as injuries, the event itself may lead to general practice registration.

Figure 4-2: Excluding ineligible and non-incident injury records



Key:

CRD: Current registration date

UTS: Up-to-standard date

DOB: Date of birth

TOD: Transfer out date

LCD: Last collection date

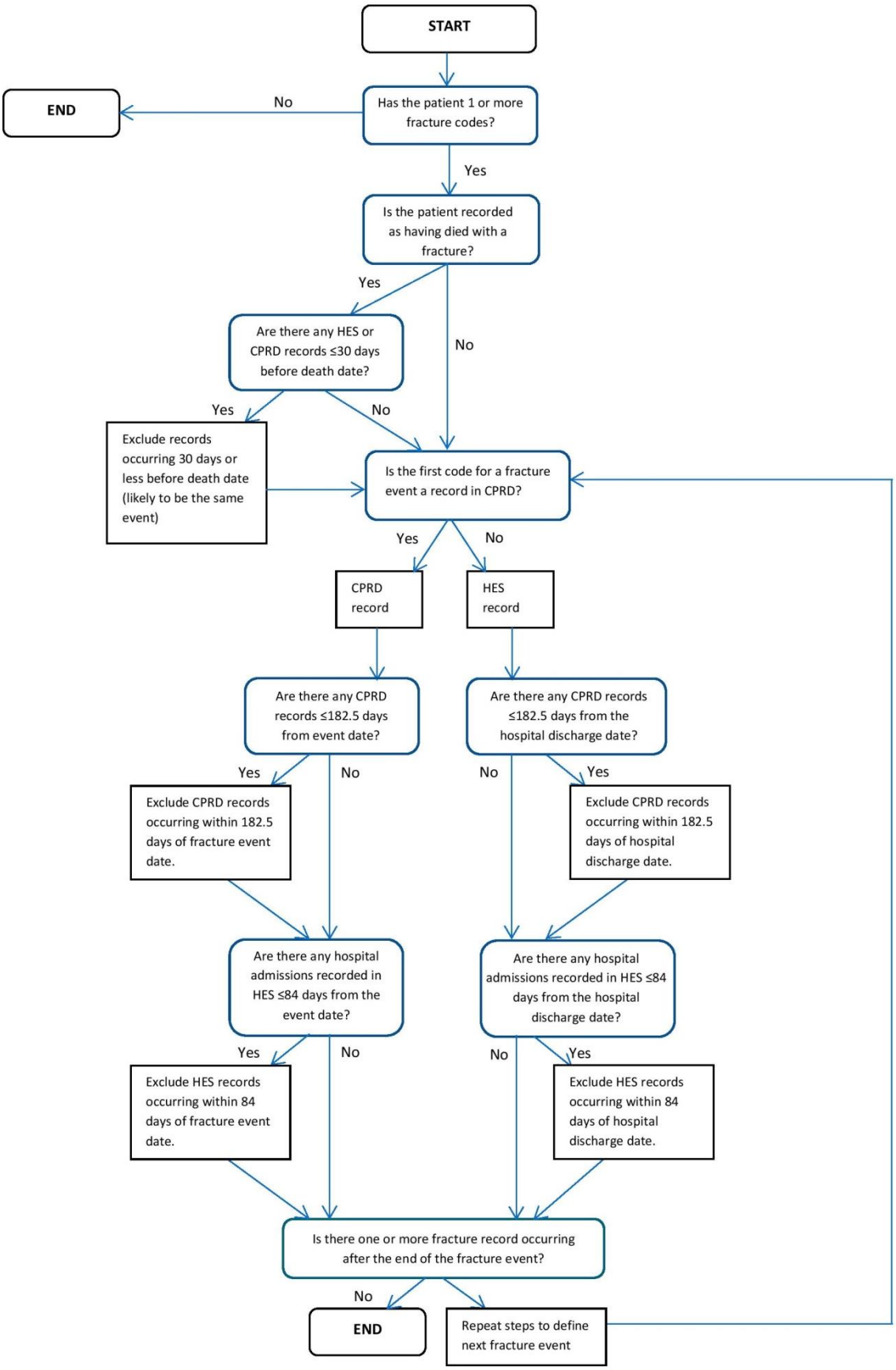
4.3.2.2 A time-based algorithm to identify incident events

Secondly, an algorithm consisting of a series of time-windows was used to distinguish between repeat codes for the same event and those for a new event (Table 4-2). Subsequent hospitalisations and primary care codes occurring within the relevant time-window after the first code were considered part of the same injury event. A longer time-window was used for injury events where the first record was a hospitalisation, as injuries requiring admission may be more severe and require longer follow-up. A third time-window determined whether hospitalisations occurring after the event start date referred to the same (e.g. readmission) or a new event. For burns, an additional time-window of 2 years was used to account for the small number of children who sustain severe burns requiring multiple grafts. This algorithm is illustrated in Figure 4-3 for fractures. The algorithm thus accounted for simple injury management such as one visit to a GP and complex management involving GP and hospital follow-up. For example, for a child initially admitted to hospital with a burn, any CPRD records occurring within 8 weeks of this admission were considered the same event. A CPRD record occurring after 8 weeks of this event date was considered a new event.

Table 4-2: Description of time-windows used to identify incident poisoning, fracture and burn events

Description of time-window	Rationale for time-window	PRIMARY ANALYSIS			SENSITIVITY ANALYSIS		
		Poisonings (weeks)	Fractures (weeks)	Burns (weeks)	Poisonings (weeks)	Fractures (weeks)	Burns (weeks)
Time-window 1: From first to subsequent code in CPRD. Time from the start date of injury event, i.e. when the first code for the injury event was recorded in primary care (CPRD). Codes recorded in primary care within this time-window were considered the same injury event.	Time-window used to exclude codes likely to be follow-up care recorded in primary care.	3	26	3	6	52	6
Time-window 2: From first code in HES to subsequent code in CPRD. Time from the hospital discharge date. Used in cases where the first code of the injury event was a hospital admission recorded in HES. Codes recorded in primary care within this time-window were considered the same injury event.	An injury leading to hospital admission may be more severe, and require longer follow-up after discharge. Time from discharge used to account for injuries requiring prolonged hospital admission.	4	26	8	8	52	16
Time-window 3: From first CPRD or HES record to subsequent code in HES. • Time from the start date of injury event if first code recorded in CPRD OR • Time from the hospital discharge date if first code recorded in HES. After this time-window, a hospital admission would be considered a new injury event.	Time-window used to distinguish whether a subsequent hospital admission could indicate the same (e.g. hospital transfer, readmission) or a new injury event.	1	12	6	2	24	12
Time-window 4 (burns only): From first CPRD or HES record to procedural codes for skin grafts. Time from the start date of injury event (whether recorded in CPRD or HES) to codes for skin grafts recorded in CPRD or HES.	Time-window used for burns to account for a small number of children with prolonged follow-up and multiple graft procedures following a severe burn.	-	-	104	-	-	208

Figure 4-3: Algorithm to define incident injury events, example for fractures



4.3.2.3 Defining time-windows to identify incident injury events

Time-windows for each injury type were defined by plotting the rates of relevant injury codes entered in the CPRD or HES after the first injury code (Appendix 6). The point at which the rate plateaued was used to define the end of the time-window during which all injury-related codes related to the first code. Clinical plausibility was also taken into account; for example, relatively short time-windows were chosen for poisonings, as repeat self-poisonings commonly occur within two to three months of the initial event(238), and poisoning hospitalisations are most likely to be incident events(239).

4.3.3 Defining injury mechanism and intent

Understanding how an injury occurred (the mechanism e.g. fall) and whether an injury was intentional or unintentional (the intent) is important when identifying and implementing prevention strategies(240). For each hospitalisation and death, ICD-10 codes V01-Y36, Y90-Y98 were extracted to assess the proportion of events with a documented mechanism and intent, classifying intent as unintentional, intentional (i.e. self-harm, assault), or undetermined.

For events recorded in the CPRD, relevant Read codes were extracted (mapped to ICD-10 codes V01-Y36, Y90-Y98) for those who had sustained a poisoning, fracture or burn. The proportion of injury events where a code referring to a mechanism or intent had been recorded on the same day as a code for that injury type was assessed for those injuries captured by the CPRD.

To assess the recording of injury mechanism and intent in linked CPRD-HES-ONS mortality data, Read and ICD-10 codes from the three data sources were used together to identify a mechanism and/or intent. If a mechanism and/or intent was recorded in more than one data source, the data source considered the most accurate was prioritised; with ONS mortality data considered first, HES data considered second, and data from the CPRD record considered the least accurate.

4.3.4 Defining injury severity

An important consideration within injury epidemiology is the potential for ascertainment bias, resulting from differences in healthcare use, the recording of

injuries in the medical record, and differing hospital admission thresholds. Defining injury severity within linked CPRD and HES data is challenging, as there are insufficient data coded to accurately assess injury severity for all the injuries captured in these databases. Two different definitions of injury severity were therefore considered:

4.3.4.1 Hospitalisation for 72 hours or more

Firstly, serious poisoning, fracture and burn events were defined as those requiring hospital admission for 72 hours or more, a definition previously used in a study of traumatic injury(38). Length of hospital admission has previously been shown to be a reasonable proxy for injury severity(241), although has the potential to be affected by changes in treatments and service pathways over the study period.

4.3.4.2 Serious injuries, based upon ICD-10 codes

Secondly, serious poisonings, fractures and burns were defined using ICD-10 codes that refer to serious injuries with a high probability of leading to hospitalisation. This definition was based upon work by the Injury Observatory for Britain and Ireland(242), and Cryer *et al,* who applied the International Classification of Diseases based injury severity score to hospitalisation data to identify a group of ICD-10 codes referring to serious non-fatal injuries that have a high likelihood of admission(243). The ICD-10 codes used to define serious poisonings, fractures and burns are shown in Table 4-3. A limitation of this definition of serious injury is that there are very few ICD-10 codes that refer to serious poisonings.

Table 4-3: ICD-10 codes defining serious poisonings, fractures and burns

POISONINGS	
T462	Poisoning: Other antidysrhythmic drugs, not elsewhere classified
T467	Poisoning: Peripheral vasodilators
T493	Poisoning: Emollients, demulcents and protectants
T504	Poisoning: Drugs affecting uric acid metabolism
T603	Toxic effect: Herbicides and fungicides
BURNS	
T203	Burn of third degree of head and neck
T210	Burn of unspecified degree of trunk
T211	Burn of first degree of trunk
T212	Burn of second degree of trunk
T213	Burn of third degree of trunk
T223	Burn of third degree of shoulder and upper limb, except wrist and hand
T264	Burn of eye and adnexa, part unspecified
T270	Burn of larynx and trachea
T271	Burn involving larynx and trachea with lung
T280	Burn of mouth and pharynx
T281	Burn of oesophagus
T290	Burns of multiple regions, unspecified degree
T293	Burns of multiple regions, at least one burn of third degree mentioned
T311	Burns involving 10-19% of body surface
T312	Burns involving 20-29% of body surface
T313	Burns involving 30-39% of body surface
T314	Burns involving 40-49% of body surface
T315	Burns involving 50-59% of body surface
T316	Burns involving 60-69% of body surface
T317	Burns involving 70-79% of body surface
T318	Burns involving 80-89% of body surface
T319	Burns involving 90% or more of body surface
FRACTURES	
S02	Fracture of skull and facial bones
S020	Fracture of vault of skull
S021	Fracture of base of skull
S023	Fracture of orbital floor
S024	Fracture of malar and maxillary bones
S026	Fracture of mandible
S027	Multiple fractures involving skull and facial bones
S028	Fractures of other skull and facial bones
S029	Fracture of skull and facial bones, part unspecified
S12	Fracture of neck
S120	Fracture of first cervical vertebra
S121	Fracture of second cervical vertebra
S122	Fracture of other specified cervical vertebra
S127	Multiple fractures of cervical spine
S128	Fracture of other parts of neck
S129	Fracture of neck, part unspecified
S220	Fracture of thoracic vertebra
S221	Multiple fractures of thoracic spine
S222	Fracture of sternum
S224	Multiple fractures of ribs
S225	Flail chest
S32	Fracture of lumbar spine and pelvis
S320	Fracture of lumbar vertebra
S321	Fracture of sacrum
S323	Fracture of ilium
S324	Fracture of acetabulum
S325	Fracture of pubis
S327	Multiple fractures of lumbar spine and pelvis
S328	Fracture of other and unspecified parts of lumbar spine and pelvis
S427	Multiple fractures of clavicle, scapula and humerus
S429	Fracture of shoulder girdle, part unspecified
S72	Fracture of femur
S720	Fracture of neck of femur
S721	Pertrochanteric fracture
S722	Subtrochanteric fracture
S723	Fracture of shaft of femur
S724	Fracture of lower end of femur
S727	Multiple fractures of femur
S728	Fractures of other parts of femur
S729	Fracture of femur, part unspecified
T02	Fractures involving multiple body regions
T020	Fractures involving head with neck
T021	Fractures involving thorax with lower back and pelvis
T022	Fractures involving multiple regions of one upper limb
T023	Fractures involving multiple regions of one lower limb
T024	Fractures involving multiple regions of both upper limbs
T025	Fractures involving multiple regions of both lower limbs
T026	Fractures involving multiple regions of upper limb(s) with lower limb(s)
T027	Fractures involving thorax with lower back and pelvis with limb(s)
T028	Fractures involving other combinations of body regions
T029	Multiple fractures, unspecified
T10	Fracture of upper limb, level unspecified

Based on the work by Cryer et al(243) and the Injury Observatory for Britain and Ireland(242)

4.4 Statistical methods

4.4.1 Identification of incident injury events using linked primary care, hospitalisation and mortality data

For each data source separately and in linked CPRD-HES-ONS data the number of incident injury events were counted, as indicated by the first primary care, hospitalisation or death record within the relevant time-window(s) (Table 4-2). The proportion of events recorded in both CPRD and HES, and those captured by all three data sources was assessed by identifying those events with records from more than one data source within the relevant time-window.

Incidence rates of poisoning, fracture and burn events overall and by age were estimated per 10,000 person-years (PY), with 95% confidence intervals (95%CI), using each of CPRD, HES, and ONS mortality data separately, and then using the three data sources together (CPRD-HES-ONS). Two sensitivity analyses were undertaken. The first assessed the impact of doubling the time-windows used to define incident injury events (e.g. a time-window of 3 weeks was extended to 6 weeks in the sensitivity analysis) (Table 4-2). The second assessed the impact of excluding groups of less specific diagnostic and procedural codes (e.g. non-specific procedural codes, less specific codes, history of injury codes) (Read code list shown Appendix 3).

4.4.2 Assessing the recording of injury mechanism and intent

The proportion of injury events with a mechanism and/or intent recorded was assessed in each of the three data sources and when the three data sources were used together (CPRD-HES-ONS). For injuries recorded in HES and ONS mortality data the external cause of injury was identified (e.g. fall, road traffic incident), with the proportion of events due to each cause examined by child age. Detailed injury mechanism/intent data are not reported for injury events only recorded in primary care due to incomplete recording, as described in Section 4.5.3.1.

4.4.3 The epidemiology of poisonings, fractures and burns using linked health and mortality data

Using the three linked data sources (CPRD-HES-ONS mortality data), incidence rates of poisonings, fractures and burns were estimated by age, sex, socioeconomic deprivation and calendar year. Incidence rates according to ethnicity are not described due to the large amount of missing data for the study population (Section 4.5.1.2).

To describe injury incidence rates according to child age and calendar time, Lexis expansion was used to divide up each subject's follow-up time into one year age bands and into one year periods. Lexis expansions enables age and calendar time to be used as time-varying covariates enabling each subject to contribute data to more than one age band and time period(244).

Adjusted incidence rate ratios (aIRRs) were estimated using negative binomial regression mutually adjusting for child age, sex, socioeconomic deprivation, region and calendar year. Where individuals had missing socioeconomic deprivation data, a missing data category was included in regression models. Geographical region was included in the adjusted model to take account of potential differences in injury recording, services and injury patterns by region. A socioeconomic gradient in injury rates was assessed using a likelihood ratio test (LRT) for trend, with $p<0.05$ considered statistically significant.

The negative binomial regression model was preferred over the Poisson regression model due to evidence of over dispersion of the data, as assessed using methods outlined by Long and Freese(245). The Poisson distribution assumes that the mean and variance of the count are equal, whereas the negative binomial model includes an additional parameter α which reflects unobserved heterogeneity between observations(245). For each injury type, both the Poisson goodness of fit test ($p<0.0001$ for each injury type) and a LRT of α (comparing the fit of the negative binomial model to the Poisson model) were statistically significant indicating over dispersion of the data ($p<0.0001$ for each injury type).

A number of interactions were assessed based on existing literature(64, 71, 77) and theoretical plausibility. To assess whether socioeconomic gradients varied by child age

and over time, interaction terms between socioeconomic deprivation and child age, and socioeconomic deprivation and calendar year, were added to the models and tested using a LRT, with $p<0.01$ considered statistically significant. In addition interactions between age and sex, and age and calendar year, were assessed using LRTs. A *p* value of <0.01 was selected due to the large study size, and to reduce the chance of a type 1 error (falsely rejecting the null hypothesis) as a result of the large number of statistical tests being conducted and the large study population.

4.4.4 Incidence rates of serious injuries and injuries leading to hospitalisation

Injury incidence rates per 10,000 person-years (PY), with 95% confidence intervals (95% CI), were estimated for poisonings, fractures and burns requiring hospitalisation and for both definitions of serious injuries (hospitalisation for ≥72 hours, and serious injury defined by ICD-10 codes), according to child age, sex, socioeconomic deprivation and calendar year. Adjusted incidence rate ratios were estimated using negative binomial regression, mutually adjusting for child age, sex, socioeconomic deprivation, region and calendar year. To examine trends over time, age was divided into two age bands (0-14 year olds, and 15-24 year olds) with Lexis expansion used to divide the study follow-up time into 1 year periods(244).

4.5 Results

4.5.1 The study population

4.5.1.1 Defining the study population

Figure 4-4 shows how the study population was extracted from the CPRD and defined. Of the 678 general practices contributing to the CPRD, 360 (53%) had patients eligible for linkage to both HES and ONS mortality data. Following exclusion of patients with no eligible person-time (*n*=727,859), those with an invalid DOB (*n*=29) or invalid gender (*n*=17), and those whose CPRD records did not meet the CPRD research quality standards (*n*=36,673), a total of 1,928,681 children and young people registered at 356 general practices remained.

4.5.1.2 Description of the study population

Of the 1,928,681 children and young people, 945,023 (49.0%) were male and 983,658 (51.0%) were female (Table 4-4). Children most commonly entered the study cohort when they were aged 0-4 years old (n=668,626, 34.7%) or 20-24 years old (n=436,550, 22.6%). A high proportion (33.1%) of the study cohort had missing ethnicity data. Of those with a recorded ethnicity, the most common ethnic groups were White (57.1%) and Asian (3.8%). The regions of England contributing the highest proportions of participants were the North West (15.7%) and London (15.7%). The regions contributing the smallest number of study participants were the North East (1.9%), Yorkshire and The Humber (4.2%) and the East Midlands (3.4%). Median follow-up for the study participants was 3.1 years (interquartile range (IQR) 1.2-7.3).

Figure 4-4: Data management to define a study population within CPRD and linked HES and ONS mortality data

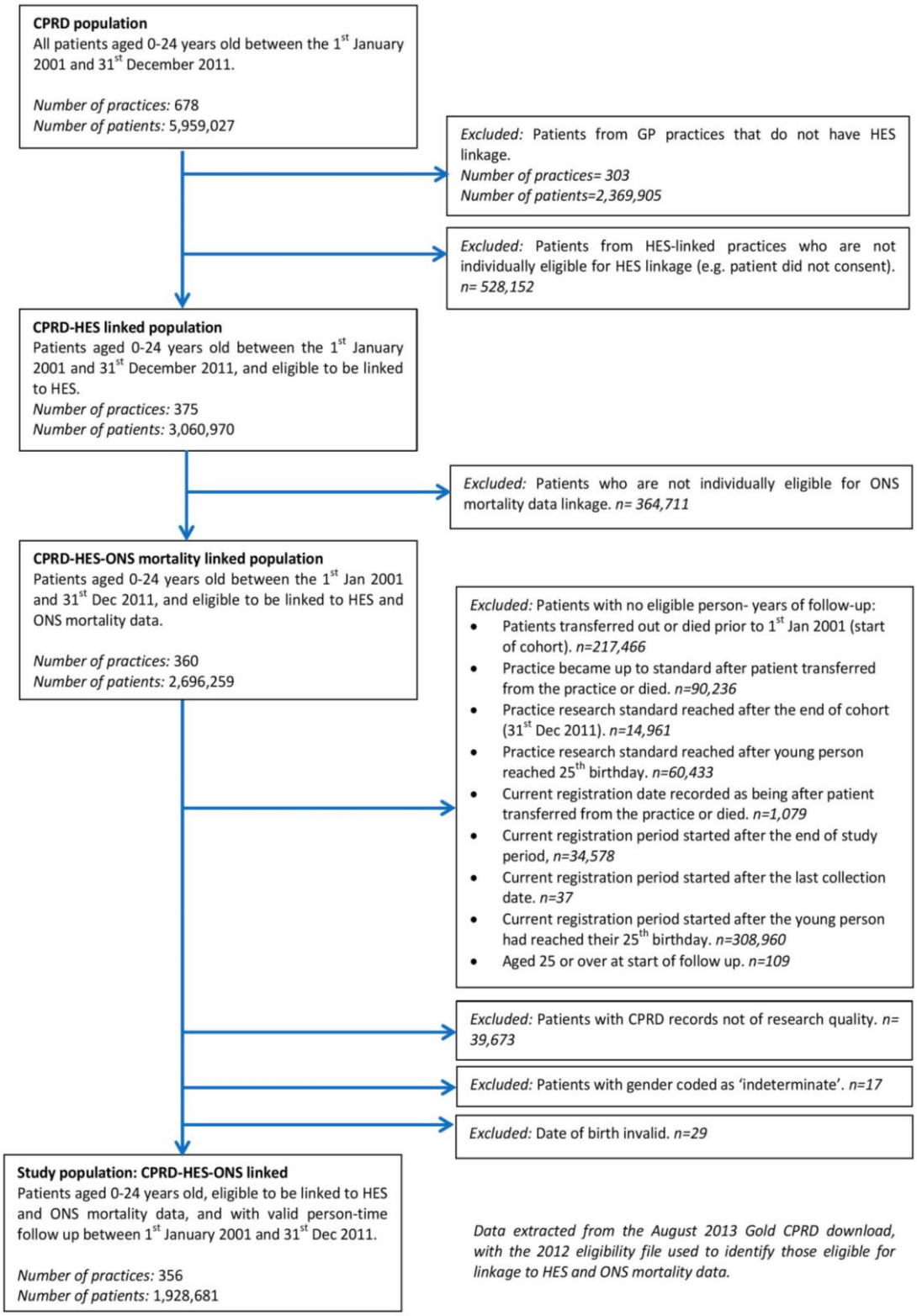


Table 4-4: Characteristics of 0-24 year old children and young people within the linked CPRD-HES-ONS databases during the study period 2001-2011

	Frequency (%)
Sex	
Male	945,023 (49.0)
Female	983,658 (51.0)
Age at start of follow up (years)	
0-4	668,626 (34.7)
5-9	281,424 (14.6)
10-14	254,525 (13.2)
15-19	287,556 (14.9)
20-24	436,550 (22.6)
Ethnicity*	
White	1,100,356 (57.1)
Mixed	30,512 (1.6)
Asian (Indian / Pakistani / Bangladeshi / Other)	74,138 (3.8)
Black (African / Caribbean / Other)	54,551 (2.8)
Other	30,823 (1.6)
Missing or unknown	638,301 (33.1)
Region where general practice located	
North East	36,272 (1.9)
North West	302,268 (15.7)
Yorkshire and Humber	81,529 (4.2)
East Midlands	66,239 (3.4)
West Midlands	218,684 (11.3)
East of England	221,879 (11.5)
South West	217,617 (11.3)
South Central	240,893 (12.5)
London	301,993 (15.7)
South East Coast	241,307 (12.5)

**As recorded in HES and/or CPRD*

4.5.2 Identification of incident injury events using linked health and mortality data

4.5.2.1 Injury events according to data source

Over the study period 35,162 poisoning, 155,653 fracture and 29,043 burn events were identified in linked CPRD-HES-ONS data for the study cohort (Table 4-5). This compared to 27,743, 142,505 and 27,620 events respectively when using CPRD alone. A total of 99 children were identified in ONS mortality data with a recorded cause of death from a poisoning, 55 from a fracture and 9 from a burn. Among those who died, most were aged 15-24 (93.9% of poisonings, 89.0% of fractures and 66.7% of burns).

When using linked CPRD-HES-ONS data, the proportions of events identified in each data source varied by injury type (Figure 4-5). For poisonings, 51.4% of events were only identified using CPRD, as were 75.2% of fracture and 90.5% of burn events. Compared to using CPRD alone, the addition of HES data increased the ascertainment of injury events for each injury type, with the greatest relative impact for poisonings (20.8% of events only identified in HES). Of the children who died with one of these injury types, 11 (11.1%) poisonings and 7 (12.7%) fractures were identified in CPRD and/or HES. None of the 9 children who died from burns were identified in CPRD and/or HES when using Read and ICD-10 code lists.

Table 4-5: Injury incidence according to data source in 0-24 year old children and young people, 2001-2011

	Poisonings			Fractures			Burns		
Data Source	**Number of poisoning records in data source(s)**	**Number of incident events**	**Rate per 10,000 PY (95% CI)**	**Number of fracture records in data source(s)**	**Number of incident events**	**Rate per 10,000 PY (95% CI)**	**Number of burn records in data source(s)**	**Number of incident events**	**Rate per 10,000 PY (95% CI)**
Clinical Practice Research Datalink (CPRD) *	30,720	27,743	33.1 (32.6-33.5)	196,268	142,505	169.8 (168.8-170.8)	33,876	27,620	32.9 (32.5-33.3)
Hospital Episode Statistics (HES) β	17,395	17,003	20.3 (20.0-20.6)	41,126	38,502	45.6 (45.2-46.1)	3,115	2,758	3.3 (3.2-3.4)
Office for National Statistics (ONS) mortality data #	99	99	0.12 (0.10-0.14)	55	55	0.07 (0.05-0.09)	9	9	0.01 (0.006, 0.02)
Linked CPRD-HES-ONS data	48,214[a]	35,162	41.9 (41.3-42.5)	237,449[a]	155,653	185.5 (184.6-186.4)	37,000[a]	29,043	34.6 (34.2-35.0)

** CPRD captures injuries seen in primary care, and information received from secondary and tertiary care (e.g. minor injury unit and ED attendances, hospital admissions).*

β HES captures inpatient hospital admissions.

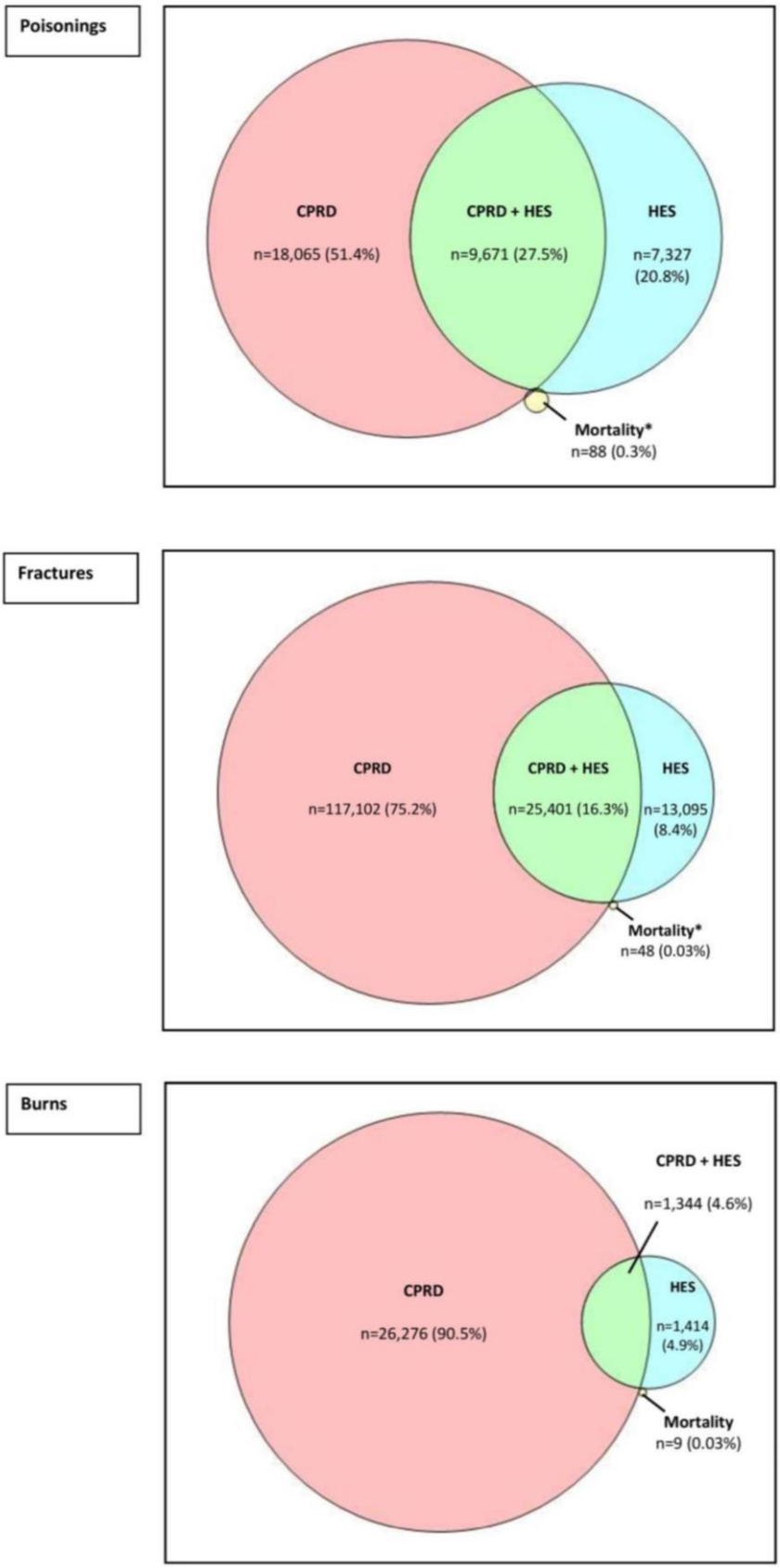
 # ONS mortality data captures those with an injury recorded as a cause of death on their death certificate.

[a] The number of records in linked CPRD-HES-ONS mortality data is the sum of the records identified in each data source separately.

PY: person-years

95% CI: 95% confidence intervals

Figure 4-5: Numbers and percentages of poisoning, fracture and burn events identified in primary care (CPRD), hospitalisation (HES) and deaths (ONS mortality) data



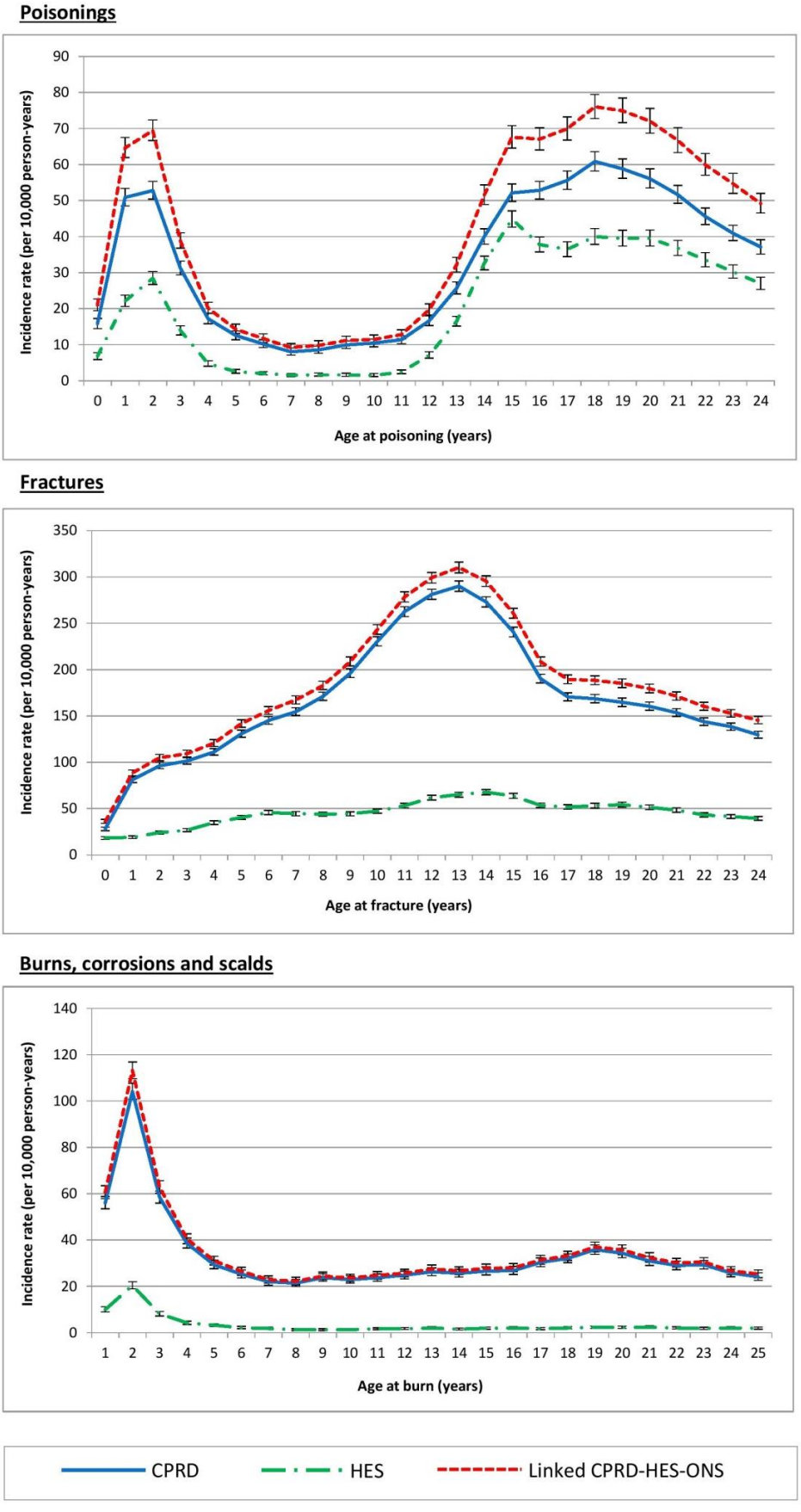
**Numbers of children who died from a poisoning, fracture or burn, where this information was also recorded within CPRD, HES or both, have not been shown in these figures due to the ethical constraint of reporting the small numbers involved.*

4.5.2.2 Incidence according to data source

Overall incidence rates for the study period were 41.9/10,000 PY (95%CI 41.3-42.5) for poisonings, 185.5 (95%CI 184.6-186.4) for fractures, and 34.6 (95%CI 34.2-35.0) for burns in linked CPRD-HES-ONS data (Table 4-5). For each injury type, estimated incidence rates were higher in linked CPRD-HES-ONS data than when using CPRD alone (non-overlapping 95% CI), with rates 27%, 9% and 5% higher for poisonings, fractures and burns, respectively.

As shown in Figure 4-6, poisoning incidence peaked at age 2 and again at 18 years old; compared to single peaks in incidence for fractures and burns at 13 and 1 years old, respectively. The impact of using linked CPRD-HES-ONS data compared to using CPRD or HES alone varied by age and injury type. For poisonings, incidence rates were higher among 0-4 year olds and 13-24 year olds in CPRD-HES-ONS mortality data compared to using CPRD alone; but were similar among children aged 5-12 years old (overlapping 95% confidence intervals). Comparatively, for fractures, estimated incidence rates were higher across all ages in linked data compared to using CPRD alone. For burns, incidence rates in CPRD-HES-ONS were similar to those in CPRD at all ages, except for those aged 1 years old (non-overlapping 95%CI).

Figure 4-6: Crude incidence of poisonings, fractures and burns according to age, using linked primary care, hospitalisation and mortality data (2001-2011)



4.5.2.3 Sensitivity analyses

Sensitivity analysis 1: extending time-windows to define incident events

Doubling the time-windows used to identify incident injury events led to the identification of 34,562 poisoning, 151,198 fracture and 28,813 burn events in the sensitivity analysis; compared to 35,162, 155,653 and 29,043 events respectively, in the primary analysis (Table 4-6). Incidence rates for 0-24 year olds and by child age were similar between the primary and sensitivity analyses for poisonings, fractures and burns (Figure 4-7, Figure 4-8 and Figure 4-9).

Sensitivity analysis 2: excluding non-specific diagnostic/procedural codes, and 'history of injury' codes

Exclusion of non-specific diagnostic and procedural codes, and 'history of injury' codes, led to the identification of 152,859 fractures and 28,690 burns, compared to 155,653 and 29,043, respectively in the primary analysis (Table 4-6). Overall incidence rates for fractures and burns were similar between the primary analysis and the sensitivity analysis, with overlapping 95% confidence intervals between the primary and sensitivity analyses when comparing incidence rates by injury type and age (Figure 4-8 and Figure 4-9).

In contrast, exclusion of non-specific poisoning and history of poisoning codes, led the poisoning incidence rate to be more than 10% lower in the sensitivity analysis (34.9/10,000 PY, 95%CI 34.5-35.3) compared to the primary analysis (41.9/10,000 PY, 95%CI 41.3-42.5). Across all ages, poisoning incidence rates were lower in the sensitivity analysis compared to the primary analysis (non-overlapping 95% confidence intervals) (Figure 4-7).

Table 4-6: Incidence rates of poisonings, fractures and burns in 0-24 year old children and young people; comparing primary and sensitivity analyses

	Primary analysis		**Sensitivity analysis 1:** Extending time-windows used to define incident events		**Sensitivity analysis 2:** Excluding non-specific diagnostic/procedural codes	
	Number of events	**Incidence rate per 10,000 PY (95%CI)**	**Number of events**	**Incidence rate per 10,000 PY (95%CI)**	**Number of events**	**Incidence rate per 10,000 PY (95%CI)**
Poisonings	35,162	41.9 (41.3-42.5)	34,562	41.2 (40.8-41.6)	29,250	34.9 (34.5-35.3)
Fractures	155,653	184.6 (183.7-185.6)	151,198	179.4 (178.5-180.3)	152,859	181.4 (180.5-182.3)
Burns	29,043	34.6 (34.2-35.0)	28,813	34.3 (33.9-34.7)	28,690	34.2 (33.8-34.6)

Figure 4-7: Crude incidence of poisonings according to age, using linked primary care, hospitalisation and mortality data, sensitivity analyses

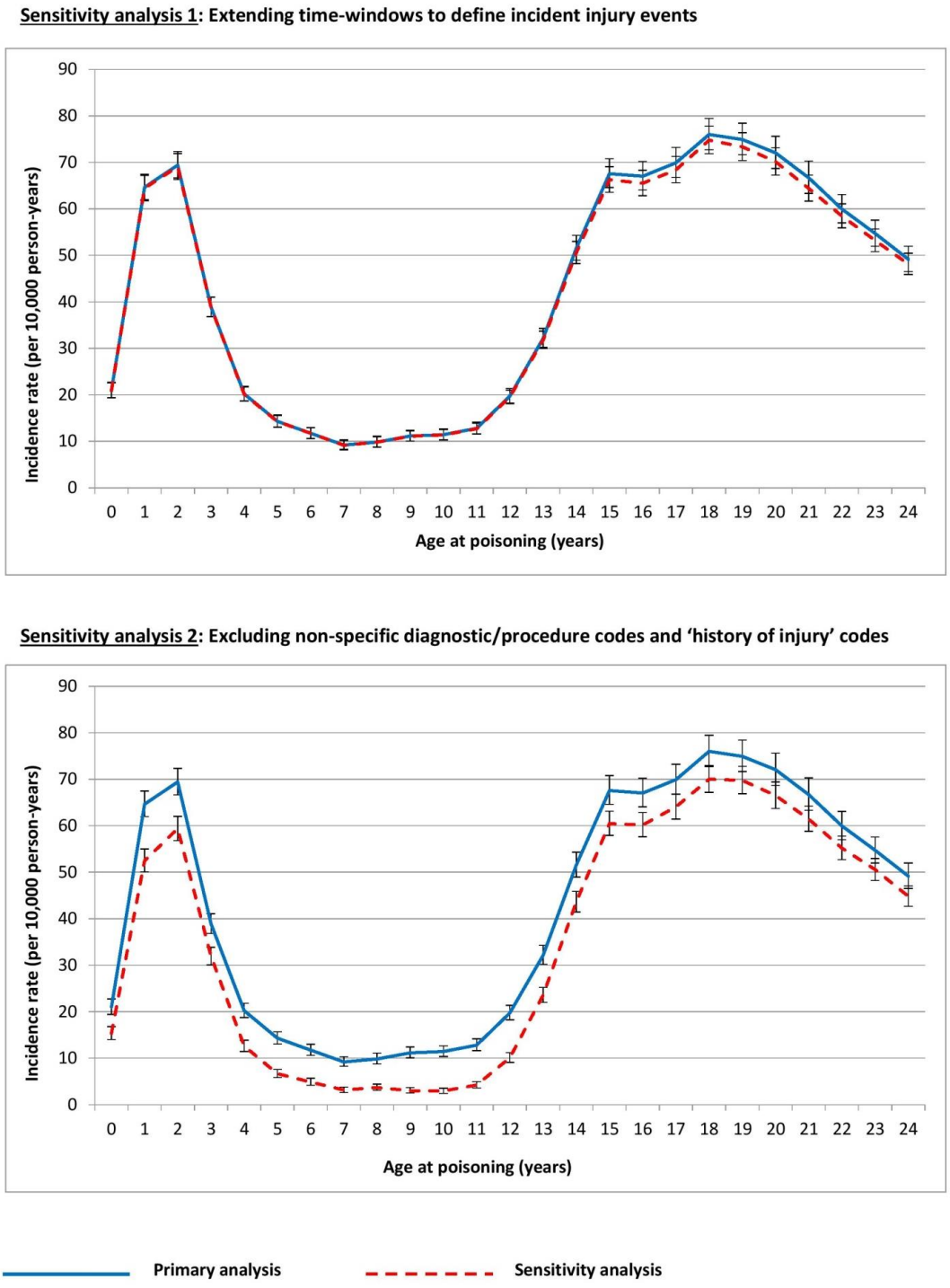


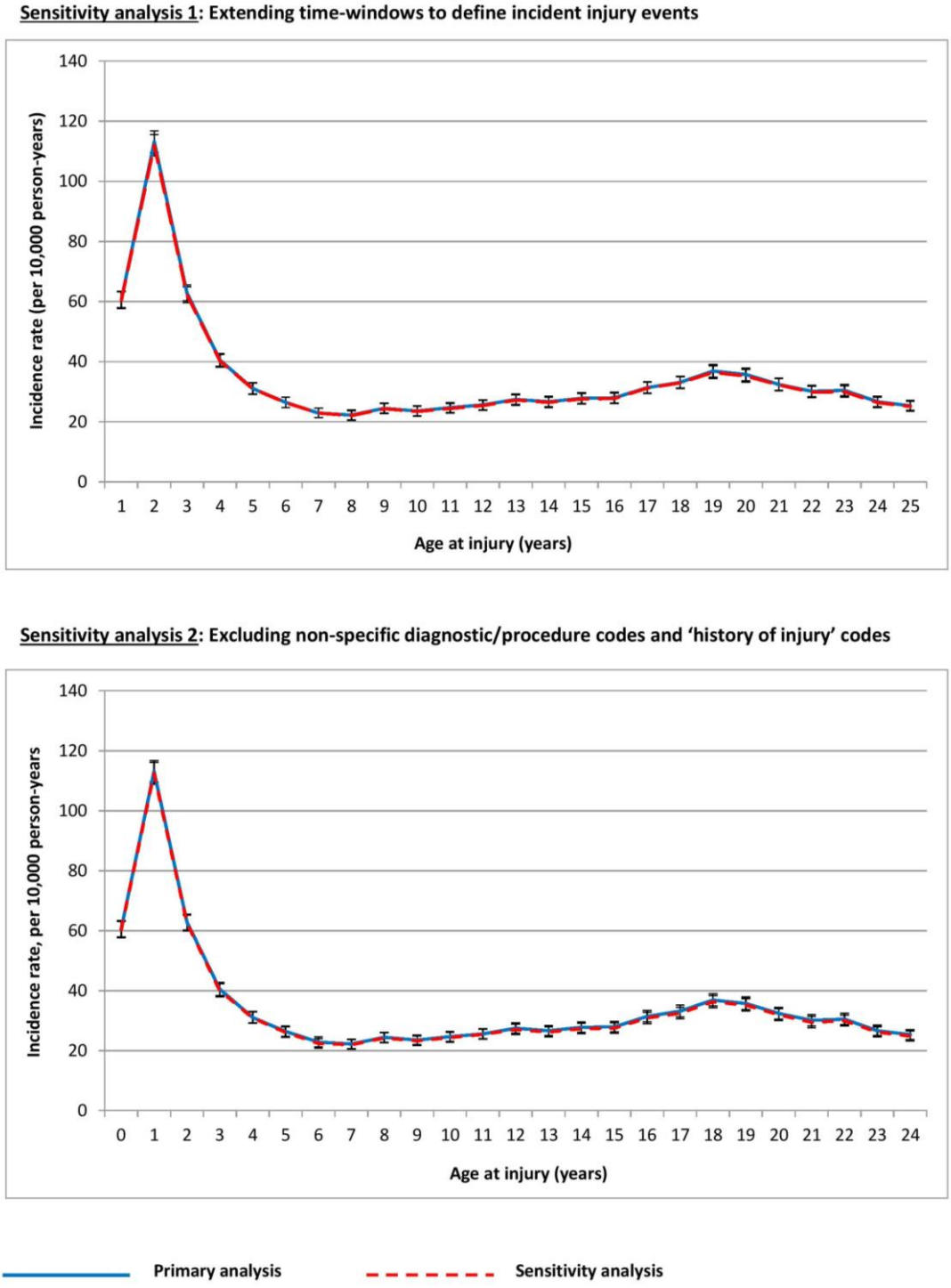
Figure 4-8: Crude incidence of fractures according to age, using linked primary care, hospitalisation and mortality data, sensitivity analyses

Sensitivity analysis 1: Extending time-windows to define incident injury events

Sensitivity analysis 2: Excluding non-specific diagnostic/procedure codes and 'history of injury' codes

Primary analysis Sensitivity analysis

Figure 4-9: Crude incidence of burns according to age, using linked primary care, hospitalisation and mortality data, sensitivity analyses



4.5.3 Assessing the recording of injury mechanisms and intent in CPRD, HES and ONS mortality data

4.5.3.1 Recording of injury mechanisms and intent according to data source

Injury mechanisms were recorded for only a small number of the injuries recorded in the CPRD: 2,145 (2%) of fracture and 1,094 (4%) of burn events (Table 4-7). The recording of an injury mechanism was much more complete in HES: 34,413 (89%) of fractures leading to hospitalisation and 2,231 (80%) of burns leading to hospitalisation. When using the 3 linked data sources together (CPRD-HES-ONS), an injury mechanism was identified for 23% of fractures (*n*=35,234) and 11% of burns (*n*=3,284). For those with a mechanism recorded, the leading mechanisms were falls (50%) and transport incidents (18%) for fractures, and heat/hot substances (66%) and smoke/fire/flames (17%) for burns.

The intent of injury was only recorded for 2,168 (2%) fractures and 1,098 (4%) burns in the CPRD. In contrast, intent was well recorded across all data sources for poisonings; identified for 28,754 (82%) of events when using linked CPRD-HES-ONS mortality data. Of these events, 19,069 (54%) were recorded as intentional self-harm, 9,272 (26%) as unintentional, and 413 (1%) as undetermined intent.

Table 4-7: Recording of injury mechanism and intent according to data source in 0-24 year olds

		Primary care data, CPRD* Number (%)	Hospital admissions data, HES# Number (%)	Mortality data, ONS# Number (%)	Linked CPRD-HES-ONS Number (%)
Poisonings	**Mechanismβ**	-	-	-	-
	Intent	20,067 (72)	16,604 (98)	99 (100)	28,754 (82)
Fractures	**Mechanism**	2,145 (2)	34,413 (89)	55 (100)	35,234 (23)
	Intent	2,168 (2)	34,409 (89)	55 (100)	33,725 (22)
Burns, scalds and corrosions	**Mechanism**	1,094 (4)	2,231 (80)	9 (100)	3,284 (11)
	Intent	1,098 (4)	2,231 (80)	9 (100)	2,253 (8)

** Intent and mechanism defined in CPRD using Read codes corresponding to ICD-10 V01-Y36, Y90-Y98.*

 # Intent and mechanism defined in HES and ONS mortality data using ICD-10 codes V01-Y36, Y90-Y98.

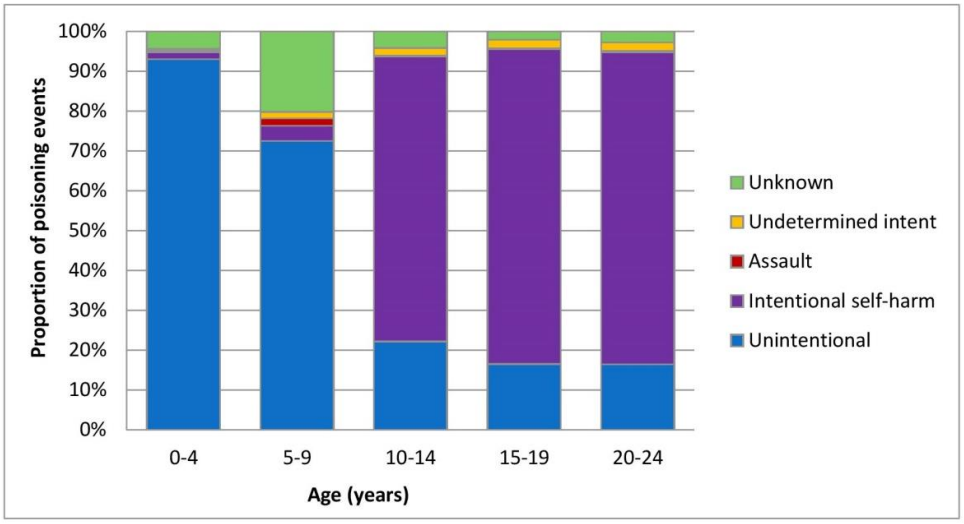
β As poisonings are both a mechanism and injury type, mechanism recording has not been reported here.

4.5.3.2 Mechanisms and intent of injury: hospitalisations and deaths

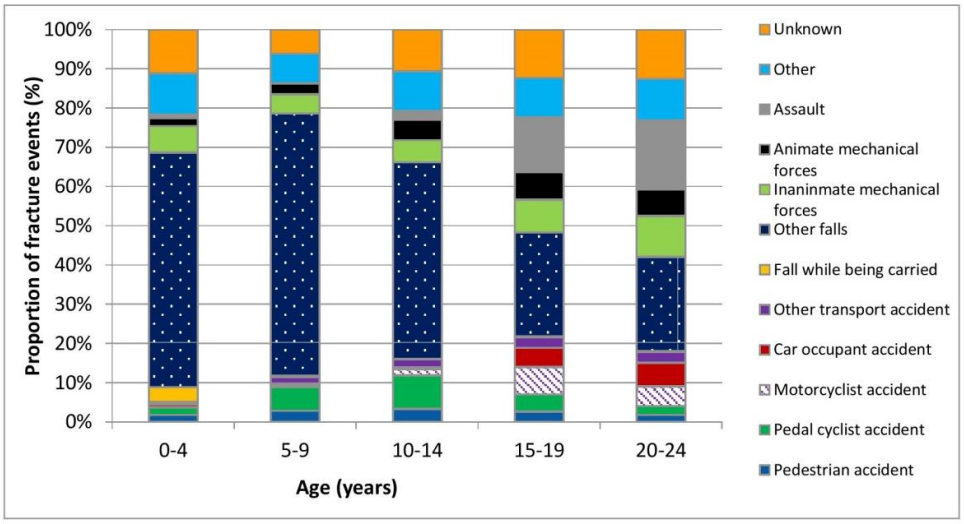
Among the cohort, 17,003 poisoning, 38,502 fracture, and 2,758 burn events led to hospitalisation, and an additional 99 poisoning, 55 fracture and 9 burn events led to death (of which some were also hospitalised prior to death) during the period 2001-2011. Figure 4-10 shows injury mechanisms for these hospitalisations and deaths. Among 0-4 year olds, 93.0% (n=2,534) of poisonings that led to death or hospitalisation were recorded as unintentional, contrasting with 78.3% (n=4,380) of poisonings among 20-24 year olds recorded as intentional self-harm. Across all ages the most common mechanism of fracture leading to death or hospitalisation was a fall, although the proportion of events due to falls reduced with age (63.5% in 0-4 year olds, 24.2% in 20-24 year olds). The proportion of fractures resulting from transport accidents peaked in 15-19 year olds, accounting for 21.6% of fractures in this age group. Assault accounted for 14.0% of fractures in 15-19 year olds and 17.9% in 20-24 year olds. In 0-4 year olds, burns leading to death or hospitalisation were most commonly due to exposure to heat and hot substances (e.g. hot drinks, bathwater scalds), accounting for 75.0% of the 1,510 hospitalised burns in this age group. The proportion of events due to this mechanism reduced with age (20.4% of the 343 burn hospitalisations in 20-24 year olds).

Figure 4-10: External causes of injury according to age, for poisoning, fracture and burn events leading to hospitalisation and/or death, 2001-2011

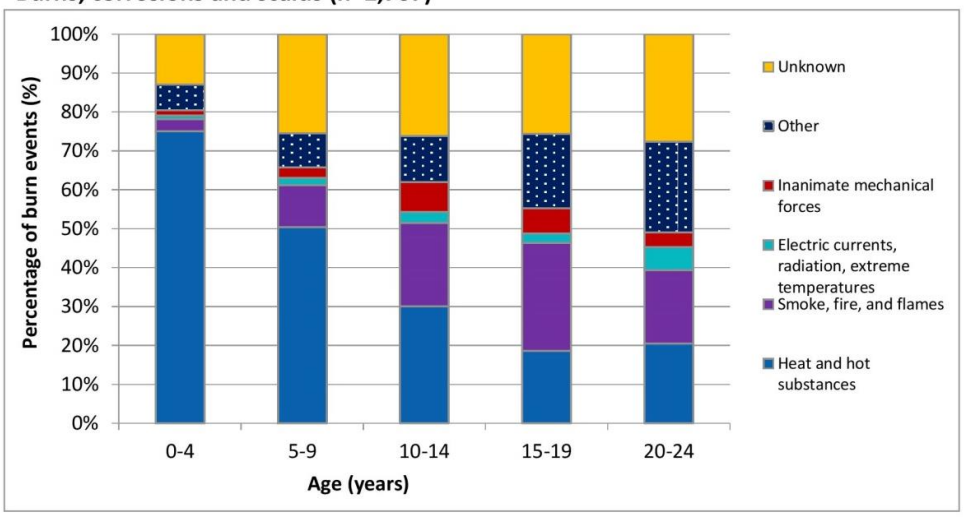
Poisonings (n=17,096)



Fractures (n=38,551)



Burns, corrosions and scalds (n=2,767)



4.5.4 The epidemiology of poisonings, fractures and burns using linked health and mortality data

Table 4-8 shows crude incidence rates, and adjusted incidence rate ratios for poisonings, fractures and burns, by age, sex, socioeconomic deprivation and calendar year. Variations by these factors are described in detail below.

4.5.4.1 Age and sex

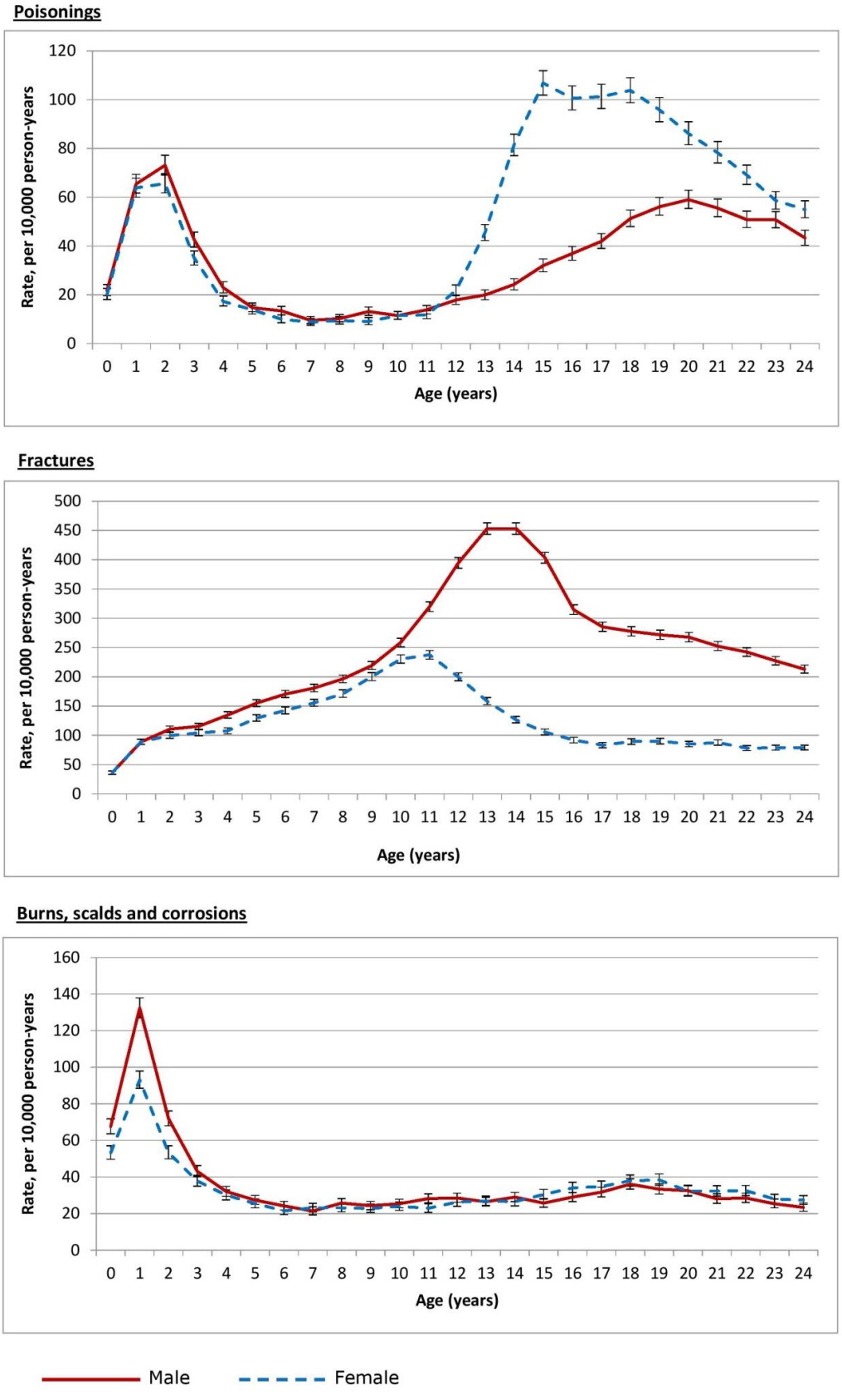
Age patterns varied by injury type (Figure 4-11), with peaks in injury incidence at age 2 (69.4/10,000 PY) and 18 (76.0/10,000 PY) for poisonings, age 13 for fractures (310.1/10,000 PY) and age 1 for burns (113.1/10,000 PY). There were significant interactions between child age and sex for each of the three injury types (p<0.001). Among children aged 0-4, males (45.6/10,000 PY, 95%CI 44.2-47.1) had a higher poisoning incidence than females (40.8/10,000 PY, 95%CI 39.4-42.2). Poisoning incidence rates increased steeply among females after the age of 12, with incidence rates more than twofold higher among females aged 15-24 compared to males of this age (females:101.7/10,000 PY versus males:43.4/10,000 PY). Across all ages, fracture incidence was higher among males than females, peaking at age 11 in females (237.6/10,000 PY) and age 13 in males (453.2/10,000 PY). Males aged 0-4 had a significantly higher burns incidence (69.4/10,000 PY) than females (53.5/10,000 PY). After the age of 5, burns incidence remained between 20-40/10,000 PY with incidence rates similar between males and females.

Table 4-8: Incidence rates and adjusted incidence rate ratios for poisonings, fractures and burns using CPRD-HES-ONS data, 0-24 year olds (2001-2011)

	Person-years	Poisonings			Fractures			Burns, Corrosions and Scalds		
		Incident events	Incidence rate per 10,000 PY (95% CI)	Adjusted IRR* (95%CI)	Incident events	Incidence rate per 10,000 PY (95% CI)	Adjusted IRR* (95%CI)	Incident events	Incidence rate per 10,000 PY (95% CI)	Adjusted IRR* (95%CI)
Sex										
Male	4,317,669	14,573	33.8 (33.2-34.3)	1	105,350	244.0 (242.5-245.5)	1	15,464	35.8 (35.3-36.4)	1
Female	4,074,702	20,589	50.5 (49.8, 51.2)	1.49 (1.43-1.54)	50,303	123.5 (122.4-124.5)	0.51 (0.51-1.52)	13,579	33.3 (32.8-33.9)	0.94 (0.91-0.96)
Age at injury (years)										
0-4	1,646,599	7,123	43.3 (42.3-44.3)	1	15,415	93.6 (92.2-95.1)	1	10,151	61.6 (60.5-62.9)	1
5-9	1,692,220	1,901	11.2 (10.7-11.8)	0.21 (0.19-0.22)	29,235	172.8 (170.8-174.8)	1.67 (1.62-1.72)	4,047	23.9 (23.2-24.7)	0.35 (0.34-0.36)
10-14	1,738,319	4,416	25.4 (24.7-26.2)	0.47 (0.44-0.50)	49,861	286.8 (284.3-289.4)	2.60 (2.52-2.67)	4,597	26.4 (25.7-27.2)	0.38 (0.37-0.40)
15-19	1,649,377	11,709	71.0 (69.7-72.3)	1.43 (1.35-1.50)	34,258	207.7 (205.5-209.9)	1.76 (1.71-1.81)	5,434	32.9 (32.1-33.8)	0.48 (0.46-0.49)
20-24	1,665,855	10,013	60.1 (58.9-61.3)	1.12 (1.06-1.18)	26,884	161.4 (159.5-163.3)	1.32 (1.29-1.36)	4,814	28.9 (28.1-29.7)	0.38 (0.37-0.40)
Socioeconomic deprivation, IMD 2010										
Quintile 1	1,914,100	5,095	26.6 (25.9-27.4)	1	35,265	184.2 (182.3-186.2)	1	5,421	28.3 (27.6-29.1)	1
Quintile 2	1,765,795	5,298	30.0 (29.2-30.8)	1.19 (1.12-1.27)	32,853	186.1 (184.0-188.1)	1.03 (1.00-1.06)	5,527	31.3 (30.5-32.1)	1.15 (1.10-1.19)
Quintile 3	1,545,129	6,987	45.2 (44.2-46.3)	1.67 (1.57-1.77)	28,375	183.6 (181.5-185.8)	1.02 (0.99-1.05)	5,404	35.0 (34.0-35.9)	1.27 (1.22-1.32)
Quintile 4	1,613,752	8,786	54.4 (53.3-55.6)	2.01 (1.89-2.13)	30,704	190.3 (188.1-192.4)	1.07 (1.04-1.10)	6,095	37.8 (36.8-38.7)	1.40 (1.34-1.45)
Quintile 5	1,486,921	8,550	57.5 (56.3-58.7)	2.20 (2.07-2.34)	27,219	183.1 (180.9-185.2)	1.04 (1.00-1.07)	6,306	42.4 (41.4-43.5)	1.55 (1.49-1.62)
Missing	71,896	446	62.0 (56.4-68.1)	2.06 (1.84-2.31)	1,237	172.1 (162.6-181.9)	1.01 (0.94-1.07)	290	40.3 (35.8-45.3)	1.39 (1.23-1.57)
Calendar year										
2001-2003	2,028,032	7,967	39.3 (38.4-40.2)	1	33,376	164.6 (162.8-166.4)	1	7,817	38.5 (37.7-39.4)	1
2004-2006	2,293,004	9,909	43.2 (42.4-44.1)	1.03 (0.98-1.08)	41,007	178.8 (177.1-180.6)	1.09 (1.06-1.11)	8,375	36.5 (35.8-37.3)	0.95 (0.92-0.99)
2007-2009	2,461,679	10,431	42.4 (41.6-43.2)	0.99 (0.94-1.04)	48,256	196.0 (194.3-198.8)	1.21 (1.18-1.23)	7,911	32.1 (31.4-32.9)	0.83 (0.80-0.86)
2010-2011	1,609,655	6,855	42.6 (41.6-43.6)	0.98 (0.92-1.03)	33,014	205.1 (202.9-207.3)	1.28 (1.24-1.31)	4,940	30.7 (29.8-31.6)	0.79 (0.76-0.82)

**Adjusted for age, sex, calendar year, region and socioeconomic deprivation*

Figure 4-11: Incidence of poisonings, fractures and burns by age and sex, using linked health and mortality data 2001-2011



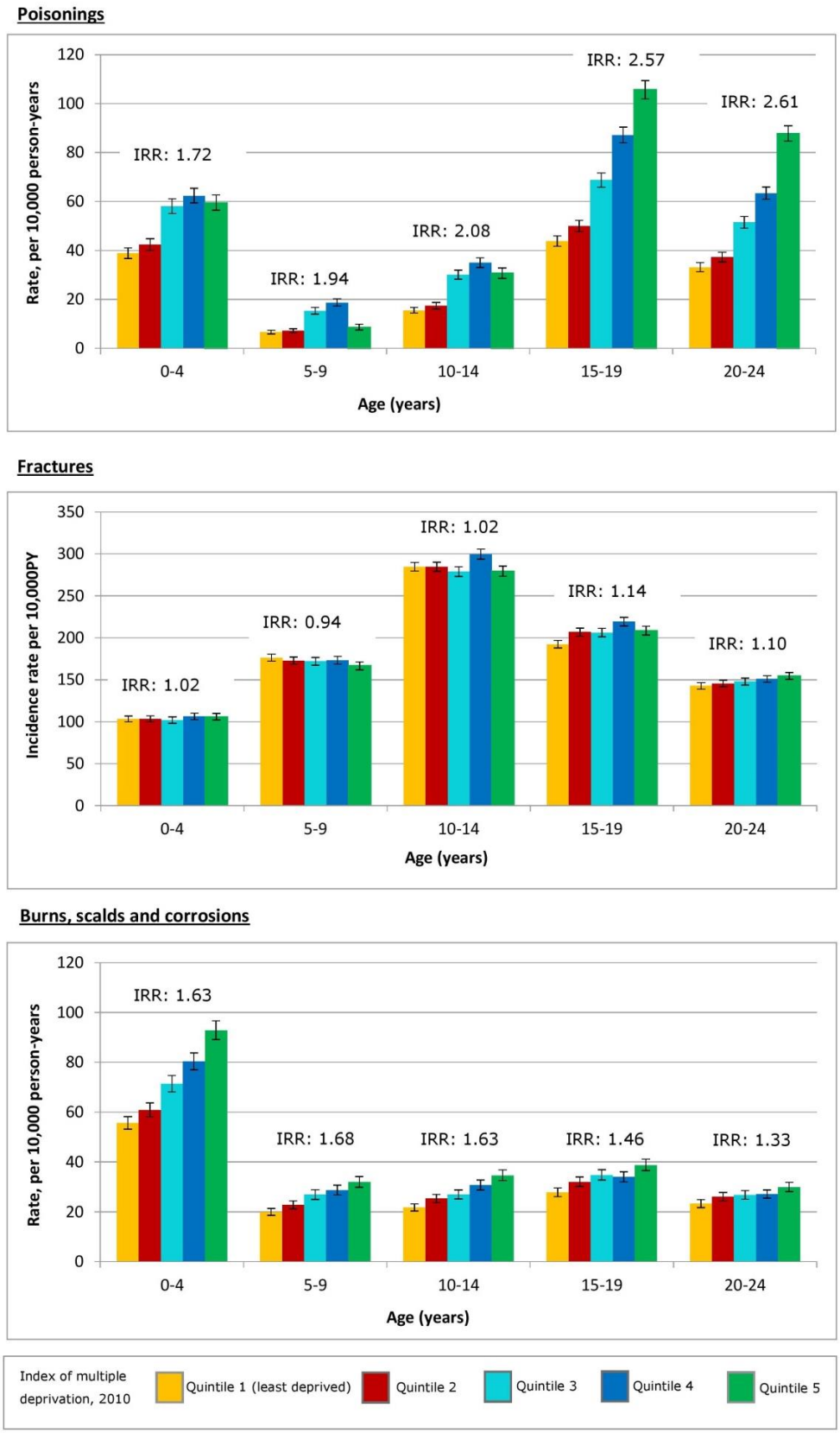
4.5.4.2 Socioeconomic inequalities

Among 0-24 year olds, those in the most deprived quintile had a two-fold higher rate of poisonings (aIRR 2.20, 95%CI 2.07-2.34), and a 55% higher rate of burns (aIRR 1.55, 95%CI 1.49-1.62) compared to those in the least deprived quintile, after adjustment for age, sex, region and calendar year. For both poisonings and burns, injury incidence rates increased with increasing deprivation (LRT test for trend, $p<0.0001$). Comparatively, incidence rates of fractures were similar between socioeconomic quintiles, with a 4% difference in fracture rates between the most and least deprived quintiles and 95% confidence intervals including 1 (aIRR 1.04, 95%CI 1.00-1.07).

The strength of socioeconomic gradients varied with age (test for interaction $p<0.0001$ for each injury type) (Figure 4-12). The steepest socioeconomic gradient was seen for poisonings among 20-24 year olds, with the most deprived quintile having a 2.6 fold higher poisoning incidence than the least deprived quintile (aIRR 2.61, 95%CI 2.39-2.86). Significant differences in fracture rates were only seen for those aged 15-19 and 20-24 years old, with those in the most deprived quintile having a 14% (aIRR 1.14, 95%CI 1.10-1.19) and 10% (aIRR 1.10, 95%CI 1.05-1.15) higher fracture rate than those in the least deprived quintile, respectively.

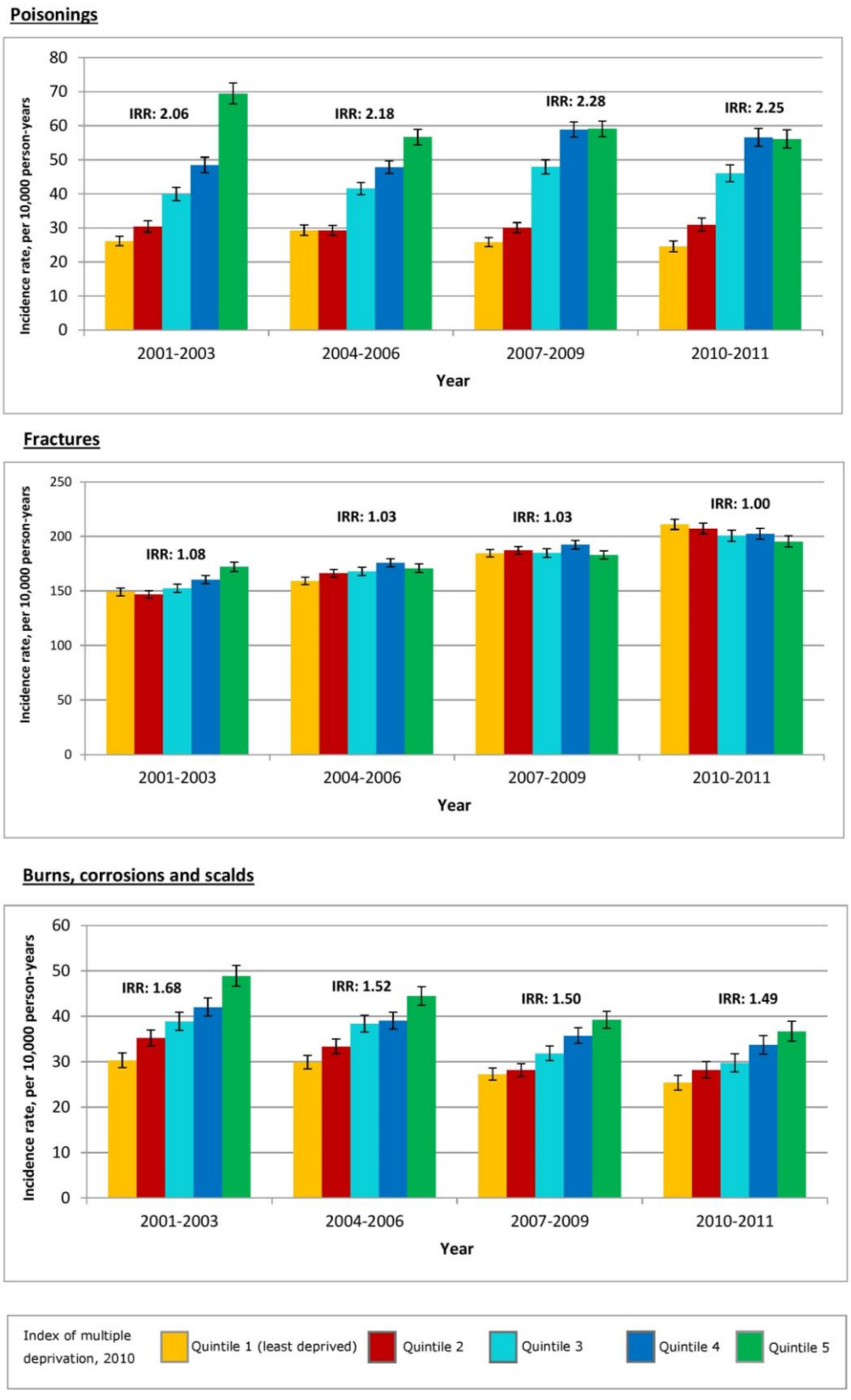
Over time there was an increase in the socioeconomic gradient between least and most deprived quintiles for poisonings ($p=0.009$ test for interaction)(Figure 4-13). Those from the most deprived quintile had a 2.25 fold higher poisoning rate compared to those from the least deprived quintile in 2010-2011 (aIRR 2.25, 95%CI 1.94-2.61); a steeper socioeconomic gradient than seen for the period 2001-2003 (aIRR 2.06, 95%CI 1.86-2.26). In contrast, there was a narrowing in socioeconomic inequalities for fractures and burns (Figure 4-13); although interactions between socioeconomic deprivation and calendar year were not statistically significant for the time period studied (fractures $p=0.38$, burns $p=0.05$ test for interaction). Children from the most deprived quintile had an 8% higher fracture rate than those in the least deprived quintile in the period 2001-2003 (aIRR 1.08, 95%CI 1.02-1.14); whereas in 2010-2011 there was no significant difference in fracture rates between the most and least deprived quintiles (aIRR 1.00, 95%CI 0.94-1.06). For burns, those from the most deprived quintile had a 68% higher rate of burns compared to the least deprived in 2001-2003 (aIRR 1.68 95%CI 1.56-1.82), falling to a 49% higher rate in 2010-2011 (aIRR 1.49, 95%CI 1.35-1.64).

Figure 4-12: Incidence of poisonings, fractures and burns among children and young people by age and socioeconomic deprivation, using linked health and mortality data 2001-2011



***IRR**: Incidence rate ratios for quintile 5 (most deprived) compared to quintile 1 (least deprived), adjusted for sex, region and calendar year*

Figure 4-13: Incidence of poisonings, fractures and burns among children and young people aged 0-24 according to socioeconomic deprivation and calendar year, 2001-2011



***IRR**: Incidence rate ratios for quintile 5 (most deprived) compared to quintile 1 (least deprived), adjusted for age, sex, and region*

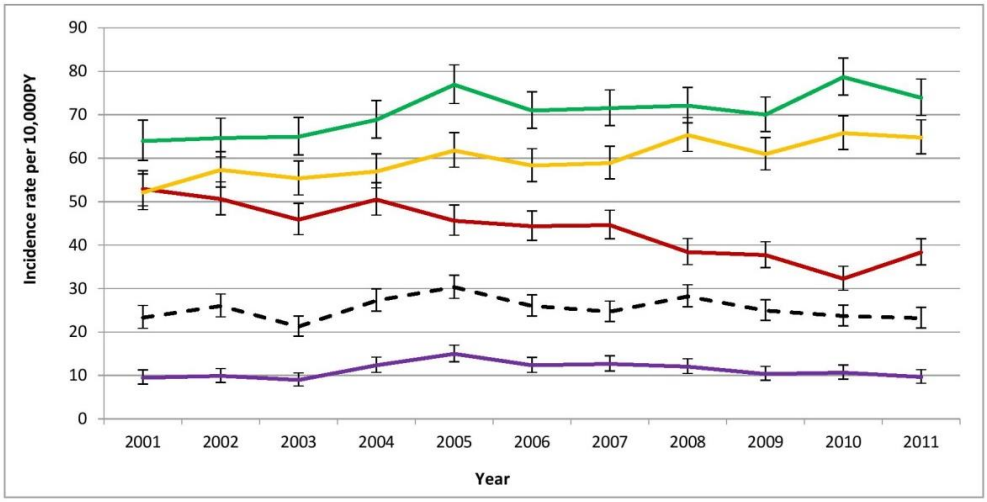
4.5.4.3 Incidence according to calendar time

Among 0-24 year olds, burns incidence rates significantly reduced from 38.5/10,000 PY (95%CI 37.7-39.4) in 2001-2003, to 30.7 (95%CI 29.8-31.6) in 2010-2011 (aIRR 0.79, 95%CI 0.76-0.82). In contrast, there was a smaller reduction in poisoning rates between these periods (aIRR 0.98, 95%CI 0.92-1.03), and a significant increase in fracture incidence rates (aIRR 1.28, 95%CI 1.24-1.31) over time, from 164.6/10,000 PY (95%CI 162.8-166.4) in 2001-2003 to 205.1 (95%CI 202.9-207.3) in 2010-2011.

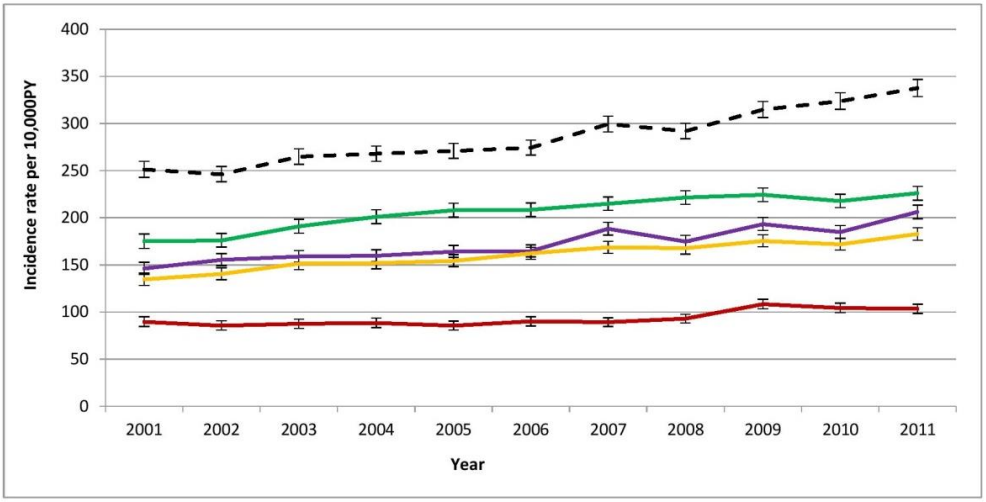
Trends over time for fractures and burns were consistent across age groups (p=0.01 fractures, p=0.1 burns test for interaction) (Figure 4-14), whereas for poisonings, trends over time differed by age group (p<0.0001 test for interaction). Among 0-4 year olds poisoning incidence rates reduced by 34% between the periods 2001-2003 and 2010-2011 (aIRR 0.66, 95%CI 0.60-0.73). For young people aged 15-19 years old, and 20-24 years old, poisoning incidence rates increased between 2001-2003 and 2010-2011, by 21% (aIRR 1.21, 95%CI 1.12-1.31) and 17% (aIRR 1.17, 95%CI 1.08-1.27), respectively.

Figure 4-14: Incidence of poisonings, fractures and burns among children and young people aged 0-24 according to age and calendar year

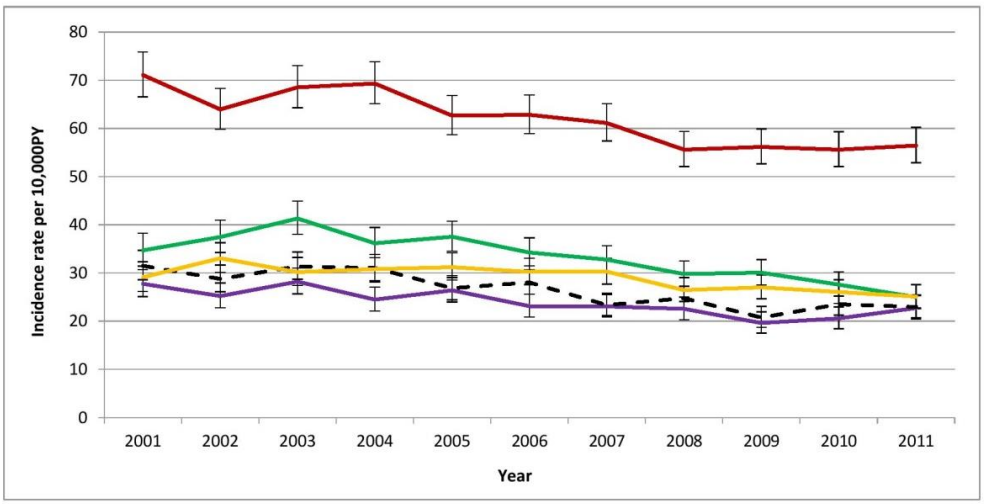
Poisonings



Fractures



Burns, corrosions and scalds



4.5.5 Incidence rates of injuries requiring hospitalisation and injuries defined as serious

During the study period 17,003 poisonings, 38,502 fractures, and 2,758 burns led to hospitalisation, of which 1,376 (8.1%), 7,249 (19.3%) and 594 (21.5%) required hospitalisation for 72 hours or more, respectively. Of the injuries requiring hospitalisation, 74 poisonings (0.4%), 5,902 (15.3%) fractures and 928 (33.6%) burns were classified as serious based on the ICD-10 codes used to record the admission. Crude incidence rates and adjusted incidence rate ratios for poisonings (Table 4-9), fractures (Table 4-10) and burns (Table 4-11) requiring hospitalisation and those classified as serious, are shown by age, sex, socioeconomic deprivation and calendar year.

4.5.5.1 Age and sex

Similar to overall incidence rates using CPRD-HES-ONS data, rates of hospitalised burns and serious burns were highest in males and children aged 0-4 years old. For poisonings, rates of hospitalisation were greatest amongst those aged 15-19 year old, with young people from this age group having a twofold higher admission rate than 0-4 year olds (aIRR 2.13, 95%CI 2.01-2.26). For poisoning hospitalisations lasting 72 hours or more, those aged 15-19 had an 11 times higher rate than 0-4 year olds (aIRR 11.72, 95%CI 8.68-15.82).

Incidence rates of fractures requiring hospitalisation were highest amongst males (64.9/10,000 PY, 95%CI 64.2-65.7) and those aged 10-14 year olds (59.4/10,000 PY, 95%CI 59.4/10,000, 95%CI 58.3-60.6); similar to the pattern seen for all fractures identified in CPRD-HES-ONS data. In contrast, incidence rates of serious fractures defined by ICD-10 codes, showed a more 'U-shaped' pattern, peaking firstly in children aged 0-4 years (5.39/10,000), and again among 20-24 year olds (11.91/10,000). Rates of fractures requiring hospitalisation for 72 hours or more were highest among 15-19 year olds (13.81/10,000).

4.5.5.2 Socioeconomic deprivation

The socioeconomic gradient between the most and least deprived quintiles was steeper for poisonings requiring hospitalisation (aIRR 2.42, 95%CI 2.26-2.59) and poisonings

leading to hospitalisation for 72 hours or more (aIRR 2.79, 95%CI 2.30-3.38), compared to all poisonings (aIRR 2.20, 95%CI 2.07-2.34). Similarly for fractures, the socioeconomic gradient between the most and least deprived quintiles was steeper for fractures requiring hospitalisation (aIRR 1.22, 95%CI 1.17-1.27), fractures requiring hospitalisation for 72 hours or more (aIRR 1.51, 95%CI 1.40-1.64), and serious fractures defined using ICD-10 codes (aIRR 1.56, 95%CI 1.42-1.70); compared to all fractures identified in CPRD-HES-ONS mortality data (aIRR 1.04, 95%CI 1.00-1.07). The steepest socioeconomic gradient for burns was for those defined as serious using ICD-10 codes, with those in the most deprived quintile having a 2.6 fold higher rate than those in the least deprived quintile (aIRR 2.64, 95%CI 2.09-3.34).

4.5.5.3 Calendar year

Trends over time varied by age for poisonings (Figure 4-15). Most notably, after 2003 there was a steep increase in the rate of poisonings requiring hospitalisation among 15-24 year olds, from 26.1/10,000 (95%CI 24.3-28.2) in 2003 to 42.7/10,000 (40.5-45.0) in 2011 (Figure 4-15). This increase was not mirrored in 0-14 year olds or the incidence of hospitalisations lasting 72 hours or more. There was some increase in the overall poisoning incidence rates using CPRD-HES-ONS between 2003 and 2011, but this was of smaller magnitude (from 60.0/10,000 PY in 2003 to 69.3/10,000 PY in 2011).

Incidence rates of fractures requiring hospitalisation (aIRR 1.02, 95%CI 0.98-1.06) and those defined as serious using ICD-10 codes (aIRR 1.00, 95%CI 0.92-1.08) did not significantly change between the periods 2001-2003 and 2010-2011 (Table 4-10). This contrasted with a 28% increase in the incidence of all fractures identified in CPRD-HES-ONS mortality data (aIRR 1.28, 95%CI 1.24-1.31) (Figure 4-16), and a 31% reduction in the incidence of fractures requiring admission for 72 hours or more (aIRR 0.69, 95%CI 0.64-0.74). Trends in the incidence of fractures over time were similar by age (Figure 4-16).

Between 2001-2003 and 2010-2011, there was a 15% reduction in the incidence of burns requiring admission for 72 hours or more (aIRR 0.85, 95%CI 0.66-1.09) (Table 4-11), whereas there was a 23% increase in the rate of burns requiring hospitalisation (aIRR 1.23, 95%CI 1.09-1.39). Rates of serious burns defined using ICD-10 codes

generally increased over time, with incidence rates 42% higher in 2010-2011 compared to 2001-2003 (aIRR 1.42, 95%CI 1.15-1.75).

Table 4-9: Crude incidence rates and adjusted incidence rate ratios for poisonings requiring hospitalisation and 'serious poisonings', 0-24 year olds, 2001-2011

	Person-years	Incident poisonings requiring hospitalisation			Serious poisonings (hospitalised ≥72 hours)			Serious poisonings (based on ICD-10 codes)		
		Incident events	Incidence rate per 10,000 PY (95% CI)	Adjusted IRR* (95%CI)	Incident events	Incidence rate per 10,000 PY (95% CI)	Adjusted IRR* (95%CI)	Incident events	Incidence rate per 10,000 PY (95% CI)	Adjusted IRR* (95%CI)
Overall	8,392,371	17,003	20.3 (20.0-20.6)	-	1,376	1.64 (1.56-1.73)	-	74	0.09 (0.07-0.11)	-
Sex										
Male	4,317,669	6,176	14.3 (14.0-14.7)	1	449	1.04 (0.95-1.14)	1	31	0.07 (0.50-0.10)	1
Female	4,074,702	10,827	26.6 (26.1-27.1)	1.83 (1.76-1.91)	927	2.28 (2.13-2.43)	2.21 (1.96-2.48)	43	0.11 (0.08-0.14)	1.47 (0.92-2.33)
Age at injury (years)										
0-4	1,646,599	2,532	15.4 (14.8-16.0)	1	47	0.29 (0.21-0.38)	1	43	0.26 (0.19-0.35)	1
5-9	1,692,220	316	1.9 (1.7-2.1)	0.11 (0.10-0.12)	7	0.04 (0.02-0.09)	0.13 (0.06-0.29)	#	0.02 (0.01-0.05)	0.06 (0.02-0.20)
10-14	1,738,319	2,072	11.9 (11.4-12.4)	0.67 (0.62-0.71)	248	1.43 (1.26-1.62)	4.51 (3.29-6.18)	#	0.03 (0.01-0.07)	0.1 (0.04-0.25)
15-19	1,649,377	6,552	39.7 (38.8-40.7)	2.13 (2.01-2.26)	621	3.77 (3.48-4.07)	11.72 (8.68-15.82)	15	0.09 (0.05-0.15)	0.31 (0.17-0.55)
20-24	1,665,855	5,531	33.2 (32.3-34.1)	1.63 (1.54-1.73)	453	2.72 (2.48-2.98)	7.58 (5.60-10.28)	8	0.05 (0.02-0.10)	0.14 (0.07-0.31)
SES, IMD 2010										
Quintile 1	1,914,100	2,311	12.1 (11.6-12.6)	1	175	0.91 (0.78-1.06)	1	12	0.06 (0.03-0.11)	1
Quintile 2	1,765,795	2,524	14.3 (13.7-14.9)	1.15 (1.08-1.24)	187	1.06 (0.91-1.22)	1.12 (0.90-1.38)	14	0.08 (0.04-0.13)	1.32 (0.60-2.86)
Quintile 3	1,545,129	2,930	19.0 (18.3-19.7)	1.46 (1.36-1.56)	243	1.57 (1.38-1.78)	1.59 (1.30-1.95)	13	0.08 (0.5-0.14)	1.41 (0.64-3.12)
Quintile 4	1,613,752	3,886	24.1 (23.3-24.9)	1.79 (1.68-1.92)	340	2.11 (1.89-2.34)	2.13 (1.76-2.58)	13	0.08 (0.04-0.13)	1.38 (0.62-3.06)
Quintile 5	1,486,921	5,156	34.7 (33.7-35.6)	2.42 (2.26-2.59)	417	2.80 (2.54-3.09)	2.79 (2.30-3.38)	19	0.13 (0.08-0.20)	1.78 (0.84-3.78)
Missing	71,896	196	27.3 (23.6-31.4)	1.84 (1.58-2.15)	14	1.95 (1.07-3.27)	1.88 (1.09-3.26)	#	0.42 (0.09-1.2)	5.65 (1.58-20.17)
Calendar year										
2001-2003	2,028,032	3,186	15.7 (15.2-16.3)	1	344	1.70 (1.53-1.89)	1	15	0.07 (0.04-0.12)	1
2004-2006	2,293,004	4,578	20.0 (19.4-20.6)	1.19 (1.12-1.26)	403	1.76 (1.59-1.94)	1.00 (0.85-1.16)	18	0.08 (0.05-0.12)	1.08 (0.54-2.14)
2007-2009	2,461,679	5,454	22.2 (21.6-22.8)	1.26 (1.19-1.34)	359	1.46 (1.32-1.62)	0.82 (0.70-0.96)	21	0.09 (0.06-0.13)	1.15 (0.59-2.23)
2010-2011	1,609,655	3,785	23.5 (22.8-24.3)	1.34 (1.26-1.43)	270	1.68 (1.49-1.89)	0.94 (0.80-1.12)	20	0.12 (0.08-0.19)	1.66 (0.85-3.24)

**mutually adjusted for age, sex, socioeconomic deprivation, calendar year and region. #numbers not presented as values were <5*

Table 4-10: Crude incidence rates and adjusted incidence rate ratios for fractures requiring hospitalisation and 'serious fractures', 0-24 year olds, 2001-2011

	Person-years	Incident fractures requiring hospitalisation			Serious fractures (hospitalised ≥72 hours)			Serious fractures (based on ICD-10 code)		
		Incident events	Incidence rate per 10,000 PY (95% CI)	Adjusted IRR* (95%CI)	Incident events	Incidence rate per 10,000 PY (95% CI)	Adjusted IRR* (95%CI)	Incident events	Incidence rate per 10,000 PY (95% CI)	Adjusted IRR* (95%CI)
Overall	8,392,371	38,502	45.9 (45.4-46.3)	-	7,429	8.85 (8.65-9.06)	-	5,902	7.03 (6.86-7.21)	-
Sex										
Male	4,317,669	28,039	64.9 (64.2-65.7)	1	5,392	12.49 (12.16-12.83)	1	4,620	10.70 (10.40-11.01)	1
Female	4,074,702	10,463	25.7 (25.2-26.2)	0.40 (0.39-0.41)	2,037	5.00 (4.79-5.22)	0.41 (0.38-0.43)	1,282	3.15 (2.98-3.32)	0.30 (0.28-0.32)
Age at injury (years)										
0-4	1,646,599	4,110	25.0 (24.2-25.7)	1	730	4.43 (4.12-4.77)	1	887	5.39 (5.04-5.75)	1
5-9	1,692,220	7,495	44.3 (43.3-45.3)	1.61 (1.54-1.69)	756	4.47 (4.16-4.80)	0.90 (0.81-1.00)	400	2.36 (2.14-2.61)	0.39 (0.35-0.44)
10-14	1,738,319	10,325	59.4 (58.3-60.6)	2.06 (1.97-2.15)	1,475	8.49 (8.06-8.93)	1.69 (1.54-1.85)	732	4.21 (3.92-4.53)	0.69 (0.63-0.76)
15-19	1,649,377	9,154	55.5 (54.4-56.6)	1.81 (1.74-1.90)	2,277	13.81 (13.25-14.38)	2.68 (2.46-2.93)	1,899	11.51 (11.01-12.04)	1.83 (1.69-1.99)
20-24	1,665,855	7,418	44.5 (43.5-45.6)	1.38 (1.32-1.44)	2,191	13.15 (12.61-13.71)	2.39 (2.20-2.61)	1,984	11.91 (11.40-12.45)	1.78 (1.64-1.93)
SES, IMD 2010										
Quintile 1	1,914,100	7,939	41.5 (40.6-42.4)	1	1,314	6.86 (6.50-7.25)	1	1,035	5.41 (5.08-5.75)	1
Quintile 2	1,765,795	7,737	43.8 (42.8-44.8)	1.06 (1.02-1.10)	1,426	8.08 (7.66-8.51)	1.15 (1.06-1.24)	1,128	6.39 (6.02-6.77)	1.15 (1.05-1.25)
Quintile 3	1,545,129	7,044	45.6 (44.5-46.7)	1.10 (1.05-1.14)	1,360	8.80 (8.34-9.28)	1.23 (1.13-1.33)	1,046	6.88 (6.37-7.19)	1.19 (1.08-1.30)
Quintile 4	1,613,752	7,835	48.6 (47.5-49.6)	1.18 (1.14-1.23)	1,603	9.93 (9.45-1.04)	1.39 (1.29-1.51)	1,252	7.76 (7.33-8.20)	1.34 (1.23-1.46)
Quintile 5	1,486,921	7,631	51.3 (50.2-42.5)	1.22 (1.17-1.27)	1,662	11.18 (10.65-11.73)	1.51 (1.40-1.64)	1,392	9.36 (8.88-9.87)	1.56 (1.42-1.70)
Missing	71,896	316	44.0 (39.2-49.1)	1.16 (1.03-1.30)	64	8.90 (6.86-11.37)	1.36 (1.06-1.75)	49	6.82 (5.04-9.01)	1.24 (0.93-1.65)
Calendar year										
2001-2003	2,028,032	9,214	45.4 (44.5-46.4)	1	2,097	10.34 (9.91-10.79)	1	1,388	6.84 (6.49-7.21)	1
2004-2006	2,293,004	10,707	46.7 (45.8-47.6)	1.02 (0.99-1.06)	2,162	9.42 (9.04-9.83)	0.90 (0.84-0.96)	1,622	7.07 (6.74-7.43)	1.01 (0.94-1.09)
2007-2009	2,461,679	11,362	46.2 (45.3-47.0)	1.03 (0.99-1.06)	2,028	8.24 (7.89-8.60)	0.78 (0.73-0.84)	1,773	7.20 (6.87-7.55)	1.02 (0.95-1.10)
2010-2011	1,609,655	7,219	44.8 (43.8-45.9)	1.02 (0.98-1.06)	1,142	7.09 (6.69-7.52)	0.69 (0.64-0.74)	1,119	6.95 (6.56-7.37)	1.00 (0.92-1.08)

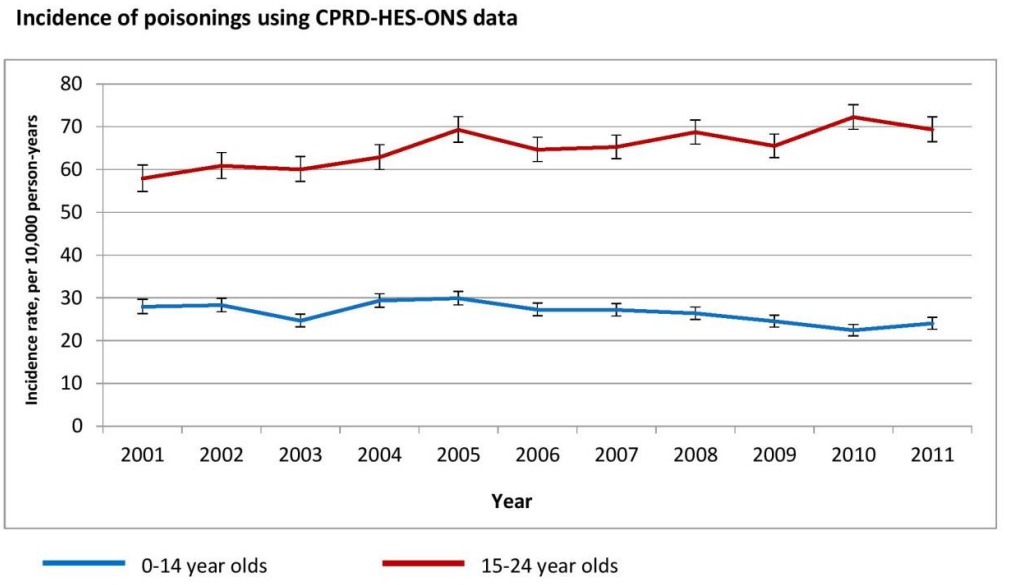
**mutually adjusted for age, sex, socioeconomic deprivation, calendar year and region*

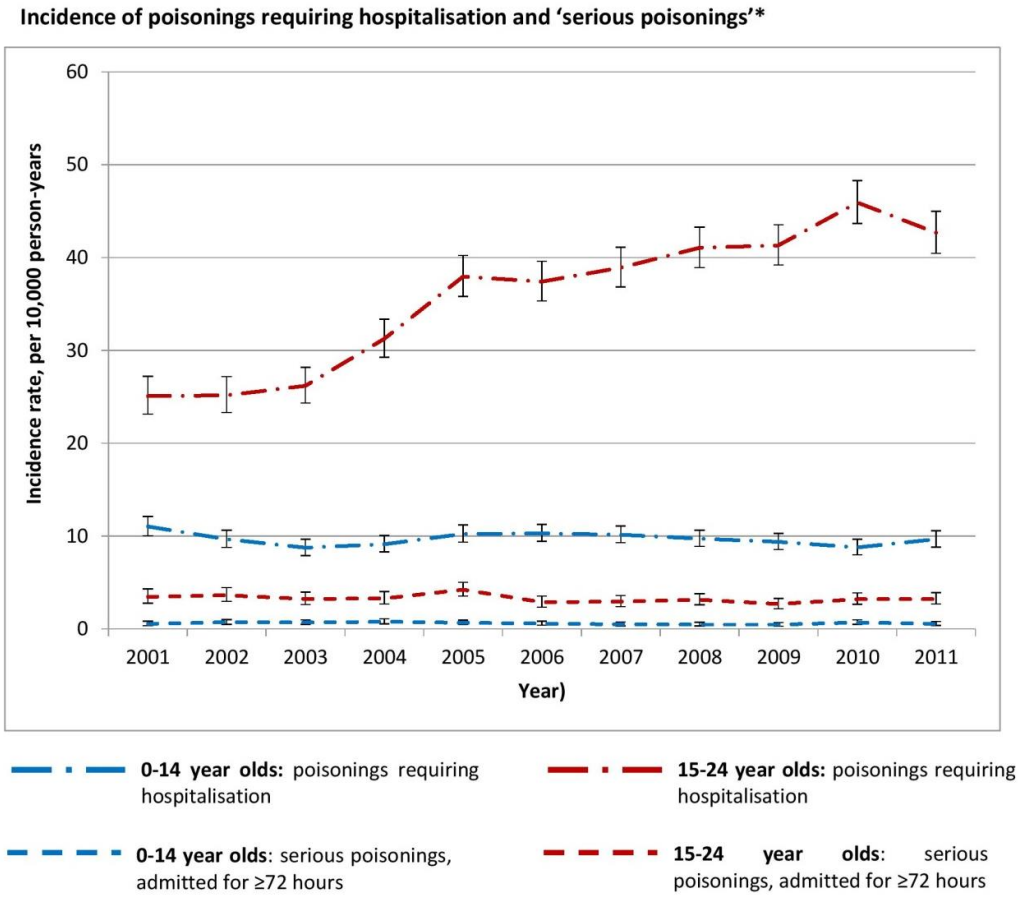
Table 4-11: Crude incidence rates and adjusted incidence rate ratios for burns requiring hospitalisation and 'serious burns', 0-24 year olds, 2001-2011

	Person-years	Incident burns requiring hospitalisation			Serious burns (hospitalised ≥72 hours)			Serious burns (based on ICD-10 code)		
		Incident events	Incidence rate per 10,000 PY (95% CI)	Adjusted IRR* (95%CI)	Incident events	Incidence rate per 10,000 PY (95% CI)	Adjusted IRR* (95%CI)	Incident events	Incidence rate per 10,000 PY (95% CI)	Adjusted IRR* (95%CI)
Overall	8,392,371	2,758	3.29 (3.17-3.41)	-	594	0.71 (0.65-0.77)	-	928	1.11 (1.04-1.18)	-
Sex										
Male	4,317,669	1,727	4.00 (3.82-4.19)	1	382	0.88 (0.80-0.98)	1	546	1.26 (1.16-1.38)	1
Female	4,074,702	1,031	2.53 (2.38-2.69)	0.62 (0.58-0.68)	212	0.52 (0.45-0.60)	0.58 (0.49-0.69)	382	0.94 (0.85-1.04)	0.73 (0.64-0.84)
Age at injury (years)										
0-4	1,646,599	1,510	9.17 (8.72-9.64)	1	302	1.83 (1.64-2.05)	1	599	3.64 (3.36-3.94)	1
5-9	1,692,220	262	1.55 (1.37-1.75)	0.16 (0.14-0.18)	49	0.29 (0.22-0.38)	0.14 (0.11-0.20)	93	0.55 (0.45-0.67)	0.14 (0.11-0.18)
10-14	1,738,319	310	1.78 (1.60-1.99)	0.18 (0.16-0.20)	56	0.32 (0.25-0.42)	0.16 (0.12-0.21)	77	0.44 (0.35-0.55)	0.11 (0.09-0.14)
15-19	1,649,377	338	2.05 (1.84-2.28)	0.20 (0.18-0.22)	90	0.55 (0.44-0.67)	0.26 (0.21-0.33)	80	0.49 (0.39-0.60)	0.12 (0.10-0.15)
20-24	1,665,855	338	2.03 (1.82-2.26)	0.18 (0.16-0.20)	97	0.58 (0.48-0.71)	0.25 (0.20-0.32)	79	0.47 (0.38-0.59)	0.11 (0.08-0.14)
SES, IMD 2010										
Quintile 1	1,914,100	381	1.99 (1.80-2.20)	1	81	0.42 (0.34-0.53)	1	124	0.65 (0.53-0.77)	1
Quintile 2	1,765,795	415	2.35 (2.13-2.59)	1.17 (1.02-1.36)	84	0.48 (0.38-0.59)	1.12 (0.82-1.52)	152	0.86 (0.73-1.01)	1.37 (1.07-1.76)
Quintile 3	1,545,129	476	3.08 (2.81-3.37)	1.52 (1.32-1.75)	98	0.63 (0.52-0.77)	1.46 (1.08-1.96)	153	0.99 (0.84-1.16)	1.56 (1.22-2.01)
Quintile 4	1,613,752	648	4.02 (3.71-4.34)	1.93 (1.69-2.21)	141	0.87 (0.74-1.03)	1.94 (1.47-2.57)	235	1.46 (1.28-1.66)	2.25 (1.78-2.84)
Quintile 5	1,486,921	810	5.45 (5.08-5.84)	2.34 (2.04-2.67)	183	1.23 (1.06-1.42)	2.55 (1.93-3.35)	275	1.85 (1.64-2.08)	2.64 (2.09-3.34)
Missing	71,896	28	3.89 (2.59-5.63)	1.56 (1.06-2.29)	7	0.97 (0.39-2.01)	2.04 (0.94-4.42)	10	1.39 (0.67-2.56)	1.70 (0.89-3.27)
Calendar year										
2001-2003	2,028,032	581	2.86 (2.64-3.11)	1	149	0.73 (0.63-0.86)	1	185	0.91 (0.79-1.05)	1
2004-2006	2,293,004	792	3.45 (3.22-3.70)	1.22 (1.09-1.36)	169	0.74 (0.63-0.86)	1.01 (0.81-1.26)	262	1.14 (1.01-1.29)	1.31 (1.08-1.60)
2007-2009	2,461,679	790	3.21 (2.99-3.44)	1.11 (0.99-1.24)	170	0.69 (0.59-0.80)	0.92 (0.74-1.14)	266	1.08 (0.96-1.22)	1.19 (0.98-1.45)
2010-2011	1,609,655	595	3.70 (3.41-4.01)	1.23 (1.09-1.39)	106	0.66 (0.54-0.80)	0.85 (0.66-1.09)	215	1.34 (1.17-1.53)	1.42 (1.15-1.75)

**mutually adjusted for age, sex, socioeconomic deprivation, calendar year and region.*

Figure 4-15: Poisoning incidence, hospitalisations, and hospitalisations requiring admission for 72 hours or more, among children and young people aged 0-24 by calendar year





*Incidence rates of serious poisonings defined using ICD-10 codes are not shown due to small numbers of cases.

Figure 4-16: Fracture incidence, hospitalisations, and hospitalisations requiring admission for 72 hours or more, among children and young people aged 0-24 by calendar year

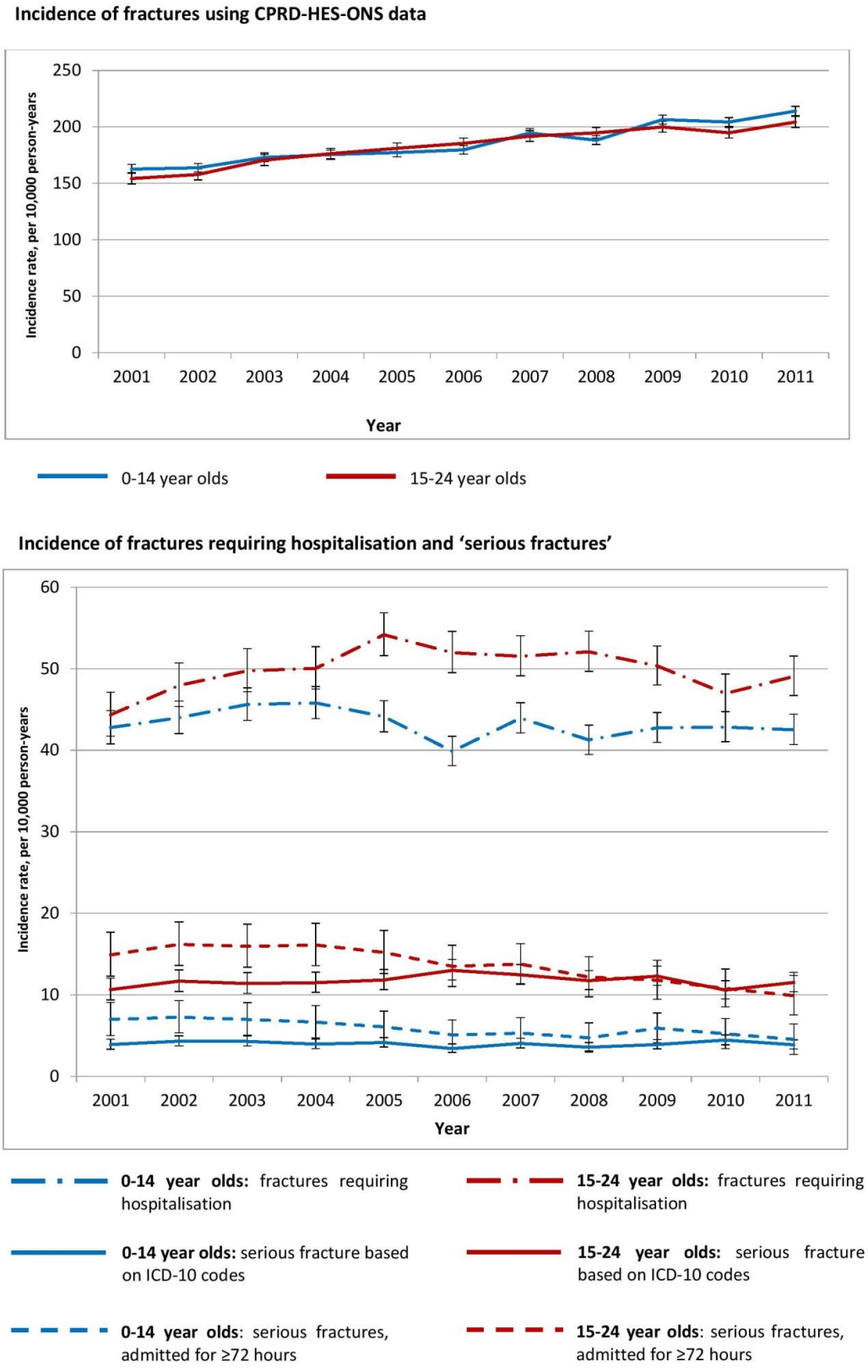
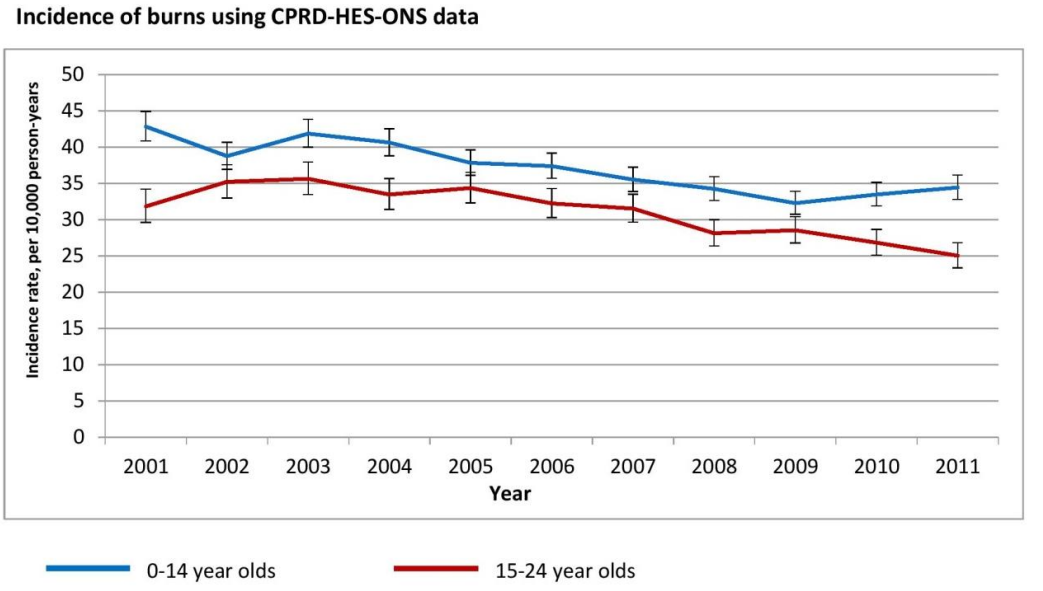
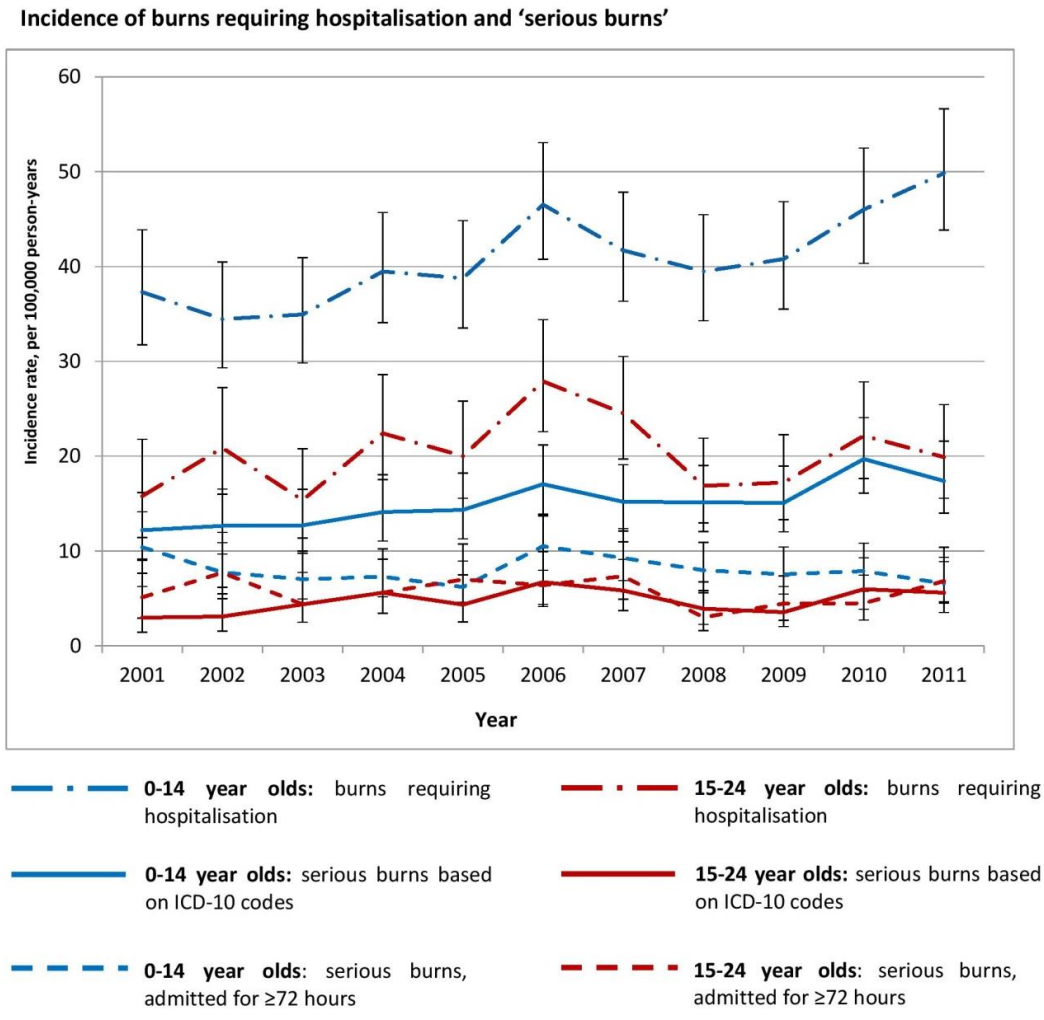


Figure 4-17: Burns incidence, hospitalisations, and hospitalisations requiring admission for 72 hours or more, among children and young people aged 0-24 by calendar year





4.6 Discussion

4.6.1 Summary of key findings

At the time of completing the work presented in this chapter, it was the first in the UK to estimate injury incidence using linked primary care, hospitalisation and mortality data, with methods developed to define incident injury events across these linked data sources. This work has demonstrated that it is essential to use multiple data sources to provide more complete estimates of injury incidence, as many injury events are only captured within a single data source. Estimates of fracture and burn incidence were similar in sensitivity analyses when time-windows used to define incident events were doubled, and less specific codes were excluded. Estimates of poisoning incidence were similar when time-windows were doubled, but were significantly lower when less specific codes were excluded. Recording of an injury mechanism and/or intent was low (2-4%) within primary care data for burn and fracture events, contrasting with the high proportion of events in hospitalisation and mortality data with this information recorded (80-100%). Poisoning intent was well recorded across all three data sources.

Notably different patterns in injury incidence were observed by age, sex, calendar year and socioeconomic deprivation for the three injury types, reflecting differences in underlying mechanism and intent. Children from more deprived areas had higher injury rates, with the strength of the socioeconomic gradient varying by age, calendar year and injury type. Among 0-24 year olds socioeconomic inequalities increased over time for poisonings, but narrowed for burns and fractures. Fracture incidence rates increased between 2001 and 2011 for all ages, whereas poisoning incidence increased only among 15-24 year olds, and burns incidence reduced over time.

Socioeconomic gradients were steeper for serious injuries compared to socioeconomic gradients for all injuries of that type. There was a notable increase in the incidence of poisoning hospitalisations among 15-24 year olds after 2003, which was not seen among 0-14 year olds. There was a significant reduction in the incidence of fractures requiring hospitalisation for 72 hours or more between 2001 and 2011; a reduction which was not observed in the incidence of all fracture hospitalisations or serious fractures defined by ICD-10 codes. A 21% reduction in the incidence of all burns (identified in CPRD-HES-ONS

mortality data) between 2001-2003 and 2010-2011 contrasted with a 23% increase in the incidence of burn hospitalisations between these time periods.

4.6.2 Strengths and limitations

4.6.2.1 External validity

Linked CPRD-HES-ONS data are broadly representative of the UK population in terms of age and sex(220, 227), and offer one of the most complete and accurate methods currently available in England to estimate injury incidence. Work by Crooks *et al,* comparing the population with linked CPRD-HES data to demographic data for England, has demonstrated some underrepresentation of children aged less than 1 year and young adults aged 18-28 years old within linked CPRD-HES data(227); likely to relate to delayed general practice registration of infants after birth, and changes in life circumstances among young adults (e.g. moving home, going to university). In addition, there is some underrepresentation of practices from the North East, East Midlands and Yorkshire and The Humber(227), in part reflecting regional variation in the uptake of the Vision clinical software system required for participation in the CPRD. Underrepresentation of young adults, and those from the North East, East Midlands and Yorkshire and The Humber could lead to some underestimation of injury incidence, as rates tend to be higher in these groups(1, 71). Ongoing recruitment of practices to CPRD, and plans for future widespread access to primary care data across the UK(246) should increase population and geographical coverage.

4.6.2.2 Bias

A time-based algorithm was used to identify incident injury events within linked data, enabling the identification of multiple injury events per child over time; an issue of importance in estimating injury burden and for surveillance. There are however limitations with this method. An injury record may have erroneously been treated as a continuation of the same event, when in fact a child had multiple injuries of the same type occurring in a short time period. Conversely, the number of injury events may have been over counted among those children requiring prolonged follow-up (e.g. severe burns). This is unlikely to have led to substantial misclassification of injury events, as even when the time-windows used to define incident injury events were doubled, incidence rates overall and by child age were broadly similar to the primary analysis for all injury types.

Primary care data are not primarily collected for research purposes and as such there are a broad range of Read codes that can be used to record injury occurrences, some of which are less specific. No studies have validated the recording of poisonings or burns within primary care data, and studies considering fractures have so far focused upon certain specific fractures in adults (e.g. hip and vertebral fractures)(231, 247). Misclassification of the injury outcome may have occurred as a result of including less specific Read codes in the definition of poisonings, fractures and burns; although a sensitivity analysis for fractures and burns demonstrated similar incidence rates to the primary analysis when these codes were excluded. For poisonings however, the exclusion of less specific codes led to a notable reduction in poisoning incidence (17%), indicating there may be some overestimation of poisoning incidence, and that there is need for validation work to better understand how injuries are recorded in primary care data.

ED data are yet to be linked to the CPRD; an important limitation of this work. General practitioners receive information about their patients' attendances at EDs, outpatient clinics and hospitalisations. At present, without linked ED data, there is reliance upon the GP both receiving information about ED attendances and recording this information in the primary care record using Read codes. Injury occurrences will not have been identified if information was recorded in the primary care record using non-specific codes (e.g. seen in ED) or within the free text of the record. The extent to which ED attendances are captured in the primary care record is unknown and difficult to quantify. Ascertainment bias could however be introduced if there are differences in the recording of ED attendances in the primary care record according to patient characteristics (e.g. child age, socioeconomic deprivation). For example, better recording of injury occurrences among those from more deprived areas could lead to an overestimation of the socioeconomic gradient between the most and least deprived groups. This highlights the need for future linkage to ED data (when it becomes available) to maximise the capture of injury occurrences and to minimise any potential biases in the recording of injury events within primary care data.

Injury ascertainment within the CPRD and HES may also be affected by changes in policy, clinical guidelines, hospital admission thresholds, and coding practices over time. While observed increases or decreases in injury incidence may reflect a true change in incidence, changes in injury ascertainment could be an important alternative

explanation. For example, the notable increase in poisoning hospitalisations among 15-24 year olds after 2003 is likely to reflect the introduction of NICE guidance on the management of self-harm in 2004, recommending inpatient admission and psychiatric assessment for those aged less than 16 years(248). It is possible that this new guidance may not only have increased numbers of young people being admitted to hospital (potentially improving ascertainment in CPRD-HES-ONS data), but could also have affected how GPs manage and document self-harm in primary care (i.e. coding may improve). Other important changes over the study period include a reorganisation of burns services with a lowering of admission thresholds(249, 250), and recommendations that paediatric short stay units are widely implemented(251), potentially increasing numbers of children admitted for observation who once would have been managed in ED alone(252). Similarly, rates of injuries requiring hospitalisation for 72 hours or more are potentially affected by changes in injury management over time, such as new treatment techniques, or increased availability of outpatient services leading to reductions in length of stay.

Read codes specifying a mechanism and/or intent were infrequently used within the CPRD for the injury types assessed. Further information may be recorded within the free text of the record or coded in alternative ways. For example, where a GP may have safeguarding concerns and suspect an intentional injury, a code such as 'referral to social services' may be used(253) without an injury code. For these reasons, the recording of mechanisms and intent in primary care data may have been underestimated; although this finding does reflect data that can be routinely extracted from the CPRD and that corresponds to the ICD-10 external cause codes. Further attention is given to the issue of identifying intentional injuries among 0-4 year olds in Chapter 6.

As data on injury mechanism and/or intent are important for the development of injury prevention programmes, the low recording of external causes of injury within primary care data is an important limitation. The presented data (Figure 4-10) on causes of injury only reflect those events leading to hospitalisation and/or death, and so over represent some injury mechanisms. For example, the percentage of fractures due to transport accidents (15.7%) is considerably higher than estimates from ED data (1.4% of fractures in 0-14 year olds(254)). Additionally, information about specific consumer products (e.g. dishwasher tablets) and where the injury occurred (e.g. playground) are poorly captured

in these data. In future, linkage of ED data to CPRD may provide more comprehensive data on injury mechanisms for those injuries not leading to hospitalisation or death; although it is unknown how complete this information will be in the ED record.

4.6.2.3 Confounding

Patterns of injury by subject characteristics, socioeconomic deprivation and over time were described, with incidence rate ratios adjusted for age, sex, socioeconomic deprivation, region and calendar year. It is however possible that there could be residual confounding, as a result of measurement error, or as a result of not having data on some potential confounders. For example, socioeconomic deprivation varies between ethnic groups(255), as do injury rates(86, 87). Due to the large amount of missing ethnicity data (>30%) for the study population, this variable was not used within the analyses, and so could lead to some residual confounding. In addition socioeconomic deprivation was based on the lower super output area of the patient's residence, which may not accurately reflect an individual's socioeconomic position. This measure of socioeconomic deprivation is however relevant to those planning and delivering services as many injury prevention programmes are delivered at population levels.

4.6.2.4 Chance

The large study population of nearly 2 million children and young people provides ample study power to examine injury patterns, including rarer injury outcomes (e.g. serious burns), according to subject characteristics, socioeconomic deprivation and over time. There is however the potential that due to the large sample size, statistically significant differences between groups may be identified that have limited clinical importance. When testing for interactions a lower *p* value of 0.01 was used due to the large sample size, and to reduce the likelihood of a type 1 error as a result of carrying out multiple statistical tests.

4.6.3 Comparison with existing data sources and published studies

4.6.3.1 Methods to identify incident injury events from routine health data

Distinguishing between multiple health records for the same and different injury events is a well-recognised challenge of estimating injury incidence from routine health data(35) with previous studies attempting to overcome this problem by only including one injury event per individual in the study(71), excluding re-attendances for the same

injury(62) or by using time-based algorithms(256, 257). In a study using CPRD, Cooper *et al* only included the first fracture Read code recorded in each child's record to prevent double counting of injuries(71), however, this method will not represent overall injury burden as is required by surveillance as it excludes children sustaining repeated injuries over time. Three previous injury studies have used time-windows to identify separate injury events within large health and administrative data sources(77, 256, 257). For example, Spady *et al* created injury episodes using a time-window of 180 days to separate injury events for 17 different categories of injury, ranging from foreign bodies, to multiple fractures of limbs(257). The use of a single time-window for all injury types however neglects the heterogeneity in clinical management, healing time, and recurrence frequency of different injuries. The work presented in this chapter has attempted to address these issues more specifically by taking account of both injury type and whether the patient was initially hospitalised.

4.6.3.2 The Home and Leisure Accident Surveillance System

As most existing data on patterns of injuries among children and young people in the UK come from single-centre studies(258, 259) or studies focusing on admission rates to hospital(260, 261) or specialist units(126), few comparable data exist for estimates of overall injury incidence. Until 2002, the HASS/LASS injury surveillance system collected data from a sample of 16-18 EDs in the UK, using these data to generate estimates of the numbers of injuries occurring nationally. While injury estimates from HASS/LASS are not directly comparable to those generated using CPRD-HES-ONS mortality data (Table 4-12), data were requested from HASS/LASS for poisonings, fractures and burns for 0-24 year olds for the purpose of comparing both the magnitude of injury rates and the patterns of injury by age and sex.

For the period 2001-2002, HASS/LASS used data from a sample of EDs to estimate that 769,470 fractures and 117,108 burns occurred among children and young people aged 0-24 living in the UK(262). This compares to an estimated 590,322 fractures and 139,008 burns during this time period using CPRD-HES-ONS data; estimated by applying estimated incidence rates by age and sex to the UK mid-year population estimates for 2001 and 2002. Differences in estimates for burns are likely to relate to differing definitions of burns (i.e. corrosions and abrasion burns were not included by HASS/LASS), and differences in the capture of injury occurrences (e.g. HASS/LASS will

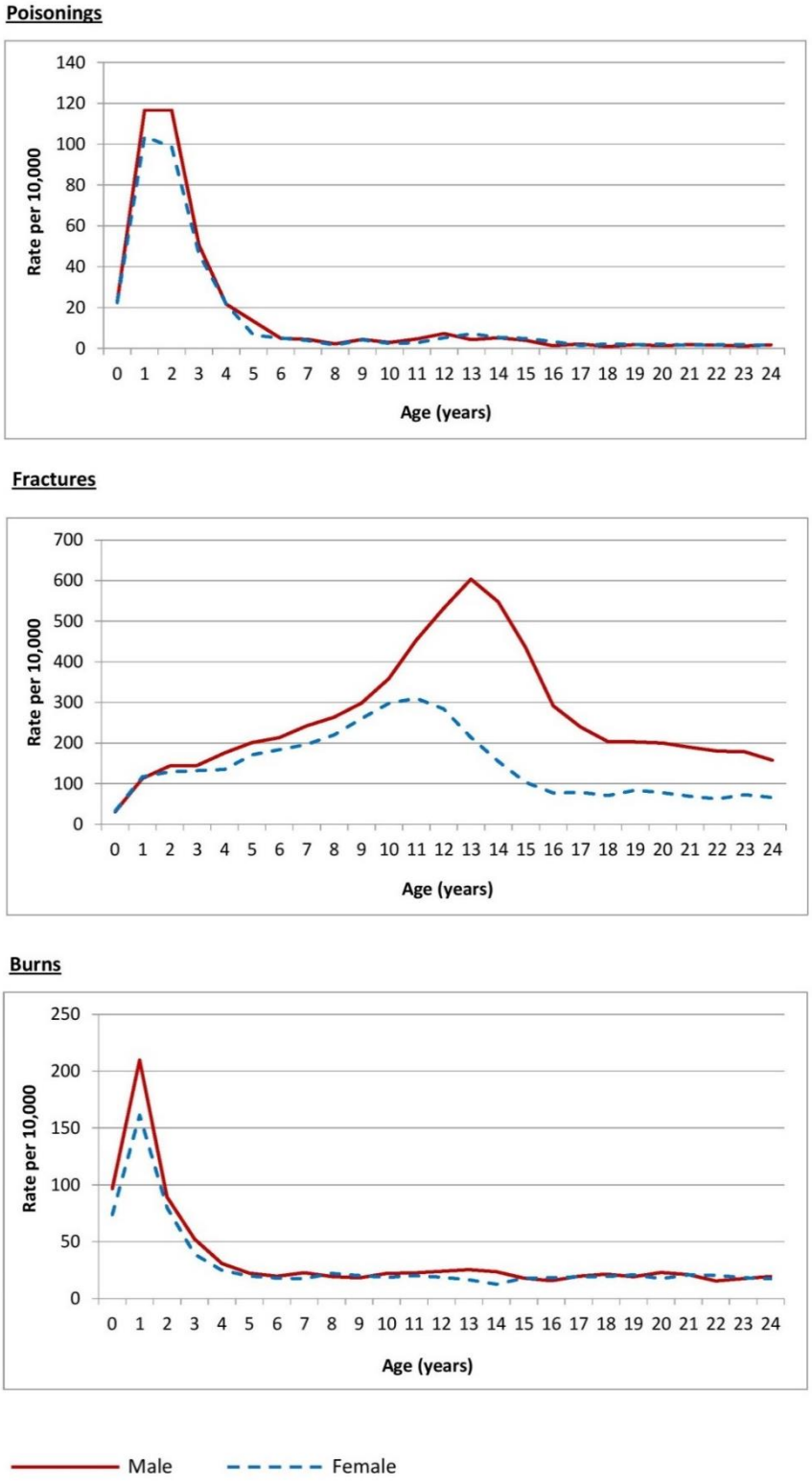
not capture burns only seen in primary care). For fractures, there is a potential underestimation of fracture occurrences by 23% in CPRD-HES-ONS mortality data; potentially reflecting under recording of attendances at ED in the primary care record. For fractures and burns, patterns by age and sex using HASS/LASS data (Figure 4-18) are remarkably similar to the patterns demonstrated in CPRD-HES-ONS mortality data (Section 4.5.4.1).

For poisonings, HASS/LASS only captures home and leisure accidents, therefore excluding nearly all poisoning events in young people (Figure 4-18). For children aged 0-4 an estimated 42,639 poisonings occurred using HASS/LASS data for the period 2001-2002, compared to 35,178 using CPRD-HES-ONS mortality data, indicating a possible underestimation of about 18%.

Table 4-12: Comparison between linked CPRD-HES-ONS data and the Home and Leisure Accident Surveillance System

	CPRD-HES-ONS mortality data	HASS/LASS data
Source of data	• Primary care, hospitalisation and mortality data for patients from 356 general practices in England • Time-based algorithm to exclude re-attendances for the same injury, or duplicate records for the same injury in multiple data sources	• Data from a sample of 16-18 EDs from the UK. Data from these EDs were used to provide national estimates of injury occurrences.
Sources of under- or over-estimation of injury rates	• Definition of burns includes 'corrosions' and abrasion burns, which differs to HASS/LASS which focuses on thermal injuries. • No linked ED data so will underestimate the incidence of injuries • Some underrepresentation of practices from the North East, Yorkshire and The Humber and East Midlands, and so may underestimate injury rates	• Will capture re-attendances for the same injury occurrence, so may overestimate injury rates • As data come from a sample of EDs, injury estimates may not be generalizable to the UK population (e.g. if EDs are based in more deprived cities) • Will not capture injuries that immediately lead to death (prior to hospitalisation) or minor injuries seen in primary care, and so will underestimate overall incidence • Excludes road traffic incidents and assault, and so will underestimate fracture incidence • Focus is on home and leisure injuries, and so excludes intentional self-harm, so does not capture poisonings in young people

Figure 4-18: Rates of poisonings, fractures and burns by age and sex, using data from the HASS/LASS injury surveillance system*, 2001-2002



** Data on the number of poisoning, fracture and burn events occurring between 2001 and 2002 were requested from HASS/LASS, with rates calculated using mid-year population estimates for 2001-2002 from the UK.*

4.6.3.3 Comparison with existing studies

1.2.1.1.1 Incidence estimates

UK studies describing the occurrence of poisonings commonly use data from individual hospitals(259), or focus upon hospitalisation rates alone(75, 101, 261). In this thesis, poisoning incidence peaked at ages 2 and 18 years old, reflecting the different aetiologies of poisonings in preschool children compared to young people (unintentional versus intentional)(263). The most comprehensive data on poisoning rates come from US and Canadian injury surveillance programmes (Table 4-13). Franklin *et al* (2008) used data from a US surveillance system, estimating poisoning incidence for children aged 0-4 as 42.9/10,000; consistent with the estimate of 43.3/10,000 for this age group using CPRD-HES-ONS mortality data(264). A comprehensive surveillance system capturing ED attendances, hospitalisations and deaths from poisonings in Columbia, estimated poisoning incidence in 10-19 years olds as 61.8/10,000(265), which compares to 47.6/10,000 for this age group in CPRD-HES-ONS data.

Estimates of fracture incidence using CPRD-HES-ONS mortality data are broadly consistent with other UK and European studies (Table 4-14); with estimates generally lower than studies that have used ED(266-269) or self-reported data(86, 270), but higher than studies that have used primary care research databases(71, 77, 271). For example, Rennie *et al* used a hospital-based database, estimating fracture incidence as 202/10,000 for 0-16 year olds living in Edinburgh(267). In this study, 1.2% of children sustained multiple fractures, with each fracture included separately, which in part explains the lower incidence of 190.8/10,000 for this age group using CPRD-HES-ONS data. Similarly, Lyons *et al* used a Welsh database of ED attendances, giving an incidence of 361/10,000 for 0-14 year olds(254). This compares to an estimate of 185.0/10,000 for children of this age, which is likely to reflect under ascertainment of ED attendances within CPRD-HES-ONS data, but may also relate to higher fracture rates in Wales compared to England(71). The three previous studies that have used primary care research databases present lower incidence rates(71, 77, 271), as none of these studies have used linked HES or ONS mortality data, and so will not have captured some fracture events leading to hospitalisation or death that were not recorded in the primary care record.

Existing data on the epidemiology of burns in the UK most commonly comes from single-centres(272) or analyses of hospitalisation(75, 260) or specialist burn unit datasets(38, 126), with these studies often not reporting injury rates. A large cohort study using self-reported data from England reported burn rates of 215.5/10,000 for boys and 160.4/10,000 for girls aged 5.5(270) (Table 4-15); rates considerably higher than those estimated using CPRD-HES-ONS data, but explained by the high proportion of these burns that were managed at home (84.3%). Injury surveillance systems from high-income countries estimate burn rates as between 21/10,000 and 82/10,000 among 0-4 year olds(273-278), compared to 61.6/10,000 person-years for this age group using CPRD-HES-ONS data; with differences in estimates reflecting the time period studied and whether the surveillance system also captured primary care attendances and deaths.

Table 4-13: Existing studies reporting incidence rates of poisonings

Study	Data source(s)	Poisoning definition	Age of subjects	Setting	Year(s)	Incidence per 10,000		Incidence rate per 10,000 PY using CPRD-HES-ONS data for same age group, 2001-2011[#]
UK Studies								
Patel, 2006(279)	ED departments, 18 EDs HASS/LASS	Unintentional	0-14	UK	1990-1999	~80 (1999, 0-4 year olds)		43.3
Orton, 2014(77)	THIN	Unintentional	0-4	UK	1990-2009	37.3		43.3
Tyrrell, 2016(280)	THIN	All intents	10-17	UK	1992-2012	32.4		41.1
Non-UK studies								
Cheng, 2006(265)	ED attendances, hospitalisations, deaths. Columbia, 6 hospitals	Unintentional, intentional, alcohol	10-19	US	1996-1998	61.8		47.6
Prosser, 2007(281)	ED attendances, NEISS	Self-harm	15-19	US	2001-2004	24.8 (females)		101.7 (15-19 females)
Franklin, 2008(264)	ED attendances, NEISS	All intents	0-4	US	2004	42.9		43.3
Xiang, 2012(282)	ED attendances, NEDS	Medications/ drugs	0-5 6-11 12-17 18-20 21-24	US	2007	25.5 28.0 25.6 36.3 31.7		38.4 11.0 51.0 74.3 57.4
WISQARS(273) (Web based injury statistics query and reporting system)	ED attendances, NEISS	All intents	0-4 5-9 10-14 15-19 20-24	US	2001-2014	26.3 38.8 10.2 43.1 45.7		43.3 11.2 25.4 71.0 60.1

#To aid comparison with existing studies, incidence rates using CPRD-HES-ONS mortality data were calculated for the same age of children and young people. It must however be noted that these are not necessarily comparable time periods nor poisoning definitions, and so differences in rates may in part reflect changes in incidence over time and different poisoning definitions.

***CHIRPP**: Canadian Hospitals Injury Reporting and Prevention Program. Surveillance system 16 Canadian EDs. **HASS/LASS**: Home and Accident Surveillance System. Surveillance system 16-18 EDs UK. **NEDS**: Nationwide Emergency Department Sample. Large all-payer ED dataset US, ~970 hospitals, 27 States. **NEISS**: National Electronic Injury Surveillance System. National probability sample ~100 US hospitals. **THIN:** The Health Improvement Network. Large UK primary care research database.*

Table 4-14: Existing studies reporting incidence rates of fractures

Study	Data Source(s)	Age of subjects	Setting	Study period	Incidence per 10,000		Incidence rate per 10,000 PY using CPRD-HES-ONS data for same age group, 2001-2011[#]
UK Studies							
Worlock, 1986(283)	Single hospital	0-12	England	1981	160		166.5
Lyons, 1999(254)	ED data	0-14	South Wales	1996	361		185.0
Cooper, 2004(71)	CPRD (primary care database)	0-18	UK	1988-1998	133		190.7
Rennie, 2007(267)	Inpatient and outpatient records, 2 hospitals	0-16	Edinburgh	2000	202		190.8
Donaldson, 2008(86)	Self-reported, Health Survey for England	0-14	England	2002-2004	490 (white males)		222.8 (males)
Mytton, 2011(270)*	ALSPAC	5.5	UK	1996-1997	216 (males) 108 (females)		155.2 (males age 5) 129.6 (females age 5)
Orton, 2014(77)	THIN (primary care database)	0-4	UK	1990-2009	75.8		93.6
Ramaesh, 2015(266)	Database of fractures, 2 hospitals Edinburgh	0-16	Scotland	2000	201.2		190.8
Moon, 2016(271)	CPRD (primary care database)	0-18	UK	1988-2012	137		190.7
Non-UK studies							
Landin, 1983(284)	Hospitalisations, ED attendances, Malmö	0-16	Sweden	1950-1979	212		190.8
Kopjar, 1998(285)	Database inpatient and outpatient care for fractures	0-12	Norway	1992-1995	128		166.5
Tiderius, 1999(286)	ED, hospitalisations, Malmö	0-16	Sweden	1993-1994	193		190.8
Lyons, 2000(287)	ED and hospitalisation data	0-14	Scandinavia	1996	154-178		185.0
Moustaki, 2001(288)	ED attendances	0-14	Greece	1996-1998	120		185.0
Brudvik, 2003(289)	2 hospitals, ED attendances, outpatient fracture clinics	0-15	Norway	1998	245		189.7
Hedstrom, 2010(268)	ED, hospitalisations	0-19	Sweden	1993-2007	201		190.4
Mäyränpää, 2010(290)	Single hospital, Helsinki	0-15	Finland	2005-2006	163		189.7
Hedstom, 2014(269)	ED, hospitalisations, 1 hospital	0-19	Sweden	1998-2011	223		190.4
Randsborg, 2014(291)	Single hospital, fracture clinic, hospital/ED attendances	0-16	Norway	2010-2011	180.1		190.8

**Self-reported data from the ALSPAC study when the child was aged 5.5 years, reporting the occurrence of a fracture in last 12 months.*

#To aid comparison with existing studies, incidence rates using CPRD-HES-ONS mortality data were calculated for the same age of children and young people. It must however be noted that these are not comparable time periods, and so differences in rates may in part reflect changes in incidence over time and by region/country.

***ED**: Emergency Department. **THIN**: The Health Improvement Network. **CPRD**: Clinical Practice Research Datalink. **ALSPAC**: Avon Longitudinal Study of Parents and Children.*

Table 4-15: Existing studies reporting rates of burns in children and young people

Study	Data source(s)	Age of subjects	Setting	Year(s)	Incidence per 10,000		Incidence rate per 10,000 PY using CPRD-HES-ONS data for same age group, 2001-2011[#]
UK Studies							
Mytton, 2011(270)*	ALSPAC	5.5	UK	1996-1997	215.5 (boys) 160.4 (girls)		27.4 (male age 5) 25.4 (female, age 5)
Orton, 2014(77)	THIN, primary care data	0-4	UK	1990-2009	57.9		61.6
Non-UK studies							
Gallagher, 1984(278)	Deaths, hospitalisations, ED attendances	0-5 6-12 13-19	Massachusetts, US	1980-1981	82 21 54		55.7 24.4 31.3
Van Rijn, 1991(276)	Registration system, medically treated burns, hospitals and general practitioners	0-4	The Netherlands	1988-1989	77.5		61.6
den Hertog, 2000(275)	ED attendances	0-4 5-14 15-24	The Netherlands	1992-1996	21.0 8.5 12.8		61.6 25.2 30.9
Wibbenmeyer, 2003(277)	ED attendances	0-4	Iowa, US	1997-1999	40.6		61.6
Fagenholz, 2007(292)	ED attendances	0-9	US	1993-2004	33		42.5
Wasiak, 2009(274)	ED attendances	0-4	Australia	2000-2006	21.9		61.6
WISQARS(273) (Web based injury statistics query and reporting system)[$]	ED attendances for burns/fires	0-4 5-9 10-14 15-19 20-24	US	2001-2014	33.6 10.7 8.8 17.0 21.9		61.6 23.9 26.4 32.9 28.9

**Self-reported data from the ALSPAC study when the child was aged 5.5 years, reporting the occurrence of a scald or burn in last 12 months. 84.3% of these burns were reported to be managed at home with no medical attention sought, explaining the considerably higher rate of burns in this study.*

[$]WISQARS: uses data from the National Electronic Injury Surveillance System (NEISS), a US injury surveillance system, which enables estimates of numbers of injury events and injury rates to be made at a national level

#To aid comparison with existing studies, incidence rates using CPRD-HES-ONS mortality data were calculated for the same age of children and young people. It must however be noted that these are not comparable time periods, and so differences in rates may in part reflect changes in incidence over time, definitions of burns, and by region/country.

4.6.3.4 Patterns by child characteristics

4.6.3.4.1 Age and sex

The observed patterns of injury incidence by age and sex are consistent with available literature. Similar to UK and European studies(71, 290, 293), a higher and later peak in fracture incidence was seen among males compared to females. A peak in burns and poisoning incidence at ages 1-2 years, higher among males than females, is consistent with studies using hospitalisation and ED data(81, 264, 294), and can largely be explained by the developmental changes and exploratory behaviour of children at this age(81, 294). Young women aged 15-24 had substantially higher rates of poisonings than males; consistent with studies of adolescent self-harm showing considerably higher rates among females(82, 259, 295).

4.6.3.4.2 Socioeconomic deprivation

Higher poisoning and burn incidence rates among more deprived groups is consistent with existing hospital-based studies(75, 101, 260, 261). Comparatively, literature on socioeconomic differences in fracture rates is less consistent(75, 296, 297). For example, Stark *et al* found children aged 0-14 from deprived areas of Glasgow had a 25% higher rate of fractures than those living in the least deprived areas(296); differing from Lyons *et al* who found no association between socioeconomic deprivation and fracture rates among children in Wales(297). In this chapter, socioeconomic gradients have been shown to vary by child age, calendar time and according to injury severity; reasons which could explain the differing findings of existing studies, which have been carried out in different time periods and using different study populations. Steeper socioeconomic gradients were demonstrated for more severe injuries compared to overall injury incidence. This potentially indicates that those from the most deprived groups not only have higher injury rates, but also more severe injuries; consistent with evidence from some previous studies(75, 298).

4.6.3.4.3 Calendar time

Similar to a recent study of poisoning hospitalisations(261) and a large cohort study using primary care data(77), reductions were observed in the incidence of poisonings and burns among children aged 0-4 over time. These observed reductions may reflect improved public awareness, legislative changes and successes of preventative

programmes(299). In contrast, there was an increase in fracture incidence rates over time across all ages, similar to a Swedish study of 0-19 year olds that found a 59% increase in fracture incidence rates between 1993 and 2007, from 151/10,000 to 240/10,000(268). Comparatively, a study from Finland of 0-15 year olds found an 18% reduction in fracture incidence between 1983 and 2005, although trends differed by fracture site (e.g. increase in forearm fractures)(290). Explanations for an increase in fracture incidence may include increasing childhood obesity, associated with both upper and lower limb fractures(300, 301), and changes in child leisure activities, with the clearest example being the increase in fractures related to trampolines(302). These explanations however may not fully explain the trend observed, particularly as there have been reductions in other fracture mechanisms, such as road traffic accidents(303). Another possible explanation is that there have been improvements in the recording of fractures in the primary care record, which could relate to changes in service pathways (e.g. redesigns of fracture clinics(304)) and how information is communicated to GPs. Assessment of incidence rates according to fracture site, and the future linkage of ED data to the CPRD (when it becomes available) will be important in verifying this trend. Observed reductions in the incidence of fractures requiring hospitalisation for 72 hours or more, without reductions in rates of serious fractures defined by ICD-10, may reflect changes in treatments available and service pathways (e.g. more outpatient services) enabling quicker hospital discharge.

The decision to admit a patient to hospital is affected by a number of supply and demand factors; such as the availability of services (e.g. introduction of paediatric short stay units(251)), changes in clinical practice, the social circumstances of the patient, and the clinical preferences of physicians(305). Poisoning hospitalisation rates increased notably after 2003 among those aged 15-24 years old, potentially reflecting the introduction of NICE guidelines on the management of self-harm in 2004(248). Observed increases in the overall incidence of poisonings in CPRD-HES-ONS among 15-24 year olds could reflect a true increase in the incidence of self-poisonings(306). On the other hand, this could also reflect increased health seeking behaviour (e.g. more media attention/awareness so young people seek medical attention), changes in GP coding of poisonings (e.g. in response to the introduction of NICE guidance), and improved ascertainment of poisoning events if more young people are being admitted (i.e. all hospitalisations are captured in HES).

Previous studies using hospitalisation(260) and specialist burns unit data(126) from England observed an increase in burns hospitalisation rates after 2006-2008; potentially reflecting changes in UK burns services following the publication of a National Burns Care Review in 2001(249) and subsequent implementation of guidelines on referrals to burns services(250). A 23% increase in burn hospitalisation rates was observed between 2001 and 2011 in the study population; but rates of all burns identified using CPRD-HES-ONS mortality data fell by 21% over this period. This could reflect a change in the hospital admission threshold, with more minor burns being admitted to hospital. These trends, and whether there have been changes in admission thresholds, could be verified in the International Burn Injury Database that captures detailed data on the severity of burns seen by specialist burns services in the UK(126).

4.7 Conclusion and implications

This work has demonstrated that it is essential to use linked data sources to build a more complete picture of injury burden, indicating that future injury studies using primary care research databases should consider using linked hospitalisation and mortality data. As linked ED data become available in the future, this may increase both the completeness of injury events captured, and potentially provide more information about injury mechanism and intent. These linked data have potential applications for injury surveillance and for providing outcome data for evaluations of injury prevention programmes (discussed in Section 8.2.2). Future research should include the linking of ED data to CPRD-HES-ONS data and extending this work to cover other injury types.

The differing injury patterns seen within this study highlight the importance of taking a strategic, life-course approach to injury prevention, with interventions tailored according to child age and injury type. High rates of adolescent self-poisonings highlight the need for close links between injury prevention, mental health and substance misuse strategies. Increasing rates over time of poisonings among young people and fractures across all ages warrant further investigation to understand the factors underlying these trends. Alongside implementing universal injury prevention approaches for all children and young people, the finding of socioeconomic gradients in injury occurrences supports the targeting of preventative interventions to households in the most deprived areas(6).

Trends over time in the incidence of hospitalised injuries and those hospitalised for 72 hours or more, may in part reflect changes in hospital admission thresholds, national guidelines and the treatments available. A measure of serious injury that is based on specific ICD-10 diagnoses indicating serious injury is potentially less affected by service factors over time.

Part 2: Defining exposure to maternal depression and anxiety during pregnancy and the child's first five years of life

Chapter 5: Defining maternal depression and anxiety using linked primary care and hospitalisation data

The ability to link longitudinal primary care and hospitalisation data of mothers and children offers a new opportunity to study the impact of the mother's mental health on child injury outcomes. To do this however, it was first necessary to establish a population of mother-child pairs and define episodes of maternal depression/anxiety using primary care and hospitalisation data, both of which will be described within this chapter. The second aim of this chapter is to describe the occurrence of maternal depression/anxiety episodes during pregnancy and the first five years of children's lives, and in particular assess whether mothers who experienced perinatal depression continue to have higher rates of depression/anxiety when the child is aged 1-4 years old.

5.1 Objectives

- To define episodes of medically attended maternal depression/anxiety using linked primary care and hospitalisation data.
- To estimate the incidence of maternal depression/anxiety during pregnancy and the first five years of a child's life, and describe the incidence according to child, maternal and household characteristics.
- To describe the incidence of maternal depression/anxiety when the child is aged 1-4 years old in relation to whether the mother had antenatal and/or postnatal depression.

5.2 Methods

5.2.1 The study population

The study population consisted of a cohort of children aged 0-4 years old from the CPRD who were born between the 1st of January 1998 and the 31st December 2013, whose primary care records had been linked to those of their mother. Mother-child pairs were

identified from the CPRD mother-baby link file which contains information on children who have been matched to their mothers by the CPRD; based on their GP practice, a unique family number (identifying those living in the same household), and information recorded in the child and mother's CPRD record about the date of delivery(307). To be included in the study population:

- Both mother and child had to be eligible for linkage of their CPRD record to HES data.
- Mother and child CPRD records had to meet the CPRD data quality standards.
- The child had to be registered with the general practice within 3 months of birth to maximise the capture of early medically attended injuries.
- Mother and child had to have overlapping follow-up time, with the mother's follow-up time commencing six months before the start of pregnancy for that child, to enable assessment of antenatal mental illnesses. Examples of the relationship between the mother and child's follow-up time are illustrated in Figure 5-1.
- Where a mother had multiple children eligible for inclusion in the study, one child was randomly selected per mother to avoid needing to account for clustering by family in the analyses.

For mother-child pairs eligible for inclusion in the study, mothers were followed up from the six months before the start of pregnancy, and children were followed up from birth. The end of follow-up for both mother and child was the earliest date of: the date mother or child left the general practice (e.g. changed practice, died), the 31st December 2013, the date information was last collected from the practice, the date the mother was diagnosed with a serious mental illness (if applicable) and the child's fifth birthday. Further detail of how this study population was identified is described in Section 5.2.2.

Figure 5-1: The relationship between mother and child person-time, some scenarios

1. Eligible for inclusion in study population

The child's person-time commences within 3 months of birth and the mother's follow-up time commences over six months prior to pregnancy. This mother-child pair would be included in the cohort.

2. Not eligible for inclusion – no overlapping person-time

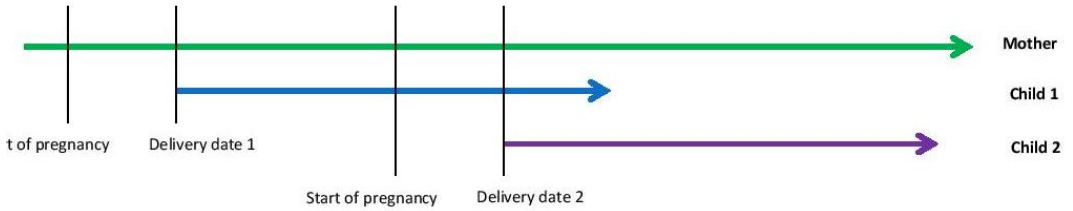
The child's person-time commences after the mother's person-time. This mother-child pair would be excluded from the cohort.

3. Not eligible for inclusion – maternal follow-up commences after pregnancy

Maternal and child follow-up commence after the birth of the child. This mother-child pair would not be included in the cohort, as the mother's person-time needs to commence six months before the start of pregnancy, and the child's follow-up time needs to commence within 3 months of birth.

4. Multiple children per mother – one child selected at random

The mother has multiple children born during her person-time. For both children, the mother's person-time commences prior to pregnancy with the child's follow-up starting at delivery. One child was randomly selected for inclusion in the study cohort.



5.2.2 Extracting a cohort of mother-child pairs from the CPRD

In order to define a cohort of mother-child pairs with linked CPRD and HES data, several steps were taken to identify those eligible for inclusion, as shown in Figure 5-2. Further detail of three of the key steps are described below.

5.2.2.1 Defining mother and child follow-up time

Similar to Section 4.2.3 a number of variables were used to identify available follow-up time within the linked CPRD and HES datasets for mothers and their children (Table 5-1). This allowed identification of mother-child pairs who had overlapping follow-up time and were eligible for inclusion in the study population.

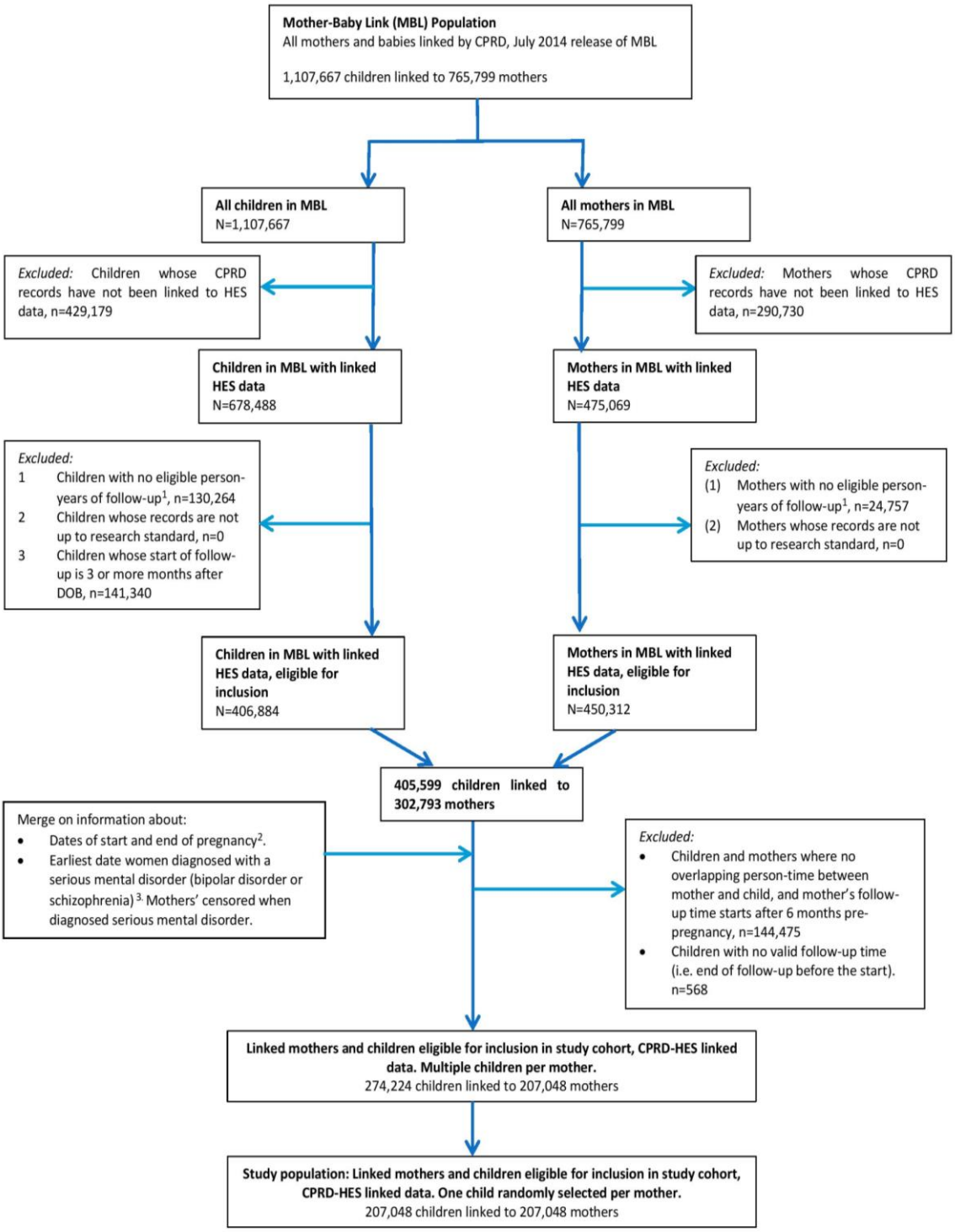
Table 5-1: Defining follow-up time for mothers and children to enable identification of mother-child pairs eligible for inclusion in the study population

	Mother	**Child**
Start of follow-up defined as the **latest** date of:	• Date of current registration period • Up-to-standard date, when the practice was deemed to be of research quality • Start of HES data (1st April 1997) • Date of birth	• Date of current registration period • Up-to-standard date, when the practice was deemed to be of research quality • Start of study period (1st Jan 1998) • Date of birth
End of follow-up defined as the **earliest** date of:	• Date patient transferred out of the practice • Date of death • Date of last data collection from practice • End of study period (31st Dec 2013) • The earliest date of diagnosis with a serious mental illness (schizophrenia or bipolar)	• Date patient transferred out of the practice • Date of death • Date of last data collection from practice • End of study period (31st Dec 2013) • Child's 5th birthday

5.2.2.2 Identifying mothers with a serious mental illness

Mothers with a serious mental illness (bipolar disorder or schizophrenia) were identified from the CPRD and HES using Read and ICD-10 diagnostic codes, respectively, with the earliest date of diagnosis identified for each mother. Mother-child pairs were excluded if the mother was diagnosed with either schizophrenia or bipolar disorder before the birth of the child. For women diagnosed with a serious mental illness during the child's life, the follow-up of both mother and child was censored at the diagnosis date (if occurring before the end of follow-up), to exclude any further episodes of mental illness from the analysis. The impact of later excluding these mother-child pairs was assessed as part of a sensitivity analysis (Section 5.2.7).

Figure 5-2: Data management to define a study population of mother-child pairs within the CPRD who had linked hospitalisation data



Notes:

1 Eligible person-time was defined as the 'end of follow up' being after the 'start of follow-up', where the start was defined as the latest date of: 1st April 1997 (for mothers), 1st Jan 1998 (for children), DOB, CRD, UTS. The end of follow-up was the earliest date of: 31st Dec 2013, TOD, death date, LCD, date when child reach age of 5 (children only).

2 Information on gestational age was extracted from the HES maternity file, HES birth record, and the mother and child's CPRD records. The start of pregnancy was estimated by taking away gestational age from the child's delivery date.

3 Diagnoses of serious mental disorders were extracted from CPRD and HES for the mothers. The earliest date of diagnosis was identified. If this date was before the end of follow-up, the mother and child's follow-up was censored at this date, contributing no further person-time to the study population.

5.2.2.3 Defining the start and end of pregnancy

Mothers were followed up from six months before the start of the pregnancy to allow more accurate assessment of the occurrence of antenatal depression. The date of the end of pregnancy (i.e. the child's date of birth) was provided as part of the CPRD mother-baby link file. The start of each pregnancy was then estimated by taking away the child's gestational age from the child's date of birth. Gestational age was estimated using information extracted from the HES maternity record (the mother's hospital admission record of the birth), HES birth record (the child's hospital admission record of the birth), and the CPRD records of the mother and child. A hierarchical approach was used, such that if a child had multiple recordings of gestational age in different data sources, the highest level method (that was considered to be more accurate) was used first (Table 5-2). For the study cohort, over 60% of children (n=130,770) had a gestational age included in their mother's HES maternity record. For 9% of children (n=19,370) no information was identified in either CPRD or HES on gestational age and so this was set as 40 weeks.

Table 5-2: Estimating gestational age for the cohort of children

Hierarchy	Method used to estimate gestational age	Number of children (%)
1	**HES maternity record.** When a child is born in hospital a maternity record is generated for the mother containing information about the delivery (e.g. outcome, number of babies, C-section, forceps). A variable is included in this record specifying the child's gestational age. This variable can be missing if not completed by hospital staff, or if the child was born outside of an English NHS hospital (e.g. home births, births in other countries).	130,770 (63.2)
2	**CPRD files of mother and child.** Specific Read codes entered by the general practice in either the mother or child's records about the gestational age of the child (e.g. 635A.00 Baby premature 37 weeks).	25,699 (12.4)
3	**CPRD file of mother**. Maternal CPRD records on the expected delivery date / date of the last menstrual period were used to estimate gestational age.	27,445 (13.3)
4	**CPRD or HES files of mother and child.** There are Read and ICD-10 codes specifying that the birth was 'preterm' (e.g. 635..13 premature baby), 'normal gestation' (e.g. full term baby), or 'post term' (e.g. Z22AE00 baby overdue). Where no other information on the length of gestation was available, the length of gestation was set as 35 weeks for preterm births, 40 weeks for normal gestation codes, and 42 weeks for post term births.	2,794 (1.4)
5	**CPRD file of mother**. Read codes for antenatal assessments (e.g. 2713.00 O/E fundus 20-24 weeks) were used to estimate the start of the pregnancy.	970 (0.5)
6	**No records for gestational age.** For those with no records indicating a gestational age, a gestational age of 40 weeks was used.	19,370 (9.4)

5.2.3 Defining maternal depression/anxiety within linked primary and hospitalisation data

For the cohort of mothers, episodes of depression/anxiety were identified through using a combination of Read codes and prescriptions data from the CPRD, and diagnostic codes from inpatient admissions recorded in HES. Episodes of depression alone, depression with anxiety, and anxiety alone were defined separately for subsequent analyses (chapter 7) due to the hypothesis that the symptoms of depression (e.g. low mood, fatigue, withdrawal) compared to anxiety (e.g. apprehension, worry) may have different effects on child injury risk.

Read code lists were developed through identifying existing published code lists(308-310) and updating these code lists via free word searches and examination of the Read code hierarchy(237) (code list included Appendix 8). Antidepressant and anxiolytic drug code lists were generated using the CPRD browser and examining published drug code lists(157, 311). Hospitalisations for depression and anxiety occurring during the mother's follow-up time were extracted from HES using ICD-10 code lists for depression (ICD-10 codes F32-F33) and anxiety (ICD-10 codes F40-F41).

Table 5-3 and Table 5-4 provide an overview of how depression and anxiety were defined using Read codes, prescriptions and hospitalisation records. Depression and anxiety were defined in two ways; firstly by a broad definition encompassing all codes referring to the occurrence of depression and anxiety (e.g. including symptom, diagnostic and review codes), and secondly by a narrower definition including only those codes referring to a diagnosis of depression or anxiety, which was used in a sensitivity analysis (Section 5.2.7). The details of how depression and anxiety were defined using Read codes and prescriptions data are outlined in more detail below (Sections 5.2.3.1 and 5.2.3.3, respectively).

Table 5-3: Definition of depression using CPRD and HES data

DEFINITION 1: Primary analysis, broadest definition	DEFINITION 2: Sensitivity analysis, definition restricted to the most specific codes	Exclusions (apply to both definition 1 and definition 2)
CPRD • Diagnostic codes: codes specifying a diagnosis of depression • Symptom codes: codes describing symptoms of depression, such as 'low mood'. • *Scale codes:* Codes referring to validated depression screening tools such as the PHQ-9 and HADS. These codes were only used to define depression when both the result of the score was included in the medical record, and the score reached the threshold* for a depression diagnosis. • *Review/management codes*. Codes referring to the management and review of patients with depression (e.g. 9H92.00 Depression interim review) were used to define depression within this thesis, although it is possible that for some patients they may be reviewed by their doctor and no longer have active depressive symptoms. • Antidepressant prescriptions (BNF 4.3.1–4.3.4) **HES** • Hospitalisation records with a primary or subsequent ICD-10 code for depression (ICD-10 codes F32-F33)	**CPRD** • Diagnostic codes: codes specifying a diagnosis of depression • *Scale codes:* Codes referring to validated depression screening tools such as the PHQ-9 and HADS. These codes were only used to define depression when both the result of the score was included in the medical record, and the score reached the threshold* for a depression diagnosis. • Antidepressant prescriptions (BNF 4.3.1–4.3.4). **HES** • Hospitalisation records with a primary or subsequent ICD-10 code for depression (ICD-10 codes F32-F33)	• Read and ICD-10 codes for bipolar disorder and cyclothymia • Read and ICD-10 codes referring to depression remission • Read codes for depression screening with no information about outcome of the screening (i.e. person may screen negative) • Read codes referring to a 'history of depression' • Antidepressant prescriptions for low-dose Amitriptyline (<75mg). • Antidepressant prescriptions where an alternative indication was identified as more likely (Section 5.2.3.3) • Antidepressant prescriptions where the patient had never been diagnosed with depression/anxiety or where there was no depression/anxiety diagnosis within six months of the course start.

**Thresholds for diagnosis were:*

Patient Health Questionnaire (PHQ-9): scores of ≥10 indicate moderate-severe depression

Hospital anxiety and depression scale (HADS): depression scores of ≥11 indicate likely clinical case of depression

Beck depression scale: Score of >20 indicates moderate-severe depression

None of the other scales (e.g. Edinburgh Postnatal Depression Scale) had a score recorded for the study population

Table 5-4: Definition of anxiety using CPRD and HES data

DEFINITION 1: Primary analysis, broadest definition	DEFINITION 2: Sensitivity analysis, definition restricted to the most specific codes	Exclusions (apply to both definition 1 and definition 2)
CPRD • Diagnostic codes: codes specifying a diagnosis of anxiety • Symptom codes: codes describing symptoms of anxiety, such as 'worried'. • *Scale codes:* Codes referring to validated anxiety screening tools. These codes were only used to define anxiety when both the result of the score was included in the medical record, and the score reached the threshold* for an anxiety diagnosis. • *Review/management codes*. Codes referring to the management and review of patients with anxiety. • Anxiolytic prescriptions (BNF 4.1.2) **HES** • Hospitalisation records with a primary or subsequent ICD-10 code for anxiety (ICD-10 F40-F41)	**CPRD** • Diagnostic codes: codes specifying a diagnosis of anxiety • *Scale codes:* Codes referring to validated anxiety screening tools. These codes were only used to define anxiety when both the result of the score was included in the medical record, and the score reached the threshold* for an anxiety diagnosis. • Anxiolytic prescriptions (BNF 4.1.2) **HES** • Hospitalisation records with a primary or subsequent ICD-10 code for anxiety (ICD-10 F40-F41)	• Read and ICD-10 codes for separation anxiety disorder (condition of childhood), selective mutism (condition of childhood), obsessive compulsive disorder or specific stress disorders, including PTSD were excluded. • Benzodiazepine and anxiolytic prescriptions if no concurrent record for anxiety was recorded within six months of the prescription.

**Hospital anxiety and depression scale, anxiety score: scores of ≥11 indicate likely clinical case of anxiety*

5.2.3.1 Defining depression and anxiety using Read codes from primary care data

There are a number of complexities in the recording of depression/anxiety within primary care data, as a result of Read codes not directly corresponding to ICD-10 codes for these conditions, and changes in the recording of depression/anxiety within primary care over time. The introduction of depression indicators as part of the QOF, a pay for performance scheme, has influenced the recording of depression within primary care(312). In particular the QOF requires practices to review patients within 10-35 days of a depression diagnosis(313), leading to the use of Read codes referring to depression reviews, which do not necessarily mean a patient has ongoing symptoms. Additionally, the introduction of a QOF indicator requiring the use of a psychosocial assessment tool as part of diagnosing depression has led to additional Read codes being used referring to these tools (e.g. PHQ-9, HADS)(313). Importantly, several studies have demonstrated an increase in the use of symptom rather than diagnostic Read codes for both depression and anxiety(308, 309, 314), meaning that those with less severe depression/anxiety who once would have received a diagnostic code, may now have their symptoms coded instead. This is likely to reflect changes in coding practices as a result of the QOF(312), and changes in GPs' willingness to label individuals with specific diagnoses(312).

At the time of extracting the data used for this study there were no published studies validating definitions of depression within primary care data. As a result of the complexities of defining depression/anxiety using Read codes, two definitions for depression and anxiety were formed. The first definition was broad and inclusive, including diagnostic codes (broadly corresponding to ICD-10), symptom codes (e.g. low mood), codes referring to clinical management (e.g. 'depression interim review), and codes referring to the use of depression/anxiety screening tools (e.g. PHQ-9). Codes for depression/anxiety screening tools were only included if the outcome of the score was recorded and reached the threshold for a likely diagnosis of depression or anxiety (Table 5-3, Table 5-4). Examples of these different categories of codes are shown in Table 5-5.

The second definition was more specific, including only those Read codes referring to a diagnosis of depression or anxiety and those codes referring to depression/anxiety screening tools where the score reached the threshold for a likely diagnosis.

Table 5-5: Examples of the different types of Read codes used to record depression and anxiety in UK primary care

	Diagnostic codes	Symptom codes	Review/management codes	Screening/scale codes
Depression	E113200 "Recurrent major depressive episodes, moderate" E1113000 Recurrent major depressive episodes, unspecified	1B17.11 "c/o-feeling depressed" 1BT..11 "Low mood"	9H90.00 "Depression annual review" 9HA0.00 "On depression register"	388f.00 "Patient health questionnaire (PHQ-9) score ZRBY.11 EPDS-Edinburgh postnatal depression scale
Anxiety	E200.00 "Anxiety states" Eu41100 "Generalised anxiety disorder"	1B13.00 'anxiousness' 1B13.11 "Anxiousness-symptom"	-	ZRre.11 "Zung's self-rating anxiety scale" 388w.00 "Generalised anxiety disorder 7 item score"

5.2.3.2 Excluding Read codes for previous episodes of depression/anxiety

For the studies included in this thesis, the focus was upon identifying those mothers with either new or ongoing episodes of depression/anxiety, and so it was necessary to exclude codes referring to previous depression/anxiety episodes, which included:

- **Read codes referring to a 'history of depression' or depression remission.** These codes were excluded as they were unlikely to refer to a current depressive episode.
- **Certain antenatal and postnatal depression Read codes.** Read codes for antenatal depression (e.g. Eu32B00 Antenatal depression) entered after pregnancy could refer to a history of antenatal depression. Similarly, Read codes recorded during pregnancy for postnatal depression (e.g. E204.11 Postnatal depression) could refer to postnatal depression in a previous pregnancy. Read codes for antenatal depression were used only twice in the cohort (neither of which were outside of pregnancy). There were 21,084 Read codes for postnatal depression, of which 1,122 were recorded prior to the delivery of the child (811 codes in the 6 months prior to the start of pregnancy, and 311 during pregnancy). These 1,122 Read codes were excluded as were likely to reflect the recording of a patient's past medical history.
- **Read codes entered after general practice registration.** Read codes occurring within 3 months of the mother's general practice registration date were excluded to take account of the recording of patients' medical history, with a three month window

defined on the basis of a previous study examining the recording of depression/anxiety after general practice registration(309).

5.2.3.3 Using prescription records from the CPRD to define depression and anxiety

Both antidepressants and anxiolytics can be used to treat conditions other than depression and anxiety, but within primary care patients can be prescribed medications without a diagnostic code entered in the medical record. This can occur where patients have been on a medication for a long duration, or in cases where the medical condition is recurring and the GP knows the patient history well. Several steps were therefore taken to exclude prescriptions likely to be used for indications other than depression and anxiety, while retaining prescriptions being used to treat depression/anxiety.

Extracting prescriptions data from the CPRD and estimating prescription length and dose

For each mother, all prescriptions of antidepressants and anxiolytics occurring during follow-up were extracted from the CPRD, including information on the prescription date, prescribed substance, dose, dosing instructions and quantity prescribed. The daily dose of prescriptions was estimated by multiplying the substance strength (e.g. Amitriptyline 25mg) by the dosing instructions (e.g. one at night). The length of each prescription was estimated using information about the duration of the prescription, the quantity of medication prescribed and the daily dose. For prescriptions with no duration recorded, the duration was estimated by dividing the quantity of the medication prescribed by the prescribed daily dose. If the quantity of medication and/or the daily dose were missing, the duration of the last antidepressant prescription (or anxiolytic) for that individual patient was used as the prescription duration. Where the mother had no information that could be used to estimate prescription duration, the median duration of all prescriptions (28 days for antidepressants, 14 days for anxiolytics) for the study population was used.

Excluding antidepressant prescriptions used for likely alternative indications

The following steps were taken to exclude antidepressant prescriptions where it was likely that they were prescribed for indications other than depression/anxiety:

- **Low dose Amitriptyline.** Amitriptyline is a tricyclic antidepressant commonly used for indications other than depression (e.g. pain, migraine prophylaxis). 75mg is the

starting dose for the treatment of depression(315), and so any prescriptions for Amitriptyline at a dose lower than 75mg were excluded as these are likely to be used for indications other than depression.

- **Identifying the indication for antidepressant courses.** To identify the likely indication for using antidepressants, prescriptions were organised into continuous periods of treatment (termed 'antidepressant courses' in this thesis), defined by a gap between the end of one prescription and the start of the next of less than 60 days. Read codes entered on the same day as the start of the antidepressant course were examined to identify likely indications for the medication (Table 5-6). Antidepressant courses with a likely alternative indication(315) (e.g. obsessive compulsive disorder, pain, migraine prophylaxis) were excluded if there was no concurrent evidence of depression/anxiety.
- **Excluding courses where there was no prior diagnosis of depression and/or anxiety.** Where there was no diagnosis of depression and/or anxiety in the primary care record prior to the start of the antidepressant course, or within six months of the course start, these antidepressant courses were excluded as they may have been prescribed for alternative indications. This led to the exclusion of 5,026 of the 90,525 (5.6%) antidepressant courses (Table 5-6).

Excluding anxiolytic prescriptions used for likely alternative indications

Benzodiazepines are used for a number of indications, and although are used to treat anxiety, cannot be used in isolation to define anxiety. Benzodiazepines and anxiolytics were excluded if the patient had no concurrent evidence of anxiety, defined by diagnostic or symptom codes for anxiety within six months of the start or end of the course of treatment.

Table 5-6: Indications for antidepressant medications recorded on the first day of the antidepressant course

Likely indication for medication(315), based on Read codes entered on first day of course		Number of antidepressant courses (%)	Number of courses excluded
Depression		43,555 (48.1)	-
Anxiety		4,678 (5.2)	-
Depression with anxiety		4,678 (5.2)	-
Other Read codes entered on first day of antidepressant course	**Premenstrual tension syndrome**	1,017 (1.1)	988[a]
	Obsessive Compulsive Disorder	224 (0.2)	197[a]
	Migraines	251 (0.3)	243[a]
	Bulimia nervosa	102 (0.1)	97[a]
	Fibromyalgia, chronic fatigue syndrome, restless leg syndrome	28 (0.03)	28[a]
	Stress urinary incontinence	2 (<0.01)	2
	Insomnia / sleeping problems	459 (0.5)	308[b]
	Neuralgia / neuropathic pain /diabetic neuropathy / back pain	132 (0.1)	109[b]
	Less specific depression codes[#]	891 (1.0)	-
	Less specific anxiety codes[#]	141 (0.2)	-
	Other	23,544 (26.0)	3,631[c]
No Read code entered at start of course		10,823 (12.0)	1,395[c]
Total number of courses		90,525	6,998

#Certain Read codes were identified that had not been used to define depression/anxiety on their own, but were likely to indicate depression or anxiety when used in conjunction with an antidepressant prescription. One of the main examples is Read codes for depression or anxiety screening (e.g. 6896 'Depression screening questions used'), where the outcome of the screening was not recorded, and so this record was not included in the primary definition of depression/anxiety. The presence of a code for depression screening on the same day as a course of antidepressants was prescribed is likely to indicate that the individual was diagnosed with depression.

[a] Courses were excluded if there was no diagnosis of depression/anxiety within 30 days of the antidepressant course. It is possible that those with premenstrual tension or eating disorders could have comorbid depression, and so antidepressant courses were not excluded if there was a depression/anxiety diagnosis within 30 days of the course start date.

[b] Courses were excluded if there was no diagnosis of depression/anxiety within six months of the antidepressant course. Many of the Read codes used to record problems with sleep or pain were relatively non-specific (e.g. N145.00 'Back pain, unspecified') and so a longer window of six months was used to identify antidepressant courses that may be being used to treat depression. Insomnia/sleep problems can be a symptom of depression itself and those with conditions leading to pain can have comorbid depression.

[c] Where there was no identified indication for the antidepressant medication, the course was excluded if there was no diagnosis/symptoms of depression and/or anxiety prior to the antidepressant course, or within 6 months of the start of antidepressant course.

5.2.4 Defining continuous episodes of depression/anxiety using a time-window

Episodes of depression/anxiety were defined using a six month time-window between records, such that any records occurring within six months of the end of the previous record were considered part of the same episode. For medications, the time-window of six months commenced from the end of the prescription, and for hospitalisations the time-window commenced from the hospital discharge date. Where there was a gap of more than six months between the end of a record and the subsequent record, this was considered the start of a new depression/anxiety episode. Figure 5-3 provides an illustration of how episodes of depression/anxiety were defined.

A time-window of six months was selected through considering the methods of existing studies(149, 312, 316), and examining the time between subsequent Read codes, hospitalisations, and prescriptions for both depression and anxiety. Previous studies have used time-windows of either six months or 1 year when defining episodes of depression(149, 312, 316), but for the purposes of using maternal depression/anxiety as a time-varying exposure (for chapter 7), a time-window of six months was selected to prevent overestimation of episode duration. There is a trade-off between using a shorter time-window and overestimating incidence, and using a longer time-window and overestimating episode duration. Extending the time-window to a year was assessed as part of a sensitivity analysis (Section 5.2.7).

It must be noted that the identified episodes reflect the duration of medical assessment and/or treatment for depression/anxiety, rather than the overall duration the patient has symptoms; a duration that cannot be estimated from the patient's medical records. To account for the patient developing symptoms prior to presenting to their doctor, and for patients having ongoing symptoms after being seen by the doctor, windows of time before and after the episodes were added for certain analyses; an issue that will be discussed in Chapter 7.

5.2.4.1 Start and end dates of depression/anxiety episodes

The start of an episode was defined as the date of the first record for depression/ anxiety, where there had been no records within the previous six months. The end of an episode was defined by the last record for depression/anxiety, using:

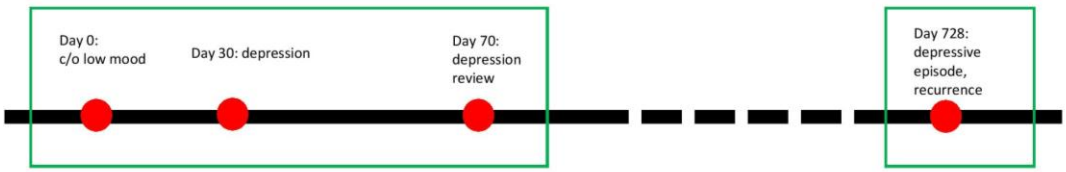
- the hospital discharge date if a hospital admission was the last record,
- the end of prescription date if a prescription was the last record,
- the date the Read code was entered, if a Read code was the last record. In the case where a single Read code was recorded (with no other depression/anxiety records either six months before or after) 28 days was added after the date the Read code was entered in the medical record to prevent the episode start and end dates being the same day.

5.2.4.2 Defining episodes of depression with anxiety

Women may experience concurrent depression and anxiety (termed 'depression with anxiety' in this thesis). Episodes of depression with anxiety were defined in two ways (Figure 5-4). Firstly by the presence of Read or ICD-10 codes that specified depression with anxiety (e.g. E200300 Anxiety with depression). Secondly, by the presence of diagnostic codes for both depression and anxiety recorded within the same continuous period of treatment (as defined by the 6 month time-window described above). For example, if a woman was receiving antidepressants for depression, the presence of an anxiety code within six months of either the diagnostic code for depression, or the antidepressant prescription, would lead this episode to be classified as depression with anxiety.

Figure 5-3: Defining episodes of depression/anxiety in linked CPRD-HES data, using Read codes, prescriptions and hospitalisations

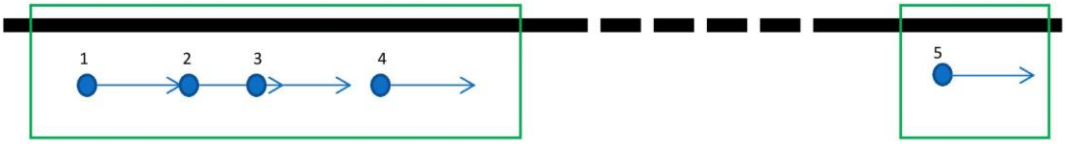
1. Read codes only for diagnoses/symptoms



Episode 1: time between Read codes is <6 months

Episode 2: time from previous Read code is >6 months, so a new episode is created

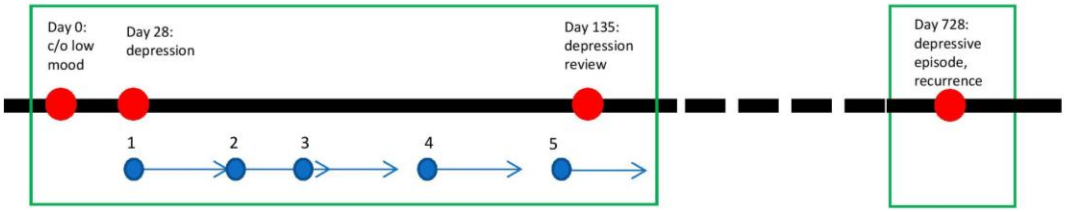
2. Prescriptions only



Episode 1: The time between the start of each prescription and the end of the last prescription is less than six months, so these prescriptions count as the same episode

Episode 2: the time from the end of the last prescription is >6 months before start of next prescription. This is defined as a new episode.

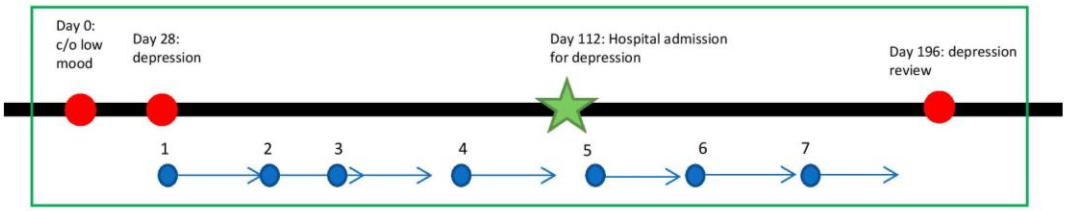
3. Read codes and prescriptions



Episode 1: Patient has multiple Read codes and a concurrent course of antidepressants. This is defined as the same depression episode, with the start of the episode being the earliest of the Read or prescription codes. Similarly the end of the episode is the latest date of the end of prescription or the last Read code.

Episode 2: the time from the end of the last prescription is >6 months before start of next depression record. This is defined as a new episode.

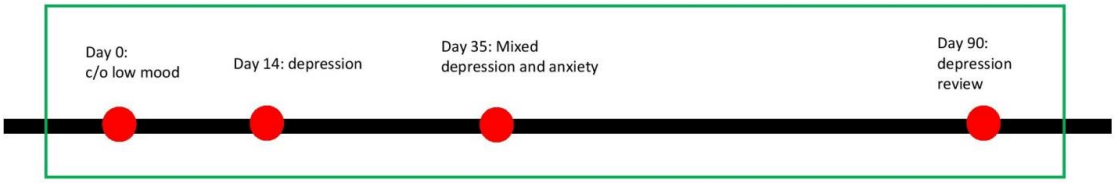
4. Read codes, prescriptions and hospitalisations



Patient has multiple Read codes for depression and a concurrent course of antidepressants. In addition the patient has a hospital admission for depression occurring during the same period the patient is being managed in primary care. This would be one depression episode, with the start of the episode being the earliest of the Read, hospital admission or prescription codes. Similarly the end of the episode is the latest date of the end of prescription, discharge date or the last Read code.

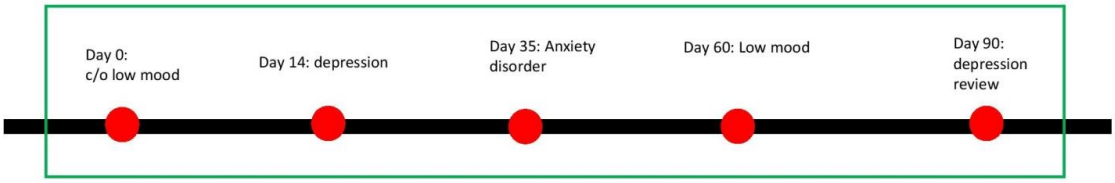
Figure 5-4: Defining episodes of depression with anxiety in linked CPRD-HES data

Depression with anxiety: specific Read or ICD-10 codes



Patient has a Read code specifying the occurrence of depression and anxiety. This episode would be classed as depression with anxiety.

Depression with anxiety: multiple codes



Patient has Read codes for both depression and anxiety occurring within the same episode (gap of <6 months between codes). This episode would be classed as depression with anxiety.

5.2.5 Definitions of mother and child covariates

Geographical region and socioeconomic deprivation were defined as described in Section 4.2.4.

5.2.5.1 Number of older children/siblings in the household

The number of older children living in the household was identified by counting the number of people with the same unique practice identifier and family number (indicating residence at the same address) during the child's follow-up time, born within the 16 year period prior to the birth of the child, excluding any mothers aged less than 16; a method used in a previous study looking at family composition within primary care data(317).

5.2.5.2 Number of children aged less than 5 years old in the household

The total number of children living in the household during the child's follow-up time was defined as the number of individuals aged less than 5 years old who had the same unique practice identifier and family number as the child, and who were living in the same household as the child at some point between the child's birth and the end of the child's follow-up. This means that if a child had one younger sibling born during their follow-up time, the number of children in the household was counted as 2, even though the younger sibling was not residing with the first child for the whole period. Children aged less than 5 years old were chosen, as the number of children aged less than 5 years old potentially has the greatest impact on maternal supervision as young children require closer and more continuous supervision(318).

5.2.5.3 Maternal age at delivery

The mother's age at delivery was estimated using the child's date of birth (supplied in the CPRD mother-baby link file) and the mother's estimated date of birth (defined using the method described in Section 4.2.2).

5.2.5.4 Maternal alcohol misuse

Maternal alcohol misuse was defined by the presence of a Read or ICD-10 code referring to hazardous or harmful levels of alcohol consumption (>14 units a week for women), or problem drinking (e.g. alcoholic cirrhosis, alcohol dependency), recorded anytime in the

CPRD or HES during the mother's follow-up time (six-months pre-pregnancy to the end of follow-up). The definition of harmful/hazardous alcohol consumption was based on existing Read code lists and work carried out by Otete *et al*(319, 320). Hospitalisations resulting from alcohol misuse were defined by alcohol specific ICD-10 codes, referring to conditions wholly attributed to alcohol (e.g. F10 mental and behavioural disorders due to alcohol, K70 alcoholic liver disease)(321).

5.2.5.5 Maternal drug misuse

Maternal drug misuse was defined by the presence of a Read or ICD-10 code referring to drug misuse, recorded in the CPRD or HES anytime during the mother's follow-up time (six-months pre-pregnancy to the end of follow-up). A Read code list referring to drug misuse was generated, using existing literature to aid in the identification of relevant codes(322, 323), to include codes referring to drug misuse, drug dependence, drug withdrawal and specific treatments for drug misuse (e.g. methadone therapy). Hospitalisations for drug misuse were identified using ICD-10 codes F11-F16 and F18-19. Alcohol and tobacco misuse were excluded from the definition.

5.2.5.6 Maternal perinatal depression

Perinatal depression includes both depression during pregnancy (antenatal depression) and depression occurring in the first year after delivery (postnatal depression)(324). For this study women were classified as having antenatal depression, postnatal depression, both or neither, using the depression records and antidepressant prescriptions extracted from the CPRD and HES, as outlined in Section 5.2.2.3.

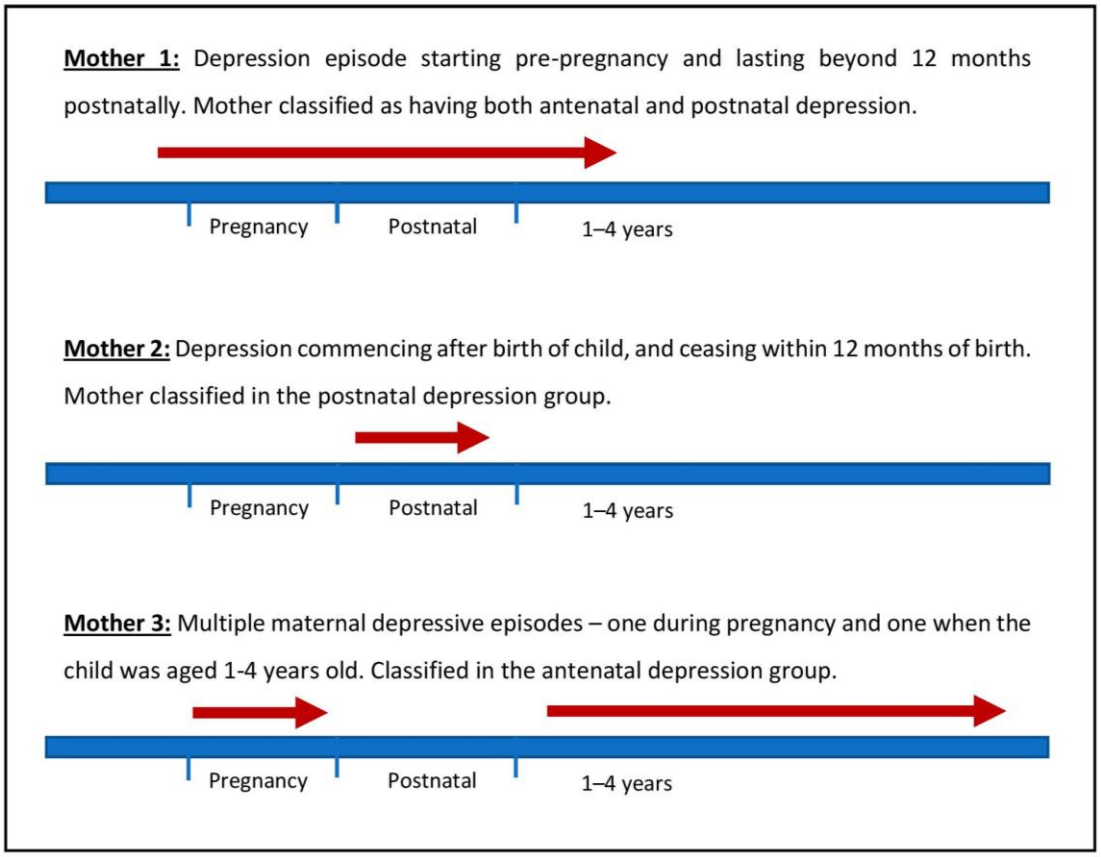
- **Antenatal depression.** Mothers were defined as having antenatal depression if at any time during pregnancy they had a medical record for depression (from either CPRD or HES) or if they received one or more prescription for an antidepressant. This definition therefore includes mothers whose depressive symptoms may have commenced prior to pregnancy and those with a new depressive episode during pregnancy.
- **Postnatal depression**: Mothers were defined as having postnatal depression if they had a medical record for depression (from either CPRD or HES) or received one or more prescription for an antidepressant during the 12 months after the birth of the child. This definition therefore includes mothers whose depressive symptoms may

have commenced prior to the birth of the child and those with a new depressive episode during the postnatal period.

- **Both antenatal and postnatal depression**. Mothers were classified as having both antenatal and postnatal depression if they had evidence of depression during pregnancy and records for depression in the 12 months following delivery.

These definitions of antenatal and postnatal depression are consistent with existing studies that have used large primary care research databases(69, 325) and studies screening women for depressive symptoms in the perinatal period(326), which assess for the presence of symptoms in the perinatal period, rather than identifying those with new symptoms commencing in the perinatal period. Figure 5-5 provides some examples of how maternal perinatal depression was defined.

Figure 5-5: Defining antenatal and postnatal depression



5.2.6 Statistical methods

5.2.6.1 Incidence of maternal depression/anxiety episodes during pregnancy and the child's first five years of life

Incidence rates of maternal depression, anxiety, and depression with anxiety were estimated per 100 PY during pregnancy and for the five years following the birth of the child. To examine incidence rates of maternal depression/anxiety according to time since delivery, Lexis expansion was used to divide the mother's follow-up time into 3 month periods following delivery(244). Crude incidence rates of maternal depression/anxiety episodes were assessed according to child (e.g. sex, age), maternal (e.g. maternal age at delivery, alcohol/drug misuse) and household (e.g. socioeconomic deprivation, number of children aged less than 5 years old in the household) characteristics.

5.2.6.2 Incidence of maternal depression/anxiety episodes according to exposure to perinatal depression

Incidence rates of maternal depression/anxiety episodes per 100 PY were estimated from one year after delivery to the child's 5th birthday, stratified by whether the mother had antenatal and/or postnatal depression. Unadjusted and adjusted incidence rate ratios, comparing rates of depression/anxiety among mothers with perinatal depression to those without, were estimated using Poisson regression. Maternal age at delivery and socioeconomic deprivation were considered *a priori* confounders based on existing literature(149). Other potential confounders were included in the final adjusted model if they changed the incidence rate ratio by 10% or more. The significance of the association between perinatal depression and incidence rates of depression/anxiety when the child was aged 1-4 years old was assessed using a LRT, with $p<0.05$ considered statistically significant.

The Poisson regression model was considered appropriate following assessment of the Poisson goodness of fit test, and a LRT examining whether the negative binomial model provided a significantly better fit than the Poisson model(245). While the Poisson goodness of fit test was significant (likely due to the very large sample size), the LRT was not significant ($p=0.5$ depression with anxiety, $p=1.0$ anxiety), indicating the Poisson model was appropriate (Table 5-7).

Table 5-7: Assessing the appropriateness of the Poisson regression model

	Mean	Variance	Poisson goodness of fit test[$]	Likelihood ratio test of alpha[#]
Depression	0.13	0.16	*p* <0.0001	*
Depression with anxiety	0.025	0.027	*p* <0.0001	*p*=0.5
Anxiety	0.045	0.054	*p* <0.0001	*p*=1.0

$ The significance of the Poisson goodness of fit test is likely to reflect the very large sample size used, therefore detecting very small differences between the mean and variance of the count.

#The Negative binomial regression model reduces to the Poisson model when alpha=0. This LRT assesses whether alpha is equal to 0. If the test is statistically significant (p<0.05) it indicates over dispersion and indicates the Negative Binomial model is preferred. In this case the LRTs of alpha were not significant, therefore indicating the Poisson regression model was appropriate.

**For depression episodes, the negative binomial model would not converge within Stata and so a LRT of alpha could not be performed.*

5.2.7 Sensitivity analyses

Three sensitivity analyses were conducted. The first assessed the impact of extending the time-window used to define episodes of depression/anxiety from six months to 12 months, such that any records occurring within 12 months of the last depression/anxiety episode were considered part of the same depression/anxiety episode. The second sensitivity analysis restricted the definition of depression/anxiety to the most specific diagnostic Read codes (Table 5-3 and Table 5-4); therefore excluding less specific symptom and clinical review Read codes. The third sensitivity analysis excluded mother-child pairs where the mother had been diagnosed with schizophrenia or bipolar disorder during study follow-up, as these mothers may have differing patterns of mental health symptoms.

5.3 Results

5.3.1 The study population

The study cohort consisted of 207,048 mother-child pairs registered at 383 general practices (Table 5-8). Of the children, 105,958 (51.2%) were male and 101,090 (48.8%) were female. Median follow-up after the child's birth was 3.9 years (IQR 1.6 – 5.0). Over 60% of the children began follow-up within a month of birth (n=132,679, 64.1%). The median maternal age at delivery was 31.0 years (IQR 26.6-34.8), with the youngest mother in the cohort being 13.5 years, and the oldest being 49.4 years. Those from the most deprived socioeconomic quintile were underrepresented in the study population (quintile 5 17.2% vs quintile 1 22.7%) and had on average a year less of follow-up (median 3.4 years) compared to those from the least deprived quintile (median 4.5 years).

Most households had 1 (n=95,558, 46.2%) or 2 (n=88,462, 42.7%) children aged less than 5 years old living in the household. Those households with only 1 child aged less than 5 years old had on average 2 years less follow-up than households with 2 or more children (median 2.8 years versus 5.0 years, respectively).

Alcohol and drug misuse were uncommon among the cohort of mothers, with alcohol misuse identified in the medical records of 4,382 women (2.1%), and drug misuse recorded in the medical records of 1,160 (0.6%) women. Of the mothers included in the study population 219 (0.1%) were diagnosed with schizophrenia or bipolar disorder after the child's birth, ending both the mother and child's follow-up time, as these mother-child pairs were censored at the diagnosis date.

Table 5-8: Characteristics of a mother-child cohort contributing to the CPRD, with children born between the 1st January 1998 and 31st December 2013

	Frequency (%)	Median length of follow up, years (IQR)
Child sex		
Male	105,958 (51.2)	3.8 (1.6-5.0)
Female	101,090 (48.8)	3.9 (1.6-5.0)
Age of child at start of follow-up (months)*		
< 1	132,679 (64.1)	3.7 (1.5-5.0)
1-2	62,558 (30.2)	4.1 (1.8-5.0)
2-3	11,811 (5.7)	4.2 (1.9-5.0)
Maternal age at delivery (years)		
<20	9,575 (4.6)	3.2 (1.4-5.0)
20-29	80,481 (38.9)	3.4 (1.4-5.0)
30-39	107,707 (52.0)	4.3 (1.8-5.0)
≥40	9,285 (4.5)	4.3 (1.9-5.0)
Socioeconomic deprivation, IMD 2010#		
Quintile 1 (least deprived)	47,010 (22.7)	4.5 (1.9-5.0)
Quintile 2	43,699 (21.1)	4.1 (1.7-5.0)
Quintile 3	39,674 (19.2)	3.8 (1.6-5.0)
Quintile 4	40,728 (19.7)	3.5 (1.5-5.0)
Quintile 5 (most deprived)	35,658 (17.2)	3.4 (1.4-5.0)
Missing	279 (0.1)	2.8 (1.0-5.0)
Maternal alcohol misuse during study follow-up		
No	202,666 (97.9)	3.8 (1.6-5.0)
Yes	4,382 (2.1)	5.0 (3.4-5.0)
Maternal drug misuse during study follow-up		
No	205,888 (99.4)	3.9 (1.6-5.0)
Yes	1,160 (0.6)	3.8 (1.6-5.0)
Total number of children in household aged <5 years during child's follow-up		
1	95,558 (46.2)	2.8 (1.2-5.0)
2	88,462 (42.7)	4.7 (2.1-5.0)
3	18,080 (8.7)	5.0 (2.5-5.0)
4 or more	4,948 (2.4)	5.0 (2.9-5.0)
Region		
North East	5,045 (2.4)	4.7 (2.1-5.0)
North West	33,000 (15.9)	4.6 (1.9-5.0)
Yorkshire and the Humber	8,247 (4.0)	4.6 (2.0-5.0)
East Midlands	7,680 (3.7)	3.8 (1.7-5.0)
West Midlands	23,487 (11.3)	4.3 (1.8-5.0)
East of England	27,247 (13.2)	3.9 (1.6-5.0)
South West	23,219 (11.2)	3.7 (1.6-5.0)
South Central	26,048 (12.6)	3.9 (1.6-5.0)
London	28,198 (13.6)	2.9 (1.3-5.0)
South East Coast	24,877 (12.0)	3.6 (1.6-5.0)

**children had to start follow-up within 3 months of birth to maximise capture of their first injury event.*

 # IMD 2010, based on residential postcode of child/family

5.3.2 Recording of depression/anxiety in the CPRD and HES

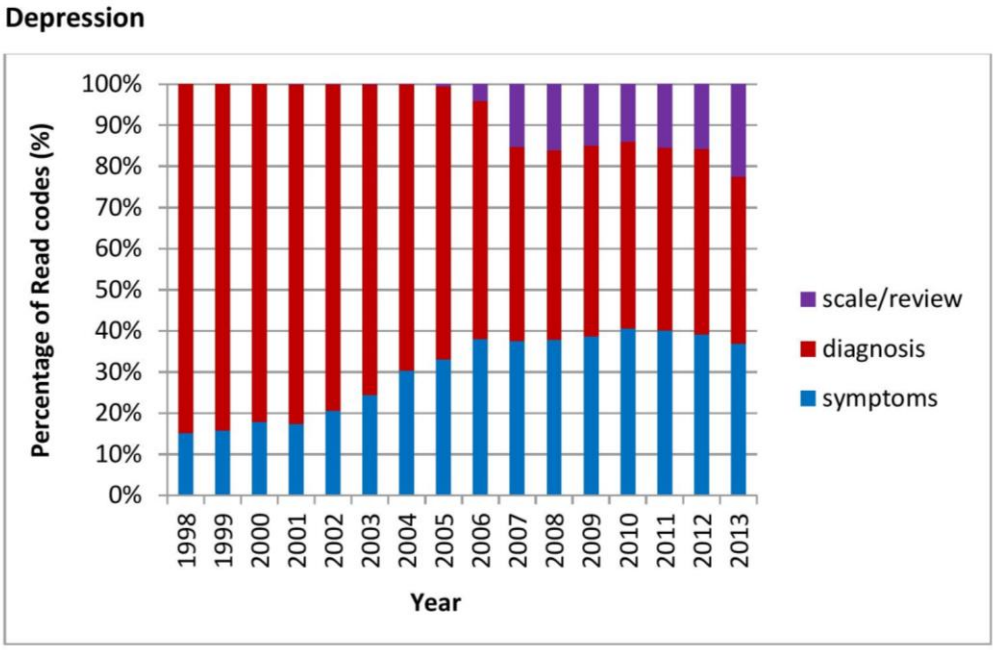
5.3.2.1 Primary care records for depression/anxiety

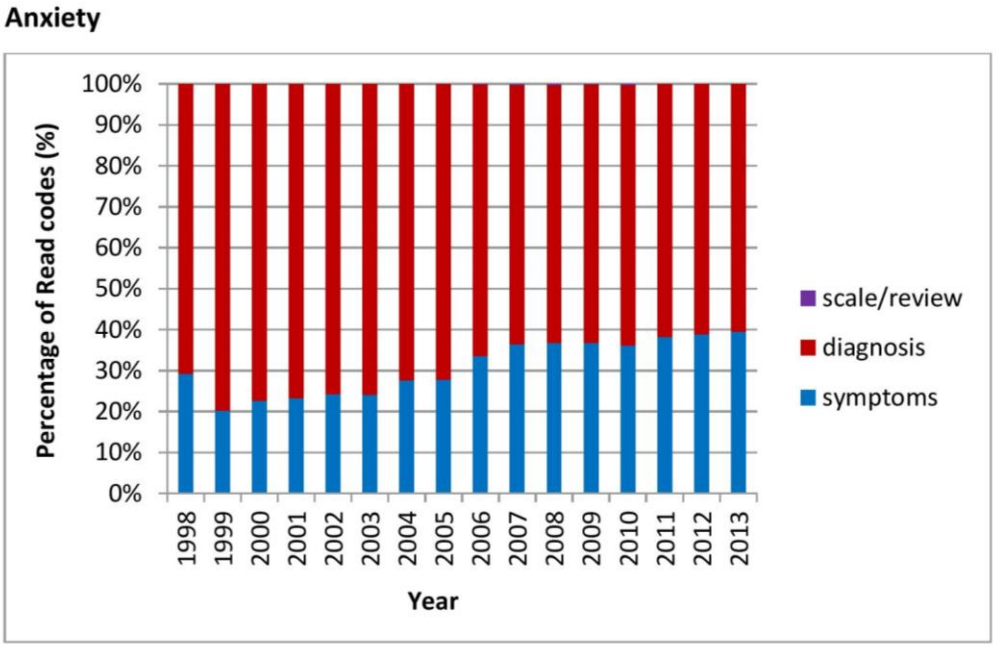
Among the study population, 57,607 women (27.8%) had a total 190,249 Read codes for depression and/or anxiety recorded in their medical record during their follow-up time (six months pre-pregnancy to child's fifth birthday). Symptom codes accounted for a third of Read codes used to record both depression (n=50,783, 33.9%) and anxiety (n=16,822, 33.2%) (Table 5-9); with this proportion changing over calendar time (Figure 5-6). In 1998, symptom codes accounted for 15.2% of all depression and 29.2% of all anxiety Read codes. This increased to 36.9% for depression and 39.5% for anxiety in 2013. Similarly, there was an increase in the proportion of codes referring to depression scales and medical reviews for depression. Of the 11,519 Read codes referring to depression reviews, 9,194 (79.8%) were the Read code 9H92.00 'Depression Interim Review'.

Table 5-9: Categories of Read codes used to record depression and anxiety in study cohort

	Depression	Anxiety
Diagnosis code	84,694 (56.5)	33,891 (66.8)
Symptom code	50,783 (33.9)	16,822 (33.2)
Scale codes (e.g. PHQ-9 for depression)	2,963 (2.0)	38 (0.1)
Management/review codes	11,519 (7.7)	-

Figure 5-6: Proportion of symptom and diagnosis Read codes for depression and anxiety over time



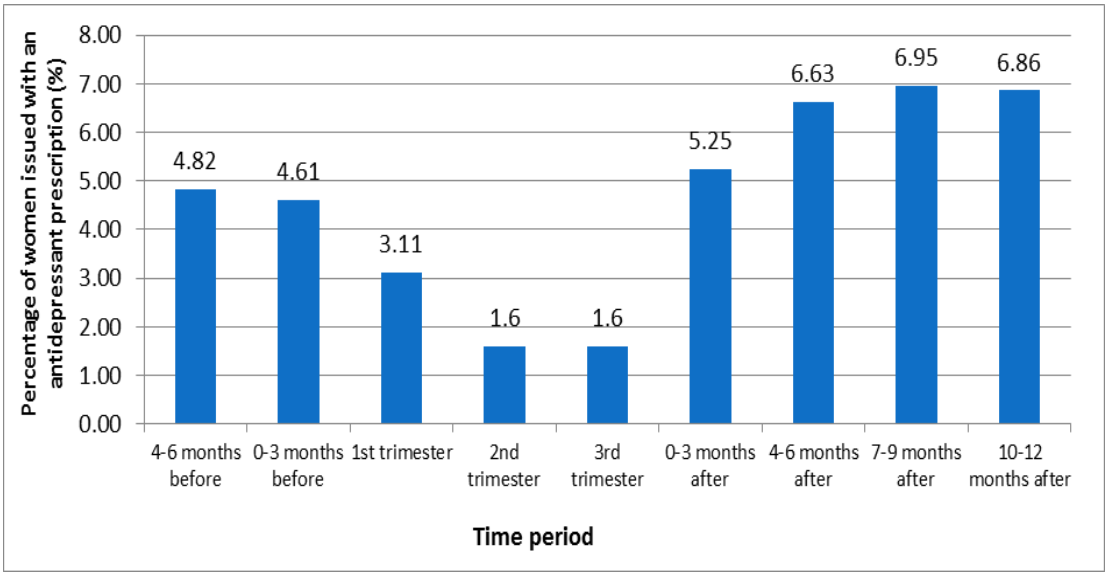


Numbers of scale/review codes for anxiety were very small (38 over study period) and so are not visible in the above figure

5.3.2.2 Prescriptions of antidepressants and anxiolytics

During study follow-up, 46,288 (22.4%) mothers had a total of 519,824 prescriptions for antidepressants (following exclusions of antidepressants for other indications, as described in Section 5.2.2.3). Of these prescriptions 84% were for selective serotonin reuptake inhibitors (n=434,208), with the three commonest drugs being Citalopram (n=183,418, 35.3%), Fluoxetine (n=133,832, 25.7%) and Sertraline (n=65,634, 12.6%). The prevalence of antidepressant prescriptions fell during pregnancy (Figure 5-7); an expected finding as many women will cease medications to prevent possible harms to the foetus. Of the mothers in the cohort, 15,852 (7.7%) received antidepressant treatment for more than 1 year of her follow-up time.

Figure 5-7: Prevalence of antidepressant prescriptions prior, during and after pregnancy



**Prevalence of antidepressant prescriptions was estimated using the methods described by Margulis et al, based on the date of issue of the prescription(327). All antidepressant prescriptions, of any duration were included.*

Among the study population there were 27,417 prescriptions for anxiolytics (after exclusion of courses with no anxiety diagnosis within six months) among 6,199 (3.0%) women. These were predominantly for Diazepam (n=15,028, 54.8%) and Temazepam (n=2,196, 8.0%).

5.3.2.3 Hospitalisations

Among the study cohort there were 5,647 hospitalisations with a diagnostic code for depression/anxiety, occurring among 4,126 women (2.0% of study cohort). Of these admissions, only 303 (5.4%) admissions had a primary diagnosis of depression and 100 (1.8%) admissions had a primary diagnosis of anxiety. For the remaining 5,244 (92.9%) admissions, an ICD-10 code for depression/anxiety was a secondary diagnosis. Of the admissions where depression/anxiety was not the primary diagnosis, half had a primary diagnosis from the ICD-10 chapter 'pregnancy, childbirth and the puerperium' (n=2,592, 51.0%) (e.g. an admission for delivery or complications of delivery, where depression/anxiety was coded as a secondary diagnosis).

5.3.3 Description of episodes of depression/anxiety occurring during study follow-up

During study follow-up (six months pre-pregnancy to end of follow-up), 62,402 mothers had a total of 92,940 incident episodes of depression/anxiety, of which 62,456 (67.2%) were depression episodes, 12,197 (13.1%) depression with anxiety episodes, and 18,287 (19.7%) anxiety episodes (Table 5-10). Most depression (n=37,261, 59.7%) and depression with anxiety (n=9,772, 80.1%) episodes were defined by Read codes and antidepressant prescriptions. Anxiety episodes were most commonly defined by single Read codes entered in the primary care record (n=9,241, 50.5%). Compared to depression (n=1,142, 1.8%) and anxiety (n=102, 0.6%) episodes, a higher proportion of depression with anxiety episodes were defined by Read codes, prescriptions and hospital admissions (n=1,126, 9.2%). Anxiety episodes were most commonly less than a month in duration (70.1%), reflecting the high proportion of episodes defined by a single Read code. In comparison, 43.0% of episodes of depression with anxiety were over 12 months in duration.

Table 5-10: Numbers of medically recorded episodes of depression/anxiety episodes, between six months pre-pregnancy and end of follow-up

	Number of depression episodes (%)	Number of depression with anxiety episodes (%)	Number of anxiety episodes (%)
Total number of episodes	62,456	12,197	18,287
How the episode defined			
Single Read Code	9,570 (15.3)	329 (2.7)	9,241 (50.5)
>1 Read Code	2,261 (3.6)	793 (6.5)	1,337 (7.3)
Single Prescription	4,096 (6.6)	0 (0)	45 (0.3)
>1 Prescription	7,052 (11.3)	0 (0)	39 (0.2)
Hospital admission only	649 (1.0)	56 (0.5)	522 (2.9)
Read code(s) & prescription(s)	37,261 (59.7)	9,772 (80.1)	6,853 (37.5)
Prescription(s) & hospital admission	359 (0.6)	63 (0.5)	83 (0.5)
Read code(s) & hospital admission(s)	66 (0.1)	58 (0.5)	65 (0.4)
Read code(s) & prescription(s) & hospital admission(s)	1,142 (1.8)	1,126 (9.2)	102 (0.6)
Duration of episode (months)			
< 1	19,356 (31.0)	1,286 (10.5)	12,824 (70.1)
1-5	22,479 (36.0)	3,205 (26.3)	3,142 (17.2)
6-11	9,971 (16.0)	2,460 (20.2)	1,195 (6.5)
≥12	10,650 (17.1)	5,246 (43.0)	1,126 (6.2)

5.3.4 Incidence rates of maternal depression/anxiety during pregnancy

During pregnancy, the 207,048 women in the study population experienced 3,725 incident episodes of depression, 898 incident episodes of depression with anxiety and 2,998 incident episodes of anxiety, giving incidence rates of 2.39/100 PY (95%CI 2.32-2.47), 0.58 (95%CI 0.54-0.62) and 1.93 (95%CI 1.86-2.00), respectively (Table 5-11). Incidence rates of depression and depression with anxiety were highest in mothers aged less than 20 years old, those from the most deprived socioeconomic quintiles and those with a record of alcohol or drug misuse. For example, compared to those in the least deprived quintile, mothers in the most deprived quintile had a 2 fold higher incidence of depression (unadj IRR 2.38, 95%CI 1.24-2.65) and a 54% higher incidence of depression with anxiety (unadj IRR 1.54, 95%CI 1.25-1.89). Mothers with a record for alcohol misuse had a 2-3 fold higher rate of depression (unadj IRR 2.16, 95%CI 1.85-2.52) and depression with anxiety (unadj IRR 2.73, 95%CI 2.05-3.63) compared to those with no record of alcohol misuse. Incidence rates of maternal anxiety were highest amongst mothers aged 20-29 years old (2.06/100 PY, 95%CI 1.95-2.18), but were not associated with socioeconomic deprivation, or maternal alcohol or drug misuse.

Table 5-11: Incidence rates of maternal depression/anxiety during pregnancy according to maternal characteristics

	Depression			Depression with anxiety			Anxiety		
	Number of episodes	Incidence rate (per 100 PY)	Unadjusted IRR (95%CI)	Number of episodes	Incidence rate (per 100 PY)	Unadjusted IRR (95%CI)	Number of episodes	Incidence rate (per 100 PY)	Unadjusted IRR (95%CI)
Overall	3,725	2.39 (2.32-2.47)	-	898	0.58 (0.54-0.62)	-	2,998	1.93 (1.86-2.00)	-
Maternal age at delivery (years)									
<20	298	4.13 (3.69-4.63)	1	62	0.86 (0.67-1.10)	1	127	1.76 (1.48-2.10)	1
20-29	1,831	3.02 (2.89-3.16)	0.73 (0.65-0.83)	425	0.70 (0.64-0.77)	0.82 (0.63-1.07)	1,247	2.06 (1.95-2.18)	1.17 (0.97-1.40)
30-39	1457	1.80 (1.71-1.90)	0.44 (0.38-0.49)	373	0.46 (0.42-0.51)	0.54 (0.41-0.70)	1,480	1.83 (1.74-1.92)	1.04 (0.87-1.24)
≥40	139	2.01 (1.70-2.37)	0.49 (0.40-0.59)	38	0.55 (0.40-0.75)	0.64 (0.43-0.96)	144	2.08 (1.77-2.45)	1.18 (0.93-1.50)
Socioeconomic deprivation, IMD 2010									
Quintile 1	526	1.49 (1.37-1.62)	1	166	0.47 (0.40-0.55)	1	689	1.95 (1.81-2.10)	1
Quintile 2	613	1.86 (1.72-2.02)	1.25 (1.11-1.41)	143	0.43 (0.37-0.51)	0.93 (0.74-1.16)	629	1.91 (1.77-2.07)	0.98 (0.88-1.09)
Quintile 3	685	2.30 (2.13-2.48)	1.54 (1.38-1.73)	178	0.60 (0.52-0.69)	1.27 (1.03-1.57)	567	1.90 (1.75-2.06)	0.98 (0.87-1.09)
Quintile 4	947	3.09 (2.90-3.30)	2.08 (1.87-2.31)	217	0.71 (0.62-0.81)	1.51 (1.23-1.85)	575	1.88 (1.73-2.04)	0.96 (0.86-1.08)
Quintile 5	948	3.55 (3.33-3.78)	2.38 (2.14-2.65)	193	0.72 (0.63-0.83)	1.54 (1.25-1.89)	535	2.00 (1.84-2.18)	1.03 (0.92-1.15)
Missing	6	2.87 (1.29-6.39)	1.93 (0.86-4.31)	*	0.48 (0.07-3.39)	1.02 (0.14-7.27)	*	1.43 (0.46-4.45)	0.74 (0.24-2.29)
Maternal alcohol misuse during study follow-up									
No	3,559	2.34 (2.26-2.41)	1	848	0.56 (0.52-0.60)	1	2,938	1.93 (1.86-2.00)	1
Yes	166	5.05 (4.33-5.88)	2.16 (1.85-2.52)	50	1.52 (1.15-2.01)	2.73 (2.05-3.63)	60	1.82 (1.42-2.35)	0.95 (0.73-1.22)
Maternal drug misuse during study follow-up									
No	3,646	2.36 (2.28-2.43)	1	878	0.57 (0.53-0.61)	1	2,978	1.92 (1.86-1.99)	1
Yes	79	9.18 (7.36-11.45)	3.90 (3.12-4.87)	20	2.32 (1.50-3.60)	4.10 (2.63-6.38)	20	2.32 (1.50-3.60)	1.21 (0.78-1.88)

**Numbers omitted to comply with CPRD small numbers policy*

5.3.5 Incidence of maternal depression/anxiety from delivery to the child's fifth birthday

From birth to the child's fifth birthday, the 207,048 women in the cohort experienced 47,483 incident episodes of depression, 8,920 incident episodes of depression with anxiety and 12,538 incident episodes of anxiety. This gave overall incidence rates of 6.92/100 PY (95%CI 6.86-6.98), 1.30 (95%CI 1.27-1.33) and 1.83 (95%CI 1.80-1.86), respectively. Crude incidence rates, and unadjusted incidence rate ratios for episodes of maternal depression (Table 5-12), depression with anxiety (Table 5-13) and anxiety (Table 5-14) are shown according to maternal, child and household characteristics.

5.3.5.1 Child characteristics

Incidence rates of maternal depression/anxiety episodes were not significantly associated with the child's sex (p=0.25 depression, p=0.90 depression with anxiety, p=0.19 anxiety), whereas significant associations were seen with child age. Incidence rates of depression and depression with anxiety peaked between birth and three months (Figure 5-8), with incidence rates of 14.6 per 100 PY (95%CI 14.3-15.0) and 2.8 per 100 PY (95%CI 2.6-2.9), respectively for this period. The incidence of depression reduced until about a year after birth, and remained at a rate of about 5-6 per 100 PY until the child's fifth birthday. Incidence rates of maternal anxiety increased with child age, with mothers of children aged 4 years old having a 27% higher rate of anxiety than those whose child was aged less than 1 year (unadj IRR 1.27, 95%CI 1.20-1.34).

5.3.5.2 Maternal characteristics

For both depression and depression with anxiety, incidence rates were highest among younger mothers; with women aged 40 or over having a 59% lower rate of depression (unadj IRR 0.41, 95%CI 0.38-0.43), and a 53% lower rate of depression with anxiety (unadj IRR 0.47, 95%CI 0.41-0.54) than mothers aged less than 20 years. Rates of anxiety were highest in women aged 20-29 years (2.12/100 PY, 95%CI 2.06-2.18), and lowest in women aged over 40 years (1.59/100 PY, 95%CI 1.47-1.73). Maternal alcohol and drug misuse were both significantly associated with higher incidence rates of maternal depression/anxiety. For example, incidence rates of depression were 79% higher among mothers with a record for alcohol misuse (unadj IRR 1.79, 95%CI 1.71-1.87) and 2.41 fold higher among mothers with a record for drug misuse (unadj IRR 2.41, 95%CI 2.22-2.60),

compared to those mothers who did not have a record for alcohol or drug misuse, respectively. The magnitude of effect was even greater for incidence rates of maternal depression with anxiety, with rates 2.68 fold higher amongst mothers with a record for alcohol misuse (unadj IRR 2.68, 95%CI 2.47-2.92), and 4.31 fold higher among mothers with a record of drug misuse (unadj IRR 4.31, 95%CI 3.75-4.94), compared to those without a record for alcohol or drug misuse, respectively.

5.3.5.3 Household characteristics

Incidence rates of depression, and depression with anxiety were 76-77% higher among women from the most deprived areas compared to women from the least deprived areas (depression unadj IRR 1.77, 95%CI 1.72-1.82; depression with anxiety unadj IRR 1.76, 95%CI 1.65-1.88). The socioeconomic gradient was less steep for the incidence of anxiety episodes, with women from the most deprived quintile had an 18% higher rate of anxiety than women from the least deprived quintile (unadj IRR 1.18, 95%CI 1.11-1.25).

A 'U-shaped' relationship was seen between incidence rates of maternal depression/anxiety and the number of children aged less than 5 years old in the household; most clearly seen for maternal depression. Compared to having 1 child aged less than 5 years old in the household, incidence rates of maternal depression were 13% lower among mothers with 2 children aged less than 5 in the household (depression unadj IRR 0.87, 95%CI 0.86-0.89). However, once there were 4 or more children aged less than 5 in the household, mothers had a 14% higher incidence of depression episodes compared to households with 1 child aged less than 5 years old (depression unadj IRR 1.14, 95%CI 1.08-1.20).

Figure 5-8: Incidence of maternal depression, anxiety, and depression with anxiety from birth to the child's fifth birthday

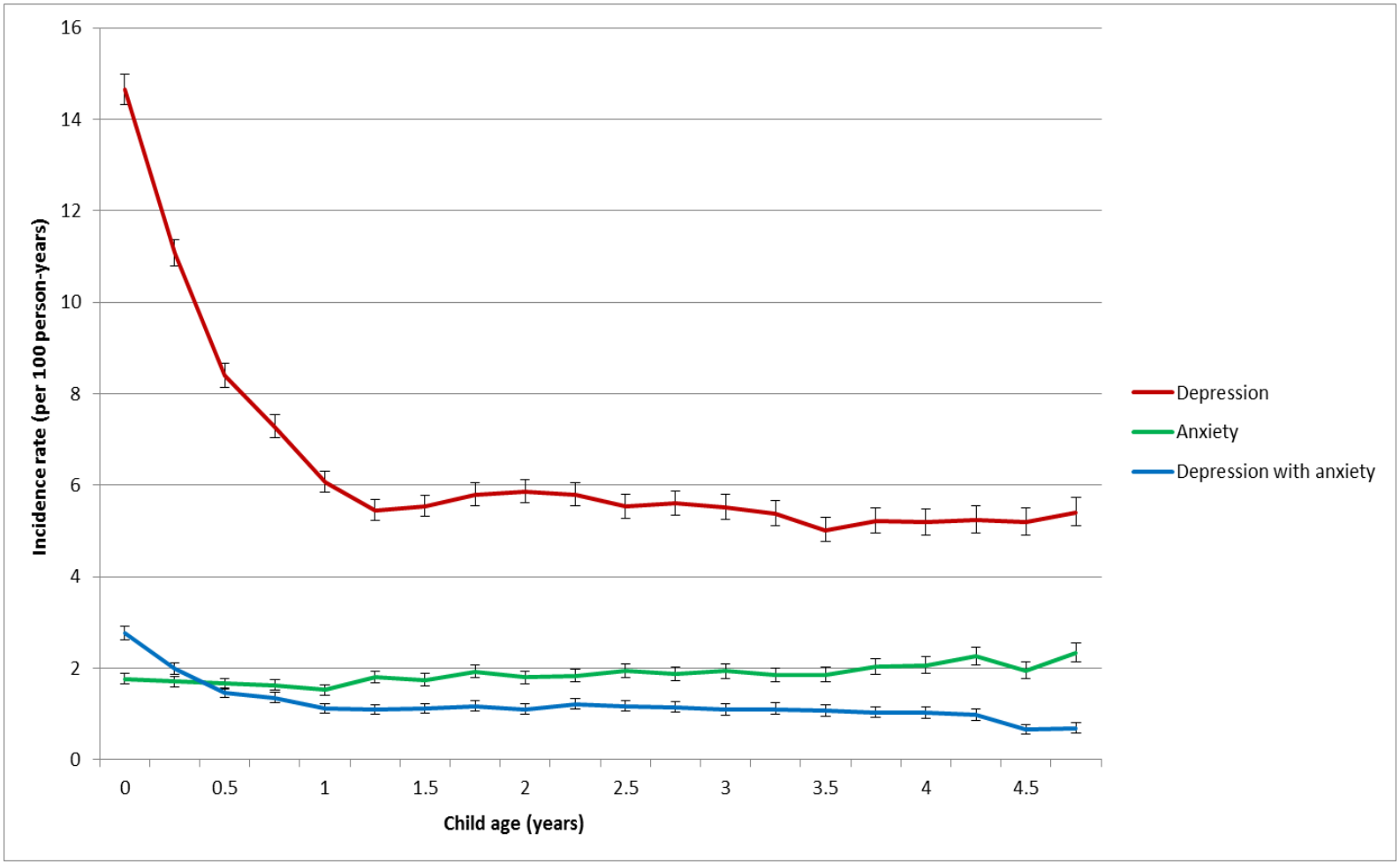


Table 5-12: Incidence of maternal depression from birth to the child's fifth birthday, according to child, maternal and household characteristics

	Number of incident episodes	Crude incidence rate per 100 PY (95%CI)	Unadjusted IRR (95%CI)	*p* value*
Overall rate	47,483	6.92 (6.86-6.98)	-	-
Child sex				
Male	24,377	6.96 (6.87-7.04)	1	0.25
Female	23,106	6.88 (6.79-6.97)	0.99 (0.97-1.01)	
Child age (years)				
0	20,157	10.49 (10.34-10.63)	1	<0.0001
1	9,103	5.72 (5.60-5.84)	0.55 (0.53-0.56)	
2	7,508	5.70 (5.58-5.83)	0.54 (0.53-0.56)	
3	5,836	5.29 (5.16-5.43)	0.50 (0.49-0.52)	
4	4,879	5.26 (5.11-5.41)	0.50 (0.49-0.52)	
Maternal age at delivery (years)				
<20	3,677	12.48 (12.09-12.89)	1	<0.0001
20-29	21,309	8.40 (8.29-8.51)	0.67 (0.65-0.70)	
30-39	20,851	5.63 (5.55-5.70)	0.45 (0.44-0.47)	
≥40	1,646	5.07 (4.83-5.33)	0.41 (0.38-0.43)	
Socioeconomic deprivation, IMD 2010				
Quintile 1 (least deprived)	8,635	5.24 (5.13-5.36)	1	<0.0001
Quintile 2	8,864	6.00 (5.88-6.13)	1.14 (1.11-1.18)	
Quintile 3	9,081	6.95 (6.81-7.09)	1.33 (1.29-1.37)	
Quintile 4	10,425	8.01 (7.86-8.17)	1.53 (1.48-1.57)	
Quintile 5 (most deprived)	10,425	9.30 (9.12-9.48)	1.77 (1.72-1.82)	
Missing	53	6.52 (4.98-8.54)	1.24 (0.95-1.63)	
Maternal alcohol misuse during study follow-up				
No	45,301	6.78 (6.72-6.84)	1	<0.0001
Yes	2,182	12.13 (11.63-12.65)	1.79 (1.71-1.87)	
Maternal drug misuse during study follow-up				
No	46,856	6.87 (6.81-6.93)	1	<0.0001
Yes	627	16.49 (15.25-17.84)	2.40 (2.22-2.60)	
Total number of children aged <5 years in household				
1	20,600	7.33 (7.23-7.43)	1	<0.0001
2	20,296	6.40 (6.31-6.49)	0.87 (0.86-0.89)	
3	4,974	7.27 (7.07-7.47)	0.99 (0.96-1.02)	
4 or more	1,613	8.34 (7.94-8.75)	1.14 (1.08-1.20)	

**Likelihood ratio test*

Table 5-13: Incidence of maternal depression with anxiety from birth to the child's fifth birthday, according to child, maternal and household characteristics

	Number of incident episodes	Crude incidence rate per 100 PY (95%CI)	Unadjusted IRR (95%CI)	*p* value*
Overall	8,920	1.30 (1.27-1.33)	-	
Child sex				
Male	4,550	1.30 (1.26-1.34)	1	0.90
Female	4,370	1.30 (1.26-1.34)	1.00 (0.96-1.05)	
Child age (years)				
0	3,673	1.91 (1.85-1.97)	1	<0.0001
1	1,776	1.12 (1.06-1.17)	0.58 (0.55-0.62)	
2	1,516	1.15 (1.10-1.21)	0.60 (0.57-0.64)	
3	1,178	1.07 (1.01-1.13)	0.56 (0.52-0.60)	
4	777	0.84 (0.78-0.90)	0.44 (0.41-0.47)	
Maternal age at delivery (years)				
<20	590	2.00 (1.85-2.17)	1	<0.0001
20-29	4,009	1.58 (1.53-1.63)	0.79 (0.72-0.86)	
30-39	4,014	1.08 (1.05-1.12)	0.54 (0.50-0.59)	
≥40	307	0.95 (0.85-1.06)	0.47 (0.41-0.54)	
Socioeconomic deprivation, IMD 2010				
Quintile 1 (least deprived)	1,642	1.00 (0.95-1.05)	1	<0.0001
Quintile 2	1,593	1.08 (1.03-1.13)	1.08 (1.01-1.16)	
Quintile 3	1,709	1.31 (1.25-1.37)	1.31 (1.23-1.40)	
Quintile 4	1,979	1.52 (1.46-1.59)	1.53 (1.43-1.63)	
Quintile 5 (most deprived)	1,970	1.76 (1.68-1.84)	1.76 (1.65-1.88)	
Missing	27	3.32 (2.28-4.85)	3.33 (2.28-4.88)	
Maternal alcohol misuse during study follow-up				
No	8,319	1.25 (1.22-1.27)	1	<0.0001
Yes	601	3.34 (3.08-3.62)	2.68 (2.47-2.92)	
Maternal drug misuse during study follow-up				
No	8,711	1.28 (1.25-1.30)	1	<0.0001
Yes	209	5.50 (4.80-6.30)	4.31 (3.75-4.94)	
Total number of children aged <5 years in household				
1	4,027	1.43 (1.39-1.48)	1	<0.0001
2	3,758	1.18 (1.15-1.22)	0.83 (0.79-0.86)	
3	856	1.25 (1.17-1.34)	0.87 (0.81-0.94)	
4 or more	279	1.44 (1.28-1.62)	1.01 (0.89-1.14)	

**Likelihood ratio test*

Table 5-14: Incidence of maternal anxiety from birth to the child's fifth birthday, according to child, maternal and household characteristics

	Number of incident episodes	Crude incidence rate per 100 PY (95%CI)	Unadjusted IRR (95%CI)	*p* value*
Overall	12,538	1.83 (1.80-1.86)	-	
Child sex				
Male	6,477	1.85 (1.80-1.89)	1	0.19
Female	6,062	1.81 (1.76-1.85)	0.98 (0.94-1.01)	
Child age (years)				
0	3,244	1.69 (1.63-1.75)	1	<0.0001
1	2,767	1.74 (1.67-1.80)	1.03 (0.98-1.08)	
2	2,435	1.85 (1.78-1.92)	1.10 (1.04-1.16)	
3	2,103	1.91 (1.83-1.99)	1.13 (1.07-1.19)	
4	1,989	2.14 (2.05-2.24)	1.27 (1.20-1.34)	
Maternal age at delivery (years)				
<20	605	2.05 (1.90-2.22)	1	<0.0001
20-29	5,373	2.12 (2.06-2.18)	1.03 (0.95-1.12)	
30-39	6,045	1.63 (1.59-1.67)	0.79 (0.73-0.86)	
≥40	515	1.59 (1.47-1.73)	0.77 (0.69-0.87)	
Socioeconomic deprivation, IMD 2010				
Quintile 1 (least deprived)	2,782	1.69 (1.63-1.75)	1	<0.0001
Quintile 2	2,598	1.76 (1.69-1.83)	1.04 (0.99-1.10)	
Quintile 3	2,385	1.83 (1.75-1.90)	1.08 (1.02-1.14)	
Quintile 4	2,522	1.94 (1.86-2.01)	1.15 (1.09-1.21)	
Quintile 5 (most deprived)	2,231	1.99 (1.91-2.08)	1.18 (1.11-1.25)	
Missing	20	2.46 (1.59-3.82)	1.46 (0.93-2.26)	
Maternal alcohol misuse during study follow-up				
No	12,009	1.80 (1.77-1.83)	1	<0.0001
Yes	529	2.94 (2.70-3.20)	1.64 (1.50-1.78)	
Maternal drug misuse during study follow-up				
No	12,432	1.82 (1.79-1.85)	1	<0.0001
Yes	106	2.79 (2.31-3.37)	1.53 (1.26-1.85)	
Total number of children aged <5 years in household				
1	5,405	1.92 (1.87-1.97)	1	<0.0001
2	5,456	1.72 (1.68-1.77)	0.89 (0.86-0.93)	
3	1,286	1.88 (1.78-1.98)	0.98 (0.92-1.04)	
4 or more	391	2.02 (1.83-2.23)	1.05 (0.95-1.16)	

**Likelihood ratio test*

5.3.6 Incidence of maternal depression and anxiety according to exposure to perinatal depression

5.3.6.1 Perinatal depression

Of the 207,048 mothers in the study cohort, 4,210 (2.0%) had antenatal depression, 20,486 (9.9%) had postnatal depression, and 7,413 (3.6%) had both. Of the 11,623 mothers with antenatal depression (Table 5-15), over half were mothers whose depression commenced before the start of pregnancy (n=7,292, 62.7%). Among the 27,899 mothers with postnatal depression, 4,195 (15.0%) were those whose depression commenced prior to the birth of the child. The median length of study follow-up varied according to whether mothers had perinatal depression or not. Median follow-up was 3.9 years (IQR 1.6-5.0) for mothers who did not have perinatal depression, 3.1 years (IQR 1.1-5.0) for mothers who had antenatal depression, 4.3 years (IQR 1.9-5.0) for mothers who had postnatal depression, and 3.1 years (IQR 1.4-5.0) for mothers who had both antenatal and postnatal depression.

Table 5-15: Numbers of women with antenatal and/or postnatal depression

	Number (%) of women with an ongoing episode*	Number (%) of women with a new episode of depression (incident episode)	Total number of women with depression (%)
Antenatal depression: during pregnancy	7,292 (3.5%)	4,331 (2.1 %)	11,623 (5.6%)
Postnatal depression: between birth and twelve months	4,195 (2.0%)	23,704 (11.4%)	27,899 (13.5%)

**For antenatal cases, this means the mother was depressed prior to pregnancy, and for postnatal depression, this means the woman was depressed prior to the delivery of the child*

5.3.6.2 Maternal depression and anxiety episodes between the child's first and fifth birthday

Of the 207,048 women in the study cohort, 175,130 (84.6%) had more than 1 year of study follow-up and so contributed person-time to the following analysis examining incidence rates of maternal depression/anxiety when the child was aged 1-4 years old, according to exposure to perinatal depression.

Mothers who had experienced perinatal depression were more likely to experience further episodes of depression/anxiety when the child was aged 1-4 years old compared

to mothers who had not had perinatal depression (Table 5-16). For example, 31.7% of mothers who had experienced antenatal depression had one or more episode of depression when the child was aged 1-4 years old (n=1,032), compared to 10.3% (n=15,036) of mothers who did not have perinatal depression.

Table 5-16: Number of maternal depression and/or anxiety episodes between the child's first and fifth birthday, according to whether the mother had antenatal and/or postnatal depression

	Antenatal Number (%)	**Postnatal** Number (%)	**Antenatal & postnatal** Number (%)	**Neither antenatal nor postnatal** Number (%)	**All women** Number (%)
Depression					
0	2,223 (68.3)	13,153 (71.4)	4,612 (75.7)	132,323 (89.8)	152,311 (87.0)
1	834 (25.6)	4,127 (22.4)	1,148 (18.8)	12,743 (8.7)	18,851 (10.8)
≥2	198 (6.1)	1,142 (6.2)	334 (5.5)	2,293 (1.6)	3,968 (2.3)
Depression with anxiety					
0	2,998 (92.1)	17,218 (93.5)	5,722 (93.9)	144,199 (97.9)	170,137 (97.2)
1	246 (7.6)	1,134 (6.2)	352 (5.8)	3,015 (2.1)	4,747 (2.7)
≥2	11 (0.3)	70 (0.4)	20 (0.3)	145 (0.1)	246 (0.1)
Anxiety alone					
0	2,981 (91.6)	17,250 (93.6)	5,805 (95.2)	140,809 (95.6)	166,843 (95.3)
1	236 (7.3)	1,044 (5.7)	252 (4.2)	5,850 (4.0)	7,384 (4.2)
≥2	38 (1.2)	128 (0.7)	37 (0.6)	700 (0.5)	903 (0.5)

**Table presents data for 175,130 women who had more than a year of study follow-up after the birth of the child and so were eligible for inclusion in the analysis.*

5.3.6.3 Maternal depression and anxiety incidence between the child's first and fifth birthday

Incidence rates of both maternal depression and depression with anxiety were approximately three times higher between the child's first and fifth birthday among women who had experienced antenatal and/or postnatal depression compared to those women who had not experienced perinatal depression (Table 5-17). Incidence rates of depression when the child was aged 1 to 4 years were 14.2/100 PY (95%CI 13.4-15.0) after antenatal depression, 12.6 (95%CI 12.3–12.9) after postnatal depression, and 11.8 (95%CI 11.3–12.3) after both, compared with 4.2 (95%CI 4.2-4.3) for women without perinatal depression. After adjustment for maternal age at delivery and socioeconomic deprivation, depression rates remained more than twice as high among women who had experienced perinatal depression as those without (antenatal aIRR 3.15, 95%CI 2.98-3.34; postnatal aIRR 2.80, 95%CI 2.72-2.88; both antenatal and postnatal aIRR 2.67, 95%CI 2.54-2.80). A similar pattern was seen for depression with anxiety. Incidence rates

of maternal depression (with or without anxiety) continued to be higher amongst mothers who had experienced perinatal depression throughout the child's first five years of life, compared to mothers who had not experienced perinatal depression (Figure 5-9).

Incidence rates of maternal anxiety when the child was aged 1-4 years old were higher amongst women who had experienced perinatal depression compared to women who had not (Table 5-17). Compared to mothers that did not have perinatal depression, rates of maternal anxiety were 97% higher following antenatal depression (aIRR 1.97, 95%CI 1.76-2.20), 38% higher after postnatal depression (aIRR 1.38, 95%CI 1.30-1.47), and 16% higher following both antenatal and postnatal depression (aIRR 1.16, 95%CI 1.04-1.30).

Table 5-17: Incidence of maternal depression and/or anxiety according to exposure to antenatal and/or postnatal depression[$]

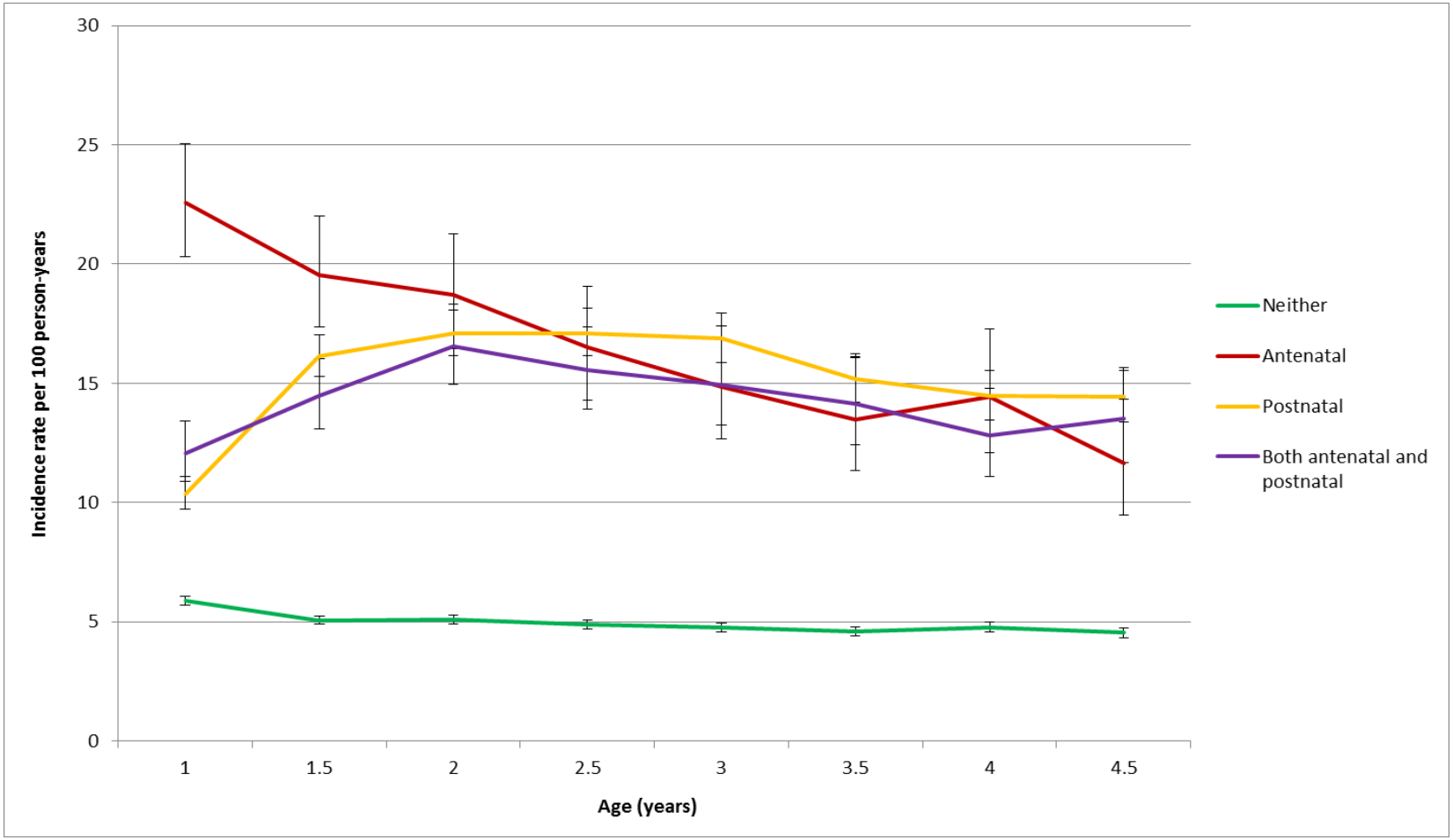
	Number of incident episodes	Person-years	Crude incidence rate per 100 PY (95%CI)	Unadjusted IRR (95%CI)	Adjusted IRR* (95%CI)	*p* value#
DEPRESSION						
Neither	17,613	427,100	4.22 (4.16-4.29)	1	1	<0.0001
Antenatal	1,263	9,169	14.20 (13.44-15.01)	3.36 (3.18-3.56)	3.15 (2.98-3.34)	
Postnatal	6,580	53,182	12.63 (12.33-12.94)	2.99 (2.91-3.08)	2.80 (2.72-2.88)	
Both antenatal & postnatal	1,870	16,388	11.78 (11.26-12.33)	2.79 (2.66-2.93)	2.67 (2.54-2.80)	
DEPRESSION WITH ANXIETY						
Neither	3,307	427,100	0.79 (0.77-0.82)	1	1	<0.0001
Antenatal	268	9,169	3.01 (2.67-3.40)	3.80 (3.36-4.30)	3.56 (3.14-4.03)	
Postnatal	1,279	53,182	2.46 (2.32-2.59)	3.10 (2.90-3.30)	2.90 (2.72-3.10)	
Both antenatal & postnatal	393	16,388	2.48 (2.24-2.73)	3.12 (2.81-3.47)	2.98 (2.69-3.31)	
ANXIETY						
Neither	7,335	427,100	1.76 (1.72-1.80)	1	1	<0.0001
Antenatal	318	9,169	3.58 (3.20-3.99)	2.03 (1.82-2.27)	1.97 (1.76-2.20)	
Postnatal	1,310	53,182	2.52 (2.38-2.66)	1.43 (1.35-1.52)	1.38 (1.30-1.47)	
Both antenatal & postnatal	331	16,388	2.09 (1.88-2.33)	1.19 (1.07-1.33)	1.16 (1.04-1.30)	

$ Table presents data for 175,130 women who had more than a year of study follow-up after the birth of the child, and so were eligible for inclusion in the analysis.

**Adjusted for a priori confounders, maternal age at delivery and socioeconomic deprivation. None of the other potential confounders led to a change in the IRR by ≥10% and so were not included in the final model.*

#Likelihood ratio test

Figure 5-9: Incidence of maternal depression episodes (with or without anxiety) between the child's first and fifth birthday, according to the presence of antenatal and/or postnatal depression



5.3.7 Sensitivity analyses

5.3.7.1 Incidence rates of maternal depression/anxiety during pregnancy and the first five years after delivery

Extending the time-window used to define episodes of maternal depression/anxiety from six to 12 months reduced the incidence of depression alone and anxiety alone in both pregnancy and the child's first five years of life (Table 5-18). For example, the incidence of depression when the child was aged 0-4 years old reduced from 6.92 per 100 PY (95%CI 6.86-6.98) in the primary analysis to 5.56 (95%CI 5.50-5.61) in the sensitivity analysis. The incidence of depression with anxiety in pregnancy increased in the sensitivity analysis (from 0.58/100 PY to 0.70/100 PY); reflecting individual episodes of depression alone and anxiety alone being classified as an episode of depression with anxiety when the longer time-window of 12 months was used.

Exclusion of symptom and clinical review Read codes from the definition of depression/anxiety led to the identification of 4,090 fewer depression episodes, 2,488 fewer depression with anxiety episodes and 4,895 fewer anxiety episodes during pregnancy and the child's first five years of life compared to the primary analysis (Table 5-18). This led to notable reductions (>10%) in the estimated incidence rates of depression/anxiety during pregnancy, and notable reductions in the incidence of depression with anxiety, and anxiety alone between birth and the child's fifth birthday.

During study follow-up, 219 mothers were diagnosed with schizophrenia or bipolar disorder. The exclusion of these mother-child pairs led to no notable changes (<10%) in the incidence rates of depression, depression with anxiety or anxiety alone (Table 5-18).

Table 5-18: Sensitivity analyses, estimating the incidence of maternal depression/anxiety episodes between the child's birth and fifth birthday

	Primary analysis. (n=207,048)		**Sensitivity analysis 1:** Extending the time-window used to define incident episodes of depression/anxiety from six to 12 months. (n=207,048)		**Sensitivity analysis 2:** Excluding symptom and clinical review Read codes for depression and/or anxiety. (n=207,048)		**Sensitivity analysis 3:** Excluding women diagnosed with schizophrenia or bipolar disorder during study follow-up. (n=206,829)	
	Number of episodes	**Incidence rate per 100 PY (95%CI)**	**Number of episodes**	**Incidence rate per 100 PY (95%CI)**	**Number of episodes**	**Incidence rate per 100 PY (95%CI)**	**Number of episodes**	**Incidence rate per 100 PY (95%CI)**
PREGNANCY								
Depression	3,725	2.39 (2.32-2.47)	2,951	**1.90 (1.83-1.97)**	2,740	**1.76 (1.70-1.83)**	3,710	2.39 (2.31-2.46)
Depression with anxiety	898	0.58 (0.54-0.62)	1,090	**0.70 (0.66-0.74)**	592	**0.38 (0.35-0.41)**	890	0.57 (0.54-0.61)
Anxiety	2,998	1.93 (1.86-2.00)	2,489	**1.60 (1.54-1.66)**	1,547	**0.99 (0.95-1.04)**	2,991	1.92 (1.86-1.99)
BETWEEN BIRTH AND CHILD'S FIFTH BIRTHDAY								
Depression	47,483	6.92 (6.86-6.98)	38,139	**5.56 (5.50-5.61)**	44,378	6.47 (6.41-6.53)	47,339	6.90 (6.84-6.97)
Depression with anxiety	8,920	1.30 (1.27-1.33)	8,388	1.22 (1.20-1.25)	6,738	**0.98 (0.96-1.01)**	8,877	1.29 (1.27-1.32)
Anxiety	12,538	1.83 (1.80-1.86)	10,335	**1.51 (1.48-1.54)**	9,094	**1.33 (1.30-1.35)**	12,531	1.83 (1.80-1.86)

Numbers highlighted in bold have changed from the primary analysis by 10% or more

5.3.7.2 Incidence of maternal depression/anxiety according to exposure to perinatal depression

Using a time-window of 12 months to define continuous episodes of depression/anxiety reduced the magnitude of observed associations between perinatal depression and subsequent rates of depression/anxiety when the child was aged 1-4 years, particularly for those with both antenatal and postnatal depression (Table 5-19). For example, in the primary analysis mothers with both antenatal and postnatal depression had a 2.67 times higher rate of depression episodes compared to those who did not have perinatal depression (aIRR 2.67, 95%CI 2.54-2.80); which reduced to a 1.45 times higher rate in the sensitivity analysis (aIRR 1.45, 95%CI 1.36-1.55). In the sensitivity analysis, incidence rates of anxiety when the child was aged 1-4 years old were no longer significantly higher among those with postnatal depression (aIRR 1.00, 95%CI 0.93-1.07), or both antenatal and postnatal depression (aIRR 0.65, 95%CI 0.56-0.76) compared to those who did not have perinatal depression.

Excluding Read codes for depression/anxiety symptoms and clinical reviews largely increased the magnitude of observed associations between perinatal depression and subsequent rates of depression/anxiety when the child was aged 1-4 years old, particularly for anxiety (Table 5-19). Those who had experienced perinatal depression continued to have a threefold higher rate of depression (with or without anxiety) compared to those who had not experienced perinatal depression. The magnitude of the association between perinatal depression and subsequent anxiety episodes increased following the exclusion of symptom and clinical review Read codes, with the strongest association seen for those with antenatal depression, who had a 2.4 fold higher rate of anxiety episodes when the child was aged 1-4 years compared to those who had not had perinatal depression (aIRR 2.40, 95%CI 2.12-2.71).

The exclusion of mother-child pairs where the mother was diagnosed with a serious mental illness during study follow-up led to no notable changes in estimated incidence rate ratios (Table 5-19).

Table 5-19: Sensitivity analyses, incidence rates of maternal depression and/or anxiety episodes according to exposure to maternal perinatal depression

	Primary analysis. (n=175,130[#])	**Sensitivity analysis 1:** Extending the time-window used to define incident episodes of depression/anxiety from six to 12 months. (n=175,130)	**Sensitivity analysis 2:** Excluding symptom and clinical review codes for depression and/or anxiety. (n=175,130)	**Sensitivity analysis 3:** Excluding women who were diagnosed with a serious mental illness during study follow-up. (n=174,954)
	Adjusted IRR* (95%CI)	**Adjusted IRR* (95%CI)**	**Adjusted IRR* (95%CI)**	**Adjusted IRR* (95%CI)**
DEPRESSION				
Neither	1	1	1	1
Antenatal	3.15 (2.98-3.34)	2.99 (2.81-3.19)	3.30 (3.11-3.50)	3.15 (2.97-3.33)
Postnatal	2.80 (2.72-2.88)	**1.82 (1.76-1.89)**	3.07 (2.98-3.16)	2.80 (2.72-2.88)
Both antenatal & postnatal	2.67 (2.54-2.80)	**1.45 (1.36-1.55)**	**2.99 (2.85-3.13)**	2.68 (2.55-2.81)
DEPRESSION WITH ANXIETY				
Neither	1	1	1	1
Antenatal	3.56 (3.14-4.03)	3.58 (3.16-4.04)	3.47 (3.00-4.02)	3.56 (3.14-4.04)
Postnatal	2.90 (2.72-3.10)	**1.93 (1.79-2.08)**	2.90 (2.69-3.12)	2.90 (2.72-3.10)
Both antenatal & postnatal	2.98 (2.69-3.31)	**1.52 (1.32-1.75)**	3.06 (2.71-3.45)	2.98 (2.69-3.32)
ANXIETY				
Neither	1	1	1	1
Antenatal	1.97 (1.76-2.20)	1.80 (1.59-2.04)	**2.40 (2.12-2.71)**	1.97 (1.76-2.21)
Postnatal	1.38 (1.30-1.47)	**1.00 (0.93-1.07)**	**1.58 (1.47-1.69)**	1.38 (1.30-1.47)
Both antenatal & postnatal	1.16 (1.04-1.30)	**0.65 (0.56-0.76)**	**1.45 (1.29-1.63)**	1.17 (1.05-1.30)

**Adjusted for a priori confounders maternal age at delivery and socioeconomic deprivation. None of the other potential confounders led to a reduction in the IRR by 10% or more and so were not included in the final model.*

[#]Only mothers who had more than 1 year of study follow-up were eligible for inclusion in the analysis.

Numbers highlighted in bold have changed from the primary analysis by 10% or more.

5.4 Discussion

5.4.1 Summary of key findings

This chapter describes the identification of episodes of maternal depression/anxiety using linked primary care and hospitalisation data for a cohort of over 200,000 mothers from England. Of the mothers 5.6% had antenatal depression and 13.5% had postnatal depression. Incidence rates of maternal depression and depression with anxiety were highest in the first three months after delivery, among younger mothers, those from the most deprived areas and those with a record of drug or alcohol misuse. In contrast incidence rates of maternal anxiety increased with child age; highest when the child was aged 4 years old. In sensitivity analyses, the use of a longer time-window to define depression/anxiety episodes and the exclusion of symptom and clinical review Read codes, significantly reduced estimated incidence rates of depression/anxiety.

Mothers who had experienced perinatal depression had higher incidence rates of depression/anxiety, even until the child's fifth birthday. Incidence rates of depression and depression with anxiety were 2-3 times higher when the child was aged 1-4 years among mothers who had experienced perinatal depression compared to those who had not. The strength of this association reduced following the use of a longer time-window to define depression/anxiety episodes, particularly for mothers who had postnatal depression or both antenatal and postnatal depression. The exclusion of symptom and clinical review Read codes increased the strength of observed associations between perinatal depression and subsequent episodes of maternal depression/anxiety, as this is likely to have excluded episodes of milder depression/anxiety.

5.4.2 Strengths and limitations

5.4.2.1 Bias

Due to the high registration levels with GPs within England (98% of resident population(226)), one of the important strengths of using routine primary care data from England is that the study population is less affected by selection biases related to who responds and agrees to participate in a study; a particular issue when studying a more sensitive topic such as maternal mental illness. Similar to births data from England,

there was a slightly higher proportion of male compared to female children in the study population (51.2% males in cohort; 51.3% of live births in 2013 were male)(328). Median maternal age at delivery was slightly higher (31.0 years) than the average for England (ranging from 28.3 years in 1998 to 30.0 in 2013(328)), and those from the most deprived socioeconomic quintile were underrepresented (17.2% of study cohort). To be included in the study population, mothers had to have follow-up time from six months pre-pregnancy, and the child had to be registered with a GP within 3 months of birth. These study requirements may have led to the exclusion of those who frequently change general practice or delay registering their child with a GP, which may explain the higher median maternal age at delivery and some underrepresentation of those from the most deprived areas. In addition, the process of matching children and mothers (carried out by the CPRD) may have excluded some groups of mothers, such as those living in large blocks of flats, those not registered with a GP and those who are homeless. These potential selection biases may exclude some of the most vulnerable mother-child pairs from the cohort, and so may lead to an underestimation of maternal depression/anxiety incidence.

Differences in the length of study follow-up were observed according to maternal and child characteristics, with younger mothers and those from the most deprived areas having on average a year less of study follow-up than mothers aged over 40 and those from the most affluent areas, respectively. In addition study follow-up varied according to whether mothers had experienced perinatal depression, lower among those with antenatal depression or both antenatal and postnatal depression. Differential loss to follow-up according to these maternal characteristics could lead to an underestimation of maternal depression/anxiety incidence, as maternal depression/anxiety rates tend to be higher in these groups(149).

An important strength of this study is the consideration of both depression and anxiety; an issue often overlooked and understudied in the perinatal period despite the high levels of comorbid depression with anxiety in the general population(145). As the effects of maternal depression on child injury risk may differ from the effects of maternal anxiety, defining these conditions separately was important for subsequent analyses (chapter 7). In addition, the use of hospitalisation data alongside primary care data is an important strength, ensuring capture of the most severe depression/anxiety episodes.

The identification of depression/anxiety episodes in this study is however affected by the reliability and accuracy of clinical coding in primary care. Unlike studies that detect depression/anxiety using standardised screening tools(156, 329), the identification of depression/anxiety in the CPRD is based on clinical diagnoses made by GPs, and is affected by how this information is recorded in the primary care record. The depression/anxiety Read code lists used in this thesis were based on previous studies(308-310), but have not been validated (i.e. compared to a gold standard) and so may not correctly identify all those with depression/anxiety. The clearest example of this is the decision about including or excluding symptom Read codes from the definition of depression/anxiety, which varies across studies(149, 308, 312), and notably influences incidence estimates (section 5.3.7.1). Including symptom Read codes may overestimate depression/anxiety incidence as a result of including those with milder depression/anxiety in the definition. Conversely, with increases in the recording of depression/anxiety symptoms over time, most likely in response to changes in depression recording following the introduction of the QOF(312), exclusion of symptom codes may underestimate incidence.

A recent validation study by John *et al* (2016) compared depression/anxiety diagnoses identified from the primary care records of 2,799 individuals from Wales, with their responses to the five-item Mental Health Inventory, conducted as part of a postal survey(232). The five-item Mental Health Inventory is a validated tool that identifies those with a likely common mental disorder (i.e. depression, anxiety, panic disorder), but does not separately distinguish these disorders from one another. Comparing 12 different algorithms, John *et al* found large variations in depression/anxiety case detection using primary care data depending on whether symptom codes, historical diagnoses of depression/anxiety and medications were included in the algorithms used to define depression/anxiety(232). The algorithm most similar to the definition used in this PhD had a sensitivity of 32% and specificity of 95% (for depression/anxiety combined)(232), consistent with other studies indicating only about one third of those with a common mental disorder are diagnosed in primary care(330). Under ascertainment of depression/anxiety in primary care is well recognised(331), as a result of individuals not seeking health care, having short term symptoms that subsequently resolve, and receiving an alternative diagnosis (e.g. social problem(330), sleeplessness(330), presenting with physical symptoms(331)). Under ascertainment of maternal depression/anxiety could lead to bias if certain groups of women are more

likely to be diagnosed with depression/anxiety. An important example of this is mothers who have had depression/anxiety previously. These mothers may be more likely to present to their doctor if they have a recurrence of symptoms, may be more likely to receive a diagnosis by their doctor, or may be more likely to start medication if they have been known to have had the condition previously. This could mean that the observed association between maternal perinatal depression and subsequent incidence rates of depression/anxiety episodes when the child was aged 1-4 years old has been overestimated.

It is not possible to accurately estimate the duration of episodes of depression/anxiety from the data sources used. The defined episodes reflect the period of time the mother was being seen by their doctor and/or received antidepressant/anxiolytic medications, rather than the true dates the mother's symptoms commenced and resolved. At the time of conducting this study, data on psychiatric outpatient appointments and the duration of any psychological therapies (e.g. Cognitive Behavioural Therapy, counselling) were not available, and so this information has not been taken account of when defining depression/anxiety episodes. As a result, the duration of episodes may have been underestimated, with the number of incident episodes overestimated; hence the reason for conducting a sensitivity analysis using a longer time-window of 12 months.

As antidepressants can be used in the management of a number of conditions (e.g. migraines, chronic pain), a strength of this study was the examination of Read codes entered at the start of the course to identify likely indications for the medication. Reassuringly, about 60% of antidepressant courses had a Read code for depression and/or anxiety at the start of the course. However, due to the difficulties in identifying an indication for some medication courses, and that some conditions can be comorbid with depression (e.g. pain, insomnia(332)), it is possible that some antidepressant prescriptions for indications other than depression/anxiety have been included, or that some prescriptions were wrongly excluded.

Within primary care data there is no consistent measure of depression/anxiety severity as many of the Read codes are non-specific (e.g. Eu32.00 Depressive episode). While medication use is a potential proxy for the severity of depression/anxiety, the decision to prescribe medication is also affected by a number of other factors, including pregnancy, patient choice and symptom severity. With no measure of

depression/anxiety severity, it is not possible to distinguish between differences in the ascertainment of depression (e.g. as a result of screening in the postnatal period) and a true change in the incidence of depression. For example, less severe depression episodes may be detected through postnatal screening (e.g. using EPDS), which might not have otherwise been identified in primary care without screening. Similarly, delays between the onset of depression symptoms and when women present to their doctor could lead some episodes of antenatal depression to be misclassified as postnatal depression. The cessation of antidepressant medications during pregnancy has several potential implications for the identification of depression episodes. Firstly, re-starting medications following the birth of the child may lead to an overestimation of the incidence of postnatal depression. Secondly, the cessation of antidepressants prior to planned pregnancies could lead to an underestimation of the prevalence of antenatal depression. Thirdly, those classified as having antenatal depression may reflect those with the most severe depression who require ongoing medications and repeated follow-up appointments, rather than truly reflecting all mothers who experience symptoms of depression during pregnancy.

Previous literature has demonstrated that women, the elderly and those with medical conditions are more likely to have lifestyle information recorded in primary care data (e.g. smoking, alcohol use) as a result of more frequent consultations at the general practice (e.g. chronic disease checks, contraception appointments)(233). The high rates of depression/anxiety observed amongst mothers with a record for alcohol or drug misuse may reflect a true association, but could also reflect a recording bias, where alcohol and drug information is more likely to be captured by healthcare professionals for those with a diagnosis of depression. Conversely, it is possible that those with drug or alcohol misuse may be more likely to be asked about mental health symptoms.

5.4.2.2 Definition of covariates and reverse causality

Three of the maternal and household variables (i.e. maternal alcohol misuse, maternal drug misuse, numbers of the children in the household) were defined as fixed covariates for the analyses based on any records during study follow-up, as it was beyond the scope of this thesis to define these variables as time-varying. 'Baseline' measures at the start of study follow-up, or within a short time window from when the mother entered the study, were not considered an appropriate alternative as maternal alcohol and drug

consumption recorded around the time of pregnancy is unlikely to accurately capture maternal alcohol or drug use following the birth of the child (e.g. women are advised to not consume alcohol during pregnancy). The use of fixed measures of alcohol and drug misuse means that the changing nature of alcohol and drug use over time is not captured, and reverse causality is a possibility. For example, those with depression/anxiety may drink more alcohol to relieve their depression/anxiety symptoms, and/or be more likely to have their alcohol and drug consumption recorded by their doctor if presenting with depressive symptoms. These issues lead to some difficulties in interpreting the univariate associations between maternal drug and alcohol misuse and rates of depression/anxiety in Tables 5-12, 5-13 and 5-14.

Similarly, the measure of the number of children aged less than 5 years old living in the household during study follow-up was a crude measure, which did not take account of changes over time, as new children were born or children in the household reached their fifth birthday. In particular this means that the temporal association between the birth of a new child and depression/anxiety symptoms has not been accurately captured (i.e. postnatal depression after the births of later children).

5.4.2.3 Confounding

There are several potential confounders that are not well captured within primary care data, such as marital status, social support and the occurrence of traumatic or stressful life events(333, 334). In addition, there could remain residual confounding as a result of misclassification or measurement error of potential confounders. The main examples of this are the measures of maternal drug and alcohol misuse used; which only capture those with the most severe levels of use (i.e. excludes lower levels of drinking), do not account for changes in drug and alcohol use over time, and are subject to social desirability biases (e.g. mothers may underestimate their alcohol consumption). Any residual confounding may lead to under or overestimation of relative risk depending on the impact of the confounding variable.

5.4.2.4 Chance

One of the important strengths of this study is the large sample size, meaning there was sufficient study power to examine associations between perinatal depression and subsequent depression/anxiety rates. In a post-hoc power calculation based on the

study results, the study was >99% powered to detect a 2.7 fold increased rate of depression episodes, 3 fold increased rate of depression with anxiety episodes, and 1.4 fold increased rate of anxiety episodes among those with perinatal depression compared to those without. It is however possible that due to carrying out multiple statistical tests, a type 1 error may have occurred (where a statistically significant difference is detected, when in fact there is no true difference).

5.4.3 Comparison to existing literature

5.4.3.1 Prevalence of perinatal depression

The prevalence of postnatal depression amongst the study cohort (13.5%) is broadly consistent with estimates from published literature which report the prevalence as between 7% and 19%(146, 148, 156, 329). In contrast, the prevalence of antenatal depression (5.6%) was lower than estimates from published studies (7-22%) (146, 147, 329, 335). For example, using a population of over 12,000 women from England Evans *et al* found the prevalence of depression (score of >12 on the EPDS) to be higher at 32 weeks of pregnancy (13.5%) than 8 weeks postnatally (9.1%)(329); suggesting depressive symptoms are just as common, if not more common during pregnancy than the postnatal period. The relatively low prevalence of antenatal depression in the study cohort, while in keeping with another study using primary care data(157), potentially reflects low ascertainment of depression during pregnancy in primary care. This low ascertainment could relate to women not seeking help during pregnancy (e.g. stigma, delayed presentation, concerns about medication use during pregnancy) or under detection by clinicians (e.g. presentation with atypical or physical symptoms)(333). Indeed a study from Sweden found that 14.1% of women in the second trimester of pregnancy met criteria for a psychiatric diagnosis (based on a clinical interview using DSM-IV criteria), but only 5.5% of women meeting these criteria had received some form of treatment (e.g. psychotherapy, medication); highlighting that antenatal psychiatric issues are often underdiagnosed and treated(336).

5.4.3.2 Incidence rates of maternal depression/anxiety episodes

A limited amount of literature reports incidence rates of depression in the perinatal period. The available literature tends to report the number of women with depression per 100 pregnancies (a proportion)(146). This is a potentially more useful way to present the data for clinicians who manage and treat women in practice, compared to the

number of women with depression per 100 person-years as presented in this thesis. For example, a systematic review by Gavin *et al* reported rates of depression, identified using clinical interviews/assessments, as 14.5/100 women during pregnancy (7.5/100 major depressive episode), and 14.5/100 women in the first three months after delivery (6.5/100 major depressive episode)(146). The estimated incidence of antenatal depression (with or without anxiety) in the study cohort (2.39/100 PY) is substantially lower than the study by Gavin *et al* whereas conversely the estimated incidence of depression (with or without anxiety) in the first 3 months after delivery is higher (17.4/100 PY). This could reflect delays in the reporting of depression by mothers to their GP, meaning antenatal depression episodes are misclassified as postnatal depression. In addition, the high rates of postnatal depression could reflect the inclusion of symptom Read codes meaning less severe episodes of depression were included when using CPRD-HES data compared to the study by Gavin *et al*.

One study has previously used primary care data (THIN) to report incidence rates of maternal depression; with the reported rate of 13.9/100 PY for the first year after delivery(149) consistent with the estimate of 12.4/100 PY for this period in CPRD-HES data. The slightly lower incidence rate compared to the study by Dave *et al* reflects some methodological differences between studies. For example Dave *et al* included 'history of depression' Read codes in the definition of depression, and used a time-window of 12 months to define episodes, whereas the present work included hospitalisation data and used different steps to exclude antidepressant prescriptions for indications other than depression/anxiety. The high incidence rates of depression in the first year after delivery, which has also been demonstrated in a number of other studies(146, 149, 333), has been explained by biological (e.g. hormonal changes(324)), as well as social and psychological changes associated with the birth of a child (e.g. new responsibilities, changes in relationship(333), poor sleep(333)). In addition, some of the increase may reflect relapses of depression amongst those who ceased medications prior to pregnancy(333).

Comorbid depression and anxiety are extremely common in the general population, with the 2007 Psychiatric Morbidity survey of adults finding that 9.0% of adults met the diagnostic criteria for mixed depression and anxiety; representing more than half of those with a common mental disorder(145). This is however not reflected in the focus of epidemiological studies, with few describing the incidence of depression with anxiety.

Available data come from the general adult population. For example, a study using primary care data from THIN for adults aged over 16 from the UK reports an incidence of depression with anxiety of 0.35/100 PY, with incidence highest in females and those aged 25-44 years old(314). The estimated incidence rate of 1.30/100 PY between the child's birth and fifth birthday is considerably higher, in part explained by the focus on new mothers, and in part because the study by Walters *et al* only used Read codes that specified comorbid depression and anxiety(314), whereas in this thesis, these codes alongside concurrent recording of codes for depression and anxiety in the same time period were used to identify depression with anxiety episodes. The low incidence of depression with anxiety diagnoses in primary care data, both in the present study and that by Walters *et al*(314), suggests that there may be a reasonably high level of under diagnosis and/or recording within primary care. This may be explained by a lack of recognition of comorbid anxiety by GPs (e.g. if depressive symptoms are more severe), or could reflect coding practices within primary care (e.g. use of free text, preferential recording of depression). For example, there is evidence from referrals to psychological therapy services that even though most patients referred had symptoms of both depression and anxiety, GPs most commonly reported the primary problem as depression(337, 338). As a result, episodes of depression with anxiety captured in this study are more likely to reflect those with very severe depression with anxiety. This is reflected in the prolonged duration of episodes (43% ≥12 months in duration), and the higher proportion of episodes that included a hospital admission (9.2% of depression with anxiety episodes, compared to 1.8% of depression episodes).

Anxiety disorders in the perinatal period are more often overlooked than depression, with studies principally reporting estimates of prevalence(156, 157, 336). Available data on the incidence of anxiety comes from studies of the general adult population, with rates of 0.97-1.4/100 PY reported in studies using primary care data(230, 314). Martin-Merino *et al* report a rate of 1.78/100 PY among young women aged 20-29 years using data from THIN(230); similar in magnitude to the estimate of 1.83/100 PY among mothers in the first five years after delivery when using CPRD-HES data. Despite evidence suggesting anxiety may be as common as depression during the perinatal period(156), the low incidence rates of anxiety compared to depression may suggest under ascertainment of anxiety episodes within primary care data.

5.4.3.3 Incidence rates of maternal depression/anxiety among mothers with and without perinatal depression

There are no directly comparable studies reporting incidence rates of maternal depression/anxiety later in the child's life according to exposure to perinatal depression. The finding that mothers who had perinatal depression continue to have higher rates of depression/anxiety throughout the child's first five years of life is consistent with a number of studies that have demonstrated that a history of depression increases the risk of further depressive episodes(156, 324, 339, 340). For example, using data from THIN, Dave *et al* demonstrated that mothers with a history of depression had a 95% higher incidence rate of depression after the birth of the child compared to those without a history of depression (unadjusted IRR 1.95, 95%CI 1.89-2.02)(149). Similarly, a cohort study of 753 women from Sweden demonstrated that a history of postpartum depression was associated with a nearly six times higher odds of having depressive symptoms when the child was aged 4 years old (aOR 5.82, 95%CI 3.79-8.93)(341).

5.5 Conclusion

This chapter highlights the complexity of defining depression/anxiety within primary care data; potentially affected by an array of issues including changes in clinical coding over time, the QOF, screening for postnatal depression, the cessation of medications in pregnancy and patient health seeking behaviours. As a result, identified episodes of maternal depression/anxiety using CPRD-HES data reflect those episodes that are medically reported/detected, rather than necessarily reflecting the true community burden of depression/anxiety. The low incidence rates of depression during pregnancy, and diagnoses of anxiety highlight the need for consideration about how data are being recorded in primary care and ways to improve ascertainment (discussed further in Section 8.2.3.2). The increased rates of maternal depression/anxiety among those who had experienced perinatal depression highlights the importance of early recognition and treatment of recurrent maternal depression episodes. In addition, with studies suggesting associations between perinatal depression and a number of child developmental and behavioural outcomes(135, 326), this work has demonstrated that future studies need to also account for ongoing/subsequent exposure to maternal depression after the postnatal period.

Part 3: Investigating the association between maternal mental illnesses and childhood injuries

Chapter 6: Maternal perinatal depression and rates of injury in children aged 0-4

This chapter describes a cohort study, aiming to examine the association between maternal antenatal and/or postnatal depression and childhood injuries, and how this association is affected by subsequent exposure to maternal depression when the child was aged 1-4 years old. As injury ascertainment can be affected by differences in hospital admission thresholds or parental health seeking behaviours, the association between maternal antenatal and/or postnatal depression and serious child injuries was also examined. As intentional harm (e.g. maltreatment, assault) could be an important explanation for an association between maternal depression and childhood injuries, this chapter outlines further work to identify potential intentional injuries among preschool children (e.g. referrals to social services).

6.1 Objectives

- To assess the association between maternal perinatal depression and the incidence of child poisonings, fractures, burns and serious injuries in the child's first five years of life.
- To assess whether an association between maternal perinatal depression and childhood injuries is explained by ongoing/subsequent exposure to maternal depression when the child is aged 1-4 years old.

6.2 Methods

6.2.1 Study design and population

The study population consisted of a cohort of mother-child pairs registered at 383 general practices submitting data to the CPRD between 1st January 1998 and 31st December 2013 who also had linked HES data, as defined in Section 5.2.1. Children had to be registered with the general practice within three months of birth to maximise the capture of early medically attended injuries. Children were followed-up from birth to the earliest date of: the date mother or child left the general practice (e.g. changed practice, died), the 31st December 2013, the date information was last collected from the

practice, the date the mother was diagnosed with a serious mental illness (if applicable) or the child's fifth birthday. Mother-child pairs where the mother had a pre-existing diagnosis of a serious mental illness prior to the birth of the child were excluded from the study cohort. One child was randomly selected per mother to avoid the need to account for clustering of injuries within children from the same family within the analysis.

6.2.2 Outcome: child injury events

6.2.2.1 Incident poisoning, fracture and burn events

For each child, the number of incident poisoning, fracture and burn events occurring between birth and the end of follow-up were identified from linked primary care (CPRD) and/or hospitalisation (HES) data. These linked data sources were used to maximise injury ascertainment, as neither of the data sources alone capture all injury occurrences. To avoid over-counting injury events, a time-based algorithm was used to exclude duplicate records for the same event recorded in both CPRD and HES and to exclude repeated records indicating follow-up care, as described in Section 4.3.2. This method enabled the inclusion of repeated injury events per study participant.

6.2.2.2 Serious injuries

Serious injuries that are very likely to lead to hospitalisation were defined using ICD-10 codes as described in Section 4.3.4. In addition to serious poisonings, fractures and burns, all serious injuries of any type were considered, with examples shown in Table 6-1. These serious injuries were identified from the hospitalisation records (HES) of the study cohort using an ICD-10 code list for all serious injuries (Appendix 7); with readmissions for the same injury excluded. Serious injuries were used as an injury outcome as ascertainment is likely to be complete and unaffected by differences in hospital admission thresholds or parental health seeking behaviours.

Table 6-1: Examples of serious injuries

Examples of serious injuries*
Serious fractures (skull, neck, multiple rib fractures, flail chest, femur, cervical vertebrae)
Intracranial injury (e.g. diffuse brain injury, traumatic subdural haemorrhage)
Injuries to the nerves and spinal cord at neck, thorax, abdomen, back or pelvis levels
Injuries of blood vessels of thorax, injury of heart, injury to intrathoracic organs
Traumatic amputations
Serious burns (third degree burns, burns of >10% of body surface)
Serious poisonings (e.g. with antidysrhythmic drugs, peripheral vasodilators)
Asphyxiation
Hypothermia

**Definition based on work by the Injury Observatory for Britain and Ireland(242) and Cryer et al(243) who have identified ICD-10 codes indicating serious injuries that are highly likely to be admitted to hospital. Full code list included in Appendix 7.*

6.2.3 Exposure: maternal depression

Mothers were classified as having antenatal depression (during pregnancy), postnatal depression (up to 12 months after delivery) or both, based upon diagnoses recorded in their primary care and/or hospitalisation records and antidepressant prescriptions data, as described in Section 5.2.5.6. Antidepressant prescriptions were excluded if it was likely that the prescription was for an indication other than depression (e.g. anxiety alone, migraine prophylaxis) (Section 5.2.3.3).

Mothers were classified as having antenatal depression if at any time during pregnancy they had a medical record in the CPRD and/or HES for depression and/or one or more antidepressant prescription. Similarly, postnatal depression was defined by the presence of a medical record for depression and/or an antidepressant prescription within 12 months of delivery. Mothers were classified as having depression when the child was aged 1-4 years old if they had a medical record for depression and/or an antidepressant prescription recorded in this period.

6.2.4 Definitions of covariates

Potential confounders available within linked CPRD and HES data included child age at injury, child sex, maternal age at delivery, socioeconomic deprivation, maternal alcohol misuse, maternal drug misuse, the number of older siblings and the number of children aged less than 5 years in the household. These variables were defined as outlined in Sections 4.2.4 and 5.2.5.

6.2.5 Statistical analyses

The incidence of each injury outcome (poisonings, fractures, burns and serious injuries) was estimated by dividing the number of incident injury events by the sum of person-years at risk, according to whether the mother had antenatal depression, postnatal depression, both or neither. To assess how child injury rates changed over the child's first 5 years of life according to exposure to maternal perinatal depression, Lexis expansion was used to divide up the follow-up time of each child into 1 year age bands(244), with injury incidence rates calculated for each year of the child's life.

Unadjusted and adjusted incidence rate ratios and 95% confidence intervals were estimated using Poisson regression. The appropriateness of a Poisson regression model was assessed(245); firstly by assessing the mean and variance of the count, secondly using the Poisson goodness of fit test and thirdly testing for over dispersion using a LRT of alpha for over dispersion. The Poisson model assumes the mean and variance for the outcome of interest are similar, which was true in the case of the four injury outcomes used in this study (Table 6-2). While the Poisson goodness of fit tests were statistically significant (likely due to the very large sample size), a subsequent LRT of alpha indicated that data were not over dispersed and a Poisson regression model was appropriate (Table 6-2).

Table 6-2: Assessing the appropriateness of the Poisson regression model

Injury Outcome	Mean	Variance	Poisson goodness of fit test[$]	Likelihood ratio test of alpha[#]
Poisonings	0.013	0.014	p <0.0001	p=0.5
Fractures	0.029	0.031	p <0.0001	p=1.0
Burns	0.020	0.021	p <0.0001	*
Serious injuries	0.0044	0.0045	p <0.0001	p=0.5

$The p values from the Poisson goodness of fit test were highly significant for the four injury types, which contrasted with the non-significant findings from the LRT of alpha. The significance of the Poisson goodness of fit test is likely to reflect the very large sample size used, therefore detecting very small differences between the mean and variance of the count.

#The Negative binomial regression model reduces to the Poisson model when alpha=0. This LRT assesses whether alpha is equal to 0. If the test is statistically significant (p<0.05) it indicates over dispersion and indicates the Negative Binomial model is preferred. In this case the LRTs of alpha were not significant, therefore indicating the Poisson regression model was appropriate.

**For burns, the negative binomial model would not converge within Stata and so a LRT of alpha could not be performed.*

Socioeconomic deprivation was treated as an *a priori* confounder, as were calendar year and geographical region due to potential differences in the recording of injury events over time and by general practice. Other confounders were included in the final model if they changed the incidence rate ratio by 10% or more(342). To account for missing socioeconomic deprivation data, a 'missing' category was included within the regression models.

The significance of the association between perinatal depression and each injury outcome was assessed using a LRT with $p<0.05$ considered statistically significant. The potential interaction between perinatal depression and socioeconomic deprivation was assessed by adding an interaction term to the model, with significance assessed using a LRT and $p<0.01$ considered statistically significant. Multicollinearity between variables was assessed using the covariate correlation matrix and by calculating the variance inflation factor.

These analyses were repeated, with mothers classified as having perinatal depression with or without depression when the child was aged 1-4 years old.

6.2.6 Sensitivity analyses

6.2.6.1 Doubling the time-window used to identify incident poisoning, fracture and burn events

By using a time-based algorithm to identify incident injury events in linked CPRD and HES data it is possible that the number of events may have been overestimated (e.g. among those requiring prolonged follow-up care). Therefore the time-windows used to define incident injury events were doubled to assess the impact of how incident injuries were defined on the study findings.

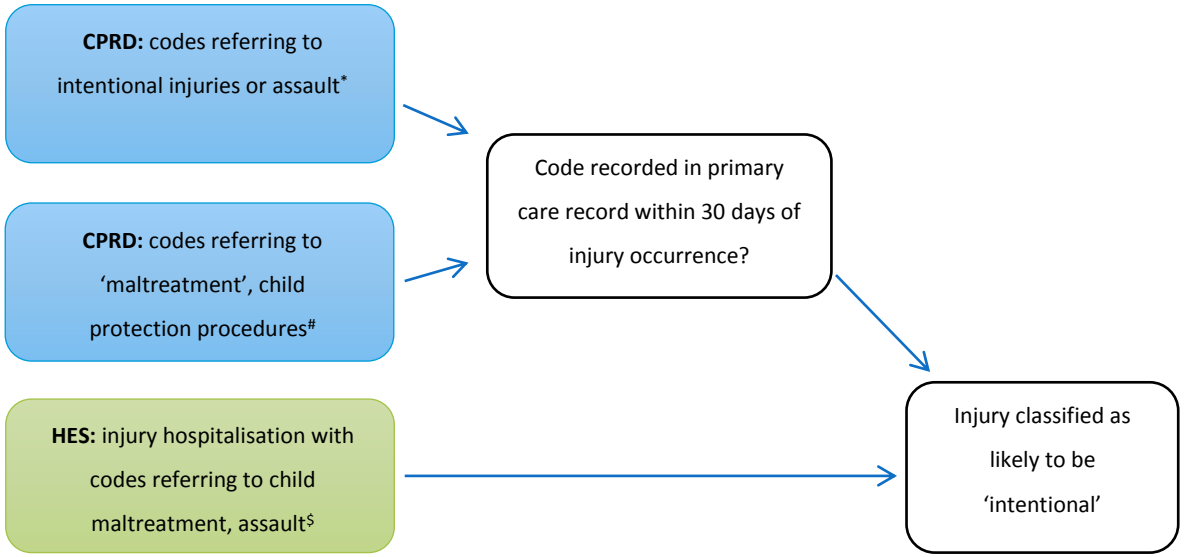
6.2.6.2 Excluding mothers with a serious mental illness

Mothers diagnosed with a serious mental illness (bipolar disorder or schizophrenia) when the child was aged 0-4 years old were excluded from the study population, as it is possible that the onset of another mental disorder could affect child injury risk.

6.2.6.3 Excluding injuries likely to be due to intentional harm

As described in Section 4.5.3.1, information about the mechanism and intent of injuries is incomplete within primary care data (e.g. available for 2% of fractures and 4% of burns). Information about suspected maltreatment may be recorded in other ways within the primary care record, such as Read codes for a referral to social services. Work by Woodman *et al* (2012) has defined a group of Read codes (e.g. child protection procedures) likely to indicate child maltreatment (Appendix 10)(253). For each child within the study cohort any records for intentional injuries (Appendix 9) or 'child maltreatment' were extracted from the CPRD, with injuries considered likely to be 'intentional' if the Read code occurred within 30 days of the injury occurrence (Figure 6-1). In addition injury hospitalisations with an ICD-10 code indicating child maltreatment (Appendix 11) were classified as intentional(343). Those injuries identified as likely to be intentional were excluded as a sensitivity analysis.

Figure 6-1: Identification of likely intentional injury events



**Read code list referring to intentional injuries, assault, neglect and maltreatment (shown in Appendix 9).*

#Read code list referring to child maltreatment and child protection procedures, based on the work by Woodman et al (2012)(253) (shown in Appendix 10).

$ICD-10 code list referring to intentional injury, assault, child abuse, as defined by McKenzie et al (2011)(343) (shown in Appendix 11).

6.3 Results

6.3.1 Characteristics of the study population

The study population consisted of 207,048 mother-child pairs (Table 6-3). Median maternal age at delivery was 31.0 years (IQR 26.06-34.8). Of the children, 81,738 (39.5%) were the oldest child within the household. During the child's follow-up most households had one (n=95,558 46.2%) or two (88,462 42.7%) children aged less than 5 years old living in the household.

Of the mothers 4,210 (2.0%) had antenatal depression, 20,486 (9.9%) had postnatal depression, 7,413 (3.6%) had both antenatal and postnatal depression, and 174,939 (84.5%) had neither. Compared to mothers who did not have perinatal depression (4.2%), a higher proportion of mothers with antenatal (5.8%) or postnatal (7.9%) depression were aged less than 20 years old at the child's birth. A higher proportion of mothers with antenatal and/or postnatal depression were from more deprived socioeconomic groups. For example, among those with antenatal depression 23.9% were from quintile 5, compared to 16.3% of mothers who had neither antenatal nor postnatal depression. The proportion of mothers with a record for alcohol misuse was highest amongst those with both antenatal and postnatal depression (n=477, 6.4%); compared to 1.7% of mothers who had neither antenatal nor postnatal depression (n=2,917). Similarly, drug misuse was most common amongst those with both antenatal and postnatal depression (n=252, 3.4%).

Compared to mothers who had neither antenatal nor postnatal depression (10.0%), a higher proportion of mothers with antenatal (29.1%), postnatal (61.4%), or both antenatal and postnatal depression (78.4%) had records for depression in their primary and/or hospitalisation record when their child was aged 1-4 years (p<0.0001).

The median duration of study follow-up after the child's birth significantly differed according to whether the mother had antenatal and/or postnatal depression (p=0.0001), with those with postnatal depression having the longest median follow-up time (4.3 years, IQR 1.9-5.0).

Table 6-3: Characteristics of the study population according to exposure to maternal antenatal and/or postnatal depression

	Neither AN nor PN depression (n=174,939)	AN depression (n=4,210)	PN depression (n=20,486)	Both AN & PN depression (n=7,413)	*p* value*
	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	
Child sex					
Male	89,496 (51.2)	2,132 (50.6)	10,521 (51.4)	3,809 (51.4)	0.83
Female	85,443 (48.8)	2,078 (49.4)	9,965 (48.6)	3,604 (48.6)	
Maternal age at delivery (years)					
<20	7,389 (4.2)	245 (5.8)	1,626 (7.9)	315 (4.3)	<0.0001
20-29	66,022 (37.7)	1,986 (47.2)	9,257 (45.2)	3,216 (43.4)	
30-39	93,501 (53.5)	1,774 (42.1)	8,944 (43.7)	3,488 (47.1)	
≥40	8,027 (4.6)	205 (2.9)	659 (3.2)	394 (5.3)	
Socioeconomic deprivation, Index of Multiple Deprivation 2010					
Quintile 1	41,456 (23.7)	643 (15.3)	3,700 (18.1)	1,211 (16.3)	<0.0001
Quintile 2	37,838 (21.6)	677 (16.1)	3,841 (18.8)	1,343 (18.1)	
Quintile 3	33,574 (19.2)	809 (19.2)	3,878 (18.9)	1,413 (19.1)	
Quintile 4	33,371 (19.1)	1,067 (25.3)	4,563 (22.3)	1,727 (23.3)	
Quintile 5	28,469 (16.3)	1,007 (23.9)	4,475 (21.8)	1,707 (23.0)	
Missing	231 (0.1)	7 (0.2)	29 (0.1)	12 (0.2)	
Maternal alcohol misuse during study follow-up					
No	172,022 (98.3)	4,020 (95.5)	19,688 (96.1)	6,936 (93.6)	<0.0001
Yes	2,917 (1.7)	190 (4.5)	798 (3.9)	477 (6.4)	
Maternal drug misuse during study follow-up					
No	174,369 (99.7)	4,128 (98.1)	20,230 (98.8)	7,161 (96.6)	<0.0001
Yes	570 (0.3)	82 (2.0)	256 (1.3)	252 (3.4)	
Total number of children in household aged <5 years during child's follow-up					
1	79,934 (45.7)	2,125 (50.5)	9,877 (48.2)	3,622 (48.9)	<0.0001
2	75,714 (43.3)	1,581 (37.6)	8,242 (40.2)	2,925 (39.5)	
3	15,188 (8.7)	395 (9.4)	1,825 (8.9)	672 (9.1)	
4 or more	4,103 (2.4)	109 (2.6)	542 (2.7)	194 (2.6)	
Number of older children/siblings					
0	70,048 (40.0)	1,545 (36.7)	7,777 (38.0)	2,368 (31.9)	<0.0001
1	67,860 (38.8)	1,491 (35.4)	7,972 (38.9)	2,839 (38.3)	
2	25,090 (14.3)	769 (18.3)	3,081 (15.0)	1,413 (19.1)	
3 or more	11,941 (6.8)	405 (9.6)	1,656 (8.1)	793 (10.7)	
Record for maternal depression when child aged 1-4 years					
No	157,368 (90.0)	2,986 (70.9)	7,913 (38.6)	1,602 (21.6)	<0.0001
Yes	17,571 (10.0)	1,224 (29.1)	12,573 (61.4)	5,811 (78.4)	
Median duration of follow-up from child's birth					
Median time in years (IQR)	3.9 (1.6-5.0)	3.1 (1.1-5.0)	4.3 (1.9-5.0)	3.1 (1.4-5.0)	0.0001#

***AN**: antenatal. **PN**: postnatal.*

** p value from Chi-squared test. #Kruskal-Wallis test to compare the medians for each group*

6.3.2 Child injury occurrences

6.3.2.1 Poisonings, fractures and burns

During study follow-up, fractures were the most common injury type, with 5,836 children (2.8% of cohort) sustaining one or more fracture, therefore giving a crude incidence rate of 88.7/10,000 PY (95%CI 86.5-91.1) (Table 6-4). Amongst the cohort, 2,614 poisoning and 4,201 burn events occurred, giving crude incidence rates of 38.1/10,000 PY (95%CI 36.6-39.7) and 61.2 (95%CI 59.4-63.2), respectively. Among those children who sustained a poisoning, fracture or burn, most children had one injury event, with only 0.1% of children sustaining more than one of the same injury type. The median child age at injury was highest for fractures (2.7 years, IQR 1.7-3.8) and lowest for burns (1.5 years, IQR 1.0-2.4).

Table 6-4: Frequency of injuries among the cohort of 0-4 year old children

		Poisonings	Fractures	Burns	Serious injuries*
Number of injury events in cohort, 1998-2013		2,614	6,088	4,201	915
Crude injury incidence rate per 10,000 person years (95%CI)		38.1 (36.6-39.7)	88.7 (86.5-91.1)	61.2 (59.4-63.2)	13.3 (12.5-14.2)
Number (%) of incident injuries per child	**0**	204, 546 (98.8)	201,212 (97.2)	202,996 (98.0)	206,139 (99.6)
	1	2,399 (1.2)	5,605 (2.7)	3,913 (1.9)	906 (0.4)
	2	96 (0.1)	216 (0.1)	128 (0.1)	1(<0.1)
	≥3	7 (<0.1)	15 (<0.1)	11 (<0.1)	2(<0.1)
Median age in years at injury (IQR)		2.0 (1.3-2.7)	2.7 (1.7-3.8)	1.5 (1.0-2.4)	1.4 (0.8-2.4)
Number (%) of injury events identified as likely 'intentional' injuries#		15 (0.6)	62 (1.0)	33 (0.8)	48 (5.2)

**Serious injuries were those that are very likely to lead to hospitalisation, defined by specific ICD-10 codes*

#Likely intentional injuries were identified using Read and ICD-10 codes indicating intentional injury or maltreatment (e.g. referral to social services).

6.3.2.2 Serious injuries

Amongst the study cohort, 909 (0.4%) children were admitted to hospital with a total of 915 serious injuries, giving a crude incidence rate for the study period of 13.3/10,000 PY (95%CI 12.5-14.2). Of the 915 serious injuries, 429 (46.9%) included one or more serious fracture, 278 (30.4%) included one or more serious burn, and 15 (1.6%) included a serious poisoning. Median age at serious injury was 1.4 years (IQR 0.8-2.4). Of the 915

serious injuries recorded in HES, 812 (88.7%) had an external cause of injury code recoded. The most common mechanisms of serious injury were falls (n=333, 36.4%), heat and hot substances (n=212, 23.2%) and inanimate mechanical forces (n=95, 10.4%).

6.3.2.3 Association between child injuries and potential confounders

Table 6-5 shows the association between each of the potential confounders and the injury outcome measures. For each injury type males had a higher injury incidence than females, with the greatest difference for burns where females had a 24% lower incidence rate compared to males (unadj IRR 0.76, 95%CI 0.72-0.81). For poisonings, burns and serious injuries, incidence rates were highest for those aged 1 years old, whereas for fractures, incidence rates increased with age with those aged 4 years old having a four-fold higher rate that those aged less than 1 year (unadj IRR 4.20, 95%CI 3.82-4.63).

Similar associations with maternal age were seen for poisonings, burns and serious injuries, with children of mothers aged 40 years old or more at delivery having a 46-53% lower injury rate than children of mothers aged less than 20 years old. The association between child fractures and maternal age at delivery was weaker; with children of mothers aged 40 years or more at delivery having a 17% lower fracture rate than children of mothers aged less than 20 years old (unadj IRR 0.83, 95%CI 0.70-0.99).

Significant socioeconomic gradients were observed for poisonings, burns and serious injuries (p<0.0001), with the steepest socioeconomic gradient between the most and least deprived quintiles seen for serious injuries (unadj IRR 1.81, 95%CI 1.47-2.23). There was no significant association between child fractures and socioeconomic deprivation (p=0.33).

Maternal alcohol misuse was significantly associated with rates of poisonings (p<0.0001), fractures (p=0.004) and burns (p=0.006); with the strongest association for child poisonings (unadj IRR 1.55, 95%CI 1.28-1.89). Maternal drug misuse was only significantly associated with child poisonings (p=0.003), with children whose mothers had a record for drug misuse having an 87% higher poisoning rate than children of mothers with no medical record of drug misuse (unadj IRR 1.87, 95%CI 1.28-2.74).

Children with a greater number of older siblings had higher fracture, burn and serious injury rates. For example, children with three or more older siblings had a 37% higher fracture rate than those children who were the oldest (unadj IRR 1.37, 95%CI 1.24-1.51). The total number of children aged less than 5 years in the household was not associated with rates of poisonings, burns or serious injuries (95% confidence intervals included 1). A greater number of children aged less than 5 years old in the household was associated with a higher rate of child fractures. For example, where there were 4 or more children in the household, children had a 28% higher rate of fracture than children in households where there was only one child aged less than 5 years old (unadj IRR 1.28, 95%CI 1.10-1.47).

Table 6-5: Associations between potential confounders and injury incidence rates

Potential confounder		POISONINGS		FRACTURES		BURNS		SERIOUS INJURIES	
		Unadj IRR (95%CI)	*p* value*	Unadj IRR (95%CI)	*p* value*	Unadj IRR (95%CI)	*p* value*	Unadj IRR (95%CI)	*p* value*
Child sex	**Male**	1	0.3	1	0.0002	1	<0.0001	1	0.0002
	Female	0.96 (0.89-1.04)		0.91 (0.86-0.96)		0.76 (0.72-0.81)		0.78 (0.69-0.89)	
Age at injury (years)	**0**	1	<0.0001	1	<0.0001	1	<0.0001	1	<0.0001
	1	3.36 (2.97-3.80)		2.76 (2.51-3.03)		1.98 (1.83-2.14)		1.17 (1.00-1.36)	
	2	3.34 (2.94-3.79)		3.46 (3.15-3.80)		1.12 (1.02-1.23)		0.77 (0.64-0.93)	
	3	1.69 (1.46-1.97)		3.73 (3.39-4.10)		0.64 (0.57-0.72)		0.44 (0.35-0.57)	
	4	0.84 (0.69-1.02)		4.20 (3.82-4.63)		0.56 (0.49-0.64)		0.33 (0.24-0.44)	
Maternal age at delivery (years)	**<20**	1	<0.0001	1	0.005	1	<0.0001	1	0.0001
	20-29	0.65 (0.56-0.76)		1.03 (0.91-1.17)		0.71 (0.63-0.80)		0.70 (0.54-0.92)	
	30-39	0.45 (0.38-0.52)		0.97 (0.85-1.10)		0.50 (0.44-0.56)		0.57 (0.43-0.74)	
	≥40	0.47 (0.37-0.60)		0.83 (0.70-0.99)		0.49 (0.40-0.59)		0.54 (0.36-0.81)	
Socioeconomic deprivation quintile (IMD, 2010)	**1**	1	<0.0001	1	0.33	1	<0.0001	1	<0.0001
	2	1.25 (1.09-1.43)		1.06 (0.98-1.14)		1.11 (1.00-1.22)		1.14 (0.92-1.42)	
	3	1.92 (1.69-2.18)		1.05 (0.97-1.14)		1.32 (1.19-1.45)		1.56 (1.27-1.92)	
	4	1.77 (1.56-2.02)		1.06 (0.98-1.15)		1.39 (1.26-1.53)		1.43 (1.16-1.77)	
	5	1.61 (1.41-1.85)		1.10 (1.01-1.19)		1.66 (1.51-1.83)		1.81 (1.47-2.23)	
	Missing	1.91 (0.72-5.05)		1.02 (0.49-2.11)		1.27 (0.54-3.02)		3.75 (1.21-11.6)	
Maternal alcohol misuse	**No**	1	<0.0001	1	0.004	1	0.006	1	0.53
	Yes	1.55 (1.28-1.89)		1.24 (1.08-1.43)		1.28 (1.08-1.52)		0.87 (0.57-1.34)	
Maternal drug misuse	**No**	1	0.003	1	0.4	1	0.09	1	0.98
	Yes	1.87 (1.28-2.74)		1.16 (0.84-1.59)		1.38 (0.97-1.95)		0.99 (0.41-2.38)	
Number of older siblings	**0**	1	0.02	1	<0.0001	1	<0.0001	1	0.04
	1	0.95 (0.87-1.04)		1.22 (1.15-1.30)		0.92 (0.86-0.98)		1.10 (0.94-1.28)	
	2	1.11 (0.99-1.24)		1.27 (1.18-1.37)		1.05 (0.96-1.15)		1.24 (1.02-1.50)	
	≥3	1.13 (0.97-1.32)		1.37 (1.24-1.51)		1.27 (1.14-1.42)		1.35 (1.06-1.73)	
Number of children aged <5 years old in household	**1**	1	0.1	1	<0.0001	1	0.001	1	0.26
	2	0.91 (0.84-0.99)		1.13 (1.07-1.19)		0.90 (0.85-0.96)		0.93 (0.81-1.07)	
	3	0.98 (0.86-1.12)		1.18 (1.08-1.29)		1.04 (0.94-1.15)		1.15 (0.92-1.42)	
	≥4	0.98 (0.78-1.24)		1.28 (1.10-1.47)		1.15 (0.97-1.36)		1.11 (0.76-1.62)	

**likelihood ratio test*

6.3.3 Maternal perinatal depression and childhood injuries

6.3.3.1 Child poisonings, fractures and burns

Crude rates of poisonings, fractures and burns were higher amongst children exposed to antenatal and/or postnatal depression compared to children whose mothers did not have perinatal depression (Table 6-6). This was most notable for poisonings with incidence rates of 63.5/10,000 PY for children of mothers with antenatal depression (95%CI 51.0-79.0), 57.2 (95%CI 51.9-63.0) for children whose mothers had postnatal depression, 69.2 (95%CI 59.2-80.9) for children exposed to both antenatal and postnatal depression, compared to 34.0 (95%CI 32.5-35.5) among children whose mothers had neither.

Figure 6-2 shows injury incidence rates according to child age and exposure to maternal perinatal depression. Children exposed to perinatal depression showed similar patterns of poisoning and burn rates according to child age as those who were not exposed, but with higher incidence rates at each age; although 95% confidence intervals were wide and overlapping at some ages. For fractures, there was no notable difference in fracture incidence rates between those exposed and unexposed to perinatal depression, with 95% confidence intervals mostly overlapping between those exposed and unexposed at each age.

Following adjustment for socioeconomic deprivation, calendar year and region, a significant association between maternal perinatal depression and child poisonings (p<0.001), fractures (p=0.002) and burns persisted (p<0.001) (Table 6-6). None of the other potential confounders led to a change in the adjusted incidence rate ratio by 10% or more and so were not included in the final Poisson regression model (shown in Appendix 12).

Poisoning rates were highest among children whose mothers had both antenatal and postnatal depression (aIRR 1.89, 95%CI 1.61-2.23) compared to those whose mothers had neither. For burns, the magnitude of effect was similar for children exposed to antenatal and/or postnatal depression. Rates of burns were 33% higher among those exposed to antenatal depression (aIRR 1.33, 95%CI 1.09-1.62), 30% higher following postnatal depression (aIRR 1.30, 95%CI 1.19-1.43), and 33% higher following both

antenatal and postnatal depression (aIRR 1.33, 95%CI 1.14-1.54), compared to those unexposed to perinatal depression. Rates of fractures were only higher compared to unexposed periods among those exposed to postnatal depression (aIRR 1.15, 95%CI 1.07-1.25). There were no significant interactions between maternal perinatal depression and socioeconomic deprivation for poisonings (p=0.22), fractures (p=0.67) or burns (p=0.55).

6.3.3.2 Serious injuries

Incidence rates of all serious injuries were increased among children whose mothers had antenatal depression (23.0/10,000 PY, 95%CI 16.0-33.1) or both antenatal and postnatal depression (25.1/10,000 PY, 95%CI 19.4-32.6), compared to those who had neither (12.7/10,000 PY, 95%CI 11.8-13.6) (Table 6-7). Similarly, incidence rates of serious fractures (12.3/10,000 PY, 95%CI 8.5-17.9) and serious burns (8.4/10,000 PY, 95%CI 5.3-13.1) were highest amongst children exposed to both antenatal and postnatal depression. Rates of serious poisonings are not presented due to small numbers (n=15).

Incidence rates of serious child injuries were significantly higher than unexposed children (non-overlapping 95% confidence intervals) among children exposed to both antenatal and postnatal depression when children were aged less than 1 and 1 years old (Figure 6-2).

All serious injuries (p<0.0001), serious fractures (p=0.003) and serious burns (p=0.02) were associated with maternal perinatal depression following adjustment for socioeconomic deprivation, calendar year and region. Children whose mothers had antenatal (aIRR 1.74, 95%CI 1.20-2.53) or antenatal and postnatal depression (aIRR 1.93, 95%CI 1.47-2.53) had higher rates of serious injury compared to those who were unexposed to perinatal depression. Similarly for serious fractures it was those exposed to antenatal (aIRR 1.87, 95%CI 1.10-2.30) or antenatal and postnatal depression (aIRR 2.12, 95%CI 1.44-3.12) who had higher fracture rates compared to those unexposed. For burns, only those exposed to both antenatal and postnatal depression had an increased rate of burns (aIRR 2.04, 95%CI 1.28-3.27) compared to those unexposed. There were no significant interactions between maternal perinatal depression and socioeconomic deprivation for serious injuries (p=0.22), serious fractures (p=0.27), or serious burns (p=0.98).

Table 6-6: Unadjusted and adjusted incidence rate ratios for the association between maternal perinatal depression and child poisonings, fractures and burns

	Person-years	Incident injury events	Incidence rate, per 10,000 PY (95%CI)	Unadjusted IRR (95% CI)	Adjusted IRR * (95% CI)	*p*-value$
POISONINGS						
Neither AN nor PN depression	578,952	1,966	34.0 (32.5-35.5)	1	1	<0.0001
AN depression	12,608	80	63.5 (51.0-79.0)	**1.87 (1.49-2.34)**	**1.74 (1.39-2.18)**	
PN depression	71,846	411	57.2 (51.9-63.0)	**1.68 (1.51-1.87)**	**1.55 (1.39-1.72)**	
Both AN and PN depression	22,697	157	69.2 (59.2-80.9)	**2.04 (1.73-2.40)**	**1.89 (1.61-2.23)**	
FRACTURES						
Neither AN nor PN depression	578,952	5,006	86.5 (84.1-88.9)	1	1	0.002
AN depression	12,608	121	96.0 (80.3-114.7)	1.11 (0.93-1.33)	1.08 (0.90-1.30)	
PN depression	71,846	730	101.6 (94.5-109.3)	**1.18 (1.09-1.27)**	**1.15 (1.07-1.25)**	
Both AN and PN depression	22,697	231	101.8 (89.5-115.8)	**1.18 (1.03-1.34)**	1.14 (0.99-1.30)	
BURNS						
Neither AN nor PN depression	578,952	3,351	57.9 (56.0-59.9)	1	1	<0.0001
AN depression	12,608	101	80.1 (65.9-97.4)	**1.38 (1.14-1.69)**	**1.33 (1.09-1.62)**	
PN depression	71,846	569	79.2 (73.0-86.0)	**1.37 (1.25-1.50)**	**1.30 (1.19-1.43)**	
Both AN and PN depression	22,697	180	79.3 (68.5-91.8)	**1.37 (1.18-1.59)**	**1.33 (1.14-1.54)**	

AN: antenatal, PN: postnatal, PY: person-years, 95%CI: 95% confidence interval

**adjusted for a priori confounders, socioeconomic deprivation, calendar year and geographical region. None of the other potential confounders changed the adjusted incidence rate ratio by 10% or more so were not included in the model.*

$Likelihood ratio test

Figure 6-2: Incidence rates of childhood injuries according to child age and exposure to maternal perinatal depression

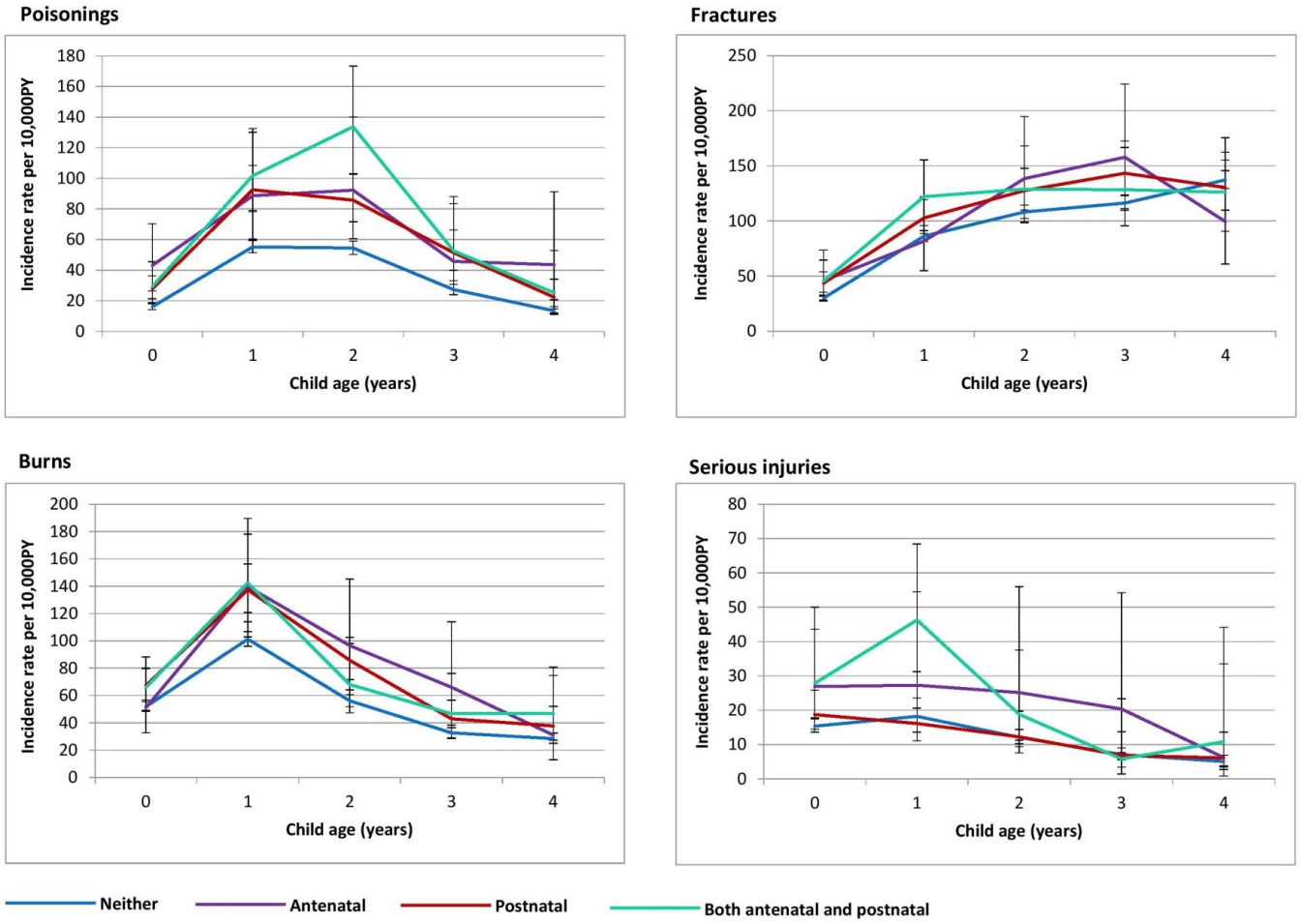


Table 6-7: Unadjusted and adjusted incidence rate ratios for the association between maternal perinatal depression and serious child injuries

	Incident injury events	Person-years	Crude incidence rate (per 10,000 PY)	Unadjusted IRR (95% CI)	Adjusted IRR * (95% CI)	*p*-value$
ALL SERIOUS INJURIES						
Neither AN nor PN depression	734	578,952	12.7 (11.8-13.6)	1	1	<0.0001
AN depression	29	12,608	23.0 (16.0-33.1)	**1.81 (1.24-2.66)**	**1.74 (1.20-2.53)**	
PN depression	95	71,846	13.2 (10.8-16.2)	1.04 (0.84-1.29)	1.00 (0.81-1.24)	
Both AN and PN depression	57	22,697	25.1 (19.4-32.6)	**1.98 (1.49-2.62)**	**1.93 (1.47-2.53)**	
SERIOUS FRACTURES						
Neither AN nor PN depression	335	578,952	5.8 (5.2-6.4)	1	1	0.001
AN depression	14	12,608	11.1 (6.6-18.7)	**1.92 (1.12-3.28)**	**1.87 (1.10-3.20)**	
PN depression	52	71,846	7.2 (5.5-9.5)	1.25 (0.93-1.68)	1.21 (0.90-1.62)	
Both AN and PN depression	28	22,697	12.3 (8.5-17.9)	**2.13 (1.45-3.14)**	**2.12 (1.44-3.12)**	
SERIOUS BURNS						
Neither AN nor PN depression	225	578,952	3.9 (3.4-4.4)	1	1	0.02
AN depression	9	12,608	7.1 (3.7-13.7)	1.84 (0.94-3.58)	1.72 (0.88-3.36)	
PN depression	25	71,846	3.5 (2.4-5.1)	0.90 (0.59-1.35)	0.86 (0.57-1.30)	
Both AN and PN depression	19	22,697	8.4 (5.3-13.1)	**2.15 (1.35-3.44)**	**2.04 (1.28-3.27)**	

AN: antenatal, PN: postnatal, PY: person-years, 95%CI: 95% confidence interval

**adjusted for a priori confounders, socioeconomic deprivation, calendar year and geographical region. None of the other potential confounders changed the adjusted incidence rate ratio by 10% or more so were not included in the model.*

$Likelihood ratio test

Results for serious poisonings are not presented as the number of serious poisoning events was too small (n=15).

6.3.4 Maternal perinatal depression and childhood injuries, taking account of maternal depression exposure when the child was aged 1-4 years

6.3.4.1 Child poisonings, fractures and burns

Table 6-8 shows the association between maternal perinatal depression and child poisonings, fractures and burns, with mothers classified according to whether they had perinatal depression and depression when the child is aged 1-4 years old, or whether they did not.

The magnitude of associations between perinatal depression and child poisonings was greater if the child was also exposed to maternal depression when aged 1-4 years old. For example, children exposed to antenatal depression had a 62% higher poisoning rate than those not exposed to maternal depression (aIRR 1.62, 95%CI 1.19-2.21); whereas those exposed to both antenatal depression and depression when aged 1-4 years had a two-fold higher poisoning rate than those unexposed to maternal depression (aIRR 2.18, 95%CI 1.58-2.99).

Incidence rates of fractures were only higher among children whose mothers had a record of depression when the child was aged 1-4 years old, compared to those whose mothers had no record of depression. For example, fracture rates were highest amongst mothers who experienced postnatal depression and were depressed when the child was aged 1-4 years old, with rates 25% higher than those unexposed to maternal depression (aIRR 1.25, 95%CI 1.14-1.37).

There was a less consistent pattern for burns, with rates highest amongst those exposed to both antenatal and postnatal depression (aIRR 1.64, 95%CI 1.14-2.35) and those exposed to depression during the antenatal period and when aged 1-4 years old (aIRR 1.52, 95%CI 1.14-2.03), compared to those not exposed to maternal depression.

Table 6-8: Association between maternal perinatal depression and child injuries according to whether mothers had depression when child was aged 1-4 years old

	Injury events	Person-years	Crude incidence rate, per 10,000 PY (95%CI)	Unadjusted IRR (95% CI)	Adjusted IRR * (95% CI)
POISONINGS					
Neither AN, PN nor ON depression #	1583	501,027	31.6 (30.1-33.2)	1	1
AN depression	41	7,377	55.6 (40.9-75.5)	1.76 (1.27-2.44)	**1.62 (1.19-2.21)**
PN depression	121	23,076	52.4 (43.9-62.7)	1.66 (1.37-2.01)	**1.54 (1.28-1.85)**
ON depression	383	77,925	49.2 (44.5-54.3)	1.56 (1.39-1.75)	**1.43 (1.28-1.60)**
AN + ON depression	39	5,230	74.6 (54.5-102.1)	2.36 (1.69-3.30)	**2.18 (1.58-2.99)**
PN + ON depression	290	48,770	59.5 (53.0-66.7)	1.88 (1.66-2.14)	**1.70 (1.50-1.93)**
AN + PN depression	17	3,173	53.6 (33.3-86.2)	1.70 (1.03-2.79)	1.61 (1.00-2.59)
AN + PN + ON depression	140	19,524	71.7 (60.8-84.6)	2.27 (1.88-2.73)	**2.08 (1.75-2.47)**
FRACTURES					
Neither AN, PN nor ON depression #	4,223	501,027	84.3 (81.8-86.9)	1	1
AN depression	73	7,377	99.0 (78.7-124.5)	1.17 (0.93-1.48)	1.14 (0.91-1.44)
PN depression	205	23,076	88.8 (77.5-101.9)	1.05 (0.92-1.21)	1.03 (0.90-1.19)
ON depression	783	77,925	100.5 (93.7-107.8)	1.19 (1.10-1.29)	**1.18 (1.09-1.28)**
AN + ON depression	48	5,230	91.8 (69.2-121.8)	1.09 (0.82-1.45)	1.07 (0.80-1.42)
PN + ON depression	525	48,770	107.6 (98.8-117.3)	1.28 (1.17-1.40)	**1.25 (1.14-1.37)**
AN + PN depression	30	3,173	94.6 (66.1-135.2)	1.12 (0.78-1.61)	1.08 (0.76-1.55)
AN + PN + ON depression	201	19,524	103.0 (89.7-118.2)	1.22 (1.06-1.41)	**1.18 (1.02-1.36)**
BURNS					
Neither AN, PN nor ON depression #	2,805	501,027	56.0 (54.0-58.1)	1	1
AN depression	54	7,377	73.2 (56.1-95.6)	1.31 (1.00-1.71)	1.26 (0.96-1.64)
PN depression	185	23,076	80.2 (69.4-92.6)	1.43 (1.23-1.66)	**1.37 (1.18-1.59)**
ON depression	547	77,925	70.2 (64.6-76.3)	1.25 (1.14-1.37)	**1.19 (1.08-1.30)**
AN + ON depression	47	5,230	89.9 (67.5-119.6)	1.61 (1.20-2.14)	**1.52 (1.14-2.03)**
PN + ON depression	384	48,770	78.7 (71.2-87.0)	1.41 (1.26-1.56)	**1.33 (1.19-1.48)**
AN + PN depression	30	3,173	94.6 (66.1-135.2)	1.69 (1.18-2.42)	**1.64 (1.14-2.35)**
AN + PN + ON depression	150	19,524	76.8 (65.5-90.2)	1.37 (1.16-1.62)	**1.32 (1.12-1.55)**

***AN**: antenatal. **PN**: postnatal. **ON**: ongoing or recurrent depression when child aged 1-4 years*

**adjusted for a priori confounders, socioeconomic deprivation, calendar year and geographical region.*

#the reference group are those who had no records for depression during study follow-up (i.e. no depression recorded during pregnancy, the postnatal period or up to the child's fifth birthday)

6.3.4.2 Serious injuries

Incidence rates of all serious injuries were generally higher among mothers who experienced antenatal depression (whether on its own or with later depression), with the highest injury rate among children of mothers who experienced both antenatal and postnatal depression (Table 6-9). Children exposed to both antenatal and postnatal depression had a nearly 3 fold higher rate of serious injury than those unexposed to perinatal depression (aIRR 2.99, 95%CI 1.69-5.31).

Numbers of serious fractures and burns were small for several groups, with 95% confidence intervals wide as a result. Children of mothers who had antenatal depression and depression when the child was aged 1-4 years had a 2.26 fold higher rate of serious fractures than those unexposed to maternal depression (aIRR 2.26, 95%CI 1.07-4.78). Similarly children exposed to antenatal depression, postnatal depression and maternal depression when aged 1-4 had a 2.41 times higher serious fracture rate than those unexposed (aIRR 2.41, 95%CI 1.62-3.59).

Incidence rates of serious burns were generally higher among those exposed to perinatal depression, but numbers were small with 95% confidence intervals often including 1. Children who were exposed to antenatal and postnatal depression had a six fold higher serious burn rate than those unexposed to maternal depression during study follow-up (aIRR 6.36, 95%CI 3.13-12.9).

Table 6-9: Association between maternal perinatal depression and serious child injuries according to whether mothers had depression when child was aged 1-4 years old

	Injury events	Person-years	Crude incidence rate, per 10,000 PY (95%CI)	Unadjusted IRR (95% CI)	Adjusted IRR* (95% CI)
SERIOUS INJURIES					
Neither AN, PN nor ON depression #	613	501,027	12.2 (11.3-13.2)	1	1
AN depression	19	7,377	25.8 (16.4-40.4)	2.11 (1.33-3.32)	**2.02 (1.28-3.19)**
PN depression	36	23,076	15.6 (11.3-21.6)	1.28 (0.91-1.78)	1.23 (0.88-1.72)
ON depression	121	77,925	15.5 (13.0-18.6)	1.27 (1.04-1.54)	1.21 (0.99-1.47)
AN + ON depression	10	5,230	19.1 (10.3-35.5)	1.56 (0.84-2.92)	1.48 (0.79-2.77)
PN + ON depression	59	48,770	12.1 (9.4-15.6)	0.99 (0.76-1.29)	0.94 (0.72-1.23)
AN + PN depression	12	3,173	37.8 (21.5-66.6)	3.09 (1.75-5.47)	**2.99 (1.69-5.31)**
AN + PN + ON depression	45	19,524	23.0 (17.2-30.9)	1.88 (1.39-2.55)	**1.83 (1.35-2.47)**
SERIOUS FRACTURES					
Neither AN, PN nor ON depression #	283	501,027	5.6 (5.0-6.3)	1	1
AN depression	$	7,377	9.5 (4.5-19.9)	1.68 (0.79-3.56)	1.65 (0.78-3.50)
PN depression	18	23,076	7.8 (4.9-12.4)	1.38 (0.86-2.22)	1.34 (0.83-2.16)
ON depression	52	77,925	6.7 (5.1-8.8)	1.18 (0.88-1.59)	1.12 (0.83-1.51)
AN + ON depression	7	5,230	13.4 (6.4-28.1)	2.37 (1.12-5.02)	**2.26 (1.07-4.78)**
PN + ON depression	34	48,770	7.0 (5.0-9.8)	1.23 (0.86-1.76)	1.17 (0.82-1.68)
AN + PN depression	$	3,173	3.2 (0.4-22.4)	0.56 (0.08-3.97)	0.56 (0.08-3.96)
AN + PN + ON depression	27	19,524	13.8 (9.5-20.2)	2.45 (1.65-3.63)	**2.41 (1.62-3.59)**
SERIOUS BURNS					
Neither AN, PN nor ON depression #	184	501,027	3.7 (3.2-4.2)	1	1
AN depression	$	7,377	8.1 (3.7-18.1)	2.21 (0.98-4.99)	2.05 (0.91-4.63)
PN depression	11	23,076	4.8 (2.6-8.6)	1.30 (0.71-2.38)	1.24 (0.67-2.27)
ON depression	41	77,925	5.3 (3.9-7.1)	1.43 (1.02-2.01)	1.39 (0.99-1.96)
AN + ON depression	$	5,230	5.7 (1.9-17.8)	1.56 (0.50-4.89)	1.48 (0.47-4.65)
PN + ON depression	14	48,770	2.9 (1.7-4.8)	0.78 (0.45-1.35)	0.75 (0.43-1.29)
AN + PN depression	8	3,173	25.2 (12.6-50.4)	6.87 (3.38-13.93)	**6.36 (3.13-12.9)**
AN + PN + ON depression	11	19,524	5.6 (3.1-10.2)	1.53 (0.83-2.82)	1.46 (0.79-2.69)

***AN**: antenatal. **PN**: postnatal. **ON**: ongoing or recurrent depression when child aged 1-4 years*

**adjusted for a priori confounders, socioeconomic deprivation, calendar year and geographical region.*

#the reference group are those who had no records for depression during study follow-up (i.e. no depression recorded during pregnancy, the postnatal period or up to the child's fifth birthday)

$numbers less than 5 omitted to comply with CPRD small numbers policy

6.3.5 Sensitivity analyses

6.3.5.1 Doubling the time-window used to identify incident poisoning, fracture and burn events

Doubling the time-windows used to define incident injury events in linked CPRD-HES data led to the identification of 2,606 poisonings, 5,994 fractures and 4,178 burns, compared to 2,614, 6,088 and 4,201, respectively in the primary analysis. Doubling the time-windows did not change observed associations between maternal perinatal depression and child injuries for any of the three injury types (Table 6-10).

6.3.5.2 Excluding mothers with a serious mental illness

Of the 207,048 mothers in the study cohort, 219 (0.1%) were diagnosed with a serious mental illness before the child's fifth birthday. Of the mothers with a serious mental illness, 11 (5%) had antenatal depression, 74 (34%) had postnatal depression and 66 (30%) had both antenatal and postnatal depression. Excluding these 219 mother-child pairs did not change the observed associations between child poisonings, fractures or burns (Table 6-10), or serious child injuries (Table 6-11).

6.3.5.3 Excluding injuries likely to be due to intentional harm

Of the 2,614 poisoning, 6,088 fracture and 4,201 burn events identified in CPRD and/or HES, 15 (0.6%), 62 (1.0%) and 33 (0.8%), respectively were identified as likely intentional injuries using information from both CPRD and HES records. The exclusion of these likely intentional injuries did not notably change adjusted incidence rate ratios for poisonings, fractures or burns (Table 6-10).

Of the 915 serious injuries, 429 serious fractures and 278 serious burns, 48 (5.2%), 34 (7.9%) and 7 (2.5%), respectively were identified as likely intentional injuries (Table 6-11). Exclusion of these likely intentional injuries led to some small reductions in adjusted incidence rate ratios but did not change the study conclusions about associations between perinatal depression and serious child injuries.

Table 6-10: Sensitivity analyses, adjusted incidence rate ratios for the association between maternal perinatal depression and child poisonings, fractures and burns

		Primary analysis (n=207,048)	Doubling time-window to define incident injury events (n=207,048)	Excluding mother-child pairs where mother has a serious mental illness (n=206,829)	Excluding likely intentional injuries# (n=207,048)
POISONINGS					
Number of incident poisonings		2,614	2,606	2,611	2,599
Association between perinatal depression and child poisonings Adjusted IRR* (95%CI)	**Neither AN nor PN depression**	1	1	1	1
	AN depression	1.74 (1.39-2.18)	1.72 (1.37-2.16)	1.74 (1.39-2.18)	1.70 (1.36-2.13)
	PN depression	1.55 (1.39-1.72)	1.55 (1.40-1.73)	1.54 (1.39-1.72)	1.54 (1.38-1.71)
	Both AN and PN depression	1.89 (1.61-2.23)	1.87 (1.59-2.21)	1.89 (1.61-2.23)	1.84 (1.56-2.17)
FRACTURES					
Number of incident fractures		6,088	5,994	6,085	6,026
Association between perinatal depression and child fractures Adjusted IRR* (95%CI)	**Neither AN nor PN depression**	1	1	1	1
	AN depression	1.08 (0.90-1.30)	1.07 (0.89-1.29)	1.08 (0.91-1.30)	1.07 (0.90-1.29)
	PN depression	1.15 (1.07-1.25)	1.15 (1.07-1.25)	1.15 (1.07-1.25)	1.15 (1.06-1.24)
	Both AN and PN depression	1.14 (0.99-1.30)	1.14 (1.00-1.31)	1.14 (1.00-1.30)	1.11 (0.97-1.27)
BURNS					
Number of incident burns		4,201	4,178	4,197	4,169
Association between perinatal depression and child burns Adjusted IRR* (95%CI)	**Neither AN nor PN depression**	1	1	1	1
	AN depression	1.33 (1.09-1.62)	1.32 (1.09-1.62)	1.33 (1.09-1.62)	1.34 (1.10-1.63)
	PN depression	1.30 (1.19-1.43)	1.31 (1.20-1.43)	1.31 (1.20-1.43)	1.30 (1.19-1.42)
	Both AN and PN depression	1.33 (1.14-1.54)	1.34 (1.15-1.55)	1.32 (1.14-1.54)	1.31 (1.12-1.52)

**adjusted for a priori confounders, socioeconomic deprivation, calendar year and geographical region. #likely intentional injuries identified using Read codes from the CPRD and ICD-10 codes from HES.*

Table 6-11: Sensitivity analyses, adjusted incidence rate ratios for the association between maternal perinatal depression and serious injuries

		Primary analysis (n=207,048)	Excluding mothers with a serious mental illness (n=206,829)	Excluding likely intentional injuries# (n=207,048)
ALL SERIOUS INJURIES				
Number of incident injuries		915	913	867
Association between perinatal depression and child serious fractures Adjusted IRR* (95%CI)	Neither AN nor PN depression	1	1	1
	AN depression	1.74 (1.20-2.53)	1.75 (1.21-2.54)	1.77 (1.21-2.58)
	PN depression	1.00 (0.81-1.24)	1.00 (0.81-1.24)	0.94 (0.75-1.18)
	Both AN and PN depression	1.93 (1.47-2.53)	1.91 (1.46-2.51)	1.85 (1.40-2.56)
SERIOUS FRACTURES				
Number of incident fractures		429	428	395
Association between perinatal depression and child serious fractures Adjusted IRR* (95%CI)	Neither AN nor PN depression	1	1	1
	AN depression	1.87 (1.10-3.20)	1.88 (1.10-3.21)	1.87 (1.07-3.27)
	PN depression	1.21 (0.90-1.62)	1.21 (0.90-1.62)	1.10 (0.80-1.50)
	Both AN and PN depression	2.12 (1.44-3.12)	2.06 (1.39-3.05)	1.96 (1.29-2.97)
SERIOUS BURNS				
Number of incident burns		278	278	271
Association between perinatal depression and child serious burns Adjusted IRR* (95%CI)	Neither AN nor PN depression	1	1	1
	AN depression	1.72 (0.88-3.36)	1.73 (0.89-3.36)	1.77 (0.91-3.44)
	PN depression	0.86 (0.57-1.30)	0.86 (0.57-1.30)	0.81 (0.53-1.24)
	Both AN and PN depression	2.04 (1.28-3.27)	2.06 (1.29-3.29)	2.09 (1.31-3.35)

**adjusted for a priori confounders, socioeconomic deprivation, calendar year and geographical region. #likely intentional injuries identified using Read codes from the CPRD and ICD-10 codes from HES*

6.4 Discussion

6.4.1 Summary of key findings

This study has demonstrated an association between maternal perinatal depression and child poisonings, fractures, burns and serious injuries amongst a cohort of over 200,000 mother-child pairs from England. The strength of association between maternal perinatal depression and child injuries varied according to injury type, with the strongest association seen for child poisonings; with children exposed having a 55-89% higher rate of poisonings compared to children whose mothers did not have perinatal depression. For serious injuries, where injury ascertainment is likely to be complete, children exposed to antenatal depression or both antenatal and postnatal depression had significantly increased injury rates compared to children whose mothers did not have perinatal depression.

When mothers were classified according to whether they had perinatal depression and/or depression when the child was aged 1-4 years old, an association between perinatal depression and child poisonings and burns persisted, and was generally stronger for those children whose mothers had both perinatal depression and depression when the child was aged 1-4 years. Rates of fractures were only elevated among children exposed to maternal depression when aged 1-4 years old.

Observed associations persisted in sensitivity analyses; when the time-windows used to define incident injuries in linked CPRD-HES data were doubled, and when mothers diagnosed with a serious mental illness were excluded. The exclusion of likely intentional injuries (e.g. maltreatment, physical abuse) led to small reductions in adjusted incidence rate ratios, particularly for serious injuries and serious fractures, but this did not change the study conclusions.

6.4.2 Strengths and limitations

6.4.2.1 Bias

In comparison to a number of injury studies assessing the effects of maternal depression on child injury risk(103, 107, 191), an important advantage of this study is the use of prospectively collected medical data from primary and secondary care, which avoids

social desirability and response biases that can occur within studies relying on parental reported data. Health data are however not without potential biases. In particular, differences in health care use for minor injuries between mothers with and without perinatal depression could lead to an overestimation of injury risk if mothers with perinatal depression are more likely to take their child to the GP for more minor injuries. Additionally, surveillance bias may be introduced if clinicians review mothers with perinatal depression more often than mothers without depression (hence giving more opportunity for the reporting of a child injury by the mother), or if clinicians are more likely to record the occurrence of a child injury in the medical record if the mother has perinatal depression. To try and account for these potential ascertainment biases, a group of serious injuries, where injury ascertainment is likely to be complete were examined, with the finding of an association between serious injuries and perinatal depression making it unlikely that observed associations are fully explained by ascertainment bias. A limitation with the definition of serious injuries is that it potentially over represents certain specific severe causes of injury (e.g. fractures due to maltreatment), which in themselves may be associated with perinatal depression and therefore lead to overestimation of the association between perinatal depression and the injury outcome. This is reflected in some reduction in incidence rate ratios when likely intentional injuries were excluded. CPRD and HES data are limited in that comprehensive data on injury severity are not available for all injuries captured by these data sources, as in many cases the codes used, particularly in the CPRD, are non-specific (e.g. 'Fracture Not Otherwise Specified'). Future studies should consider work to better define injury severity within linked CPRD and HES data.

While the Read code list used to identify depression for this study has not been validated, a study by John *et al* has reported a high positive predictive value of 74% for diagnoses of depression/anxiety within primary care data from Wales(232). This indicates that a high proportion of those diagnosed with depression/anxiety by a GP truly have the condition. The key limitation with the definition of perinatal depression within this study is that it only captures mothers seen or treated for depression by health services (including those where symptoms of depression were recorded). This excludes women who do not present to their doctor or where a Read code is not entered in the medical record. Compared to a systematic review of studies that used clinical assessments/interviews to diagnose depression, estimates of the prevalence for antenatal depression (5.6%) and postnatal depression (13.5%) in this study were

considerably lower(146), particularly for antenatal depression (e.g. Gavin *et al* estimated major depression prevalence during pregnancy as 12.7%(146)). Under ascertainment of maternal depression within primary care may lead to an underestimation of the association between maternal perinatal depression and child injuries, as children who were exposed to maternal depression have been misclassified as being 'unexposed'. Similar to other studies using routine health data, it was not possible to assess depression severity(316, 325), as no diagnostic or screening tool is consistently used within UK primary care. As it is likely that those identified with depression in CPRD-HES data are those with more severe and persistent depression symptoms, this affects the external validity of the findings, with the observed associations relating to maternal depression of sufficient severity to be medically diagnosed and/or treated.

As described in Section 5.4.2.1, there is likely to be some selection bias, related to which mothers could be matched to their children by the CPRD, and the requirements for mothers to have follow-up time from six months pre-pregnancy and children to have been registered with a GP within 3 months of birth. These study requirements may lead to the exclusion of those who frequently change general practice or delay registering their child with a GP. This selection bias may exclude some of the most vulnerable mother-child pairs from the cohort, and so may lead to an underestimation of the association between perinatal depression and child injury.

Length of study follow-up varied according to maternal characteristics; lower in those from more deprived socioeconomic quintiles and those with antenatal depression or both antenatal and postnatal depression. Differential loss to follow-up according to these maternal characteristics could lead to an underestimation of injury risk if those who more regularly change general practices are those whose children are at higher injury risk.

The exclusion of likely intentional injuries led to some reduction in observed associations between perinatal depression and serious injuries. While both primary care and hospital admission data were used to identify likely intentional injuries, the very nature of child maltreatment means that not all intentional injuries may have been identified (e.g. not recognised by clinicians, not coded in the medical record), and as a result it is possible that the association between perinatal depression and serious child injuries has been overestimated. Conversely, it is possible that surveillance bias may lead to an over

recording of likely intentional harm amongst mothers with depression, as health professionals may review these mothers more frequently and be more vigilant for signs of child harm.

6.4.2.2 Confounding

Although a number of potential confounders were considered within the analysis, there were some potential confounders that could not be adjusted for (e.g. single parenthood, maternal education level) as these data are not well recorded within UK primary care data. As a result the observed association between perinatal depression and child injuries may be under- or overestimated as a result of residual confounding. Paternal risk factors were not examined within this study due to the challenges of accurately identifying the child's father within primary care data. In many cases this is not possible, particularly if the father is registered at a different general practice, does not live with the child or there are multiple adult males within the household. The impact of paternal health, parental supervision, home safety behaviours and child care use could not be examined within this study; factors that could act as confounders but could also lie on the causal pathway between the mother's mental wellbeing and child injury risk.

6.4.2.3 Chance

A key strength of this study is the use of a large study cohort, which enabled the examination of a number of injury outcomes, including serious injuries (a rare outcome). Based on the size of the study cohort, the study had 95% power to detect a 1.5 fold increased rate of serious fractures among mothers with perinatal depression. For the other more common injury outcomes, the study was adequately powered to detect a difference between groups. For example, for all fractures (using CPRD and/or HES) there was over 99% power to detect a 1.2 fold increase in the fracture rate. However, as serious burns (n=278) were rare, a lack of association with antenatal depression alone or postnatal depression alone may be due to a type 2 error resulting from insufficient study power for this injury outcome. Additionally, it was not possible to assess the association between serious poisonings and perinatal depression as there were only 15 serious poisonings amongst the cohort over the study period.

Through using a large dataset and conducting multiple significance tests, a type 1 error (a significant difference is found when in fact no true difference between groups exists)

could have been introduced. To reduce the likelihood of this, a lower *p* value of 0.01 was used when assessing for interactions.

6.4.2.4 Reverse causation

There is the potential for reverse causation as a result of the overlap between maternal depressive symptoms during the first year after delivery (postnatal depression) and the occurrence of child injuries in this first year. Reverse causation would be most likely in cases of severe child injury, where a severe traumatic event could lead mothers to experience symptoms of stress, blame, anxiety and depression(344). The effect of this is however likely to be small, as within this dataset only 11 (0.4%) poisonings, 34 (0.6%) fractures, 28 (0.7%) burns and 15 (1.6%) serious injuries were recorded before the onset of maternal depression in this first year after delivery. For all other injury events, children were either classified as not exposed to maternal depression during study follow-up, or a diagnosis of antenatal and/or postnatal depression preceded the occurrence of an injury event.

The effect of reverse causation may however be greater for the analysis where mothers were classified as having perinatal depression and/or depression when the child was aged 1-4 years old (Section 6.3.4); as there is overlap between the measurement of maternal depressive symptoms and child injury events throughout study follow-up (from the child's birth to fifth birthday). Of the injury events, 210 (8.0%) poisonings, 341 (5.6%) fractures, 353 (8.4%) burns and 81 (8.9%) serious injuries occurred prior to the mother's diagnosis with depression; with about 50-60% of these injuries occurring in the year before maternal depression was diagnosed (i.e. 103 poisonings, 163 fractures, 171 burns, 34 serious injuries). With over 90% of injuries occurring after the onset of maternal depression, it is unlikely that observed associations are the result of reverse causality.

6.4.3 Comparison to existing literature

Similar to several existing studies, a significant association between maternal perinatal depression and the risk of child injuries was found(69, 191, 199). For example, in a series of nested case-control studies by Orton *et al,* children aged 0-4 years who had sustained a poisoning or thermal injury had a 50% (aOR 1.50, 95%CI 1.29-1.75) and 22% (aOR 1.22, 95%CI 1.08-1.39), respectively, greater odds of exposure to maternal perinatal

depression than controls who had not sustained a poisoning or burn(69). No association was however identified with child fractures (aOR 1.06, 95%CI 0.93-1.20)(69). A key difference to previous studies is that the independent effects of antenatal depression and postnatal depression were examined separately, finding that fracture rates were only elevated in children whose mothers had postnatal depression. The lack of association between perinatal depression and child fractures in previous studies(69, 345) may reflect the use of a single combined measure of perinatal depression in these studies.

There are several potential pathways through which maternal perinatal depression could affect child injury risk. Firstly, maternal supervision has been identified as an important determinant of the risk of injuries in preschool children(318, 346-349), with environmental (e.g. presence of hazards, use of safety equipment), maternal (e.g. personality, parenting style) and child (e.g. age, personality, behaviour) factors affecting the level of supervision mothers undertake(318, 348). Maternal depression has been associated with more negative, and withdrawn parenting practices and lower child supervision(135, 200, 201, 350). A study by Phelan *et al* found that depressed mothers reported more time supervising their children aged less than 3 years old, but a smaller proportion of this time was 'intense' supervision(201). Intense supervision was defined by Phelan *et al* as the mother directly interacting with the child, either touching their infant or able to do so within 1-2 seconds. The least intensive supervision style (termed 'peripheral') referred to caregivers who listened for noises from another part of the house who could not have easily reached their child in seconds. Less time providing 'intense' supervision may be explained by depression symptoms, such as tiredness and poor concentration, affecting the mother's ability to continuously watch and interact with the child(201). Secondly, maternal depression has been associated with child behavioural disorders (e.g. hyperactivity, temper tantrums)(135), which are in themselves associated with greater injury risk(89, 351), as the child may not respond appropriately to hazards (e.g. impulsivity) or parental instruction(88). Thirdly, an association between maternal depression and child injuries may be explained by reduced safety practices, which have been observed among depressed mothers (e.g. use of car seats, poison accessibility)(170, 174)(section 1.7.1), with the effect greater for those with more severe and persistent depression symptoms(174). Fourthly, increased poisoning rates could reflect increased exposure to poisoning substances, either as a result of mothers with perinatal depression being prescribed antidepressants or having a

greater number of other medications in the household (e.g. those with depression may have a greater number of other medical conditions, such as chronic pain or insomnia). Finally, increased child injury rates in relation to maternal depression may be explained by wider family and socioeconomic circumstances that are interconnected with the mother's mental wellbeing (e.g. social support, paternal health, domestic violence, quality of housing, single parenthood)(350). For example, there is some evidence that men whose partners are depressed, are more likely to have psychological difficulties themselves (e.g. depression, alcohol misuse)(207), which could in turn have effects on child supervision and parenting practices.

Similar to existing studies the magnitude of the association between perinatal depression and child injuries was found to vary by injury type(69, 70, 73, 345), with the greatest effect seen for child poisonings. Patterns of child injury largely relate to the developmental age of the child, with the incidence of poisonings and burns peaking in children aged 1-2 years old as children increase in mobility and exploratory behaviours(81). The greater effect of perinatal depression on poisonings and burns may relate to the types of interventions required to prevent these injuries. Work by Morrongiello *et al* has described that parents give greater attention to child safety where there is a perception that the resulting injury is severe, that their child is at particular risk, that the level of inconvenience is low and that they have the potential to lower the injury risk by intervening(318). Preventing poisonings and burns often relies upon changes in parental behaviours (e.g. putting hot drinks out of reach, not leaving medications accessible) and close supervision. In contrast, falls the commonest cause of fractures in preschool children, are often prevented by using safety equipment such as stair gates and window locks, and may be perceived as a more serious injury and receive greater attention by parents.

Previous cohort studies from the US have demonstrated child injury risk increases with both the severity of maternal depressive symptoms and the chronicity of symptoms(182, 183). Within this study, the highest injury rates were among children whose mothers had both antenatal and postnatal depression. While it has not been possible to assess depression severity within this study, mothers with both antenatal and postnatal depression were also more commonly depressed when the child was aged 1-4 years old than the other groups of mothers (78.4% of those with both antenatal and

postnatal depression); potentially reflecting a group of mothers with more severe and chronic depression.

Poisoning and burn rates were generally higher amongst children exposed to both perinatal depression and depression when the child was aged 1-4 years old, which is consistent with previous studies suggesting greater injury risk when the mother has chronic depression(183). Interestingly, rates of child poisonings and burns were still increased amongst mothers who were only diagnosed with antenatal depression, indicating that observed associations between antenatal depression and child injuries are not fully explained by subsequent postnatal or ongoing depression episodes. Existing literature has suggested independent effects of antenatal depression and/or stress on several child outcomes (e.g. child mental illnesses, behavioural problems, temperament)(326, 352). A body of literature suggests that environmental factors (including maternal depression and stress) occurring prenatally at key periods when the fetus is developing can have long term impacts on child outcomes (referred to as fetal programming)(352, 353). This is one potential explanation for observed associations between antenatal depression and child injuries, but may be also explained by lasting impacts of antenatal depression on early mother-child interactions(135, 166), that some mothers with perinatal depression did have ongoing depressive symptoms but no medical attention was sought, and residual confounding. Fracture rates were only elevated amongst children whose mothers were depressed in the postnatal period or when the child was aged 1-4 years old. This is not unsurprising due to the timing and mechanisms through which fractures occur; most commonly due to falls(268), with rates increasing with age as children become mobile(81).

To my knowledge no studies have previously examined the risk of serious child injuries and maternal perinatal depression. Significant associations between maternal perinatal depression and rates of serious child injuries were seen, with rates highest among children whose mothers had both antenatal and postnatal depression. This may relate to those with both antenatal and postnatal depression reflecting mothers with the most severe and enduring symptoms; which if reflecting a true finding, could relate to the mother's ability to supervise the child, parenting practices, or the safety of the home environment. On the other hand this elevated risk may in part be explained by residual confounding, if those with antenatal and postnatal depression captured in this dataset

are more likely to experience other adverse life circumstances (e.g. domestic violence, poor social support(354)).

6.4.4 Conclusions and implications

This study has demonstrated significantly higher rates of injuries, particularly poisonings and burns, among children whose mothers had perinatal depression. This highlights the importance of screening mothers for perinatal depression, and ensuring they receive appropriate treatment. Clinicians working with young families, such as GPs, health visitors and the Family Nurse Partnership (working with teenage mothers), need to be aware of the increased injury rates among children of depressed mothers. These clinicians can refer families for home safety advice and to equipment schemes, where these are available, in accordance with NICE guidance on preventing injuries(24). In addition, prescribers and pharmacists should consider providing advice about safe medication storage and disposal to mothers being managed for depression. Future randomised controlled trials focusing upon perinatal depression should consider assessment of child injuries rates, and whether treatment of maternal depression (with/without provision of home safety advice) reduces the occurrence of child injuries.

Chapter 7: Maternal depression and anxiety and the risk of injuries in children aged 0-4 years

This chapter describes a cohort study that assesses the association between maternal depression/anxiety episodes and childhood injuries. Maternal depression/anxiety episodes were used as a time-varying exposure, to take account of remission and relapses in maternal depression/anxiety over the course of the child's first five years of life. Two analyses were carried out; the first a traditional cohort analysis with confounding controlled using Poisson regression; and the second a self-controlled case series (SCCS) analysis, a within person study design. The aim of using these methods was firstly to assess how rates of childhood injuries relate to the occurrence of maternal depression/anxiety episodes, and secondly to assess whether study findings differ when using different methods to account for confounding.

7.1 Objectives

- To examine the relationship between the occurrence of maternal depression/anxiety episodes and the incidence of childhood injuries during the child's first five years of life.
- To compare the rates of childhood injuries between periods when the mother is recorded as having depression/anxiety and periods when the mother has no medical record of depression/anxiety using the self-controlled case series method.

7.2 Methods

7.2.1 Study design and population

The study population consisted of a cohort of children aged 0-4 years old from the CPRD who were born between 1st January 1998 and 31st December 2013, whose primary care records had been linked to those of their mother, and for whom linked hospitalisation

data (HES) were available (as defined in Section 5.2.2). The children were followed up until the earliest date of: the date mother or child left the general practice (e.g. changed practice, died), the 31st December 2013, the date information was last collected from the practice, the date the mother was diagnosed with a serious mental illness (e.g. schizophrenia, bipolar disorder, if applicable) or the child's fifth birthday. To be included in the study population, the child had to be registered with the general practice within 3 months of birth to maximise the capture of early medically attended injuries. One child was randomly selected per mother.

7.2.2 Outcome: child injury events

7.2.2.1 Incident poisoning, fracture and burn events

Numbers of incident poisoning, fracture and burn events occurring during the child's follow-up time were identified using the child's primary care (CPRD) and hospitalisation (HES) records. As some children sustained more than one injury event during their follow-up, a time-based algorithm, as previously described (Section 3.4), was used to distinguish between records for the same event (e.g. follow-up care, same event recorded in both data sources) and those for a new incident injury event.

7.2.2.2 Serious injuries

Serious injuries were defined as described in Section 6.2.2.2; a group of serious injuries of any type (e.g. fractures, injuries to internal organs, intracranial injuries), which were likely to always lead to hospitalisation. Serious injuries were used as an injury outcome within this study as injury ascertainment is likely to be near-complete and unaffected by differences in hospital admission thresholds or parental health seeking behaviours.

7.2.3 Exposure: episodes of maternal depression and/or anxiety

7.2.3.1 Defining episodes of maternal depression/anxiety

The exposure of interest was episodes of maternal depression alone, depression with anxiety and anxiety alone, collectively referred to as 'depression/anxiety' within this thesis. As anxiety is commonly comorbid with depression, and antidepressants can be used in the management of anxiety, it was important to consider these two conditions together; to both aid in distinguishing depression and anxiety episodes from each other, and to assess whether depression with comorbid anxiety had a different effect on injury

risk than depression or anxiety alone. Episodes of depression/anxiety were identified using diagnostic, symptom and prescription records from the CPRD, and diagnostic records from HES (as described in Section 5.2.2.3). Continuous periods of medical management and/or treatment for depression/anxiety were defined using a time-window of six months, such that records occurring within six months of the end of the previous record (end of prescription, discharge date, date Read code entered) were considered part of the same ongoing episode of depression/anxiety. Where there was a gap of more than six months from the last record for depression/anxiety, the new record was considered the start of the next depression/anxiety episode. Episodes of depression with anxiety were defined in one of two ways; by the presence of specific Read or ICD-10 codes that specify both depression and anxiety (e.g. E200300 Anxiety with depression), or by concurrent recording of diagnostic codes for both anxiety and depression.

7.2.3.2 Detailed time-windows for depression/anxiety episodes

The episodes of depression/anxiety defined within this study represent periods during which mothers' symptoms were being managed/treated via their GP or that were recorded during a hospitalisation. To account for time that mothers develop symptoms prior to presenting to their doctor and time mothers may continue to have symptoms following their last depression/anxiety record, additional time periods were defined before and after the depression/anxiety episodes. Some mothers received antidepressant or anxiolytic medications and so in addition, periods when mothers were receiving medications were defined. The follow-up time of each mother was therefore divided into the following periods, as illustrated in Figure 7-1.

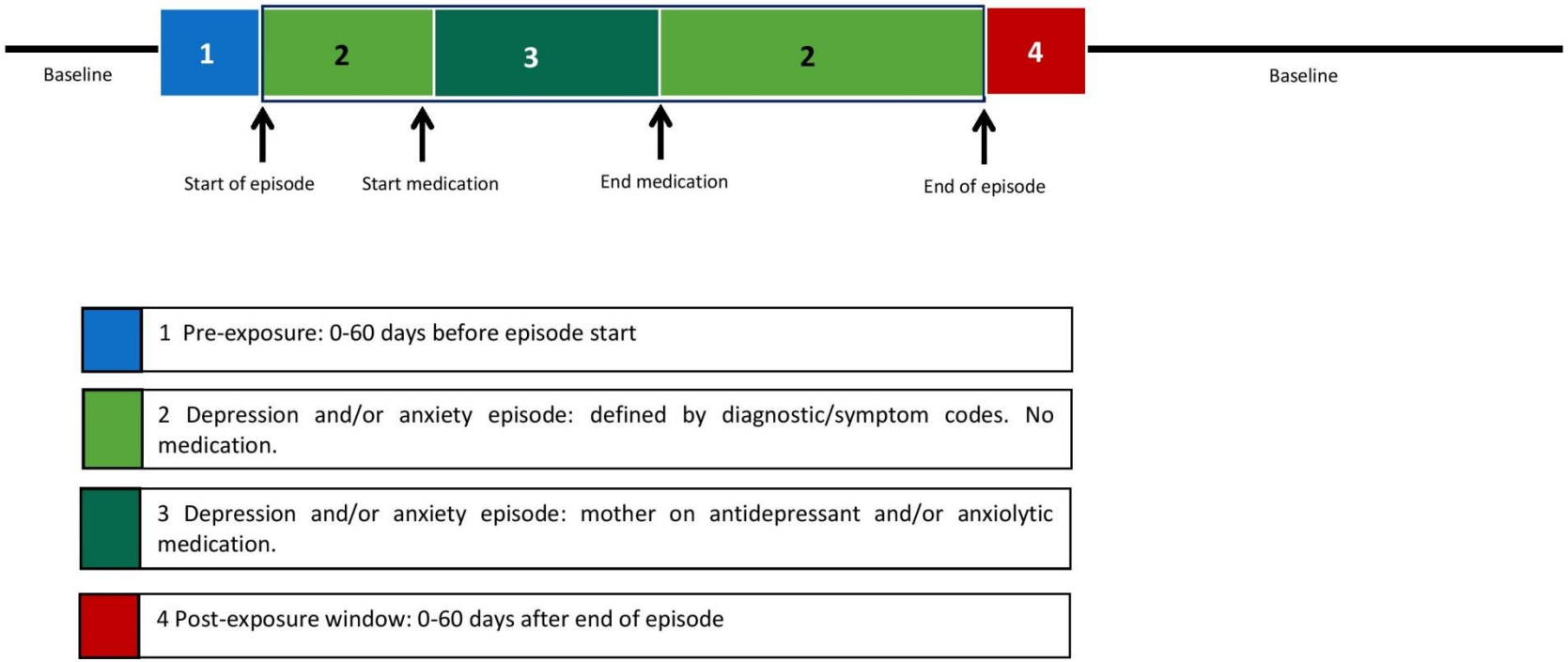
- **Pre-exposure period:** a 60 day period of time before the first presentation with depression/anxiety to take account of women developing symptoms prior to presentation to their doctor.
- **Episode without medication:** period of time where the mother had diagnostic or symptom codes for depression/anxiety but was not receiving any medications to treat depression/anxiety.
- **Episode with medication:** period of time where the mother was receiving medication to treat depression/anxiety.

- **Post-exposure period:** a 60 day period of time after the end of the depression/anxiety episode to take account of women having residual symptoms of depression/anxiety as the episode resolved.

- **Unexposed/baseline time:** all other periods were classified as baseline exposure time ('unexposed').

Figure 7-1 gives an example of a depression/anxiety episode where for some of the time medication was prescribed, and for the rest of the episode medication was not prescribed. In other cases, depression/anxiety episodes may be defined by only diagnostic codes, or conversely the mother might be prescribed an antidepressant or anxiolytic for the whole of the depression/anxiety episode.

Figure 7-1: Defining detailed episodes of maternal depression/anxiety, including pre- and post-exposure windows



This is an example of how maternal depression/anxiety episodes were defined using detailed time-windows. The sequence and duration of periods 2 (depression/anxiety: not on medication) and 3 (depression/anxiety: on medication) will vary in sequence and duration. For example, the mother might not be prescribed medication at all and so all of the depression/anxiety episode would be classified as period 2.

7.2.4 Definitions of covariates

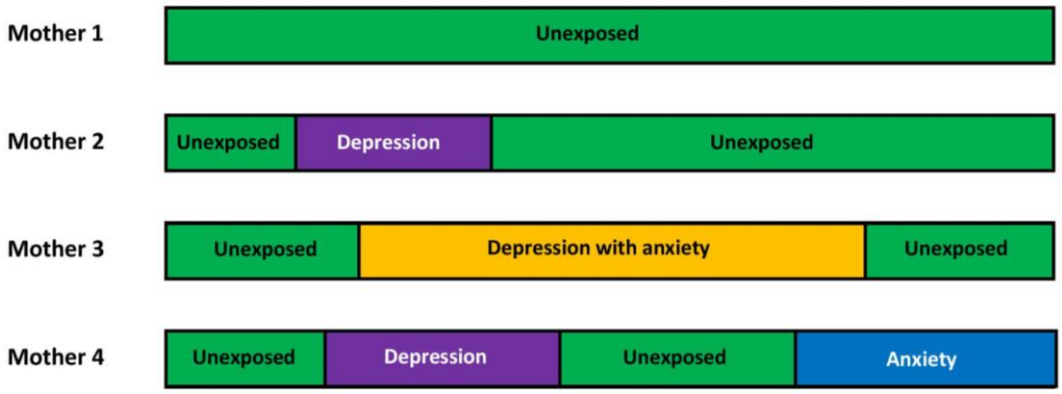
Potential confounders available within the CPRD and/or HES datasets included child age at injury, child sex, maternal age at delivery, socioeconomic deprivation, calendar year, region, maternal alcohol misuse, maternal drug misuse, the number of older siblings and the number of children aged less than 5 years in the household. These variables were defined as outlined in Sections 4.2.4 and 5.2.5.

7.2.5 Statistical analyses

7.2.5.1 Cohort analysis

Maternal depression/anxiety episodes were used as a time-varying exposure, with the child's follow-up time divided into exposed (periods of maternal depression/anxiety) and unexposed periods (Figure 7-2). For mothers who had no records of depression/anxiety during their follow-up time, all of their person-time was classified as unexposed.

Figure 7-2: Illustration of episodes of maternal depression/anxiety as a time-varying exposure



Incidence rates of poisonings, fractures, burns and serious injuries were calculated by dividing the number of injury events by the sum of the person-years at risk, according to exposure to maternal depression/anxiety. To assess whether the effect of maternal depression/anxiety differed according to child age, Lexis expansion was used to divide up each child's follow-up time into 1 year age bands allowing estimation of injury incidence rates according to child age and exposure to maternal depression/anxiety(244).

Unadjusted and adjusted incidence rate ratios were estimated using Poisson regression, with the effect of potential confounders assessed by adding each variable into a Poisson regression model and assessing whether the estimated incidence rate ratio changed by 10% or more. Socioeconomic deprivation, region and calendar year were considered *a priori* confounders; with region and calendar year included to account for differences in clinical coding by region and over time. The statistical significance of the associations between episodes of maternal depression/anxiety and child injuries were assessed using LRTs, with $p<0.05$ considered statistically significant. Multicollinearity between variables was assessed using the covariate correlation matrix and by calculating the variance inflation factor. Interactions between maternal depression/anxiety and socioeconomic deprivation were tested based on theoretical plausibility, and were assessed by adding interaction terms into the adjusted Poisson regression models, with $p<0.01$ considered statistically significant. For example, the effect of maternal depression/anxiety on child injury risk could be moderated by socioeconomic deprivation if more affluent mothers are able to pay for childcare or buy safety equipment to reduce injury risk.

This analysis was repeated using the detailed time periods shown in Figure 7-1, which included pre- and post- exposure periods, and separated the time when mothers received medications from periods when mothers had depression/anxiety but were not on medication.

The appropriateness of the Poisson regression model was assessed, as described in Section 6.2.5, with the Poisson model considered appropriate as data were not over dispersed (LRT of alpha not significant, $p>0.05$ for each injury type).

7.2.5.2 Self-controlled case series analysis

The SCCS method is derived from standard cohort methods and compares the rate of an outcome in exposed periods with the rate of an outcome in unexposed periods within the same individual(355). It uses only cases as the study population (those with both the outcome and exposure) and provides a measure of relative incidence between exposed and unexposed periods amongst those who have had an injury outcome. The SCCS method was developed by Farrington *et al* to assess adverse outcomes following vaccination(356), has subsequently been used for a wide range of different outcomes and exposures(357-360), and is ideal for assessing acute outcomes such as injury. A key

strength of the SCCS method is that it takes account of confounding factors that vary between individuals; a strength when considering maternal depression/anxiety as a risk factor for child injury, as there are many potential confounding factors that are difficult to record and capture within routine health data.

Comprehensive instructions on using the method and setting up data for the analysis have been published by Whitaker *et al*(355). For the SCCS analysis, the follow-up time of each child was divided into exposed and unexposed periods as described in Section 7.2.3.2. A SCCS analysis was carried out for each of the injury outcomes (poisonings, fractures, burns, serious injuries), with the study populations consisting of only those who had sustained the injury outcome of interest. Conditional Poisson regression was used to compare the rates of child injuries in exposed and unexposed periods. Adjustment was made for child age (in 3 month bands) and calendar year (in 1 year bands), as the SCCS method does not account for confounding that varies over time. Children who had sustained the injury outcome but had not been exposed to maternal depression/anxiety contributed information on the patterns of injury by child age and calendar time but did not contribute information to the analysis about the relative impact of exposure to maternal depression/anxiety compared to unexposed periods. Differences in associations between maternal depression/anxiety and child injury incidence were assessed by adding interaction terms(355) between maternal depression/anxiety and socioeconomic deprivation into the conditional Poisson regression model.

7.2.5.3 Sensitivity analyses

Sensitivity analyses were conducted for both the cohort and SCCS analyses to assess the impact of changing underlying study assumptions and definitions.

- **Doubling the time-windows used to define incident injury events.** By using a time-based algorithm to distinguish between incident injury events in linked CPRD-HES-ONS data it is possible that the number of events may have been overestimated (e.g. among those requiring prolonged follow-up care). Therefore the time-windows used to define incident injury events in linked CPRD-HES data were doubled, as described in Section 4.4.1, to assess the impact on study findings.

- **Changing the time-window to define episodes of depression/anxiety.** The time-window of six months used to define continuous periods of maternal depression/anxiety was extended to 12 months, meaning that for mothers with repeated depression/anxiety records, more of their follow-up time was classified as being exposed.

- **Exclusion of symptom and clinical review codes for depression/anxiety.** The definition of depression/anxiety was restricted to the most specific diagnostic codes referring to a diagnosis of depression/anxiety.

- **Excluding mothers with serious mental illnesses.** Mother-child pairs where the mothers was diagnosed with a serious mental illness during study follow-up were excluded as it is possible that these mothers may have started to develop symptoms of the serious mental illness for some time before the diagnosis (e.g. psychosis, delusions).

- **Excluding likely intentional injuries.** As maternal mental illnesses and some of the associated risk factors have been linked to child maltreatment, likely intentional injuries (as defined in Section 6.2.6.3) were excluded as a sensitivity analysis.

7.2.5.4 Analyses to test the assumptions of the SCCS method

There are several key assumptions of the SCCS method, which need to be assessed as these issues can bias the findings of SCCS analyses:

Outcome affects the likelihood of exposure.

The SCCS method requires that the probability of exposure is unaffected by the occurrence of an outcome event, with the observation periods independent of when the outcome occurs(355). This requirement is firstly violated when outcome events lead to death, as the censoring of follow-up time is dependent on the outcome. Therefore, to assess this, any children who died from an injury event (poisoning, fracture, burn, serious injury) were excluded from the analysis.

Secondly, this requirement could be violated in cases where a child sustains a serious injury, increasing the likelihood of maternal depression/anxiety(344). If mothers became

depressed/anxious following a child injury, it would be likely that the rate of child injury would be higher in the period before the depression/anxiety episode, which could bias the relative incidence downwards. A common method to test this assumption is to define a pre-exposure risk period and to remove this from the baseline/unexposed time(355). This assumption was therefore tested by excluding the 60 day period before the start of depression/anxiety episodes from the baseline/unexposed time. A large change in adjusted incidence rate ratio from the primary analysis would suggest that child injury events influenced the probability of subsequent exposure. It must however be noted that this assumption is more difficult to test for this study, as there is no clearly defined time period that one could expect maternal depression/anxiety symptoms to commence following a child injury (i.e. could be weeks, months, a year), which is different to studies where there is a clear window beforehand one could expect the outcome to exert an effect on the exposure.

Independence of injury events.

The SCCS method allows multiple outcome events to occur, but assumes that events are independent and do not affect the rate of subsequent events(355). This assumption may not hold for injury events, as children who have had one injury may have a higher risk of subsequent injuries than children who have not had an injury(361). Recurrent injury events per child were rare within the data set used (e.g. 3-4% of children who had an injury sustained more than one injury of the same type). To assess whether the inclusion of multiple events affected study findings, the analysis was restricted to the first event per child. To ensure that the date children were censored at was not dependent on the occurrence of the first injury event (to meet first assumption of the SCCS), children who had sustained more than one injury were censored on the day before their next injury event.

7.3 Results

7.3.1 The study population

The study cohort consisted of 207,048 mother-child pairs (Table 7-1). Of the children, 159,787 (51.2%) were male and 152,129 (48.8%) were female, with median study follow-up from birth 3.9 years (IQR 1.6-5.0). Children from the most deprived socioeconomic quintile were underrepresented in the study cohort (17.2%) whereas those from the most affluent quintile were overrepresented (22.7%).

Of the mothers, 54,694 (26.4%) experienced one or more episode of depression/anxiety between the child's birth and end of follow-up. For those children exposed to one or more episode of maternal depression/anxiety, the median duration of exposure was 152 days (IQR 30-463). Of the 54,694 children exposed to maternal depression/anxiety, 38,080 (69.6%) were exposed for less than 12 months, 8,116 (14.8%) were exposed for 12-23 months, and 8,498 (15.5%) were exposed for 24 months or more of the child's follow-up time.

Table 7-1: Characteristics of mother-child cohort, children born between the 1st January 1998 and 31st December 2013

	Frequency (%)
Child sex	
Male	105,958 (51.2)
Female	101,090 (48.8)
Age of child at start of follow-up (months)	
< 1	132,679 (64.1)
1-2	62,558 (30.2)
2-3	11,811 (5.7)
Maternal age at delivery (years)	
<20	9,575 (4.6)
20-29	80,481 (38.9)
30-39	107,707 (52.0)
≥40	9,285 (4.5)
Socioeconomic deprivation, IMD 2010	
Quintile 1 (least deprived)	47,010 (22.7)
Quintile 2	43,699 (21.1)
Quintile 3	39,674 (19.2)
Quintile 4	40,728 (19.7)
Quintile 5 (most deprived)	35,658 (17.2)
Missing	279 (0.1)
Maternal alcohol misuse during study follow-up	
No	202,666 (97.9)
Yes	4,382 (2.1)
Maternal drug misuse during study follow-up	
No	205,888 (99.4)
Yes	1,160 (0.6)
Total number of children aged <5 in the household	
1	95,558 (46.2)
2	88,462 (42.7)
3	18,080 (8.7)
4 or more	4,948 (2.4)
Number of older siblings/children	
0	81,738 (39.5)
1	80,162 (38.7)
2	30,353 (14.7)
3 or more	14,795 (7.2)
Total duration of exposure to maternal depression/anxiety during child's follow-up time (months)[$]	
Not exposed	152,354 (73.6)
0-11	38,080 (18.4)
12-23	8,116 (3.9)
24-35	3,973 (1.9)
36-47	2,215 (1.1)
48-59	2,310 (1.1)

[$]The total duration of depression/anxiety episodes captured by CPRD and/or HES occurring between the child's birth and end of follow-up was estimated for each mother. If mothers had multiple episodes of depression, these durations were summed.

7.3.2 Cohort analysis

7.3.2.1 Crude injury incidence rates during episodes of depression/anxiety

For poisonings and burns, crude injury incidence rates were higher during episodes of depression/anxiety than unexposed periods (where the mother had no records for depression or anxiety in her medical record) (Table 7-2). For poisonings, crude incidence rates were 57.9/10,000 PY (95%CI 50.1-66.8) during episodes of depression, 86.9 (95%CI 73.1-103.4) during episodes of depression with anxiety and 59.2 (95%CI 37.9-88.3) during episodes of anxiety alone, compared to 35.8 (95%CI 34.4-37.3) during unexposed periods. A similar pattern was seen for burns with the highest rate observed during periods when mothers had both depression and anxiety (94.4/10,000 PY, 95%CI 69.6-89.4) compared to unexposed periods (59.4, 95%CI 57.5-61.3). For fractures, crude incidence rates were 103.0/10,000 PY (95%CI 95.2-114.7) during episodes of depression, 112.0 (95%CI 96.2-130.5) during episodes of depression with anxiety, and 79.0 (95%CI 55.8-111.6) during anxiety episodes; compared to 87.5 (95%CI 85.3-89.9) during unexposed periods. Crude incidence rates of serious injuries were highest during episodes of depression (16.8/10,000 PY, 95%CI 12.9-21.9) compared to unexposed periods (13.2/10,000 PY, 95%CI 12.3-14.1), but 95% confidence intervals overlapped.

Figure 7-3 shows incidence rates of child poisonings, fractures and burns according to child age and exposure to episodes of maternal depression/anxiety. Serious injuries are not shown due to the small number of events when follow-up time was divided by child age. For both poisonings and burns, patterns in injury incidence showed broadly similar patterns by child age (i.e. peaking at age 2 for poisonings, age 1 for burns) but incidence rates were of greater magnitude during episodes of depression or depression with anxiety than during unexposed periods. For anxiety, incidence rates of poisonings peaked at an earlier age of 1 year, and for burns peaked at a later age of 2 years. For fractures, there was no notable difference in fracture incidence rates between those exposed and unexposed to maternal depression/anxiety episodes, with 95% confidence intervals overlapping between those exposed and unexposed at each age.

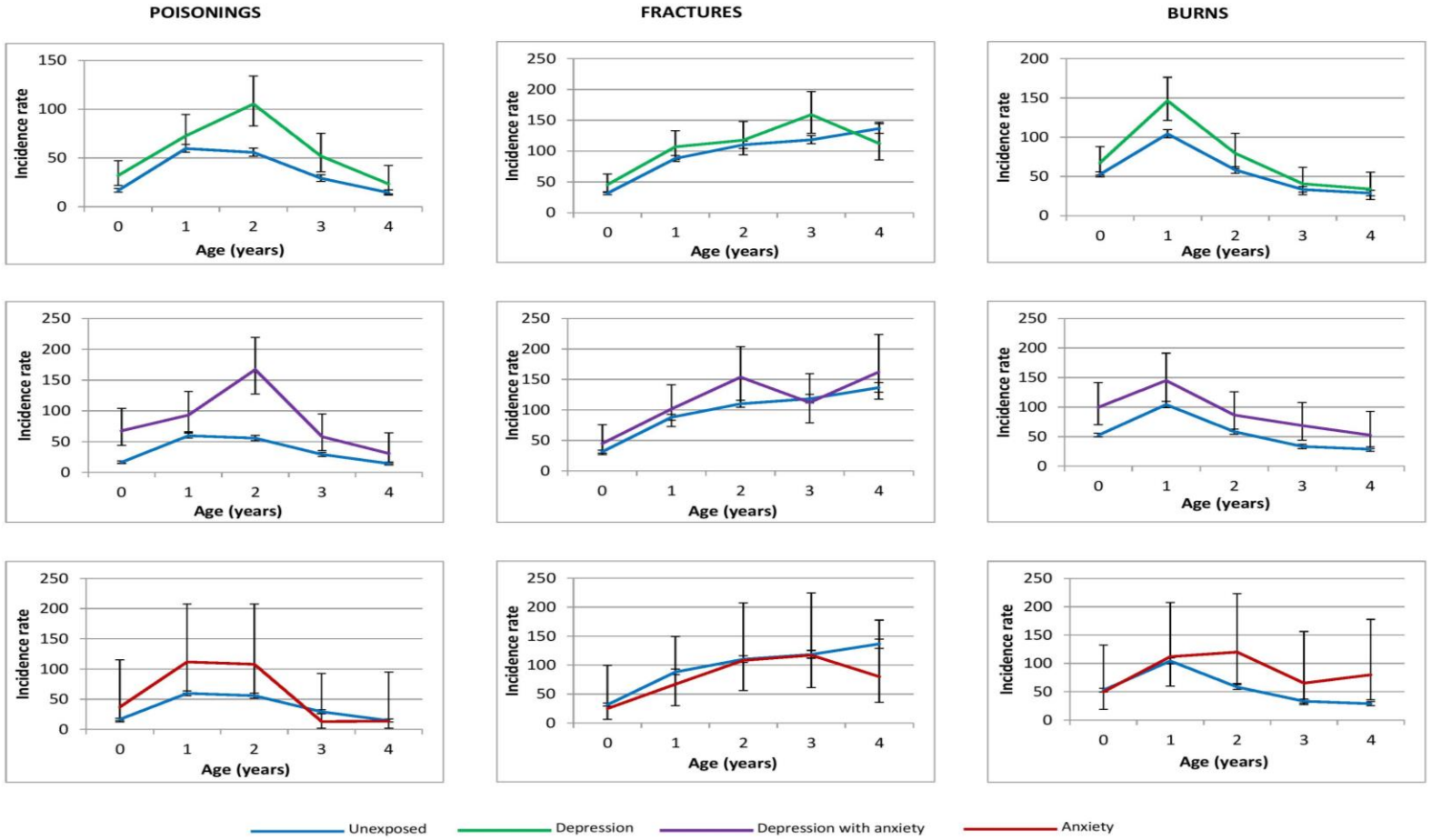
Table 7-2: Unadjusted and adjusted incidence rate ratios for the association between maternal depression/anxiety episodes and child injuries

		Number of incident events	Person-years	Crude incidence rate per 10,000 PY (95%CI)	Unadjusted IRR (95% CI)	Adjusted IRR # (95% CI)	*p* value*
POISONINGS	Unexposed	2,276	635,195	35.8 (34.4-37.3)	1	1	<0.0001
	Depression	186	32,127	57.9 (50.1-66.8)	**1.62 (1.39-1.88)**	**1.52 (1.31-1.76)**	
	Depression with anxiety	128	14,727	86.9 (73.1-103.4)	**2.43 (2.03-2.90)**	**2.30 (1.93-2.75)**	
	Anxiety	24	4,053	59.2 (39.7-88.3)	**1.65 (1.11-2.47)**	**1.63 (1.09-2.43)**	
FRACTURES	Unexposed	5,560	635,195	87.5 (85.3-89.9)	1	1	0.005
	Depression	331	32,127	103.0 (92.5-114.7)	**1.18 (1.05-1.32)**	**1.15 (1.03-1.28)**	
	Depression with anxiety	165	14,727	112.0 (96.2-130.5)	**1.28 (1.10-1.49)**	**1.24 (1.06-1.44)**	
	Anxiety	32	4,053	79.0 (55.8-111.6)	0.90 (0.64-1.28)	0.87 (0.61-1.23)	
BURNS	Unexposed	3,773	635,195	59.4 (57.5-61.3)	1	1	<0.0001
	Depression	254	32,127	79.0 (69.9-89.4)	**1.33 (1.17-1.51)**	**1.31 (1.15-1.48)**	
	Depression with anxiety	139	14,727	94.4 (79.9-111.4)	**1.59 (1.34-1.88)**	**1.53 (1.29-1.81)**	
	Anxiety	35	4,053	86.4 (62.0-120.3)	**1.45 (1.04-2.03)**	**1.47 (1.05-2.05)**	
SERIOUS INJURIES	Unexposed	837	635,195	13.2 (12.3-14.1)	1	1	0.47
	Depression	54	32,127	16.8 (12.9-21.9)	1.28 (0.97-1.68)	1.25 (0.95-1.65)	
	Depression with anxiety	19	14,727	12.9 (8.2-20.2)	0.98 (0.62-1.54)	0.95 (0.60-1.50)	
	Anxiety	5	4,053	12.3 (5.1-29.6)	0.94 (0.39-2.26)	0.95 (0.39-2.29)	

 # adjusted for a priori confounders, calendar year, region and socioeconomic deprivation. None of the other potential confounders led to a ≥10% change in the incidence rate ratio when added to the model.

**likelihood ratio test*

Figure 7-3: Incidence rates of child poisonings, fractures and burns (per 10,000 PY) according to child age and exposure to episodes of maternal depression/anxiety



Incidence rates shown are per 10,000 person-years

7.3.2.2 Adjusted incidence rate ratios for the association between maternal depression/anxiety and child injuries

Potential confounders were examined by adding each variable into the Poisson regression model and assessing whether there was a change in the incidence rate ratio of 10% or more. None of the potential confounders available within linked CPRD and HES data led to a change in the incidence rate ratio of 10% or more (results shown in Appendix 13) and so Table 7-2 shows the final model adjusted for *a priori* confounders.

Maternal depression/anxiety episodes were significantly associated with child poisonings ($p<0.0001$), fractures ($p=0.005$) and burns ($p<0.0001$), but not with serious injuries ($p=0.47$). The strongest association was seen for child poisonings. After adjustment for calendar year, region and socioeconomic deprivation, children had a 52% higher poisoning rate during episodes of maternal depression (aIRR 1.52, 95%CI 1.31-1.76), a two-fold higher poisoning rate during episodes of depression with anxiety (aIRR 2.30, 95%CI 1.93-2.75) and a 63% higher poisoning rate during episodes of anxiety (aIRR 1.63, 95%CI 1.09-2.43) compared to unexposed periods. Similarly, rates of burns and fractures were greatest during episodes of maternal depression with anxiety, with burn rates 53% higher (aIRR 1.53, 95%CI 1.29-1.81) and fracture rates 24% higher (aIRR 1.24, 95%CI 1.06-1.44) compared to unexposed periods. Incidence rates of serious injuries were highest during episodes of maternal depression, but this association was not significant in the adjusted model (aIRR 1.25, 95%CI 0.95-1.65).

There were no significant interactions between exposure to maternal depression/anxiety episodes and socioeconomic deprivation (poisonings $p=0.91$, fractures $p=0.70$, burns $p=0.18$, serious injuries $p=0.37$).

7.3.2.3 Adjusted incidence rate ratios for the association between maternal depression/anxiety and child injuries: detailed time periods

Table 7-3, Table 7-4 and Table 7-5 show crude incidence rates, unadjusted and adjusted incidence rate ratios for child poisonings, fractures and burns during episodes of maternal depression/anxiety when additional time periods before and after the episode were used. Numbers of serious child injuries were too small to enable use of detailed time-windows, and so are not displayed.

7.3.2.3.1 Poisonings

During episodes of depression alone, rates of poisonings (aIRR 1.56, 95%CI 1.33-1.83) were only significantly elevated compared to unexposed periods when the mother was prescribed medication (Table 7-3). Comparatively, for episodes of depression with anxiety, rates of child poisonings were elevated during periods when the mother was depressed and anxious but not prescribed medication (aIRR 3.32, 95%CI 2.30-4.79), prescribed medication (aIRR 2.16, 95%CI 1.76-2.64) and in the 60 day time-window after their last depression/anxiety record (aIRR 2.61, 95%CI 1.44-4.71). Rates of child poisonings were 2 fold-higher compared to unexposed periods in the 60 days before mothers were diagnosed with anxiety (aIRR 2.22, 95%CI 1.36-3.63).

7.3.2.3.2 Fractures

Fracture rates were 14% higher than unexposed periods when the mother had depression and was prescribed medication (aIRR 1.14, 95%CI 1.01-1.29) (Table 7-4). Similarly, rates of fractures were only significantly elevated compared to unexposed periods during episodes of depression with anxiety when the mother was prescribed medication (aIRR 1.25, 95%CI 1.06-1.48). In all other exposure periods, 95% confidence intervals included 1.

7.3.2.3.3 Burns

Rates of child burns were elevated compared to unexposed periods during depression episodes when the mother was prescribed medication (aIRR 1.27, 95%CI 1.11-1.46) and during depression episodes when medication was not prescribed (aIRR 1.53, 95%CI 1.13-2.08), but not during the 60 days before or after the episode (Table 7-5). Similarly, for episodes of depression with anxiety, rates of burns were highest during periods when mothers were not prescribed medication, with children having a two-fold increased rate of burns (aIRR 2.06, 95%CI 1.44-2.95). There was an increased rate of burns in the 60 days after the last record for an episode of depression with anxiety compared to the 'unexposed' period (aIRR 1.99, 95%CI 1.18-3.37). Rates of burns were only elevated compared to 'unexposed' periods during anxiety episodes when mothers were on medication (aIRR 1.52, 95%CI 1.01-2.26).

Table 7-3: Unadjusted and adjusted incidence rate ratios for the association between maternal depression/anxiety episodes and child poisonings

	Exposure*	Poisoning events	Person-years of follow-up	Crude incidence rate (95%CI)	Unadjusted incidence rate ratio (95%CI)	Adjusted incidence rate ratio# (95%CI)
UNEXPOSED	**Time where no records for anxiety or depression in the medical record**	2162	614,854	35.2 (33.7-36.7)	Reference	Reference
DEPRESSION	**60 days pre-exposure period**	38	7,432	51.1 (37.2-70.3)	**1.45 (1.06-2.00)**	1.33 (0.97-1.83)
	Episode: Diagnostic/symptom codes	24	4,322	55.5 (37.2-82.8)	**1.58 (1.06-2.36)**	1.45 (0.97-2.17)
	Episode: On medication	162	27,803	58.3 (50.0-68.0)	**1.66 (1.41-1.94)**	**1.56 (1.33-1.83)**
	60 days post-exposure period	31	6,548	47.3 (33.3-67.3)	1.35 (0.94-1.92)	1.23 (0.87-1.76)
DEPRESSION WITH ANXIETY	**60 days pre-exposure period**	9	1,386	64.9 (33.8-124.8)	1.85 (0.96-3.55)	1.70 (0.89-3.28)
	Episode: Diagnostic/symptom codes	29	2,306	125.7 (87.4-181.0)	**3.58 (2.48-5.16)**	**3.32 (2.30-4.79)**
	Episode: On medication	99	12,421	79.7 (65.5-97.1)	**2.27 (1.85-2.77)**	**2.16 (1.76-2.64)**
	60 days post-exposure period	11	1,121	98.1 (54.3-177.2)	**2.79 (1.54-5.05)**	**2.61 (1.44-4.71)**
ANXIETY	**60 days pre-exposure period**	16	2,004	79.8 (48.9-130.3)	**2.27 (1.39-3.71)**	**2.22 (1.36-3.63)**
	Episode: Diagnostic/symptom codes	9	1,329	67.7 (35.2-130.2)	1.93 (1.00-3.71)	1.89 (0.98-3.64)
	Episode: On medication	15	2,722	55.1 (33.2-91.4)	1.57 (0.94-2.60)	1.54 (0.93-2.56)
	60 days post-exposure period	9	1,855	48.5 (25.2-93.2)	1.38 (0.72-2.66)	1.36 (0.70-2.61)

 # adjusted for a priori confounders, calendar year, region and socioeconomic deprivation. None of the other potential confounders led to a ≥10% change in the incidence rate ratio when added to the model.

**Pre- and post- exposure periods of 60 days before and after the episode, respectively, to take account of time mothers may develop symptoms prior to presenting to doctor, or have ongoing symptoms afterwards. Episodes of depression/anxiety were divided into periods where mothers were prescribed antidepressant/anxiolytic medication and when they were not.*

Table 7-4: Unadjusted and adjusted incidence rate ratios for the association between maternal depression/anxiety episodes and child fractures

	Exposure*	Fracture events	Person-years of follow-up	Crude incidence rate (95%CI)	Unadjusted incidence rate ratio (95%CI)	Adjusted incidence rate ratio# (95%CI)
UNEXPOSED	**Time where no records for anxiety or depression in the medical record**	5365	614,854	87.3 (85.0-89.6)	1	1
DEPRESSION	**60 days pre-exposure period**	74	7,432	99.6 (79.3-125.0)	1.14 (0.91-1.44)	1.13 (0.90-1.42)
	Episode: Diagnostic/symptom codes	46	4,322	106.4 (79.7-142.1)	1.22 (0.91-1.63)	1.20 (0.90-1.60)
	Episode: On medication	285	27,803	102.5 (91.3-115.1)	**1.17 (1.04-1.32)**	**1.14 (1.01-1.29)**
	60 days post-exposure period	69	6,548	105.4 (83.2-133.4)	1.21 (0.95-1.53)	1.19 (0.94-1.50)
DEPRESSION WITH ANXIETY	**60 days pre-exposure period**	11	1,386	79.4 (43.9-143.3)	0.91 (0.50-1.64)	0.90 (0.50-1.62)
	Episode: Diagnostic/symptom codes	24	2,306	104.1 (69.8-155.3)	1.19 (0.80-1.78)	1.16 (0.78-1.74)
	Episode: On medication	141	12,421	113.5 (96.2-133.9)	**1.30 (1.10-1.54)**	**1.25 (1.06-1.48)**
	60 days post-exposure period	9	1,121	80.3 (41.8-154.3)	0.92 (0.48-1.77)	0.89 (0.46-1.72)
ANXIETY	**60 days pre-exposure period**	14	2,004	69.9 (41.4-118.0)	0.80 (0.47-1.35)	0.78 (0.46-1.32)
	Episode: Diagnostic/symptom codes	9	1,329	67.7 (35.2-130.2)	0.78 (0.40-1.49)	0.76 (0.40-1.46)
	Episode: On medication	23	2,722	84.5 (56.1-127.2)	0.97 (0.64-1.46)	0.92 (0.61-1.39)
	60 days post-exposure period	18	1,855	97.0 (61.1-154.0)	1.11 (0.70-1.77)	1.08 (0.68-1.72)

 # adjusted for a priori confounders, calendar year, region and socioeconomic deprivation. None of the other potential confounders led to a ≥10% change in the incidence rate ratio when added to the model.

**Pre- and post- exposure periods of 60 days before and after the episode, respectively, to take account of time mothers may develop symptoms prior to presenting to doctor, or have ongoing symptoms afterwards. Episodes of depression/anxiety were divided into periods where mothers were prescribed antidepressant/anxiolytic medication and when they were not.*

Table 7-5: Unadjusted and adjusted incidence rate ratios for the association between maternal depression and/or anxiety episodes and child burns

	Exposure*	Burn events	Person-years of follow-up	Crude incidence rate (95%CI)	Unadjusted incidence rate ratio (95%CI)	Adjusted incidence rate ratio# (95%CI)
UNEXPOSED	**Time where no records for anxiety or depression in the medical record**	3,641	614,854	59.2 (57.3-61.2)	1	1
DEPRESSION	**60 days pre-exposure period**	45	7,432	60.5 (45.2-81.1)	1.02 (0.76-1.37)	0.97 (0.72-1.30)
	Episode: Diagnostic/symptom codes	41	4,322	94.9 (69.8-128.8)	**1.60 (1.18-2.18)**	**1.53 (1.13-2.08)**
	Episode: On medication	213	27,803	76.6 (67.0-87.6)	**1.29 (1.13-1.49)**	**1.27 (1.11-1.46)**
	60 days post-exposure period	42	6,548	64.1 (47.4-86.8)	1.08 (0.80-1.47)	1.03 (0.76-1.40)
DEPRESSION WITH ANXIETY	**60 days pre-exposure period**	12	1,386	86.6 (49.2-152.4)	1.46 (0.83-2.58)	1.36 (0.77-2.39)
	Episode: Diagnostic/symptom codes	30	2,306	130.1 (91.0-186.1)	**2.20 (1.53-3.15)**	**2.06 (1.44-2.95)**
	Episode: On medication	109	12,421	87.8 (72.7-105.9)	**1.48 (1.22-1.79)**	**1.43 (1.18-1.73)**
	60 days post-exposure period	14	1,121	124.9 (74.0-210.9)	**2.11 (1.25-3.56)**	**1.99 (1.18-3.37)**
ANXIETY	**60 days pre-exposure period**	10	2,004	49.9 (26.8-92.7)	0.84 (0.45-1.57)	0.83 (0.45-1.55)
	Episode: Diagnostic/symptom codes	11	1,329	82.8 (45.8-149.5)	1.40 (0.77-2.53)	1.38 (0.76-2.50)
	Episode: On medication	24	2,722	88.2 (59.1-131.5)	1.49 (1.00-2.22)	**1.52 (1.01-2.26)**
	60 days post-exposure period	9	1,855	48.5 (25.2-93.2)	0.82 (0.43-1.58)	0.81 (0.42-1.57)

 # adjusted for a priori confounders, calendar year, region and socioeconomic deprivation. None of the other potential confounders led to a ≥10% change in the incidence rate ratio when added to the model.

**Pre- and post- exposure periods of 60 days before and after the episode, respectively, to take account of time mothers may develop symptoms prior to presenting to doctor, or have ongoing symptoms afterwards. Episodes of depression/anxiety were divided into periods where mothers were prescribed antidepressant/anxiolytic medication and when they were not.*

7.3.2.4 Sensitivity analyses

Table 7-6 shows the results of five sensitivity analyses.

- **Doubling the time-windows used to define incident injury events.** Doubling the time-windows used to define incident injury events reduced the number of incident poisoning, fracture and burn events identified but did not notably change adjusted incidence rate ratios for any of the three injury types (Table 7-6).
- **Changing the time-window to define episodes of depression/anxiety.** Extending the time-window used to define continuous periods of maternal depression/anxiety from six to 12 months increased the median duration of exposure (for those children exposed) from 152 days (IQR 30-463) to 185 days (IQR 30-552). Extending this time-window led to small changes in the magnitude of adjusted incidence rate ratios for poisonings, fractures and burns. In this sensitivity analysis, there was a 39% higher rate of serious injuries during episodes of maternal depression compared to unexposed periods (aIRR 1.39, 95%CI 1.08-1.80), which had not been significant in the primary analysis (aIRR 1.25, 95%CI 0.95-1.65).
- **Exclusion of symptom and clinical review codes for depression/anxiety.** Excluding symptom and clinical review codes for depression and anxiety generally reduced the magnitude of association between episodes of depression with anxiety and injury; and conversely increased the magnitude of association between anxiety episodes and child injury. The association between episodes of depression with anxiety and child fractures was no longer significant in the sensitivity analysis (aIRR 1.10, 95%CI 0.91-1.33), with the 95% confidence interval including 1.
- **Excluding mothers with serious mental illnesses.** Of the 219 mothers diagnosed with a serious mental illness, 185 (84.5%) had one or more depression/anxiety episode during the child's follow-up time. Exclusion of these 219 mother-child pairs led to no notable changes in the adjusted incidence rate ratios for the association between maternal depression/anxiety and any of the four injury outcomes.
- **Excluding likely intentional injuries.** The exclusion of 15 poisonings, 62 fractures, 33 burns and 48 serious injuries that were identified as likely intentional injuries led to no notable changes in the estimated incidence rate ratios.

Table 7-6: Sensitivity analyses, cohort analysis of the association between maternal depression/anxiety episodes and child injuries

			Primary analysis (n=207,048)	Doubling time-window to define incident injuries (n=207,048)	Doubling time-window depression/ anxiety episodes (n=207,048)	Excluding symptom codes for depression/ anxiety (n=207,048)	Excluding mothers with serious mental illnesses (n=206,829)	Excluding likely intentional injuries (n=207,048)
POISONINGS	**Number of incident poisonings**		2,614	2,606	2,614	2,614	2,611	2,599
	aIRR # (95%CI)	**Unexposed**	1	1	1	1	1	1
		Depression	1.52 (1.31-1.76)	1.52 (1.31-1.77)	1.55 (1.33-1.79)	1.54 (1.33-1.78)	1.51 (1.30-1.76)	1.49 (1.28-1.74)
		Depression+Anxiety	2.30 (1.93-2.75)	2.29 (1.92-2.74)	2.37 (2.03-2.76)	2.27 (1.85-2.79)	2.28 (1.91-2.73)	2.32 (1.94-2.77)
		Anxiety	1.63 (1.09-2.43)	1.63 (1.09-2.44)	1.67 (1.12-2.47)	**2.04 (1.46-2.87)**	1.63 (1.09-2.44)	1.57 (1.04-2.36)
FRACTURES	**Number of incident fractures**		6,088	5,994	6,088	6,088	6,085	6,026
	aIRR # (95%CI)	**Unexposed**	1	1	1	1	1	1
		Depression	1.15 (1.03-1.28)	1.14 (1.02-1.27)	1.19 (1.07-1.33)	1.16 (1.04-1.29)	1.15 (1.03-1.28)	1.14 (1.02-1.28)
		Depression+Anxiety	1.24 (1.06-1.44)	1.23 (1.05-1.44)	1.20 (1.05-1.37)	**1.10 (0.91-1.33)**	1.25 (1.07-1.45)	1.23 (1.05-1.43)
		Anxiety	0.87 (0.61-1.23)	0.91 (0.64-1.28)	0.97 (0.71-1.35)	**1.19 (0.90-1.57)**	0.84 (0.59-1.20)	0.87 (0.62-1.24)
BURNS	**Number of incident burns**		4,201	4,178	4,201	4,201	4,196	4,168
	aIRR # (95%CI)	**Unexposed**	1	1	1	1	1	1
		Depression	1.31 (1.15-1.48)	1.31 (1.16-1.49)	1.28 (1.13-1.45)	1.31 (1.15-1.48)	1.31 (1.16-1.49)	1.28 (1.13-1.46)
		Depression+Anxiety	1.53 (1.29-1.81)	1.52 (1.29-1.81)	1.60 (1.38-1.84)	1.53 (1.26-1.86)	1.51 (1.28-1.80)	1.52 (1.29-1.81)
		Anxiety	1.47 (1.05-2.05)	1.48 (1.06-2.06)	1.60 (1.16-2.19)	1.51 (1.11-2.05)	1.47 (1.05-2.05)	1.39 (0.99-1.96)
SERIOUS INJURIES	**Number of serious injuries**		915	N/A	915	915	913	867
	aIRR # (95%CI)	**Unexposed**	1		1	1	1	1
		Depression	1.25 (0.95-1.65)		**1.39 (1.08-1.80)**	1.20 (0.91-1.59)	1.26 (0.96-1.67)	1.30 (0.99-1.72)
		Depression+Anxiety	0.95 (0.60-1.50)		**1.15 (0.81-1.65)**	**0.86 (0.50-1.49)**	0.96 (0.61-1.51)	0.90 (0.56-1.46)
		Anxiety	0.95 (0.39-2.29)		0.93 (0.39-2.24)	**1.49 (0.77-2.88)**	0.95 (0.40-2.30)	**0.80 (0.30-2.14)**

 # Adjusted incidence rate ratio (IRR), adjusted for a priori confounders, calendar year, region and socioeconomic deprivation. Adjusted IRR highlighted in bold have changed by ≥10% from the primary analysis

7.3.3 Self-controlled case-series analysis

7.3.3.1 Study population

For each of the SCCS analyses, the study populations consisted of the children who had sustained the injury outcome of interest (Table 7-7). There were 2,502 children who had sustained one or more poisoning, 5,836 children who had sustained one or more fracture, 4,051 children who had sustained one or more burn, and 909 children who had sustained a serious injury. A greater proportion of those who had sustained an injury were male, with the greatest proportion seen for burns and serious injuries where 57% of the children were male. For poisonings, fractures and burns, most children sustained one injury of that type, with only 3-4% of children having repeated injury occurrences of the same type.

Of the 2,502 children who had sustained a poisoning, 1,083 (43.2%) were exposed to one or more episodes of maternal depression/anxiety during their follow-up time, and therefore contributed to the SCCS analysis. This was a higher proportion compared to the fracture, burn and serious injury study populations, where 1,970 (33.8%), 1,501 (37.1%) and 320 (35.2%) children were exposed to maternal depression/anxiety, respectively. Children who had sustained an injury but had not been exposed to maternal depression/anxiety were retained within the study populations as they provided data on the patterns of the injuries by age and calendar year.

Table 7-7: Characteristics of the study populations for poisoning, fracture, burn and serious injury self-controlled case series analyses

	Poisonings	Fractures	Burns	Serious injuries[#]
Number of children with injury outcome	2,502	5,836	4,051	909
Males (%)	1,305 (52.2)	3,135 (53.7)	2,327 (57.4)	522 (57.4)
Socioeconomic deprivation, IMD 2010				
Quintile 1	413 (16.5)	1,351 (23.2)	778 (19.2)	162 (17.8)
Quintile 2	460 (18.4)	1,251 (21.4)	763 (18.8)	163 (17.9)
Quintile 3	610 (24.4)	1,114 (19.1)	798 (19.7)	201 (22.1)
Quintile 4	565 (22.6)	1,124 (19.3)	842 (20.8)	183 (20.1)
Quintile 5	450 (18.0)	989 (17.0)	865 (21.4)	197 (21.7)
Missing	4 (0.2)	7 (0.1)	5 (0.1)	3 (0.3)
Median age in months at first injury event (IQR)	23.5 (15.8-32.6)	31.4 (19.8-45.2)	18.2 (11.9-28.8)	17.3 (9.0-28.1)
Number of injury events per child				
1	2,399 (95.9)	5,605 (96.0)	3,912 (96.6)	906 (99.7)
2	96 (3.8)	216 (3.7)	128 (3.2)	1 (0.1)
≥3	7 (0.3)	15 (0.3)	11 (0.3)	2 (0.2)
Number of maternal depression/anxiety episodes per child, between birth and end of follow-up				
0	1,419 (56.7)	3,866 (66.2)	2,550 (63.0)	589 (64.8)
1	675 (27.0)	1,292 (22.1)	956 (23.6)	212 (23.3)
2	290 (11.6)	498 (8.5)	397 (9.8)	82 (9.0)
≥3	118 (4.7)	180 (3.1)	148 (3.6)	26 (2.9)
Median age in months at first exposure to maternal depression/anxiety (IQR)	9.4 (2.9-24.9)	11.3 (3.6-29.7)	10.9 (3.3-25.4)	11.1 (3.3-25.4)

 # Serious injuries were hospitalised injuries, which were likely to always lead to hospitalisation (defined by ICD-10 codes).

7.3.3.2 Injury rates during episodes of depression/anxiety compared to unexposed periods

Table 7-8 shows unadjusted and adjusted incidence rate ratios for the occurrence of child poisonings, fractures, burns and serious injuries during periods of exposure to maternal depression/anxiety compared to unexposed periods.

Following adjustment for child age and calendar year, the incidence of child poisonings was 48% higher during episodes of maternal depression compared to unexposed periods (aIRR 1.48, 95%CI 1.19-1.85). Similarly, incidence rates of child burns were only significantly elevated during episodes of maternal depression, with children having a 29% higher incidence rate compared to unexposed periods (aIRR 1.29, 95%CI 1.07-1.55). For both episodes of depression with anxiety and anxiety alone, rates of poisonings and burns were elevated compared to unexposed periods, but the 95% confidence intervals included 1.

Incidence rates of child fractures were higher compared to unexposed periods during episodes of maternal depression (aIRR 1.06, 95%CI 0.89-1.24) and depression with anxiety (aIRR 1.10, 95%CI 0.82-1.47), but were lower during episodes of anxiety alone (aIRR 0.75, 95%CI 0.47-1.19). In each case, 95% confidence intervals included 1 and so there may be no true difference in fracture rates compared to the unexposed periods. A similar pattern was seen for serious injuries, with all 95% confidence intervals including 1.

There were no significant interactions between episodes of maternal depression/anxiety and socioeconomic deprivation for any of the four injury outcomes (poisonings p=0.93, fractures p=0.02, burns p=0.48, serious injuries p=0.1).

Table 7-8: Self-controlled case series analysis, unadjusted and adjusted incidence rate ratios for the association between maternal depression/anxiety episodes and child injuries

		Number of incident events	Person-years	Unadjusted incidence rate ratio (95% CI)	Adjusted incidence rate ratio # (95% CI)
POISONINGS	Unexposed	2,276	9,546.6	1	1
	Depression	186	649.3	**1.44 (1.17-1.77)**	**1.48 (1.19-1.85)**
	Depression with anxiety	128	473.4	1.39 (0.99-1.93)	1.23 (0.86-1.77)
	Anxiety	24	95.8	1.05 (0.62-1.78)	1.03 (0.60-1.78)
FRACTURES	Unexposed	5,558	23,894.5	1	1
	Depression	332	1,287.7	1.11 (0.95-1.30)	1.06 (0.89-1.24)
	Depression with anxiety	165	645.2	1.24 (0.94-1.62)	1.10 (0.82-1.47)
	Anxiety	32	153.2	0.89 (0.58-1.39)	0.75 (0.47-1.19)
BURNS	Unexposed	3,773	15,319.3	1	1
	Depression	254	887.9	**1.36 (1.14-1.63)**	**1.29 (1.07-1.55)**
	Depression with anxiety	139	539.4	1.22 (0.91-1.63)	1.22 (0.90-1.65)
	Anxiety	35	131.2	1.22 (0.79-1.88)	1.36 (0.88-2.11)
SERIOUS INJURIES	Unexposed	837	3365.9	1	1
	Depression	54	199.2	1.01 (0.68-1.51)	1.01 (0.67-1.52)
	Depression with anxiety	19	79.6	0.99 (0.48-2.02)	1.15 (0.55-2.38)
	Anxiety	5	27.4	0.63 (0.18-2.22)	0.68 (0.18-2.61)

 # The adjusted IRR gives the relative rate of injury during periods of maternal depression/anxiety compared to unexposed periods where the mother had no records for depression/anxiety. All estimates are self-controlled, and adjusted for child age (in 3 month age bands) and calendar year (in 1 year periods)

7.3.3.3 Injury occurrences during episodes of depression/anxiety: detailed time-windows

Table 7-9, Table 7-10 and Table 7-11 show adjusted incidence rate ratios for the occurrences of poisonings, fractures and burns during episodes of maternal depression/anxiety when more detailed time-windows around the depression/anxiety episodes were used. Data are not presented for serious child injuries, as numbers of injury events were too small in a number of the exposure windows.

For both episodes of depression and depression with anxiety, most of the person-time was explained by time that mothers were prescribed medications (e.g. of the 649.3 person-years when mothers were classified as being depressed, 561.3 (86.4%) person-years were when mothers were prescribed medications).

7.3.3.3.1 Child poisonings

When using detailed time periods, the increased rate of child poisonings during episodes of maternal depression was principally explained by an elevated poisoning rate during periods when the mother was taking medications (aIRR 1.56, 95%CI 1.22-1.98) (Table 7-9).

7.3.3.3.2 Child fractures

There were no significant associations between episodes of maternal depression/anxiety and the incidence of child fractures, with all 95% confidence intervals including 1 (Table 7-10).

7.3.3.3.3 Child burns

Rates of child burns were higher than unexposed periods (95% confidence intervals did not include 1) during episodes of maternal depression when the mother was on medication (aIRR 1.25, 95%CI 1.02-1.53) (Table 7-11).

Table 7-9: Self-controlled case-series analysis assessing child poisoning rates during periods of maternal depression and/or anxiety

	Exposure*	Poisoning events	Person-years of follow-up	Unadjusted incidence rate ratio (95%CI)	Adjusted incidence rate ratio# (95%CI)
UNEXPOSED	**Baseline time where no records for anxiety or depression in the medical record**	2162	9084.0	Reference	Reference
DEPRESSION	**60 days pre-exposure period**	38	157.5	1.07 (0.77-1.50)	1.23 (0.88-1.72)
	Episode: Diagnostic/symptom codes	24	88.0	1.26 (0.81-1.94)	1.34 (0.86-2.08)
	Episode: On medication	162	561.3	**1.50 (1.19-1.88)**	**1.56 (1.22-1.98)**
	60 days post-exposure period	31	143.2	0.95 (0.66-1.38)	0.96 (0.66-1.39)
DEPRESSION WITH ANXIETY	**60 days pre-exposure period**	9	37.8	1.19 (0.60-2.37)	1.29 (0.65-2.59)
	Episode: Diagnostic/symptom codes	29	91.5	**1.76 (1.10-2.83)**	1.64 (1.00-2.70)
	Episode: On medication	99	381.9	1.37 (0.95-1.99)	1.22 (0.81-1.82)
	60 days post-exposure period	11	33.7	1.58 (0.84-2.96)	1.40 (0.74-2.65)
ANXIETY	**60 days pre-exposure period**	16	47.7	1.45 (0.87-2.43)	1.51 (0.89-2.54)
	Episode: Diagnostic/symptom codes	9	32.4	1.20 (0.60-2.40)	1.09 (0.54-2.20)
	Episode: On medication	15	63.4	0.99 (0.48-2.06)	1.06 (0.49-2.33)
	60 days post-exposure period	9	42.8	0.90 (0.46-1.76)	0.88 (0.45-1.74)

 # The adjusted IRR gives the relative rate of injury during periods of maternal depression/anxiety compared to unexposed periods where the mother had no records for depression/anxiety. All estimates are self-controlled, and adjusted for child age (in 3 month age bands) and calendar year (in 1 year periods)

**Pre- and post- exposure periods of 60 days before and after the episode, respectively, to take account of time mothers may develop symptoms prior to presenting to doctor, or have ongoing symptoms afterwards. Episodes of depression/anxiety were divided into periods where mothers were prescribed antidepressant/anxiolytic medication and when they were not.*

Table 7-10: Self-controlled case-series analysis assessing child fracture rates during periods of maternal depression and/or anxiety

	Exposure*	Fracture events	Person-years of follow-up	Unadjusted incidence rate ratio (95%CI)	Adjusted incidence rate ratio# (95%CI)
UNEXPOSED	**Baseline time where no records for anxiety or depression in the medical record**	5363	23084.5	Reference	Reference
DEPRESSION	**60 days pre-exposure period**	74	295.7	1.04 (0.81-1.32)	1.24 (0.97-1.58)
	Episode: Diagnostic/symptom codes	47	169.5	1.19 (0.87-1.64)	1.24 (0.89-1.71)
	Episode: On medication	285	1118.2	1.11 (0.93-1.31)	1.06 (0.89-1.27)
	60 days post-exposure period	69	265.9	1.08 (0.84-1.38)	1.13 (0.88-1.46)
DEPRESSION WITH ANXIETY	**60 days pre-exposure period**	11	55.3	0.86 (0.47-1.59)	1.03 (0.56-1.91)
	Episode: Diagnostic/symptom codes	24	95.6	1.16 (0.73-1.83)	1.12 (0.70-1.79)
	Episode: On medication	141	549.6	1.23 (0.92-1.65)	1.09 (0.80-1.49)
	60 days post-exposure period	9	44.6	0.87 (0.45-1.71)	0.83 (0.42-1.63)
ANXIETY	**60 days pre-exposure period**	14	77.8	0.77 (0.45-1.31)	0.75 (0.44-1.29)
	Episode: Diagnostic/symptom codes	9	51.1	0.74 (0.37-1.46)	0.70 (0.35-1.39)
	Episode: On medication	23	102.1	1.00 (0.58-1.74)	0.77 (0.43-1.39)
	60 days post-exposure period	18	70.6	1.07 (0.66-1.72)	1.01 (0.63-1.64)

 # The adjusted IRR gives the relative rate of injury during periods of maternal depression/anxiety compared to unexposed periods where the mother had no records for depression/anxiety. All estimates are self-controlled, and adjusted for child age (in 3 month age bands) and calendar year (in 1 year periods)

**Pre- and post- exposure periods of 60 days before and after the episode, respectively, to take account of time mothers may develop symptoms prior to presenting to doctor, or have ongoing symptoms afterwards. Episodes of depression/anxiety were divided into periods where mothers were prescribed antidepressant/anxiolytic medication and when they were not.*

Table 7-11: Self-controlled case-series analysis assessing child burn rates during periods of maternal depression and/or anxiety

	Exposure*	Burn events	Person-years of follow-up	Unadjusted incidence rate ratio (95%CI)	Adjusted incidence rate ratio# (95%CI)
UNEXPOSED	**Baseline time where no records for anxiety or depression in the medical record**	3641	14692.8	Reference	Reference
DEPRESSION	**60 days pre-exposure period**	45	216.9	0.85 (0.63-1.15)	0.87 (0.64-1.19)
	Episode: Diagnostic/symptom codes	41	134.9	1.32 (0.94-1.86)	1.24 (0.87-1.76)
	Episode: On medication	213	753.1	**1.33 (1.09-1.61)**	**1.25 (1.02-1.53)**
	60 days post-exposure period	42	196.4	0.87 (0.64-1.20)	0.79 (0.58-1.09)
DEPRESSION WITH ANXIETY	**60 days pre-exposure period**	12	49.8	1.05 (0.58-1.90)	1.09 (0.60-1.98)
	Episode: Diagnostic/symptom codes	30	89.9	1.55 (1.00-2.40)	1.55 (0.99-2.44)
	Episode: On medication	109	449.5	1.14 (0.82-1.57)	1.13 (0.81-1.59)
	60 days post-exposure period	14	43.3	1.35 (0.77-2.34)	1.25 (0.72-2.20)
ANXIETY	**60 days pre-exposure period**	10	62.1	0.65 (0.35-1.23)	0.66 (0.35-1.24)
	Episode: Diagnostic/symptom codes	11	44.2	1.00 (0.53-1.88)	1.03 (0.54-1.95)
	Episode: On medication	24	87.0	1.31 (0.75-2.29)	1.55 (0.88-2.74)
	60 days post-exposure period	9	58.0	0.61 (0.31-1.19)	0.64 (0.32-1.24)

 # The adjusted IRR gives the relative rate of injury during periods of maternal depression/anxiety compared to unexposed periods where the mother had no records for depression/anxiety. All estimates are self-controlled, and adjusted for child age (in 3 month age bands) and calendar year (in 1 year periods)

**Pre- and post- exposure periods of 60 days before and after the episode, respectively, to take account of time mothers may develop symptoms prior to presenting to doctor, or have ongoing symptoms afterwards. Episodes of depression/anxiety were divided into periods where mothers were prescribed antidepressant/anxiolytic medication and when they were not.*

7.3.3.4 Sensitivity analyses

Table 7-12 shows the results of sensitivity analyses for poisonings, fractures, burns and serious injuries for the SCCS method. Doubling the time-windows used to define incident injury events, the exclusion of mothers with serious mental illnesses, and the exclusion of likely intentional injuries had no notable impacts on the adjusted incidence rate ratios for any of the injury outcomes compared to the primary analyses.

Extending the time-window used to define episodes of depression/anxiety. Extending the time-window to 12 months to define continuous periods of maternal depression/anxiety had a greater impact. The poisoning rate during episodes of depression with anxiety increased from 23% higher in the primary analysis (aIRR 1.23, 95%CI 0.86-1.77) to 50% higher in the sensitivity analysis (aIRR 1.50, 95%CI 1.07-2.09), with 95% confidence intervals no longer including 1. The adjusted incidence rate ratio for burns during episodes of anxiety increased from 1.36 (95%CI 0.88-2.11) in the primary analysis to 1.90 (95%CI 1.23-2.93) in the sensitivity analysis.

Exclusion of symptom and clinical review codes for depression/anxiety.

The exclusion of symptom and clinical review codes for depression/anxiety generally reduced the magnitude of adjusted incidence rate ratios for depression and depression with anxiety episodes, but increased the magnitude of association between maternal anxiety episodes and child injuries. Despite these changes, the study conclusions were not altered from the primary analysis, with the only significant associations continuing to be between maternal depression episodes and child poisonings (aIRR 1.40, 95%CI 1.12-1.74) and burns (aIRR 1.27, 95%CI 1.05-1.53).

Table 7-12: Sensitivity analyses, self-controlled case series analysis assessing child injury rates during periods of maternal depression and/or anxiety

	Primary analysis	Sensitivity analyses					Testing assumptions of SCCS		
		Double time-windows define injury events	Double time-window define depression/ anxiety	Exclude symptom codes define dep/ anxiety	Exclude mothers with serious mental illnesses	Exclude intentional injuries	Exclude injuries that led to death	Excluding the 60 days pre-exposure	Restrict to first injury event per child
	aIRR# (95%CI)	aIRR# (95%CI)	aIRR# (95%CI)	aIRR# (95%CI)	aIRR# (95%CI)	aIRR# (95%CI)	aIRR# (95%CI)	aIRR# (95%CI)	aIRR# (95%CI)
POISONINGS									
Unexposed	1	1	1	1	1	1	No deaths in poisoning study population	1	1
Depression	1.48 (1.19-1.85)	1.48 (1.19-1.85)	1.55 (1.23-1.96)	1.40 (1.12-1.74)	1.47 (1.18-1.84)	1.47 (1.18-1.84)		1.52 (1.22-1.91)	1.52 (1.21-1.90)
Depression with anxiety	1.23 (0.86-1.77)	1.25 (0.87-1.80)	**1.50 (1.07-2.09)**	1.32 (0.87-1.99)	1.22 (0.85-1.75)	1.25 (0.87-1.79)		1.28 (0.89-1.83)	1.23 (0.85-1.77)
Anxiety	1.03 (0.60-1.78)	1.03 (0.60-1.78)	**0.85 (0.48-1.52)**	**1.31 (0.75-2.23)**	1.03 (0.60-1.78)	0.96 (0.55-1.68)		1.06 (0.62-1.84)	**1.13 (0.65-1.98)**
FRACTURES									
Unexposed	1	1	1	1	1	1	1	1	1
Depression	1.06 (0.89-1.24)	1.06 (0.90-1.25)	**1.17 (0.99-1.38)**	1.05 (0.89-1.24)	1.06 (0.89-1.25)	1.07 (0.91-1.27)	1.05 (0.89-1.24)	1.07 (0.90-1.26)	1.03 (0.87-1.22)
Depression with anxiety	1.10 (0.82-1.47)	1.12 (0.84-1.50)	1.00 (0.77-1.31)	**0.90 (0.64-1.27)**	1.11 (0.83-1.49)	1.08 (0.81-1.45)	1.10 (0.82-1.47)	1.11 (0.83-1.48)	1.12 (0.83-1.51)
Anxiety	0.75 (0.47-1.19)	0.81 (0.52-1.28)	**0.92 (0.59-1.42)**	**0.89 (0.58-1.38)**	0.72 (0.45-1.15)	0.76 (0.48-1.20)	0.75 (0.47-1.19)	0.76 (0.48-1.20)	0.78 (0.49-1.24)
BURNS									
Unexposed	1	1	1	1	1	1	1	1	1
Depression	1.29 (1.07-1.55)	1.30 (1.08-1.57)	1.25 (1.03-1.52)	1.27 (1.05-1.53)	1.29 (1.07-1.56)	1.29 (1.07-1.55)	1.29 (1.07-1.55)	1.27 (1.05-1.54)	1.30 (1.07-1.57)
Depression with anxiety	1.22 (0.90-1.65)	1.19 (0.88-1.62)	1.24 (0.93-1.64)	1.31 (0.92-1.86)	1.22 (0.90-1.65)	1.26 (0.93-1.71)	1.22 (0.90-1.65)	1.20 (0.89-1.63)	1.23 (0.91-1.66)
Anxiety	1.36 (0.88-2.11)	1.36 (0.88-2.11)	**1.90 (1.23-2.93)**	1.30 (0.83-2.04)	1.36 (0.87-2.11)	1.31 (0.84-2.04)	1.36 (0.88-2.11)	1.34 (0.86-2.08)	1.44 (0.92-2.24)
SERIOUS INJURIES									
Unexposed	1	Not applicable	1	1	1	1	1	1	1
Depression	1.01 (0.67-1.52)		**1.42 (0.95-2.13)**	1.05 (0.69-1.60)	1.01 (0.67-1.52)	**1.18 (0.78-1.79)**	0.97 (0.64-1.47)	1.04 (0.69-1.57)	1.04 (0.69-1.57)
Depression with anxiety	1.15 (0.55-2.38)		**0.98 (0.50-1.94)**	1.12 (0.46-2.74)	1.16 (0.56-2.40)	1.24 (0.57-2.68)	1.15 (0.55-2.38)	1.18 (0.57-2.46)	**0.92 (0.42-1.98)**
Anxiety	0.68 (0.18-2.61)		**1.13 (0.35-3.59)**	**1.14 (0.42-3.07)**	0.68 (0.18-2.60)	0.61 (0.14-2.56)	0.68 (0.18-2.61)	0.71 (0.19-2.68)	0.68 (0.18-2.61)

*# adjusted for child age (in 3 month bands) and calendar year (in 1 year bands). Numbers in **bold** indicate a change of 10% or more from the primary analysis*

7.3.3.5 Testing the assumptions of the SCCS method

Excluding injury events that led to death

One of the assumptions of the SCCS method is that the occurrence of the outcome does not change the probability of subsequent exposure. This assumption does not hold when a child dies from an injury as the child's follow-up will cease at the death date (meaning they cannot be exposed after death). During study follow-up none of the children in the poisoning study population died from an injury. Two children from the fracture study population, one child from the burns population, and six children from the serious injury population died following their injury. Exclusion of these children from the SCCS analyses led to no notable changes in the adjusted incidence rate ratios.

Excluding the 60 day period before exposure

Similarly, the assumption that the outcome does not affect the exposure may not be met in cases where a serious child injury leads the mother to develop symptoms of depression/anxiety. This was tested by excluding the 60 day period before the depression/anxiety episodes from the unexposed/baseline time. This did not lead to notable changes in the adjusted incidence rate ratios.

Restricting the number of injury events to one per child

An assumption of the SCCS method is that outcome events are independent of one another. Most of the study population only sustained one injury outcome, with about 3-4% of children in the poisoning, fracture and burn study populations having repeated injury events. Restricting the study to the first injury event (ceasing follow-up earlier in those with repeated injuries, and excluding 103 poisonings, 231 fractures and 139 burns) did not lead to any notable changes in the study findings compared to when multiple events per child were included in the analyses. The exclusion of repeated serious injuries (six events) led the adjusted incidence rate ratio during episodes of depression with anxiety to reduce from 1.15 (95%CI 0.55-2.38) in the primary analysis to 0.92 (95%CI 0.42-1.98).

7.3.4 Summary of study findings: comparing the results of the cohort and self-controlled case series analyses

Table 7-13 summarises the findings from the cohort and SCCS analyses for the four injury outcomes. Adjusted incidence rate ratios were generally smaller in magnitude in the SCCS analysis compared to the cohort analysis.

For child poisonings and burns, both the cohort and SCCS analyses demonstrated significantly higher injury rates during episodes of maternal depression compared to unexposed periods, with the magnitude of the association similar between the two methods. For example the adjusted incidence rate ratio for poisonings during episodes of depression was 1.52 (95%CI 1.31-1.77) in the cohort analysis, and 1.48 (95%CI 1.19-1.85) in the SCCS analysis. For burns, the adjusted incidence rate ratio during episodes of maternal depression compared to unexposed periods was 1.29 (95%CI 1.13-1.46) in the cohort analysis, and 1.29 (95%CI 1.07-1.55) in the SCCS.

In contrast however, significant associations between episodes of maternal depression with anxiety and child poisonings (aIRR 2.18, 95%CI 1.82-2.62) and burns (aIRR 1.53, 95%CI 1.29-1.82) in the cohort analysis were not seen in the SCCS analysis (95% confidence intervals included 1). Similarly, significant associations between episodes of maternal anxiety and child poisonings (aIRR 1.58, 95%CI 1.05-2.36) and burns (aIRR 1.48, 95%CI 1.06-2.06) in the cohort analysis were not seen in the SCCS analysis.

In the cohort analysis rates of child fractures were significantly higher during episodes of maternal depression (aIRR 1.15, 95%CI 1.03-1.28) and depression with anxiety (aIRR 1.24, 95%CI 1.06-1.44). In the SCCS analysis, rates of fractures were not significantly elevated during episodes of depression/anxiety, with 95% confidence intervals including 1. No significant associations between episodes of maternal depression/anxiety and serious child injuries were seen in either the cohort or the SCCS analysis.

Table 7-14 compares the findings of the cohort and SCCS analyses when detailed time periods were used. Adjusted incidence rate ratios were very similar between the cohort and SCCS analyses for depression episodes when mothers were prescribed medication for poisonings and burns.

Table 7-13: Summary of the cohort and self-controlled case series analyses unadjusted and adjusted incidence rate ratios

		Cohort analysis		Self-controlled case series analysis	
		Unadjusted incidence rate ratio (95% CI)	**Adjusted incidence rate ratio # (95% CI)**	**Unadjusted incidence rate ratio (95% CI)**	**Adjusted incidence rate ratio * (95% CI)**
POISONINGS	Unexposed	1	1	1	1
	Depression	**1.62 (1.39-1.88)**	**1.52 (1.31-1.76)**	**1.44 (1.17-1.77)**	**1.48 (1.19-1.85)**
	Depression with anxiety	**2.43 (2.03-2.90)**	**2.30 (1.93-2.75)**	1.39 (0.99-1.93)	1.23 (0.86-1.77)
	Anxiety	**1.65 (1.11-2.47)**	**1.63 (1.09-2.43)**	1.05 (0.62-1.78)	1.03 (0.60-1.78)
FRACTURES	Unexposed	1	1	1	1
	Depression	**1.18 (1.05-1.32)**	**1.15 (1.03-1.28)**	1.11 (0.95-1.30)	1.06 (0.89-1.24)
	Depression with anxiety	**1.28 (1.10-1.49)**	**1.24 (1.06-1.44)**	1.24 (0.94-1.62)	1.10 (0.82-1.47)
	Anxiety	0.90 (0.64-1.28)	0.87 (0.61-1.23)	0.89 (0.58-1.39)	0.75 (0.47-1.19)
BURNS	Unexposed	1	1	1	1
	Depression	**1.33 (1.17-1.51)**	**1.31 (1.15-1.48)**	**1.36 (1.14-1.63)**	**1.29 (1.07-1.55)**
	Depression with anxiety	**1.59 (1.34-1.88)**	**1.53 (1.29-1.81)**	1.22 (0.91-1.63)	1.22 (0.90-1.65)
	Anxiety	**1.45 (1.04-2.03)**	**1.47 (1.05-2.05)**	1.22 (0.79-1.88)	1.36 (0.88-2.11)
SERIOUS INJURIES	Unexposed	1	1	1	1
	Depression	1.28 (0.97-1.68)	1.25 (0.95-1.65)	1.01 (0.68-1.51)	1.01 (0.67-1.52)
	Depression with anxiety	0.98 (0.62-1.54)	0.95 (0.60-1.50)	0.99 (0.48-2.02)	1.15 (0.55-2.38)
	Anxiety	0.94 (0.39-2.26)	0.95 (0.39-2.29)	0.63 (0.18-2.22)	0.68 (0.18-2.61)

 # Traditional cohort analysis in 207,048 mother-child pairs. Adjusts for confounders using Poisson regression. Adjusted for socioeconomic deprivation, calendar year and region.

**Self-controlled case series analysis consisting of children who had the outcome of interest. A within person-design comparing rates of injury during exposed and unexposed periods. Adjusted for child age and calendar year.*

Table 7-14: Summary of the cohort and self-controlled case series analyses: adjusted incidence rate ratios for detailed time-windows

	Exposure	POISONINGS Adjusted IRR (95%CI)		FRACTURES Adjusted IRR (95%CI)		BURNS Adjusted IRR (95%CI)	
		Cohort analysis[#]	SCCS[*]	Cohort analysis[#]	SCCS[*]	Cohort analysis[#]	SCCS[*]
UNEXPOSED	**Time where no records for anxiety or depression in the medical record**	1	1	1	1	1	1
DEPRESSION	**60 days pre-exposure period**	1.33 (0.97-1.83)	1.23 (0.88-1.72)	1.13 (0.90-1.42)	1.24 (0.97-1.58)	0.97 (0.72-1.30)	0.87 (0.64-1.19)
	Episode: Diagnostic/symptom codes	1.45 (0.97-2.17)	1.34 (0.86-2.08)	1.20 (0.90-1.60)	1.24 (0.89-1.71)	**1.53 (1.13-2.08)**	1.24 (0.87-1.76)
	Episode: On medication	**1.56 (1.33-1.83)**	**1.56 (1.22-1.98)**	**1.14 (1.01-1.29)**	1.06 (0.89-1.27)	**1.27 (1.11-1.46)**	**1.25 (1.02-1.53)**
	60 days post-exposure period	1.23 (0.87-1.76)	0.96 (0.66-1.39)	1.19 (0.94-1.50)	1.13 (0.88-1.46)	1.03 (0.76-1.40)	0.79 (0.58-1.09)
DEPRESSION WITH ANXIETY	**60 days pre-exposure period**	1.70 (0.89-3.28)	1.29 (0.65-2.59)	0.90 (0.50-1.62)	1.03 (0.56-1.91)	1.36 (0.77-2.39)	1.09 (0.60-1.98)
	Episode: Diagnostic/symptom codes	**3.32 (2.30-4.79)**	1.64 (1.00-2.70)	1.16 (0.78-1.74)	1.12 (0.70-1.79)	**2.06 (1.44-2.95)**	1.55 (0.99-2.44)
	Episode: On medication	**2.16 (1.76-2.64)**	1.22 (0.81-1.82)	**1.25 (1.06-1.48)**	1.09 (0.80-1.49)	**1.43 (1.18-1.73)**	1.13 (0.81-1.59)
	60 days post-exposure period	**2.61 (1.44-4.71)**	1.40 (0.74-2.65)	0.89 (0.46-1.72)	0.83 (0.42-1.63)	**1.99 (1.18-3.37)**	1.25 (0.72-2.20)
ANXIETY	**60 days pre-exposure period**	**2.22 (1.36-3.63)**	1.51 (0.89-2.54)	0.78 (0.46-1.32)	0.75 (0.44-1.29)	0.83 (0.45-1.55)	0.66 (0.35-1.24)
	Episode: Diagnostic/symptom codes	1.89 (0.98-3.64)	1.09 (0.54-2.20)	0.76 (0.40-1.46)	0.70 (0.35-1.39)	1.38 (0.76-2.50)	1.03 (0.54-1.95)
	Episode: On medication	1.54 (0.93-2.56)	1.06 (0.49-2.33)	0.92 (0.61-1.39)	0.77 (0.43-1.39)	**1.52 (1.01-2.26)**	1.55 (0.88-2.74)
	60 days post-exposure period	1.36 (0.70-2.61)	0.88 (0.45-1.74)	1.08 (0.68-1.72)	1.01 (0.63-1.64)	0.81 (0.42-1.57)	0.64 (0.32-1.24)

 # Traditional cohort analysis in 207,048 mother-child pairs. Adjusts for confounders using Poisson regression. Adjusted for socioeconomic deprivation, calendar year and region.

**Self-controlled case series analysis consisting of children who had the outcome of interest. A within person-design comparing rates of injury during exposed and unexposed periods. Adjusted for child age and calendar year.*

7.4 Discussion

7.4.1 Summary of key findings

This chapter presents the results of two analyses. The first, a cohort analysis (a between person design) of over 200,000 mother-child pairs, using maternal depression/anxiety episodes as a time-varying exposure to take account of the changing nature of maternal depressive symptoms over time (i.e. remission, relapses). The second, a SCCS analysis (a within person design) assesses the relative timing of child injuries during exposed and unexposed periods among children who experienced both the outcome event and exposure to maternal depression/anxiety.

The cohort analysis demonstrated significant associations between episodes of maternal depression/anxiety and rates of child poisonings, fractures and burns. Associations were strongest for child poisonings, with rates 52% higher during episodes of depression, 2.3 times higher during episodes of depression with anxiety and 63% higher during episodes of anxiety alone, compared to unexposed periods. Similar to this, rates of fractures and burns were highest during episodes of depression with anxiety; with fracture rates 24% higher and burn rates 53% higher than unexposed periods. Rates of serious injuries were not significantly associated with episodes of maternal depression/anxiety in the cohort analysis. When examining injury rates during medicated and un-medicated periods of maternal depression/anxiety, poisoning and fracture rates were only significantly higher than unexposed periods during medicated depression episodes, whereas burn rates were significantly higher during both medicated and un-medicated depression episodes. Poisoning and burn rates were significantly higher throughout depression with anxiety episodes whether medicated or not, and in the 60 days after the episode. Poisoning rates were 2 times higher in the 60 days before a maternal anxiety episode than unexposed periods, and rates of burns were significantly higher when mothers had anxiety for which medication was prescribed.

In the SCCS analysis, associations were only seen between episodes of maternal depression and rates of child poisonings and burns, with the magnitude of the adjusted incidence rate ratios similar to the findings of the cohort analysis. The key difference in findings between the cohort and SCCS analyses was finding no significant association

between episodes of maternal depression with anxiety and child injury rates in the SCCS. This may relate to confounding variables being controlled for within the SCCS analysis that the cohort analysis was unable to control for, but could also relate to how the exposure variable was defined, and the length of exposed to unexposed time within the SCCS analysis. Among children whose mothers had chronic depression with anxiety, there may have been insufficient unexposed time to enable the SCCS analysis to estimate differences in rates between exposed and unexposed periods. Similar to the cohort analysis, no significant association was found between episodes of maternal depression/anxiety and rates of serious injuries. When examining medicated and un-medicated periods of depression/anxiety, rates of poisonings and burns were only significantly elevated compared to unexposed periods when the mother had depression and was prescribed medication.

Findings were broadly similar to the primary analysis in each of the sensitivity analyses; except when the definitions of maternal depression/anxiety episodes were altered. Extending the time-window to 12 months to define episodes of depression/anxiety generally increased the magnitude of observed associations between episodes of maternal depression/anxiety and child injuries. For example, in the SCCS analysis, the use of a 12 month time-window to define depression/anxiety episodes led there to be a significant association between episodes of maternal depression with anxiety and child poisoning rates (aIRR 1.50, 95%CI 1.07-2.09). In the cohort analysis, the use of a longer time-window led the association between maternal depression episodes and serious child injuries to become significant (aIRR 1.39, 95%CI 1.08-1.80). The exclusion of symptom and clinical review codes for depression/anxiety tended to reduce the magnitude of association between episodes of depression with anxiety and child injury, but conversely increased the strength of associations between episodes of depression alone and anxiety alone and child injuries.

7.4.2 Strengths and limitations

The strengths and limitations of the work described in this chapter are described in terms of bias, confounding and chance.

7.4.2.1 Bias

As maternal depression/anxiety episodes may commence at different time points for different mothers and are relapsing and remitting in nature, a key strength of this study is the use of episodes of maternal depression/anxiety as a time-varying exposure; an important difference to the existing evidence base. Existing studies have tended to measure maternal depressive symptoms at one or two time points over the study period, categorising mothers into depressed and non-depressed groups for the whole of study follow-up(69, 182, 184, 191, 199). This approach may lead to an underestimation of the effect of maternal depression on child injury risk due to misclassification of the exposure (i.e. mothers may develop depression but be classified as 'not depressed', or symptoms may resolve but still be categorised in the 'depressed' group). The use of maternal depression/anxiety episodes as a time-varying exposure allows a more accurate assessment of the timing of child injury occurrence in relation to maternal depression/anxiety episodes, particularly across a 5 year study period.

There are however limitations with using routine primary care and hospitalisation data to define the exposure. Within UK primary care there is no single or consistent measure used to diagnose depression/anxiety, with GPs largely making diagnoses on clinical judgement(331). This means there may be some inconsistencies in clinical coding between GPs, and over time as other factors affect coding (e.g. the QOF, clinical guidelines)(312). The Read code lists use to define depression/anxiety within this study have not been validated, and may not be consistent with either the DSM-IV or ICD-10 diagnostic classification systems due to some patients being included whose symptoms were not of sufficient severity or persistence to meet these criteria. To try and account for this, Read codes referring to symptoms and clinical reviews (i.e. part of QOF) were excluded from the definition of depression/anxiety as a sensitivity analysis and reassuringly did not notably change study findings (section 7.3.2.4). There however remains the potential for misclassification of the exposure as a result of the Read codes used to define depression/anxiety. For example, the inclusion of codes for mild depression or depression symptoms may lead to an underestimation of the association between maternal depression/anxiety and child injuries, compared to if only those with more severe and persistent depression were included in the definition. This effect has previously been demonstrated by Schwebel and Brezausek where severe levels of maternal depression were associated with an increased risk of child injury, whereas

moderate depression levels were not(183). As symptom screening tools are not consistently used in UK primary care, and many of the Read codes do not describe the severity of depression (e.g. Eu32.00 Depressive episode), depression severity was not accounted for within this study.

Maternal depression/anxiety episodes were identified using the mother's health records, and as such will not accurately capture the duration of depression/anxiety episodes or those mothers who experienced mild symptoms of depression/anxiety and did not present to their doctor (as described in Section 5.4.2.1). This misclassification of the exposure will move the association towards the null hypothesis (no association between maternal depression/anxiety and child injuries), as some of the mother's follow-up time will be classified as unexposed when she may have been developing, or had ongoing symptoms of depression/anxiety. This is likely to particularly affect episodes of anxiety, which were most commonly defined using Read codes alone and so are likely to substantially underestimate the duration of symptoms. When a longer time-window of 1 year was used to define the continuous periods of maternal depression/anxiety, the magnitude of adjusted incidence rate ratios generally increased in both the cohort and SCCS analyses. Work by Lovejoy *et al* highlights that individuals with major depressive disorders can have ongoing symptoms and functional impairment between episodes(200), which may be one explanation of the lack of association seen between maternal depression with anxiety episodes and child injuries in the SCCS analysis.

The effects of maternal depression/anxiety on child injury rates were examined separately due to the hypothesis that the two conditions could have different effects as a result of their differing symptoms. Depression is characterised by symptoms of low mood, fatigue and withdrawal. Maternal depression has previously been associated with less intense child supervision(201) and more disengaged parenting(350); factors which could increase child injury risk. Conversely, symptoms of anxiety include apprehension about the future, excessive fear, and worry. Existing literature has reported more intrusive parenting and lower parenting efficacy (parents' beliefs about parenting abilities) amongst anxious mothers(362), which could lead anxious mothers to maintain more intense supervision or have a lower threshold for seeking healthcare in the event of a child injury. While depression and anxiety are distinct diagnoses within diagnostic classifications (i.e. DSM, ICD-10), in practice there is firstly under ascertainment of these

conditions in primary care, secondly these conditions are commonly comorbid(145), and thirdly the two conditions may not be accurately differentiated by GPs (e.g. symptoms do not clearly conform to case definitions, limited psychiatry training, lack of standardised diagnostic tools used in primary care)(331). Therefore, it could be argued that episodes of depression and/or anxiety could have been considered together as one exposure variable within analyses (e.g. as 'common mental disorders'), which would have had the additional benefit of increasing the number of events (and study power) in the different time-windows used for the cohort and SCCS analyses. This however would have prevented the examination of differences in associations for the two conditions, and could have led to an association being underestimated if the effects of depression and anxiety acted in different directions.

In this study it was not possible to assess the severity of maternal depression/anxiety. There is some evidence to suggest that the risk of child injuries increases with severity of maternal depression(182, 183), and so by grouping all severities of depression/anxiety together in this study (e.g. from mild symptoms to major depressive episodes), the impact of maternal depression/anxiety may have been underestimated. This issue is further complicated by the use of medication to treat depression/anxiety, which to some extent is a marker of more severe illness, but on the other hand should lead to improvement in symptoms.

An advantage of using prospectively collected health data in this study is that the recording of child injury events is less affected by recall biases, which potentially affect a number of existing studies that have asked mothers to recall injury occurrences over 12 to 18 month periods(107, 182, 184-186, 199). There is however the potential for differences in the reporting of injuries by mothers to health services (i.e. reporting biases) and the capture of injuries by health services (e.g. surveillance biases) according to whether mothers have mental health symptoms or not, as described in Section 6.4.2.1. For example, an explanation for the high rate of child poisonings in the 60 days before maternal anxiety episodes is that mothers developing symptoms of anxiety may take their child to the doctors more frequently with less severe injuries (Table 7-3). Ideally a measure of injury severity would be used to assess whether children of mothers with depression/anxiety were truly having a greater number of injuries, or whether higher injury rates were explained by less severe injuries being brought to medical attention. Unfortunately, numbers of serious poisonings, fractures and burns

were too small to be able to assess whether associations persisted when only injuries that were likely to be fully ascertained were included. Ascertainment bias therefore remains a potential explanation for the increased child injury rates during maternal depression/anxiety episodes, particularly as associations were not seen with all serious injuries.

7.4.2.2 Confounding

In the traditional cohort analysis confounding was taken account of through adjusting for potential confounders available within the dataset using Poisson regression. However, the estimates of the effect of maternal depression/anxiety on child injuries may be over- or underestimated as a result of residual confounding, as data on all potential confounders were not available in linked CPRD-HES data (e.g. single parenthood, social support, paternal risk factors). Therefore a key strength of this chapter is the use of the SCCS analysis, a method which takes account of the effects of fixed confounders that do not vary over time (e.g. genetics, child personality/temperament, ethnicity, socioeconomic deprivation, maternal education) as injury rates are compared in exposed and unexposed periods within the same individual. The finding of significantly higher poisoning and burn rates during maternal depression episodes in the SCCS analysis provides additional support to the findings of the cohort study that there is a true association between maternal depression and higher rates of child injuries. However, the SCCS analysis does not take account of confounders that change over time. In particular, this method will not have accounted for any changes in household composition (e.g. birth of new child) or adverse life events (e.g. bereavement, parental separation, loss of parental employment) that occurred during study follow-up. As a result there may still be some under- or overestimation of the association between maternal depression/anxiety and child injuries in the SCCS as a result of residual confounding.

7.4.2.3 Chance

While the study cohort consisted of over 200,000 mother-child pairs, it was not possible to examine some rarer injury outcomes (e.g. serious poisonings, fractures or burns) as numbers of injury events and person-years were small, particularly when the follow-up time of mothers was divided into a number of periods. Even for all poisonings, fractures and burns, numbers of events became small when looking at detailed time-windows

(Section 7.3.2.2) with the study potentially underpowered to detect true differences in injury rates in these different periods (type 2 error).

By using antidepressant and anxiolytic prescriptions as part of defining episodes of depression/anxiety, associations between medicated depression/anxiety episodes and child injuries may in part reflect the person-time available. Most of the person-time of depression and depression with anxiety episodes were when mothers were on medications (e.g. of the 32,125 person-years of follow-up when mothers were depressed, 86.5% was when mothers were on medications). This means there may not have been sufficient power to detect differences in injury rates between periods when mothers were not on medications and unexposed periods.

7.4.3 Comparison to existing literature

To our knowledge there are no existing studies that have used maternal depression/anxiety episodes as a time-varying exposure to study associations with child injuries. An early study by Brown and Davidson (1978) reported higher child injury rates during periods when mothers reported having active psychiatric symptoms, although this was a cross-sectional study and relied upon maternal reporting of symptom onset(188). The finding of higher incidence rates of poisonings and burns during episodes of maternal depression is consistent with previous cohort studies that found an association between symptoms of maternal depression and child injuries(107, 182, 183). It is reassuring that the observed association in the cohort analysis between maternal depression and child poisonings and burns persisted when another method to deal with confounding (SCCS analysis) was used. While it has not been possible to examine mechanisms explaining the link between maternal depression and child poisonings and burns, existing literature suggests this association could relate to the impact of depression on child supervision(201), effects on parenting practices and the mother-child interaction(170, 200), and the safety of the home environment(170, 174, 176).

Existing literature has predominantly focused upon maternal depression alone, and so this study provides new information about associations between maternal depression with anxiety and child injuries, and maternal anxiety alone and child injuries. In the cohort analysis, rates of child injuries were highest during episodes of maternal depression with anxiety, with rates of poisonings two times higher compared to

unexposed periods, rates of fractures 24% higher and rates of burns 53% higher compared to unexposed periods. Although it has not been possible to assess depression severity, episodes of depression with anxiety in this dataset had a longer median duration and more commonly included a hospitalisation (Section 5.3.3) than depression episodes alone. Depression with anxiety episodes in this dataset therefore potentially reflect periods of more severe and enduring symptoms. The higher child injury rates during these episodes are consistent with existing studies that have demonstrated greater child injury risk amongst mothers with persistent and severe depressive symptoms(182, 183). Another potential explanation is that mothers experiencing symptoms of both depression and anxiety may be more likely to seek medical attention in the event of an injury than mothers who experienced depression alone, as a result of experiencing symptoms of anxiety.

In the SCCS analysis episodes of depression with anxiety were not significantly associated with child injuries. This may be explained by the SCCS analysis dealing with confounding that was not adjusted for within the cohort analysis. On the other hand, it may relate to how depression/anxiety episodes were defined, and study power. Firstly, mothers who had episodes of depression with anxiety appear to represent a group with the most persistent symptoms. As linked primary care and hospitalisation do not contain accurate information on the start and end dates of depression/anxiety episodes, women may still have had symptoms in the periods classified as unexposed, therefore meaning no differences between exposed and unexposed periods were detected. When a longer time-window of 12 months was used to define depression/anxiety episodes, the association between maternal depression with anxiety episodes and child poisonings became significant in the SCCS (aIRR 1.50, 95%CI 1.07-2.09). The second reason may relate to the smaller number of children exposed to maternal depression with anxiety compared to depression alone, and the amount of their follow-up time that children were exposed for (Appendix 14). For example, a child exposed to maternal depression with anxiety for all of their follow-up time would not have contributed data to the SCCS analysis as there would have been no unexposed time. The SCCS analysis may therefore have been underpowered to detect differences in injury rates between exposed and unexposed periods for episodes of depression with anxiety due to both smaller numbers of children exposed, and in some cases the chronicity of exposure to maternal depression with anxiety.

In this chapter, the strength of association between maternal depression/anxiety episodes and child injuries varied by injury type; strongest for child poisonings and burns. This may be explained by ascertainment bias affecting poisonings and burns; where mothers with depression/anxiety are more likely to take their child to the doctors with a minor burn or poisoning, whereas injury ascertainment should be more complete for fractures and serious injuries. Conversely it may also be explained by differences in the underlying mechanisms of injury and how sensitive these mechanisms are to the effects of maternal depression/anxiety. Morrongiello *et al* demonstrated variation in mothers' engagement in safety practices according to injury type; with differences related to perceptions of the severity of injury, the child's vulnerability, and the ability of the parent to intervene(363).

Significantly higher child poisoning, fracture and burn rates were seen during periods when mothers were prescribed medication for depression or depression with anxiety (Sections 7.3.2.2 and 7.3.3.3). For poisonings, one explanation for this association could be that the risk of poisoning is increased due to increased exposure to poisoning substances, either as a result of exposure to antidepressants/anxiolytics, or as a result of mothers with depression also being more likely to have other comorbid medical conditions for which they are treated (e.g. pain, chronic diseases)(332, 364, 365). Further work could be conducted to assess the substances children were poisoned by and the number of other medications mothers were prescribed. This explanation would of course not explain the association seen for burns or fractures. Periods when mothers are on medication could reflect times when the mother is experiencing more severe symptoms, therefore increasing child injury risk (e.g. greater impact on supervision and home safety practices). The third potential explanation, certainly for the SCCS analysis, is that observed associations with medicated depression/anxiety periods may be explained by the greater amount of person-time available compared to un-medicated periods, as described in Section 7.4.2.3.

7.4.4 Conclusions and implications

Increased rates of child poisonings, fractures and burns during episodes of maternal depression/anxiety suggest that maternal depression/anxiety is a modifiable risk factor for child injury. While further research is required to establish whether treatment of maternal depression/anxiety reduces child injury risk, this study highlights the

importance of early detection and effective treatment of maternal depression/anxiety episodes, as this could lead to improvements in health for both mother and child. Clinicians treating and reviewing mothers during episodes of depression/anxiety (e.g. GPs, psychiatrists) should be aware that children of depressed mothers may have an increased risk of injury, and provide safety advice and referral to home safety schemes, where appropriate. In addition, there are a number of other services available to support families (e.g. health visiting programme, children's centres, parenting programmes, free nursery places), which could provide additional support to mothers experiencing depression/anxiety. Clinicians involved in the prescribing and dispensing of medications (e.g. GPs, pharmacists) should provide advice to mothers about safe medication storage and use, particularly where the medication could cause serious harm (e.g. benzodiazepines, opiates).

Chapter 8: Conclusion and Implications of Work

This chapter summarises the findings of the studies carried out in this thesis, describes the implications of this work for policy and practice, and makes recommendations for future research in light of study strengths and limitations.

8.1 Summary of findings

This thesis has described a series of studies undertaken to firstly describe the epidemiology of three common injury types (poisonings, fractures and burns) using linked primary care, hospitalisation and mortality data; secondly to identify and define episodes of maternal depression/anxiety during the child's first five years of life; and thirdly to assess whether the mental health of the mother influences rates of child injuries. The key findings from the studies undertaken are described below.

8.1.1 The epidemiology of injuries among children and young people using linked health and mortality data

- Using primary care, hospitalisation or mortality data in isolation misses a substantial proportion of injury events. When used in isolation, the CPRD misses approximately 20% of poisonings, 8% of fractures and 5% of burns, compared to using the three linked data sources together.
- Injury mechanism and intent recording was high within hospitalisation and mortality data, but low within primary care data, with only 2-4% of fractures and burns having a mechanism and/or intent recorded.
- Patterns of injury by age, sex, socioeconomic deprivation and calendar year varied by injury type. Peaks in injury incidence were at the age of 2 and 18 years old for poisonings, age 1 year for burns and 13 years for fractures.
- Steep socioeconomic gradients between the most and least deprived quintiles were seen, particularly for poisonings, burns and serious injuries.

- Incidence rates of burns across all ages, and poisonings among 0-4 year olds reduced between 2001 and 2011, whereas incidence rates of fractures increased across all ages, as did incidence rates of poisonings among 15-24 years olds.

8.1.2 Maternal depression and anxiety during pregnancy and the child's first five years of life

- About 1 in 4 children (26.4%) were exposed to maternal depression/anxiety between birth and their fifth birthday; highlighting that maternal depression/anxiety is a common exposure of childhood.
- The incidence (2.39/100 PY) and prevalence (5.6%) of depression during pregnancy appeared low compared to existing literature suggesting depressive symptoms may be as common during pregnancy as the postnatal period(329). Similarly, incidence rates of depression with anxiety, and anxiety alone were low compared to community surveys(145); potentially reflecting poor coding and/or low ascertainment of these conditions in primary care.
- Mothers who experienced perinatal depression had significantly higher incidence rates of depression/anxiety after the postnatal period than mothers without perinatal depression; highlighting that those children exposed to perinatal depression often continue to experience greater exposure to maternal depression/anxiety throughout their first five years of life.

8.1.3 Association between maternal mental illnesses and child injury rates

8.1.3.1 Perinatal depression and child injuries

- Rates of injuries, particularly poisonings and burns, were increased among children whose mothers experienced perinatal depression. For example, children whose mothers had perinatal depression had a 55-89% higher rate of poisonings and 30-33% higher rate of burns than children whose mothers did not have perinatal depression.
- Maternal perinatal depression was associated with all serious injuries, and serious fractures and burns, indicating that observed associations between perinatal depression and child injuries were unlikely to be fully explained by differences in health seeking behaviours by mothers or the recording of injuries by clinicians according to whether mothers had depression/anxiety or not.

8.1.3.2 Episodes of maternal depression/anxiety and child injuries

- Significantly higher rates of child poisonings and burns were seen during episodes of maternal depression, with this finding similar between the traditional cohort and SCCS analyses. In these analyses, children had a 48-52% higher poisoning rate and a 29% higher burn rate during episodes of maternal depression.
- In the traditional cohort analysis, child poisoning and burn rates were highest during episodes of maternal depression with anxiety; whereas in the SCCS analysis, depression with anxiety episodes were not significantly associated with rates of child poisonings or burns. This difference in findings may be explained by confounding being taken account of within the SCCS analysis which was not accounted for in the traditional cohort, but may also relate to the chronicity of depression with anxiety episodes and study power in the SCCS analysis.
- Serious injuries were not significantly associated with episodes of maternal depression/anxiety in either analysis.

8.2 Implications of study findings for policy and practice

The implications of the studies presented in this thesis can be divided into those relating to injury prevention programmes and uses of linked health and mortality data, those relating to the detection of maternal depression/anxiety in primary care, and those relating to the prevention of injuries among children whose mothers have depression/anxiety. These will be addressed in turn.

8.2.1 Tailoring interventions across the life course and responding to changes in injury epidemiology

The differing injury patterns seen within this thesis highlight the importance of taking a strategic life course approach to injury prevention, tailoring interventions according to child age and injury type. A broad range of interventions have been shown to be effective; including population-wide initiatives (e.g. product safety measures(366)), community initiatives (e.g. traffic calming measures(366)), and interventions targeting families (e.g. home safety schemes(118)). Local authorities and Clinical Commissioning Groups (CCG) should ensure that a strategic approach to injury prevention is taken within their area; including ensuring injury prevention initiatives are coordinated, multiagency partners are involved (e.g. health services, police, fire services, local authority, education) and the needs of the local population are taken into account. The

formation of local partnership groups, the inclusion of child injuries in the Joint Strategic Needs Assessment, and the development of an injury prevention strategy assist in ensuring action is coordinated, evidence based, and links with other policy areas (e.g. child poverty, domestic violence, adolescent mental health). Local areas should consider implementing recommendations made within NICE guidance on preventing injuries in the home(367) and on the roads(25). Figure 8-1 illustrates some of the interventions that can be implemented to prevent poisonings, fractures and burns according to injury type and age across the life course. Alongside implementing universal injury prevention approaches for all children and young people, the finding of steep socioeconomic gradients, particularly for poisonings and serious injuries, supports the targeting of preventative interventions to households in the most deprived areas(6).

Injuries among preschool children most commonly occur within the home(115). Where home safety programmes are not in place, local areas should consider whether funding can be identified to commission home safety education and equipment schemes; demonstrated to be effective at reducing injuries(118) and recommended by NICE(367). Areas with home safety schemes need to ensure clinicians and those working with families are aware of the scheme and how to refer to it. Children's centre staff, health professionals and voluntary groups are well placed to deliver safety messages; whether through promoting particular national awareness days (e.g. National Burns Awareness Day) or delivering one-to-one advice. Local areas should ensure appropriate staff training on injury prevention is in place (e.g. to health visitors, children's centres, Family Nurse Partnership, GPs) so that staff are equipped to advise parents about preventing injuries. In particular, there is recognition that educating parents about stages of child development and how this relates to injury risk is beneficial; with a number of resources available from Child Accident Prevention Trust(368) and the Keeping Children Safe at Home study(369) to assist with this. Staff training should highlight high risk groups, such as mothers with depression/anxiety and those living in deprived areas, with home safety schemes targeted to these high risk groups.

Figure 8-1: A life course approach to injury prevention

	Life course approach		
	Early years: 0-4 year olds	**School-aged children: 5-14 years old**	**Adolescents and young adults: 15-24 year olds**
General injury prevention measures	• Provision and installation of home safety equipment (e.g. cupboard locks, stair gates). • Education of parents about child development, and potential hazards. • Parenting programmes	• Injury minimisation programmes in schools	• Risk minimisation strategies – e.g. alcohol/substance misuse.
Poisonings	• Safe medication storage & advice about medication use and storage by prescribers. Safe disposal of old medications. • Safe storage of household chemicals/products.	• Personal, Social and Health Education in schools: strategies to improve health and wellbeing of young people • Alcohol and substance misuse prevention • Accessible, appropriate mental health services for children and young people (CAMHS)	
	• Carbon monoxide detectors		
Fractures	• Appropriate use of car seats according to child age, height and weight • Falls prevention- stair gates, window locks	• Appropriate use of car seats according to child age, height and weight • Pedestrian training in road safety • Cycle training and helmets • Safe playgrounds, and appropriate play equipment. • Protective sports equipment	• Training in road safety / driving. Use of protective equipment (e.g. motorcycle helmets, cycle helmets). • Enforcement of road safety laws – speeding, drink driving • Protective sports equipment
Burns	• Education for parents about causes of burns/scalds (hot drinks, hair straighteners, bath water scalds)		
	• Fitting of thermostatic mixing valves to hot taps. • Education of families about developing a fire escape plan • Fitting of working smoke alarms • Fire safety education; e.g. in schools, to high risk groups (e.g. smokers, temporary accommodation)		
Cross-cutting themes	Targeting of high risk groups (e.g. those in more deprived areas) Multiagency action – coordinated response Education and training of staff (e.g. children's centres, clinicians, voluntary sector) – including safeguarding training Information to parents about support services and advice (e.g. Children's centres)		
Other	The built environment: ensuring safe play areas, street lighting, local authority housing, urban planning, road infrastructure Links to child poverty, domestic violence, substance misuse strategies		

***CAMHS**: Child and Adolescent Mental Health Services*

The Public Health Outcomes Framework aims to assist local areas to improve the health of their population and reduce health inequalities; with injuries among 0-24 year olds included as an indicator(56). The work included in this thesis demonstrates that injuries cannot be treated as one homogenous indicator, due to the differing patterns of injuries by age, sex, socioeconomic deprivation and over time according to injury type. Public health teams need to use local injury data to identify priorities for prevention in their area; distinguishing between different injury types and intents to aid in the prioritisation of injury prevention initiatives. From the work conducted in this thesis, increases in fracture incidence across all ages, and poisoning incidence among 15-24 year olds over time are a cause for concern. Further work is required to verify whether this increase in fracture incidence is genuine (rather than changes in coding) and whether increases are seen for particular anatomical sites (e.g. forearm fractures) or mechanisms of fracture. Similarly, if the increase in poisonings among young people is genuine, consideration may need to be given to the commissioning of Child and Adolescent Mental Health Services (CAMHS) and alcohol services to ensure there is adequate provision to meet this increased demand. There is a need to ensure adequate detection and management of low level mental health problems among young people within the community (e.g. in schools, general practice, youth groups, voluntary sector), alongside programmes to increase resilience, in order to prevent problems escalating and leading to self-harm. Delivering training to those working in the community, about symptoms and signs of mental illness and the services available would be of benefit. Further work to examine the poisoning substances used, and whether poisonings occur alongside other types of self-harm (e.g. cutting) would be useful in planning preventative interventions. Qualitative research to understand the underlying issues leading to the observed increases in self-poisonings may support the development of interventions to prevent self-poisonings (e.g. the role of social media, access to employment and educational opportunities, bullying, family breakdown).

8.2.2 Using linked health and mortality data for injury research, evaluation and surveillance

This work has demonstrated that it is essential to use linked data sources to provide a more complete estimate of injury incidence, as even though GPs should receive information about their patients' attendances in secondary and tertiary health services, the CPRD alone did not capture all injury events identified in the HES or ONS mortality

datasets. This is likely to relate to what information is communicated to the GP (e.g. level of detail about the injury included in hospital discharge summary) and how this information is then entered in the primary care record (e.g. whether it is entered using Read codes, in the free text, or scanned in). Similarly, using hospitalisation or mortality data alone misses a substantial proportion of the injury burden. While injuries not leading to admission or death may be less severe, many still have a significant impact in terms of time off work or school, costs of follow-up care, and psychological impact(370). Indeed, less severe injuries treated in ED alone have been shown to account for 67% of years lived with disability in the UK(371). With it now being feasible to link routinely collected primary care, hospitalisation and mortality data, these data offer more complete estimates of injury burden, and have several potential applications, including:

- **Evaluations of injury prevention initiatives.** CPRD-HES-ONS mortality data could offer an inexpensive and efficient mechanism of obtaining outcome data for evaluations of injury prevention interventions. For example, these data could be used as part of natural experiments, studying the impact of changes that have happened in some areas but not others.
- **Assessment of health costs associated with injury.** There are a limited number of studies that have described the economic costs resulting from injuries in children. In particular there are few data on the use of primary care services and associated costs. It is possible to use cost information about primary care services, Health Resource Groups (method used to cost hospital admissions) and drug costing data to estimate costs of healthcare use using CPRD and linked HES data(372, 373), which could be applied to child injuries.
- **Primary care alerts.** A number of tools have been developed using primary care data to identify individuals at increased risk of disease (e.g. QFracture, QRisk2, QDiabetes(374)). Consideration could be given to the development of tools for primary care to alert clinicians to children (or children within households) who have sustained repeated injuries or who are at particularly high injury risk. This could be of benefit in alerting clinicians to potential cases of maltreatment or neglect, or underlying medical conditions leading to repeated injuries. Careful consideration would need to be given to such a tool; to its validity and reliability and the processes taken if a child were flagged as being at high risk.

- **Injury surveillance.** Surveillance is defined as *"the ongoing systematic collection, analysis and interpretation of health data, essential to the planning, implementation and evaluation of health practice, closely integrated with the timely dissemination of these data to those who need to know"*(375). The previous UK injury surveillance system (HASS/LASS) ceased in 2002, and since then, reliance on hospitalisation and mortality data means that much of the injury burden within England is not accounted for within health service or injury prevention planning. CPRD-HES-ONS mortality data could offer an affordable mechanism for injury surveillance in England; although there are a number of issues that would need to be considered to make this happen (Section 8.2.3).

8.2.3 Linked CPRD-HES-ONS mortality data: a role in injury surveillance?

Table 8-1 summarises the attributes of a good surveillance system(376), highlighting the strengths and limitations of CPRD-HES-ONS mortality data for injury surveillance.

8.2.3.1 Strengths of CPRD-HES-ONS data for injury surveillance and areas for development

- **The information generated.** A strength of CPRD-HES-ONS mortality data is it's breadth of coverage, capturing all deaths, injury hospitalisations and primary care injury records. Some surveillance systems are focused on specific injury types (e.g. burns seen by specialist burns services(126)), mechanisms (e.g. HASS/LASS focused on home and leisure injuries) or age groups, and so exclude some of the injury burden. CPRD-HES-ONS mortality data contain a wealth of information on injury outcomes across all ages of the population, and potentially, once linked to ED data will capture all medically recorded injuries in England. Additionally, with longitudinal follow-up data, it is possible to identify those children and young people sustaining repeated injuries over time. The work contained in this thesis has focused on three injury types. To develop this further, this work should be repeated for other injury types, prioritised based on stakeholder needs (e.g. Public Health England).

- **Risk factor data.** UK primary care data contains a wealth of information about individuals, their medical conditions, and families. Addressing inequalities in injury occurrences is a priority for public health; yet existing hospital admissions data and the Public Health Outcomes Framework include no measure of socioeconomic deprivation or changes in inequalities in injury rates over time(1). Linked CPRD-HES-

ONS mortality data can be used to produce detailed incidence rates by age, sex, calendar year and socioeconomic deprivation. As the recording of ethnicity data improves with time(236), data could also be presented by ethnic group.

- **Representative population.** The CPRD population is broadly representative of the UK population in terms of age and sex, meaning that data are reasonably generalisable to the population. As the CPRD continues to recruit more GP practices (including practices using the EMIS medical record system(377)), geographical coverage will improve. With plans to gain access to all primary care data in the future (care.data programme), national primary care data may become available(246), and methods such as described within this thesis could be used to describe injury epidemiology at a national level.

- **Processing and reporting of data.** An important strength of CPRD-HES-ONS mortality data is that it builds on existing data collection systems and processes. Currently a similar primary care research database, QResearch, is used to produce infectious disease surveillance data (QSurveillance)(378), demonstrating that primary care databases can be used to provide timely, accessible and representative surveillance data. Once methods to define specific injury types of interest have been agreed, much of the process of extracting and analysing data could be automated, allowing regular reports to be produced. Currently HES data are released on an annual basis to researchers using the CPRD. To use these data for surveillance, partnerships would need to be developed, or even the work conducted within the Health and Social Care Information Centre or Public Health England, to allow timely and more frequent reports.

- **Affordability.** Through using routinely collected health and mortality data, CPRD-HES-ONS data potentially offer an affordable surveillance mechanism. Costs to use these data for surveillance include data access costs and staff time for data analysis and dissemination, making it a potentially more sustainable and affordable system than the collection of enhanced injury data from EDs.

Table 8-1: Attributes of a good surveillance system(346): could CPRD-HES-ONS mortality data be used for injury surveillance?

	Description	Strengths of CPRD-HES-ONS mortality data	Limitations of CPRD-HES-ONS mortality data	How could these data be developed?
Simplicity	System should be simple, enabling collection of the right quantity of data, without duplication or wasting staff time	• Uses routinely collected health data, and so has minimal impact on staff time. • Hospital admissions data uses established coding systems (ICD-10), which are simple and used internationally.	• Extraction of the data requires skills in using large primary care research databases. Data would need to be prepared and cleaned for use by other stakeholders. • Different clinical coding systems are used in primary care, ED and hospital admissions data. This introduces some complexity and less clarity in injury definitions.	• Development of computer scripts and automation processes to allow regular extraction of injury data. • Agreement of injury definitions with stakeholders (e.g. Public Health England) and validation of code lists for these injuries. • Data tools (e.g. Injury Profiles), such as those produced by the Public Health Observatories would enable data to be usable by different stakeholders.
Flexibility	System should be easy to change	• New algorithms can be developed to define multiple injuries, other injury types.	• Very difficult to capture new or more detailed information (e.g. mechanism data, consumer product data), as reliance on coded information from medical records. Current recording of injury mechanisms/intent are poor in primary care. • Data are captured at a national level and so any changes would be slow to introduce.	• Simplify injury coding within primary care, similar to the ED minimum dataset for injuries. Include a template in the primary care record to standardise primary care recording of injuries. • Primary care recording has previously been improved through incentives (QOF). If funding were available, incentives to improve coding would be likely to have an impact. • Include dedicated reporting of specific consumer products/hazards within an area of template.
Acceptability	Staff, patients and the public should find the system acceptable and be willing to participate in it.	• Routinely collected health data has little additional impact on staff or patient time. • HES and mortality data are routinely published and are acceptable to the public.	• Plans for national access to primary care records (Care.data) have been delayed due to mixed public and clinician responses. If patients choose not to allow access to their data, primary care data may not be representative of the population. • There is a need for standardised coding of ED data across the country; this may require staff training and take more time, which may not be acceptable to staff. Similarly, thorough coding of injuries in primary care may take more time, and not be acceptable to primary care staff.	• Partnerships would need to be developed to ensure data produced met the requirements of end users (e.g. Public Health England, Local Authority public health teams)

Table 8-1 continued

	Description	Strengths of CPRD-HES-ONS mortality data	Limitations of CPRD-HES-ONS mortality data	How could these data be developed?
Reliability	Data should be accurate, fully capturing injury events within a relevant population, using a representative sample or complete population coverage	• CPRD representative of UK population. Continued recruitment of practices would enable increased geographical coverage. • The use of linked data sources improves ascertainment of injury events – capturing the whole injury burden, from mild injuries to those leading to death.	• Ascertainment of injuries can be affected by changes in hospital admission thresholds. There is a need for linked ED data (which includes some attendances at Walk in Centres). • Differences in injury recording and coding practices could affect injury definitions. There are some injury codes that are non-specific.	• Linkage of ED data to CPRD planned for the future • Validation work to define injuries using Read, ED and ICD-10 code lists. Ensure clear and transparent injury definitions.
Utility	Practical and affordable system	• Affordable system that uses routine health data. Less likely to be affected by funding cuts compared to a surveillance system requiring additional data collection. • Longitudinal data enables analysis of time trends.		• Funding would need to be identified to access CPRD-HES-ONS mortality data, alongside funding to carry out analysis and disseminate data.
Sustainability	System should be easy to maintain and update	• The use of routine clinical data means the system is potentially more sustainable and less affected by funding cuts.		

Table 8-1 continued

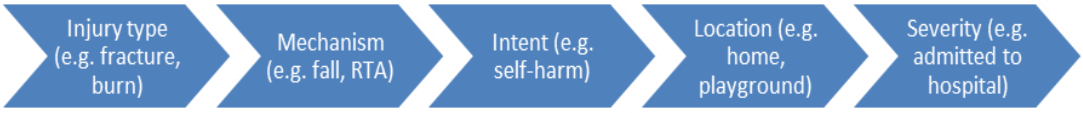
	Description	Strengths of CPRD-HES-ONS mortality data	Limitations of CPRD-HES-ONS mortality data	How could these data be developed?
Timeliness	System should be able to generate up-to-date information when required	• QResearch, already in use for infectious disease surveillance, producing weekly, monthly reports, demonstrates it could be feasible to establish such systems for injuries.	• Current license arrangements with the CPRD would not allow such regular data access. HES data released on a yearly basis to researchers.	• For injury surveillance data to be produced on a more regular basis, a partnership with CPRD and the HSCIC (that holds HES / ONS mortality data) would be required to obtain more frequent data access. • Exploration of whether the work could be repeated in QResearch, building on their existing processes and structures for surveillance.
Security and confidentiality	Appropriate measures in place to ensure patient details are secure	• CPRD data are anonymised and researchers are required to adhere to certain standards when using and reporting the data.	• Small numbers of practices in some regions mean that regional data are not representative, and data on smaller geographical areas cannot be presented	• Expansion of geographical coverage could enable presentation of data at smaller geographical areas

8.2.3.2 Limitations of CPRD-HES-ONS data for surveillance and areas for development

- **Case ascertainment.** A good surveillance system should correctly identify all cases for a given population. Linkage of ED data to the CPRD is expected from 2016 and so should increase ascertainment of injury events. Correct identification of injury cases when using routinely collected data relies on the accuracy of clinical coding within each dataset, and so validation studies of the codes being used would be of benefit. When ED data become available, work would need to be carried out to assess how injuries are coded, and produce algorithms to take account of using the four data sources together (CPRD-HES-ED-ONS).

- **Injury coding.** Currently there are thousands of injury Read codes that can be used to record injuries within primary care. One of the biggest limitations of primary care data for injury surveillance is the poor recording of injury mechanism and intent data. For primary care data to be effectively used as part of a surveillance system, a simplified set of Read codes would be beneficial. For example, an ED minimum dataset has been developed(379), and could be modified for use in primary care, giving simple categories, allowing capture of information on injury type, mechanism, intent and location (Figure 8-2). This could be embedded as a simple template within the electronic primary care systems (e.g. as has been done for NHS health checks). If improved injury recording in primary care were to be a priority, incentives to improve coding have previously been effective (e.g. inclusion of ethnicity in the QOF(236)).

Figure 8-2: Example of information collected as part of an injury minimum dataset



- **Geographical coverage.** Currently CPRD-HES-ONS mortality data can only be used to present data at a national or regional level, with regional rates potentially not generalisable to the whole region. Public health and clinical services (e.g. specialised burns services) often present detailed data by CCG and wards. In addition health boundaries can change (e.g. as a result of NHS reorganisations), and so data would

need to be adaptable to be able to present data for different areas as required. To be of use to those developing injury prevention programmes at a local level, there is a need for improved geographical coverage. As there are plans for widespread access to primary care data across the country(246), it may become feasible in the future to produce lower level geographical data.

8.2.4 Detecting maternal depression and anxiety during pregnancy and the child's first five years of life

The frequent occurrence of depression in the postnatal period and early years of a child's life is a concern, given the scale of economic, societal, personal and interpersonal costs associated with depression(131, 132). The under recognition of mental illnesses in pregnancy and the postnatal period, particularly of anxiety disorders is recognised and highlighted by NICE and the Royal College of General Practitioners(138, 139). The low incidence rates of anxiety and comorbid depression with anxiety, may reflect true under ascertainment in primary care, but could also reflect poor data coding (e.g. Read code not entered in the medical record). For example, health visitors may screen women for mental health symptoms, but this may not be systematically captured in the primary care record. There is a need to consider further whether clinicians (i.e. GPs, health visitors) are discussing symptoms of depression and anxiety with patients and how this is being recorded in the medical record, which could be done through a qualitative study.

The detection of depression/anxiety within primary care could be improved through a number of mechanisms. Firstly, it is important that women are routinely screened for mental health symptoms during pregnancy and the postnatal period, as recommended by NICE(138)(Box 1). Positively, the government have increased numbers of health visitors between 2011 and 2015, with maternal mental health included as one of the six 'high impact areas' of the new health visiting service(380). Clinicians working with families during pregnancy and the early years (e.g. GPs, health visitors, midwives) should be aware that rates of depression are higher amongst younger mothers, those in deprived areas and those with a record of substance misuse. Secondly, research has demonstrated that the detection of mental disorders can be improved through staff training and education(331, 381, 382). This may increase confidence to manage cases detected by screening, to make decisions about use of medications, and to have greater

awareness of how to manage comorbid depression with anxiety. The provision of training to early year's staff (e.g. children's centres) about the signs and symptoms of depression/anxiety and where women can be referred to may be beneficial. Finally, health promotion and/or patient education programmes may help to make women more aware of the symptoms of depression/anxiety, reduce the stigma associated with mental illness, and make women aware of the support available to them.

Box 1: Summary of recommendations about detection of maternal depression/anxiety, NICE guideline CG192 Antenatal and postnatal mental health: clinical management and service guidance(138)

1.5.4 At a woman's first contact with primary care or her booking visit, and during the early postnatal period, consider asking the following depression identification questions as part of a general discussion about a woman's mental health and wellbeing:

- During the past month, have you often been bothered by feeling down, depressed or hopeless?
- During the past month, have you often been bothered by having little interest or pleasure in doing things?

Also consider asking about anxiety using the 2-item Generalized Anxiety Disorder scale (GAD-2):

- Over the last 2 weeks, how often have you been bothered by feeling nervous, anxious or on edge?
- Over the last 2 weeks, how often have you been bothered by not being able to stop or control worrying

1.5.5 If a woman responds positively to either of the depression identification questions in recommendation 1.5.4, is at risk of developing a mental health problem, or there is clinical concern, consider:

- using the Edinburgh Postnatal Depression Scale (EPDS) or the Patient Health Questionnaire (PHQ-9) as part of a full assessment or
- referring the woman to her GP or, if a severe mental health problem is suspected, to a mental health professional.

1.5.6 If a woman scores 3 or more on the GAD-2 scale, consider:

- using the GAD-7 scale for further assessment or
- referring the woman to her GP or, if a severe mental health problem is suspected, to a mental health professional.

1.5.8 At all contacts after the first contact with primary care or the booking visit, the health visitor, and other healthcare professionals who have regular contact with a woman in pregnancy and the postnatal period (first year after birth), should consider:

- asking the 2 depression identification questions and the GAD-2 (see recommendation 1.5.4) as part of a general discussion about her mental health and wellbeing and using the EPDS or the PHQ-9 as part of monitoring.

The finding that mothers with perinatal depression continued to have higher incidence rates of depression/anxiety throughout their child's first five years of life highlights the importance of early detection and management of recurrent depressive episodes. Studies assessing perinatal depression as a risk factor for child outcomes (e.g. behavioural and emotional problems(135)) may also need to take account of subsequent exposure to maternal depression/anxiety.

Researchers using primary care data to examine depression/anxiety need to be aware that the data captured reflects those seen within primary care services, and the nuances of primary care coding (e.g. affected by QOF, increases in symptom recording over time). As such, findings may not be comparable to community surveys using symptom screening tools, and associations between maternal depression/anxiety and maternal characteristics may in part reflect which patient groups present to their GP and receive a diagnosis.

8.2.5 Reducing injury risk among children of mothers with depression/anxiety

Addressing maternal depression/anxiety as a risk factor for child injury involves both recognition and effective treatment of maternal depression/anxiety (Section 8.2.3.2), and the use of interventions, such as those in Figure 8-1, to reduce the risk of child injuries. This particularly applies to those mothers experiencing prolonged and severe symptoms of depression/anxiety where the impact on child injury risk is potentially the greatest.

An important issue in the delivery of advice to mothers, particularly those with mental illnesses, is ensuring advice is non-judgemental, does not lead to blame, and empowers mothers to make changes. Encouraging clinicians working in primary (e.g. GPs, health visitors) and secondary care (e.g. psychiatrists, paediatricians) to '*think family*' is important. For clinicians caring for mothers with depression/anxiety, they should consider the impact of the illness on the mother-child relationship(138), and whether the mother and child would benefit from referral for particular support to improve the mother-child relationship, or to help with parenting(383) (e.g. parenting programmes, behaviour management programmes). Clinicians managing the health of the child should also consider the health of the mother; encouraging mothers to seek support (e.g. from their health visitor or GP, from support groups) and treatment if they have signs of depression/anxiety or their health is impacting on the health of the child. Clinicians and pharmacists can also have a role in preventing poisonings through provision of advice about safe medication storage and disposal when they are prescribing and dispensing medications; particularly in the case of medications that can cause particular harm (e.g. benzodiazepines, methadone(384)).

Among mothers with multiple and complex issues that potentially affect maternal mental health and child injuries (e.g. poverty, domestic violence, substance misuse, temporary accommodation), tackling these wider determinants of health is a potentially important mechanism to improve the health of both mother and child. Local authorities and CCGs should ensure connections are made between policy areas (e.g. between reducing child poverty and injuries), and that those working with families (e.g. GPs, health visitors) are aware of the services available (e.g. housing advice, domestic violence services). While this thesis has not specifically focused upon intentional injury or neglect, it is important to recognise that mental illness can in some cases affect the ability of the mother to meet the child's needs, which can result in injury. With moves to promote early intervention to support families in need, clinicians need to be aware of the local assessment tools and pathways available to gain access to these services(385); alongside there being good safeguarding training and policies in place.

8.3 Implications for future research

Implications for future research are outlined below, in light of the strengths and limitations of the work conducted.

Choice of injury outcomes

One of the challenges of injury research is that injuries encompass a broad range of conditions, of differing severities, which occur as a result of a range of mechanisms and intents. This means that the same injury event could be coded in multiple different ways; according to injury type (e.g. a fracture), mechanism (e.g. a fall), or intent (e.g. self-harm). For the purposes of this thesis it was not possible to estimate the incidence of all injuries in linked CPRD, HES and ONS mortality data due to the complexity of identifying incident events in the CPRD and linked data. Those using CPRD data in the future need to choose injury outcomes with some care, selecting those that are most likely to be well recorded within the primary care record, as for example, injury mechanisms (e.g. falls, contact heat and hot substances) were not well recorded for fractures or burns in the CPRD.

Validating injury Read codes in primary care

To date, only Read codes for vertebral and hip fractures have been validated(231, 247), through asking GPs to complete questionnaires confirming diagnoses of patients

identified in the CPRD (e.g. from discharge summaries, x-ray reports). There is a need for studies assessing the recording of injuries among children in primary care data, particularly as there are several less specific injury codes where it is difficult to determine how the code is used in clinical practice. This could be conducted, similar to previous studies(231, 247), through the use of a GP questionnaire asking them to confirm diagnoses of patients identified in the CPRD as having sustained an injury. On the other hand, a qualitative study asking GPs about how injuries are recorded in the primary care record could be used; exploring how information from secondary care is entered in the primary care record and whether there are factors affecting their use of clinical codes (e.g. injury type, severity, patient/family characteristics).

Linked emergency department data

An important limitation with the studies presented is the absence of linked ED data meaning that the incidence rates presented are likely to be underestimates. It is unknown how well information received from EDs is recorded in the primary care record (e.g. scanned in, use of non-specific codes). Linked ED data are due to be released by the CPRD during 2016. The addition of this data source should improve ascertainment of injury occurrences, although potentially adds another layer of complexity due to differences in how data are likely to be recorded. ED data have not consistently been coded in a standardised way and so consideration will need to be given as to which injury outcomes are most likely to be well coded across all data sources, and to the development of algorithms to avoid over counting injury occurrences. In addition, similar to the work presented in Section 4.5.2.1 it would be helpful to understand what proportion of injuries seen in EDs are captured in the primary care record.

Multiple injuries and injury severity

Among children aged 0-4 years old, recurrent injuries of the same type (e.g. repeated fractures) were uncommon (Section 6.3.2.1). What is not addressed in this thesis is the occurrence of repeated injuries of any type (e.g. child has a burn, followed by a poisoning). Observed associations between maternal depression/anxiety and child injuries may be stronger if those children sustaining repeated injuries of any type were identified. The work in this thesis could therefore be extended to other injury types, and further work could be conducted to define repeated injuries. For example, a first step would be to use the three injury outcomes described in this thesis together to identify those children sustaining repeated fractures, poisonings or burns.

Quantifying the severity of injuries, and the number of children sustaining multiple injuries within the same event (e.g. multiple fractures) is complex in the CPRD, due to, for example the use of non-specific codes (e.g. 43% of the fracture Read codes used did not specify an anatomical site) and potential selective recording of the most severe injuries by GPs. As injury severity, and the number of injury types and body regions injured affect functional and health status outcomes(386), quantifying this injury burden is potentially important. With potential differences in health seeking behaviours by patient characteristics and hospital admission thresholds, defining injury severity is important in epidemiological studies. Future studies using linked data will need to consider methods to systematically identify children sustaining multiple injuries and consider the feasibility of further defining injury severity within these data. Methods already exist to use ICD-10 codes to calculate injury severity scores(387, 388); methods which could be applied to HES data as a next step to define injury severity within these data.

Identifying families at risk of injury

Within this thesis (chapters 5-7) one child was randomly selected per mother. Primary care data is a potentially useful tool to identify high risk families who would benefit from home safety interventions and advice, as recommended by NICE(24). An issue not addressed within this thesis is the assessment of injury risk according to family unit. Those children sustaining injuries may have brothers or sisters who also have a higher injury risk (e.g. related to home environment, parental supervision, types of leisure activities). Describing the burden of injuries according to family, and family characteristics could support the development of injury prevention programmes and primary care risk assessment tools to flag families who might benefit from interventions (e.g. computer alert highlighting families where there have been repeated injuries within a certain time frame).

Confounders and the complex pathways between maternal mental illnesses and child injuries

The studies presented in chapters 5-7 have focused upon the mental health of the mother. A limitation of these studies is that paternal mental health and risk factors (e.g. paternal alcohol/drug misuse) have not been accounted for. It is possible that there could be an interaction between maternal and paternal mental illness, with any

association between maternal mental illness and child injuries greater if the father also has a mental illness. It is possible to identify adult males living in the same household as the mother-child pair within the CPRD(149); although this is limited in that only males registered at the same general practice and living at the same residential address as the mother-child pair can be identified. An extension to the work presented in this thesis would be to repeat the work, taking account of the mental health and risk factors of the adult male within the household.

The health of the child is a potentially important issue that could affect both the mental health of the mother, and the risk of injury; an issue not addressed within this thesis. Disabilities and long term medical conditions (e.g. epilepsy, diagnosed behavioural disorders) are relatively uncommon among preschool children(95, 389-391), and so are unlikely to have had a substantial impact on the study findings. In addition, there are a number of other variables that are difficult to measure and capture within primary care data. In particular measures of child supervision, child behaviour, traumatic life events, domestic violence, poor quality housing and single parenthood; factors which can cluster together and could affect the association between maternal mental illness and child injury(102, 107, 392). Figure 8-3 provides an illustration of some of this complexity, with some potential confounding factors also potentially lying on the causal pathway between maternal depression and childhood injuries. In reality, it is difficult to distinguish the order these events may occur in or the interactive effects these factors may have; issues which cannot readily be examined in primary care data. Understanding some of the challenges women face, and how numerous factors affect their experiences of living with depression and caring for their child could be explored through qualitative work, as discussed below.

Understanding the perceptions of mothers and clinicians around maternal mental illness and child injuries

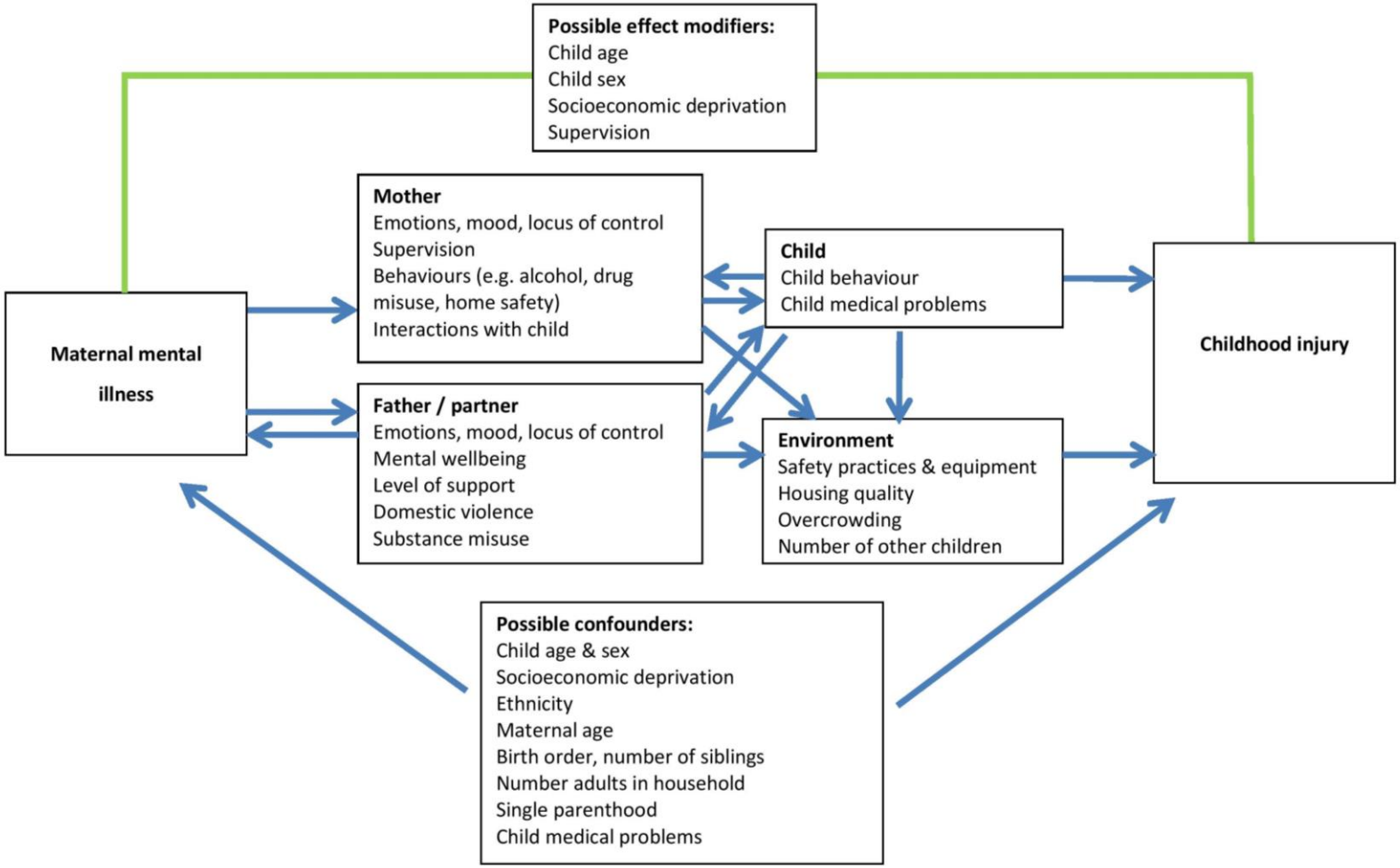
The work presented in this thesis has been purely quantitative, and as such cannot provide a deep understanding of the issues affecting mothers caring for young children, or the clinicians providing them with medical care. One of the biggest concerns around the topic of maternal mental illness and child injuries is that it could increase stigma associated with mental illness, and lead mothers to fear reporting child injuries to clinicians(138, 393, 394) (e.g. concern they would be seen as a 'bad/incompetent parent'). Qualitative work with mothers, to understand their experiences of living with

depression/anxiety and caring for their child would be beneficial; to understand the challenges they face, the interventions they might find useful (e.g. peer support, parenting interventions), and the best ways to communicate home safety messages. In addition, understanding the perceptions of clinicians (e.g. GPs, health visitors) would be useful; the extent to which they consider child injuries when a mother is diagnosed with depression/anxiety and their knowledge of local services which could support mothers.

Serious mental illnesses and child injuries

One of the gaps in the existing evidence base is the examination of the association between serious maternal mental illnesses (schizophrenia and bipolar disorder) and childhood injuries (Section 1.7.2). While the CPRD is very large, serious mental illnesses among mothers were rare, with 219 (0.1%) mothers newly diagnosed with schizophrenia or bipolar disorder during the child's follow-up. Based upon the three injury outcomes defined in this thesis, there was insufficient study power to assess differences in poisoning, fracture and burn rates between children of mothers with and without serious mental illnesses, with numbers of injury events in these children small (only 6 poisonings, 7 fractures and 6 burn events occurred before age 5 among the 219 children). Future studies could examine the association between serious maternal mental illnesses and child injuries by using a more common injury outcome (e.g. first injury of any type in the CPRD or all hospitalisations using measures of injury severity) and through increasing the number of mother-child pairs by extending the study period to 2016.

Figure 8-3: The complex pathways and potential confounders between maternal mental illnesses and the risk of childhood injuries



Assessing the impact of interventions for mothers with depression/anxiety on child injuries

The studies presented in chapters 6 and 7 demonstrate higher child injury rates among mothers with depression/anxiety. These studies do not however demonstrate causality and the observed associations could still be explained by residual confounding and biased definitions of exposure and outcome variables. If a causal relationship between maternal depression/anxiety and child injuries were to be present, one would expect the risk of child injuries to reduce when mothers are treated for depression/anxiety and symptoms improve. Future studies assessing the impact of interventions for maternal depression/anxiety (e.g. randomised controlled trials of pharmacological treatments or support groups/parenting interventions) could include child injuries as an outcome measure to assess whether these interventions altered child injury risk. As these studies would be unlikely to be powered to assess changes in child injury rates, this would need to be assessed via a meta-analysis of multiple studies that included this outcome.

A summary of the research questions arising from this thesis is shown in Table 8-2 and Table 8-3.

Table 8-2: Research questions arising from thesis: epidemiology of injuries and methodological developments

Areas for further research	Specific research questions	Suggested study methods
Methodological work using linked CPRD, HES and ONS mortality data		
Injury recording in the CPRD	• How accurate and reliable are the Read codes for poisonings, fractures and burns for identifying these injury types from primary care data?	GP questionnaire study assessing whether Read codes used to record injuries accurately identify the injury outcomes of interest. I.e. ask GP to confirm diagnosis of a particular injury type from scanned discharge letters, radiology reports
	• How do general practitioners record and code injury occurrences in primary care data?	Qualitative study asking GPs to describe how they record injuries and what affects their use of Read codes.
Addition of ED data	• What is the incidence of poisonings, fractures and burns in CPRD-HES-ED-ONS data? • What proportion of injury attendances at ED are captured by the CPRD?	Cohort study using ED data once linked to the CPRD. Development of algorithm to include ED attendances for injuries. Identification of the proportion of poisonings, fractures and burns seen in ED also captured by the CPRD database.
Defining injury severity	• What is the severity of injuries that children are admitted to hospital with?	Cohort study using linked CPRD-HES-ONS mortality data. Use of an injury severity score that has been applied to ICD-10 codes to classify hospitalised injuries according to severity. Would allow better definition of a group of serious injuries.
Epidemiology of injuries		
Extend injury incidence work to other injury types	• What are the patterns and trends over time of other important injuries, such as head injuries, drownings and threats to breathing?	Cohort study using CPRD-HES-ONS mortality data (and ED data when available).
Incidence of poisonings among young people	• What are the trends in the substances young people use in self-poisonings? How common are poisonings with other types of self-harm (e.g. cutting)? • Is the increase in poisoning incidence in 15-24 year olds over time a genuine trend (rather than changes in coding/admission thresholds)?	Further analysis using CPRD-HES-ONS data, estimating incidence over time according to poisoning substance. Identification of young people with concurrent records for other types of self-harm. Addition of linked ED data to CPRD when available.
Incidence of fractures	• Has there been increases in the incidence of particular fractures by anatomical site? • Is the increase in fracture incidence over time a genuine trend?	Further analysis using CPRD-HES-ONS data, estimating incidence over time according to anatomical site of fracture. Addition of linked ED data to the CPRD when available.

Table 8-3: Research questions arising from thesis: risk factors for injuries in preschool children

Areas for further research	Specific research questions	Suggested study methods
Paternal mental health and risk factors	• Is there an association between paternal mental illness and rates of child injuries? • Is the risk of child injury greater for children where both parents have mental health problems?	Cohort study using CPRD-HES data. Identify mother-father-child triads. Define episodes of paternal mental illness.
Families	• What are the characteristics of families where children have an increased risk of injury?	Cohort study within the CPRD. Identify 'family units' and use the family as the unit of analysis to identify risk factors for increased injury risk.
Qualitative work- experiences of mothers	• What are the experiences of mothers living with depression and/or anxiety and looking after young children? • What are their perceptions around keeping children safe and preventing injuries? What support would they find helpful? What ways do they want clinicians to communicate safety messages and provide support?	Qualitative study, e.g. semi-structured interviews with mothers who experienced mental health symptoms in the child's first five years of life.
Serious mental illnesses and chid injury	• Do children whose mothers have a serious mental illness have an increased rate of injury?	Cohort study of children whose mothers have a diagnosis of a serious mental illness, and matched controls whose mothers do not have a serious mental illness. Use of a more common injury outcome measure, such as hospitalised injuries with a measure of injury severity.

8.4 Conclusion

Injuries are a common occurrence in childhood and adolescence, with the epidemiology of injuries complex due to their recurring nature and that no single data source comprehensively identifies all injury occurrences. The ability to link routine primary care, hospitalisation and mortality data from England holds much potential for injury epidemiology and surveillance; particularly with additional linkage of emergency department data planned for the future. Increased rates of childhood injuries amongst mothers with depression/anxiety highlights the importance of prompt recognition and treatment of maternal mental illnesses, alongside providing advice to mothers about injury prevention and home safety interventions to reduce injury risk. Brown and Harris (1978) capture well the complex nature of depression and its wide ranging causes and effects; *"depression is not just another problem but a central link between many kinds of problems, those that may lead to depression and those that may follow"*(395). Preventing childhood injuries requires both holistic support to families, and policies to address the wider social, economic and environmental factors affecting both maternal mental illnesses and child injury risk.

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Appendices

Appendix 1: Details of literature search, epidemiology of injuries among children and young people

Studies describing the epidemiology of injuries among children and young people within the UK were identified through searching Medline, Embase, Cumulative Index to Nursing and Allied Health Literature (CINAHL) and PsycINFO using MeSH terms and free word searches for studies of injuries among children and/or young people occurring within the UK and published between 1995 and 2016. Additionally, reference lists of published studies were examined. Studies were excluded if they focused only on intentional injuries (non-accidental injury or self-harm), specific injury types (e.g. traumatic brain injury), or single mechanisms (e.g. road traffic incidents, trampoline injuries).

Appendix 2: Details of literature search, association between maternal mental illnesses and childhood injuries / child safety

Searches were carried out using MeSH search terms alongside free word searches of Medline, Embase, AMED, BNI, CINHAL and PsycINFO. Additional studies were identified through searching the reference lists of published studies.

Databases searched	Medline, EMBASE, CINAHL, AMED, BNI, PsychINFO
Dates	Medline 1946-present EMBASE 1974-present CINAHL 1981-present AMED 1985-present BNI 1992-present
Free word search terms	injur* OR accident* OR safety OR "unintentional injury" OR "injury prevention" OR poisoning OR burn OR fracture OR safety **AND** child* OR infant OR toddler OR baby OR "young child" **AND** depress* OR anxi* OR "perinatal anxiety" OR "perinatal depression" OR "postpartum depression" OR postnatal depression" OR "postnatal anxiety" OR "postpartum anxiety" OR schizo* OR bipolar OR "affective disorder" OR "psychiatric disorder" OR neurosis OR affective OR psychosis **AND** mother* OR maternal OR caregiver* OR parent*
MeSH search terms	exp CHILD OR exp CHILD, PRESCHOOL OR exp INFANT or exp INFANT,NEWBORN exp TODDLER OR exp BABY **AND** exp ACCIDENT PREVENTION/ OR exp ACCIDENT PRONENESS/ OR exp ACCIDENTAL FALLS/ OR exp ACCIDENTS/ OR exp ACCIDENTS, HOME/ OR exp ACCIDENTS, TRAFFIC/ OR exp ACCIDENTAL FALLS OR exp POISON OR exp POISONING or exp BURNS/ OR exp BURNS, CHEMICAL/ OR exp BURNS, ELECTRIC/ OR exp BURNS, INHALATION/ OR exp FRACTURE OR WOUNDS AND INJURIES **AND** exp DEPRESSION/ OR exp DEPRESSION, POSTPARTUM OR exp ANXIETY/ OR exp ANXIETY DISORDERS OR exp SCHIZOPHRENIA/ OR exp SCHIZOPHRENIA AND DISORDERS WITH PSYCHOTIC FEATURES/ OR exp SCHIZOPHRENIA, CATATONIC/ OR exp SCHIZOPHRENIA, DISORGANIZED/ OR exp SCHIZOPHRENIA, PARANOID OR exp BIPOLAR DISORDER OR exp BIPOLAR DEPRESSION OR exp MANIC DEPRESSION OR exp MIXED ANXIETY AND DEPRESSION OR exp PUERPURAL DEPRESSION OR exp PERINATAL DEPRESSION OR exp MENTAL DISORDER **AND** exp MOTHER-CHILD RELATIONS/ OR exp MOTHERS/ exp CAREGIVERS/ exp PARENT-CHILD RELATIONS/ OR exp PARENTS/ exp FATHER-CHILD RELATIONS OR exp FATHERS (1 AND 2) AND (3 AND 4)
Exclusions /restrictions	No restrictions were placed on the date of publication. Studies were excluded that were not published in English. Studies describing the impact of an injury on the caregiver's mental health were excluded (e.g. post traumatic stress disorder after serious child injury), as were studies specifically focusing on intentional harm/child abuse.

Appendix 3: Read code lists: Fractures, burns and poisonings

FRACTURES

Read code	Read code description
5134	X-ray # reduction control
7206100	Open reduction of fracture of orbit
7206400	Open reduction of fracture of orbit and internal fixation
7206700	Packing of maxilla to correct blow-out fracture of orbit
7206800	Internal fixation of fracture of orbit
7403600	Outfracture of turbinates of nose
7433300	Reduction of laryngeal fracture
7J02200	Elevation of depressed fracture of cranium
7J02300	Repair of fracture of cranium NEC
7J03.00	Reduction of fracture of facial bone
7J03000	Reduction of fracture of nasoethmoid complex of bones
7J03100	Reduction of fracture of nasal bones NEC
7J03200	Reduction of fracture of zygomatic bones
7J03300	Reduction of closed fracture of orbit bone
7J03y00	Other specified reduction of fracture of facial bone
7J03z00	Reduction of fracture of facial bone NOS
7J12.00	Reduction of fracture of mandible
7J12.11	Reduction of fracture of jaw NEC
7J12000	Reduction of fracture of alveolus of mandible
7J12100	Open reduction of fracture of mandible NEC
7J12200	Closed reduction of fracture of mandible NEC
7J12y00	Other specified reduction of fracture of mandible
7J12z00	Reduction of fracture of mandible NOS
7J13.00	Reduction of fracture of maxilla
7J13000	Reduction of fracture of alveolus of maxilla
7J13100	Open reduction of fracture of maxilla NEC
7J13200	Closed reduction of fracture of maxilla NEC
7J13300	Reduction of blowout fracture of orbital floor
7J13400	Reduction of Le Fort 1 fracture of maxilla
7J13500	Reduction of Le Fort 2 fracture of maxilla
7J13600	Reduction of Le Fort 3 fracture of maxilla
7J13y00	Other specified reduction of fracture of maxilla
7J13z00	Reduction of fracture of maxilla NOS
7J17700	Traction for fracture of jaw
7J41.00	Decompression of fracture of spine
7J41000	Complex decompression of fracture of spine
7J41100	Anterior decompression of fracture of spine
7J41200	Posterior decompression of fracture of spine
7J41300	Vertebroplasty of fracture of spine
7J41400	Posterior decompression of fracture of spine NEC
7J41500	Balloon kyphoplasty of fracture of spine
7J41y00	Other specified decompression of fracture of spine
7J41z00	Decompression of fracture of spine NOS
7J42.00	Other reduction of fracture of spine
7J42.11	Other reduction of fracture of spine and stabilisation
7J42000	Open reduction of fracture of spine & excis facet of spine
7J42100	Open reduction of fracture of spine NEC
7J42200	Manipulative reduction of fracture of spine
7J42300	Spinal extension traction for fracture of spine
7J42400	Halo skull traction for fracture of spine
7J42500	Spinal traction for fracture of spine NEC
7J42600	Primary bedrest stabilisation of spinal fracture
7J42700	Primary collar stabilisation of spinal fracture
7J42900	Primary cast stabilisation of spinal fracture
7J42B00	Primary other external stabilisation of spinal fracture
7J42L00	Primary cls reduction spinal fracture+bedrest stabilisation
7J42M00	Primary cls reduc spinal fracture+skull traction stabilisatn
7J42y00	Other specified other reduction of fracture of spine
7J42z00	Other reduction of fracture of spine NOS
7J43.00	Fixation of fracture of spine
7J43.11	Internal fixation of fracture of spine
7J43000	Primary open reduc spinal fracture+internal fix+plate
7J43100	Fixation of fracture of spine using Harrington rod
7J43200	Fixation of fracture of spine and skull traction HFQ
7J43211	Barr skull traction for fracture of spine
7J43300	Primary open reduc spinal fracture+internal fix+wire
7J43400	Primary open reduc spinal fracture+internal fix+rod system
7J43600	Primary open reduc spinal #+internal fix+internal fixator
7J43700	Primary open reduc spinal fracture+other internal fix
7J43y00	Other specified fixation of fracture of spine
7J43z00	Fixation of fracture of spine NOS
7K1D.00	Primary open reduction fracture bone & intramedull fixation
7K1D000	Prmy open red+int fxn prox femoral #+screw/nail+plate device
7K1D011	Prim open reduct # neck femur & op fix - Blount nail plate
7K1D012	Prim op red # nck femur & op fix- Charnley compression screw
7K1D013	Prim op red # nck femur & op fix - Deyerle multiple hip pin
7K1D014	Prim open reduct # neck femur & op fix - Holt nail
7K1D015	Prim open reduct # neck femur & op fix - Jewett nail plate
7K1D017	Prim open red # neck femur & op fix - McLaughlin nail plate
7K1D018	Prim open reduct # neck femur & op fix - Neufield nail plate
7K1D019	Prim open reduct # neck femur & op fix - Pugh nail plate
7K1D01A	Prim open reduct # neck femur & op fix - Richards screw
7K1D01B	Prim open reduct # neck femur & op fix - Ross Brown nail
7K1D01D	Prim op red # nck femur & op fix- Zickel intramed nail plate
7K1D01E	DHS - Dynamic hip screw primary fixation of neck of femur

7K1D01F	Dynamic hip screw primary fixation of neck of femur
7K1D100	Prim open reduct fract long bone & fixation rigid nail NEC
7K1D111	Kuntschner intramedullary fixation
7K1D200	Prim open reduct fract long bone & fixation flexible nail
7K1D211	Prim open red # long bone & fix - Ender flexi intramed nail
7K1D212	Prim open red # long bone & fix - Rush flexi intramedul nail
7K1D300	Prim open reduction fract small bone & fixation using screw
7K1D400	Prim open reduction fragment of bone & fixation using screw
7K1D411	Prim open reduction fragment of bone & fix - Herbert screw
7K1D500	Prim open reduction fragment bone & fixation using wire syst
7K1D511	K wiring of fracture
7K1D512	Fixation of bone fragment using Kirschner wire
7K1D600	Prmy open red+int fxn prox femoral #+screw/nail device alone
7K1D700	Prmy open red+int fxn prox fem #+screw/nail+intramed device
7K1D800	Prmy open reduction #+locked reamed intramedullary nail fxtn
7K1D900	Prmy open red #+locked unreamed intramedullary nail fixation
7K1DA00	Prmy open red #+unlocked reamed intramedullary nail fixation
7K1DB00	Prmy open reduction #+unlocked unreamed intramedullary nail
7K1DC00	Prmy open reduction of #+internal fixation with K-wire
7K1DD00	Prmy open reduction of #+intramedullary nail fixation
7K1DE00	Prim op red frac neck fem op fix us prox fem nail antirotatn
7K1Dy00	Prim open reduction fracture bone & intramedullary fixatn OS
7K1Dz00	Prim open reduction fracture bone & intramedull fixation NOS
7K1E.00	Primary open reduction fract bone & extramedullary fixation
7K1E000	Prmy open reduction of #+internal fixation with plate NEC
7K1E011	Prim open reduct fract long bone & fix using Eggers plate
7K1E012	Prim open reduct fract long bone & fix using Ellis plate
7K1E013	Prim open reduct fract long bone & fix using Hicks plate
7K1E100	Prmy open reduction #+internal fixation with cerclage wiring
7K1E112	Prim open reduct # long bone & fix - Parham circlage band
7K1E200	Prim open reduct fract long bone & extramedull fixatn suture
7K1E300	Prim open reduc fract long bone & cmplx extramedul fixat NEC
7K1E400	Prim open reduct fract ankle & complex extramedull fixat NEC
7K1E600	Prmy open reduction # elbow+fixation with Hook fixtn plate
7K1E700	Prmy open reduction #+internal fxn with tension band wiring
7K1E800	Prmy open reduction of #+internal fixation with screw(s)
7K1E900	Prmy open reduction #+int fxtn with multiple implant types
7K1EA00	Prim open reduct fract ankle & extramedull fixat NEC
7K1EB00	Prim open reduct fract ankle & complex extramedull fixat NEC
7K1Ey00	Prmy open reduction #+other int(extramedullary) fixation
7K1Ez00	Prim open reduction fracture bone & extramedull fixation NOS
7K1F.00	Primary open reduction of intraarticular fracture of bone
7K1F200	Prim fixat fragment chondral cartilage intraartic fract bone
7K1F300	Primary intraarticular fixation intraartic fracture bone NEC
7K1F400	Prim extraarticular reduction intraartic fracture bone NEC
7K1F500	Primary open reduction fracture patella fixat tension band
7K1Fy00	Primary open reduction of intraarticular fracture bone OS
7K1Fz00	Primary open reduction of intraarticular fracture bone NOS
7K1G.00	Other primary open reduction of fracture of bone
7K1G000	Prmy open reduction of fracture and skeletal traction
7K1G100	Prmy open reduction of fracture and external fixation
7K1G200	Primary open reduction+external fixation of femoral fracture
7K1G300	Primary open reduction of fracture alone
7K1G400	Primary open reduction of fracture and cast immobilisation
7K1G500	Primary open reduction of fracture and functional bracing
7K1G600	Primary open reduction of fracture and skin traction
7K1Gy00	Primary open reduction of #+other ext immobilisation
7K1Gy11	Primary open reduction of bone fracture & external fixation
7K1Gz00	Other primary open reduction of fracture of bone NOS
7K1J.00	Closed (or no) reduction of fracture and internal fixation
7K1J000	Cls red+int fxn proximal femoral #+screw/nail device alone
7K1J011	Cl red intracaps frac neck femur fix-Garden cannulated screw
7K1J012	Cl red intracaps fract neck femur fix - Smith-Petersen nail
7K1J013	Cls red+int fxn prox femoral #+Richard's cannulat hip screw
7K1J100	Closed reduction fract long bone & rigid internal fixatn NEC
7K1J200	Closed reduction fract long bone & flexible intern fixat HFQ
7K1J300	Closed reduction fracture small bone & fixation using screw
7K1J500	Primary int fxn(no red) prox fem #+screw/nail device alone
7K1J600	Primary int fxn(no red) prox fem #+scrw/nail+intramed device
7K1J700	Primary int fxn(no red) prox fem #+screw/nail+plate device
7K1JB00	Primary cls red+int fxn prox fem #+screw/nail device alone
7K1JC00	Prim cls rd+int fxn prox fem #+screw/nail+intramdulry device
7K1JD00	Primary cls red+int fxn prox fem #+screw/nail+plate device
7K1JH00	Primary wire fixation of fracture
7K1JK00	Primary closed reduction of fracture and wire fixation
7K1JM00	Primary cls reduction #+locked reamed intramed nail fxn
7K1JN00	Primary cls reduction #+locked unreamed intramed nail fxn
7K1JP00	Primary cls reduction #+unlocked reamed intramed nail fxn
7K1JQ00	Primary cls reduction #+unlocked unreamed intramed nail fxn
7K1JR00	Primary closed reduction #+internal fixation with wire
7K1JS00	Primary closed reduction #+internal fixation with screw(s)
7K1JT00	Primary closed reduction #+other internal fixation
7K1Jb00	Primary closed reduction #+intramed nail fixation
7K1Jd00	Closed reduction of intracapsular # NOF internal fixat DHS
7K1Jy00	Closed reduction of bone fracture and internal fixation OS
7K1Jz00	Closed reduction of bone fracture and internal fixation NOS
7K1K.00	Closed (or no) reduction of fracture and external fixation

7K1K000	Closed reduction fracture bone and fixation to skeleton HFQ
7K1K100	Closed reduct fract bone and fixat functional bracing system
7K1K300	Primary external fixation(without reduction) prox femoral #
7K1K500	Primary cls reduction+external fixation proximal femoral #
7K1K700	Primary functional bracing of fracture
7K1K800	Primary external fixation of fracture
7K1K900	Other primary external immobilisation of fracture
7K1KE00	Primary closed reduction of fracture and external fixation
7K1Ky00	Closed reduction of bone fracture and external fixation OS
7K1Kz00	Closed reduction of bone fracture and external fixation NOS
7K1Kz11	Closed reduction bone fract & fix with Gissane spike fixator
7K1L.00	Other closed reduction of fracture of bone
7K1L000	Primary closed reduction of # and skeletal traction NEC
7K1L011	Manipulation of fracture and skeletal traction NEC
7K1L100	Manipulation of fracture of bone NEC
7K1L400	Closed reduction of fracture of hip
7K1L500	Closed reduction of fracture of femur
7K1L600	Closed reduction of fracture of knee
7K1L700	Closed reduction of fracture of tibia and or fibula
7K1L800	Closed reduction of fracture of ankle
7K1L900	Closed reduction of fracture of metatarsus
7K1LA00	Closed reduction of fracture of toe
7K1LB00	Closed reduction of fracture of hallux
7K1LC00	Closed reduction of fracture of lower limb
7K1LC11	Closed reduction # leg
7K1LD00	Closed reduction of fracture of nasal bone
7K1LE00	Closed reduction of fracture of elbow
7K1LF00	Closed reduction of fracture of humerus
7K1LG00	Closed reduction of fracture of shoulder
7K1LH00	Closed reduction of fracture of finger
7K1LJ00	Closed reduction of fracture of thumb

7K1LK00	Closed reduction of fracture of metacarpus
7K1LL00	Closed reduction of fracture of radius and or ulna
7K1LM00	Closed reduction of fracture of wrist
7K1LN00	Closed reduction of fracture of upper limb
7K1LN11	Closed reduction # arm
7K1LT00	Primary closed reduction of fracture and cast immobilisation
7K1LV00	Primary closed reduction of fracture alone
7K1LW00	Primary closed reduction of fracture and skin traction
7K1LZ00	Primary skin traction of fracture
7K1Lb00	Primary cast immobilisation of fracture
7K1Ld00	Primary arthroscopic reduction of fracture
7K1Le00	Primary arthroscopic reduction and fixation of fracture
7K1Ly00	Other specified other closed reduction of fracture of bone
7K1Lz00	Other closed reduction of fracture of bone NOS
7K1M.00	Fixation of epiphysis
7K1M400	Temporary fixation epiphysis
7K1M500	Hip pin for fixation of epiphysis
7K1M511	Fixation of epiphysis using Adams hip pin
7K1My00	Other specified fixation of epiphysis
7K1Mz00	Fixation of epiphysis NOS
7K1N900	Primary skeletal traction of fracture
7K1T100	Debridement of open fracture
7K1Y.00	Sec cls red fr bne and int fix
7K1Y100	Rema fr lng bo rig int fix NEC
7K1Y400	Remanip frag bone fix us screw
7K1Yz00	Sec clsd red fr bo int fix NOS
7K6F000	Primry opn redctn of # dislocation of jt + skeletal traction
7K6F200	Primary open reduction of fracture dislocation of joint NEC
7K6F400	Open reduction of # dislocation of joint+fxn of jnt,unspec
7K6FE00	Primary open reduction of fracture dislocation alone
7K6FF00	Primary open reduction of # dislocation+cast immobilisation
7K6FJ00	Primary open reduction of # dislocation+wire fixation

7K6FK00	Primary open reduction of # dislocation+external fixation
7K6FM00	Primary open reduction of # dislocation+fixation+screw(s)
7K6FN00	Primary open reduction of # dislocation+fixation+plate(s)
7K6FP00	Primary open reduction # dislocation+other jnt stabilisation
7K6FQ00	Primary open reduction # dislocation joint internal fix NEC
7K6FR00	Primary open reduct # dislocat joint comb int external fix
7K6G000	Primary closed reduction # dislocation jnt+skeletal traction
7K6GK00	Prim closed reduc fract dislocat joint and internal fixation
7K6GN00	Closed reduction fracture disloc joint & internal fixation
7K6GX00	Primary closed reduction of fracture dislocation alone
7K6GY00	Primary closed reduction of # dislocation+cast immobil
7K6Gb00	Primary closed reduction # dislocation+fixation by wire(s)
7K6Gc00	Primary closed reduction of # dislocation+external fixation
7K6Gd00	Primary closed reduction # dislocation+other extrnal immobil
7K6Hh00	Sec open red fracture dislocat joint and intern fixation NEC
7K6J.00	Primary reduction of injury to growth plate
7K6J000	Open reduction injury growth plate and internal fixation HFQ
7K6J200	Open reduction of injury to growth plate NEC
7K6J300	Closed reduction injury growth plate & internal fixation HFQ
7K6J500	Closed reduction of injury to growth plate NEC
7K6Jz00	Primary reduction of injury to growth plate NOS
82...11	Closed reduction of fracture
8F86.00	Convalesc. after fracture Rx
8HB9.00	Fracture therapy follow-up
8HTo.00	Referral to fracture clinic
9N0X.00	Seen in fracture clinic
J051000	Loss of teeth due to an accident
N331.13	Sponanteous fracture
S0...00	Fracture of skull
S00..00	Fracture of vault of skull
S00..11	Frontal bone fracture

S00..12	Parietal bone fracture
S000.00	Closed fracture vault of skull without intracranial injury
S000000	Closed #skull vlt no intracranial injury, unspec state consc
S000100	Closed #skull vlt no intracranial injury, no loss of consc
S000200	Closed #skull vlt no intracranial injury, <1hr loss of consc
S000300	Closed #skull vlt no intracranial injury, 1-24hr loss consc
S000500	Closed #skull vlt no intracranial inj,>24hr LOC not restored
S000600	Closed #skull vlt no intracranial inj, LOC unspec duration
S000z00	Closed #skull vlt no intracranial injury + concussion unspec
S001.00	Closed fracture vault of skull with intracranial injury
S001000	Closed #skull vlt + intracranial injury, unspec state consc
S001100	Closed #skull vlt + intracranial injury, no loss of consc
S001200	Closed #skull vlt + intracranial injury, <1hr loss of consc
S001300	Closed #skull vlt + intracranial injury, 1-24hr loss consc
S001400	Closed #skull vlt + intracranial injury, >24hr LOC+recovery
S001600	Closed #skull vlt + intracranial injury, LOC unspec duration
S001z00	Closed #skull vlt with intracranial injury+concussion unspec
S002.00	Open fracture vault of skull without intracranial injury
S002000	Open #skull vlt no intracranial injury, unspec state consc
S002100	Open #skull vlt no intracranial injury, no loss of consc
S003.00	Open fracture vault of skull with intracranial injury
S003000	Open #skull vlt + intracranial injury, unspec state of consc
S003100	Open #skull vlt + intracranial injury, no loss of consc
S003400	Open #skull vlt + intracranial injury, >24hr LOC + recovery
S003600	Open #skull vlt + intracranial injury, LOC unspec duration
S003z00	Open #skull vlt with intracranial injury + concussion unspec
S00z.00	Fracture of vault of skull NOS
S01..00	Fracture of base of skull
S01..11	Anterior fossa fracture
S01..12	Ethmoid sinus fracture
S01..13	Frontal sinus fracture
S01..14	Middle fossa fracture
S01..15	Occiput bone fracture

S01..16	Orbital roof fracture
S01..17	Posterior fossa fracture
S01..18	Sphenoid bone fracture
S01..19	Temporal bone fracture
S010.00	Closed fracture base of skull without intracranial injury
S010000	Closed #skull bse no intracranial injury, unspec state consc
S010100	Closed #skull bse no intracranial injury, no loss of consc
S010200	Closed #skull bse no intracranial injury, <1hr loss of consc
S010400	Closed #skull bse no intracranial injury, >24hr LOC+recovery
S010600	Closed #skull bse no intracranial inj, LOC unspec duration
S010z00	Closed #skull bse no intracranial injury + concussion unspec
S011.00	Closed fracture base of skull with intracranial injury
S011000	Closed #skull bse + intracranial inj, unspec state of consc
S011300	Closed #skull bse + intracranial injury, 1-24hr loss consc
S011400	Closed #skull bse + intracranial injury, >24hr LOC+recovery
S011600	Closed #skull bse + intracranial injury, LOC unspec duration
S012.00	Open fracture base skull without mention intracranial injury
S012200	Open #skull bse no intracranial injury, <1hr loss of consc
S013.00	Open fracture base of skull with intracranial injury
S013200	Open #skull bse + intracranial injury, <1hr loss of consc
S013400	Open #skull bse + intracranial injury, >24hr LOC + recovery
S013600	Open #skull bse + intracranial injury, LOC unspec duration
S013z00	Open #skull bse + intracranial injury + concussion unspec
S01z.00	Fracture of base of skull NOS
S02..00	Fracture of face bones
S020.00	Closed fracture nose
S020.11	Closed fracture nasal bone
S021.00	Open fracture nose
S021.11	Open fracture nasal bone
S022.00	Fracture of mandible, closed
S022.11	Fracture of inferior maxilla, closed
S022.12	Fracture of lower jaw, closed

S022000	Closed fracture mandible (site unspecified)
S022100	Closed fracture of mandible, condylar process
S022200	Closed fracture of mandible, subcondylar
S022300	Closed fracture of mandible, coronoid process
S022400	Closed fracture of mandible, ramus, unspecified
S022500	Closed fracture of mandible, angle of jaw
S022600	Closed fracture of mandible, symphysis of body
S022700	Closed fracture of mandible, alveolar border of body
S022800	Closed fracture of mandible, body, other and unspecified
S022x00	Closed fracture of mandible, multiple sites
S022z00	Fracture of mandible, closed, NOS
S023.00	Fracture of mandible, open
S023.11	Fracture of lower jaw, open
S023000	Open fracture mandible (site unspecified)
S023100	Open fracture of mandible, condylar process
S023200	Open fracture of mandible, subcondylar
S023400	Open fracture of mandible, ramus, unspecified
S023500	Open fracture of mandible, angle of jaw
S023600	Open fracture of mandible, symphysis of body
S023700	Open fracture of mandible, alveolar border of body
S023800	Open fracture of mandible, body, other and unspecified
S023x00	Open fracture of mandible, multiple sites
S023z00	Fracture of mandible, open, NOS
S024.00	Fracture of malar or maxillary bones, closed
S024.11	Fracture of upper jaw, closed
S024000	Closed fracture maxilla
S024100	Closed fracture zygoma
S024z00	Fracture of malar or maxillary bones, closed, NOS
S025.00	Fracture of malar or maxillary bones, open
S025.11	Fracture of upper jaw, open
S025000	Open fracture maxilla
S025100	Open fracture zygoma
S025z00	Fracture of malar or maxillary bones, open, NOS

S026.00	Closed orbital blow-out fracture
S027.00	Open orbital blow-out fracture
S028.00	Fracture of skull and facial bones
S028000	Fracture of nasal bones
S028100	Fracture of orbital floor
S028200	Fracture of malar and maxillary bones
S028300	Fracture of mandible
S02A.00	Le Fort I fracture maxilla
S02B.00	Le Fort II fracture maxilla
S02C.00	Le Fort III fracture maxilla
S02x.00	Closed fracture other facial bone
S02x000	Fracture of alveolus, closed
S02x100	Fracture of orbit NOS, closed
S02x200	Fracture of palate, closed
S02xz00	Fracture of other facial bones, closed, NOS
S02y.00	Open fracture other facial bone
S02y000	Fracture of alveolus, open
S02y100	Fracture of orbit NOS, open
S02y200	Fracture of palate, open
S02yz00	Fracture of other facial bones,open, NOS
S02z.00	Fracture of facial bone NOS
S02z.11	Jaw fracture NOS
S03..00	Other and unqualified skull fractures
S030.00	Closed fracture of skull NOS without intracranial injury
S030100	Closed #skull NOS no intracranial inj, no loss of consc
S030300	Closed #skull NOS no intracranial inj, 1-24hr loss of consc
S030z00	Closed #skull NOS no intracranial inj + concussion unspec
S031.00	Closed fracture of skull NOS with intracranial injury
S031200	Closed #skull NOS + intracranial inj, <1hr loss of consc
S031300	Closed #skull NOS + intracranial inj, 1-24hrs loss of consc
S031600	Closed #skull NOS + intracranial inj, LOC unspec duration
S032.00	Open #skull NOS without mention of intracranial injury
S032z00	Open #skull NOS no intracranial inj + concussion unspec

S033.00	Open fracture of skull NOS with intracranial injury
S03z.00	Skull fracture NOS
S03z.11	Depressed skull fracture NOS
S04..00	Multiple fractures involving skull or face with other bones
S04..11	Multiple face fractures
S04..12	Multiple skull fractures
S040.00	Mult #skull/face+other bones, closed, no intracranial injury
S040000	Closed #skull/face, mult, no intracranial inj, unspec consc
S040100	Closed #skull/face, mult, no intracranial inj, no loss consc
S040200	Closed #skull/face, mult, no intracranial inj, <1hr LOC
S041.00	Mult #skull/face+other bones, closed + intracranial injury
S041000	Closed #skull/face, mult + intracranial inj, unspec consc
S041300	Closed #skull/face, mult + intracranial inj, 1-24hrs LOC
S041600	Closed #skull/face,mult + intracran inj, LOC unspec duration
S041z00	Closed #skull/face,mult + intracran inj, concussion unspec
S042.00	Mult #skull/face + other bones, open, no intracranial injury
S043000	Open #skull/face, mult + intracranial inj, unspec consc
S043400	Open #skull/face, mult + intracran inj, >24hr LOC + recovery
S044.00	Multiple fractures involving skull and facial bones
S04z.00	Multiple fractures involving skull/face with other bones NOS
S0z..00	Fracture of skull NOS
S1...00	Fracture of neck and trunk
S10..00	Fracture of spine without mention of spinal cord injury
S10..11	Fracture of transverse process spine - no spinal cord lesion
S10..12	Fracture of vertebra without spinal cord lesion
S100.00	Closed fracture of cervical spine
S100000	Closed fracture of unspecified cervical vertebra
S100100	Closed fracture atlas
S100111	C1 vertebra closed fracture - no spinal cord lesion
S100200	Closed fracture axis
S100211	C2 vertebra closed fracture without spinal cord lesion
S100300	Closed fracture of third cervical vertebra

S100311	C3 vertebra closed fracture without spinal cord lesion
S100400	Closed fracture of fourth cervical vertebra
S100411	C4 vertebra closed fracture without spinal cord lesion
S100500	Closed fracture of fifth cervical vertebra
S100511	C5 vertebra closed fracture without spinal cord lesion
S100600	Closed fracture of sixth cervical vertebra
S100611	C6 vertebra closed fracture without spinal cord lesion
S100700	Closed fracture of seventh cervical vertebra
S100711	C7 vertebra closed fracture without spinal cord lesion
S100800	Closed fracture atlas, isolated arch or articular process
S100900	Closed fracture atlas, comminuted
S100A00	Closed fracture axis, odontoid process
S100B00	Closed fracture axis, spondylolysis
S100C00	Closed fracture axis, spinous process
S100D00	Closed fracture axis, transverse process
S100E00	Closed fracture axis, posterior arch
S100G00	Closed fracture cervical vertebra, burst
S100H00	Closed fracture cervical vertebra, wedge
S100J00	Closed fracture cervical vertebra, spondylolysis
S100K00	Closed fracture cervical vertebra, spinous process
S100L00	Closed fracture cervical vertebra, transverse process
S100M00	Closed fracture cervical vertebra, posterior arch
S100x00	Multiple closed fractures of cervical vertebrae
S100z00	Closed fracture of cervical spine not otherwise specified
S101.00	Open fracture of cervical spine
S101000	Open fracture of unspecified cervical vertebra
S101100	Open fracture atlas
S101111	C1 vertebra open fracture without spinal cord lesion
S101200	Open fracture axis
S101211	C2 vertebra open fracture without spinal cord lesion
S101311	C3 vertebra open fracture without spinal cord lesion
S101500	Open fracture of fifth cervical vertebra
S101511	C5 vertebra open fracture without spinal cord lesion

S101600	Open fracture of sixth cervical vertebra
S101611	C6 vertebra open fracture without spinal cord lesion
S101711	C7 vertebra open fracture without spinal cord lesion
S101A00	Open fracture axis, odontoid process
S101x00	Multiple open fractures of cervical vertebrae
S102.00	Closed fracture thoracic vertebra
S102000	Closed fracture thoracic vertebra, burst
S102100	Closed fracture thoracic vertebra, wedge
S102200	Closed fracture thoracic vertebra, spondylolysis
S102300	Closed fracture thoracic vertebra, spinous process
S102400	Closed fracture thoracic vertebra, transverse process
S102500	Closed fracture thoracic vertebra, posterior arch
S102y00	Other specified closed fracture thoracic vertebra
S102z00	Closed fracture thoracic vertebra not otherwise specified
S103.00	Open fracture thoracic vertebra
S103100	Open fracture thoracic vertebra, wedge
S103500	Open fracture thoracic vertebra, posterior arch
S104.00	Closed fracture lumbar vertebra
S104000	Closed fracture lumbar vertebra, burst
S104100	Closed fracture lumbar vertebra, wedge
S104200	Closed fracture lumbar vertebra, spondylolysis
S104300	Closed fracture lumbar vertebra, spinous process
S104400	Closed fracture lumbar vertebra, transverse process
S104500	Closed fracture lumbar vertebra, posterior arch
S104600	Closed fracture lumbar vertebra, tricolumnar
S105.00	Open fracture lumbar vertebra
S105000	Open fracture lumbar vertebra, burst
S105100	Open fracture lumbar vertebra, wedge
S105400	Open fracture lumbar vertebra, transverse process
S106.00	Closed fracture sacrum
S106000	Closed compression fracture sacrum
S106100	Closed vertical fracture of sacrum
S107.00	Open fracture sacrum
S107000	Open compression fracture sacrum
S107100	Open vertical fracture of sacrum
S108.00	Closed fracture pelvis, coccyx
S109.00	Open fracture pelvis, coccyx
S10A.00	Fracture of neck
S10A000	Fracture of first cervical vertebra
S10A100	Fracture of second cervical vertebra
S10A200	Multiple fractures of cervical spine
S10B.00	Fracture of lumbar spine and pelvis
S10B000	Fracture of lumbar vertebra
S10B100	Fracture of sacrum
S10B200	Fracture of coccyx
S10B300	Fracture of ilium
S10B400	Fracture of acetabulum
S10B500	Fracture of pubis
S10B600	Multiple fractures of lumbar spine and pelvis
S10x.00	Closed fracture of spine, unspecified,
S10y.00	Open fracture of spine, unspecified,
S10z.00	Fracture of spine without mention of spinal cord lesion NOS
S11..00	Fracture of spine with spinal cord lesion
S11..11	Fracture of transverse process of spine + spinal cord lesion
S11..12	Fracture of vertebra with spinal cord lesion
S110.00	Closed fracture of cervical spine with cord lesion
S110000	Cls spinal fracture with unspec cervical cord lesion, C1-4
S110500	Cls spinal # with incomplete cervical cord lesion, C1-4 NOS
S110600	Cls spinal fracture with unspec cervical cord lesion, C5-7
S110700	Cls spinal fracture with complete cervcl cord lesion, C5-7
S110800	Cls spinal fracture with anterior cervcl cord lesion, C5-7
S110B00	Cls spinal # with incomplete cervical cord lesion, C5-7 NOS
S110z00	Closed fracture of cervical spine with cord lesion NOS
S111.00	Open fracture of cervical spine with spinal cord lesion
S112.00	Closed fracture of thoracic spine with spinal cord lesion
S112100	Cls spinal fracture wth complete thoracic cord lesion,T1-6
S112600	Cls spinal fracture with unspec thoracic cord lesion, T7-12
S112700	Cls spinal fracture with complete thorac cord lesion, T7-12
S112A00	Cls spinal fracture with posterior thorac cord lesion, T7-12
S112B00	Cls spinal # with incomplete thoracid cord lesion, T7-12 NOS
S112z00	Closed fracture of thoracic spine with cord lesion NOS
S113.00	Open fracture of thoracic spine with spinal cord lesion
S113000	Opn spinal fracture with unspec thoracic cord lesion, T1-6
S113A00	Opn spinal fracture with posterior thorac cord lesion, T7-12
S114.00	Closed fracture of lumbar spine with spinal cord lesion
S114000	Closed spinal fracture with unspecified lumbar cord lesion
S114100	Closed spinal fracture with complete lumbar cord lesion
S114500	Closed spinal fracture with cauda equina lesion
S115.00	Open fracture of lumbar spine with spinal cord lesion
S116.00	Closed fracture of sacrum with spinal cord lesion
S116z00	Closed fracture of sacrum with spinal cord lesion NOS
S117.00	Open fracture of sacrum with spinal cord lesion
S117300	Open fracture of sacrum with other spinal cord injury
S118.00	Closed fracture of coccyx with spinal cord lesion
S118z00	Closed fracture of coccyx with spinal cord lesion NOS
S11x.00	Closed fracture of spine with spinal cord lesion unspecified
S11z.00	Fracture of spine with spinal cord lesion NOS
S12..00	Fracture of rib(s), sternum, larynx and trachea
S120.00	Closed fracture rib
S120000	Closed fracture of rib, unspecified
S120100	Closed fracture of one rib
S120200	Closed fracture of two ribs
S120300	Closed fracture of three ribs
S120400	Closed fracture of four ribs
S120500	Closed fracture of five ribs
S120600	Closed fracture of six ribs
S120700	Closed fracture of seven ribs

S120800	Closed fracture of eight or more ribs
S120900	Closed fracture multiple ribs
S120A00	Cough fracture
S120z00	Closed fracture of rib(s) NOS
S121.00	Open fracture rib
S121000	Open fracture of rib, unspecified
S121200	Open fracture of two ribs
S121700	Open fracture of seven ribs
S121900	Open fracture multiple ribs
S121z00	Open fracture of rib(s) NOS
S122.00	Closed fracture sternum
S123.00	Open fracture sternum
S124.00	Flail chest
S124000	Closed flail chest
S125.00	Closed fracture larynx and trachea
S125000	Closed fracture larynx
S125100	Closed fracture of hyoid bone
S125200	Closed fracture of thyroid cartilage
S125300	Closed fracture of trachea
S126100	Open fracture of hyoid bone
S126300	Open fracture of trachea
S127.00	Fracture of rib
S127000	Multiple fractures of ribs
S127100	Cough fracture of ribs
S128.00	Fracture of sternum
S12X.00	Fracture of bony thorax, part unspecified
S12X000	Closed fracture of bony thorax part unspecified
S12y.00	Fracture of other parts of bony thorax
S12y000	Closed fracture of other parts of bony thorax
S12z.00	Fracture of rib(s), sternum, larynx or trachea NOS
S12z.11	Rib fracture NOS
S12z.12	Sternum fracture NOS
S13..00	Fracture or disruption of pelvis

S130.00	Closed fracture acetabulum
S130000	Closed fracture acetabulum, anterior lip alone
S130100	Closed fracture acetabulum, posterior lip alone
S130200	Closed fracture acetabulum, anterior column
S130300	Closed fracture acetabulum, posterior column
S130400	Closed fracture acetabulum, floor
S130600	Closed fracture acetabulum, double column unspecified
S130y00	Other specified closed fracture acetabulum
S130z00	Closed fracture acetabulum NOS
S131.00	Open fracture acetabulum
S131y00	Other specified open fracture acetabulum
S131z00	Open fracture acetabulum NOS
S132.00	Closed fracture pubis
S132000	Closed fracture pelvis, single pubic ramus
S132100	Closed fracture pelvis, multiple pubic rami - stable
S132200	Closed fracture pelvis, multiple pubic rami - unstable
S132y00	Other specified closed fracture pubis
S132z00	Closed fracture pubis NOS
S133.00	Open fracture of pubis
S133000	Open fracture pelvis, single pubic ramus
S133100	Open fracture pelvis, multiple pubic rami - stable
S133200	Open fracture pelvis, multiple pubic rami - unstable
S133y00	Other specified open fracture of pubis
S133z00	Open fracture of pubis NOS
S134.00	Other or multiple closed fracture of pelvis
S134000	Closed fracture of ilium, unspecified
S134100	Closed fracture pelvis, ischium
S134200	Closed multiple disruptions of pelvis
S134300	Closed fracture pelvis, ischial tuberosity
S134400	Closed fracture pelvis, anterior superior iliac spine
S134500	Closed fracture pelvis, anterior inferior iliac spine
S134600	Closed fracture pelvis, iliac wing
S134700	Closed vertical fracture of ilium

S134800	Closed fracture dislocation of sacro-iliac joint
S134z00	Other or multiple closed fracture of pelvis NOS
S135.00	Other or multiple open fracture of pelvis
S135000	Open fracture of ilium, unspecified
S135200	Open multiple disruptions of pelvis
S135300	Open fracture pelvis, ischial tuberosity
S135400	Open fracture pelvis, anterior superior iliac spine
S135600	Open fracture pelvis, iliac wing
S135800	Open fracture dislocation of sacro-iliac joint
S135y00	Other open fracture of pelvis
S135z00	Other/multiple open fracture of pelvis NOS
S136.00	Closed complete rupture of pelvic ring
S136000	Closed complete rupture pubic symphysis
S136100	Closed complete rupture sacro-iliac joint
S137.00	Open complete rupture of pelvic ring
S137000	Open complete rupture pubic symphysis
S137100	Open complete rupture of sacro-iliac joint
S138.00	Traumatic rupture of symphysis pubis
S13y.00	Closed fracture of pelvis NOS
S13z.00	Open fracture of pelvis NOS
S14..00	Fracture of ill-defined bones of trunk
S140.00	Closed fracture of ill-defined bone of trunk
S14z.00	Fracture of ill-defined bone of trunk NOS
S15..00	Fracture of thoracic vertebra
S150.00	Multiple fractures of thoracic spine
S150000	Closed multiple fractures of thoracic spine
S150100	Open multiple fracture of thoracic spine
S1z..00	Fracture of neck and trunk NOS
S2...00	Fracture of upper limb
S2...11	Arm fracture
S20..00	Fracture of clavicle
S20..11	Collar bone fracture
S200.00	Closed fracture of clavicle

S200000	Closed fracture of clavicle, unspecified part
S200100	Closed fracture clavicle, medial end
S200200	Closed fracture clavicle, shaft
S200300	Closed fracture clavicle, lateral end
S200z00	Closed fracture of clavicle NOS
S201.00	Open fracture of clavicle
S201000	Open fracture of clavicle, unspecified part
S201100	Open fracture clavicle, medial end
S201200	Open fracture clavicle, shaft
S201300	Open fracture clavicle, lateral end
S201z00	Open fracture of clavicle NOS
S20z.00	Fracture of clavicle NOS
S21..00	Fracture of scapula
S21..11	Shoulder blade fracture
S210.00	Closed fracture of scapula
S210000	Closed fracture of scapula, unspecified part
S210100	Closed fracture scapula, acromion
S210200	Closed fracture scapula, coracoid
S210300	Closed fracture scapula, glenoid
S210400	Closed fracture scapula, blade
S210500	Closed fracture scapula, spine
S210600	Closed fracture scapula, neck
S210z00	Closed fracture of scapula NOS
S211.00	Open fracture of scapula
S211000	Open fracture of scapula, unspecified part
S211100	Open fracture scapula, acromion
S211200	Open fracture scapula, coracoid
S211300	Open fracture scapula, glenoid
S211400	Open fracture scapula, blade
S211600	Open fracture scapula, neck
S211z00	Open fracture of scapula NOS
S21z.00	Fracture of scapula NOS
S22..00	Fracture of humerus

S220.00	Closed fracture of the proximal humerus
S220000	Closed fracture of proximal humerus, unspecified part
S220100	Closed fracture proximal humerus, neck
S220200	Closed fracture of proximal humerus, anatomical neck
S220300	Closed fracture proximal humerus, greater tuberosity
S220400	Closed fracture proximal humerus, head
S220500	Closed fracture of humerus, upper epiphysis
S220600	Closed fracture proximal humerus, three part
S220700	Closed fracture proximal humerus, four part
S220z00	Closed fracture of proximal humerus not otherwise specified
S221.00	Open fracture of the proximal humerus
S221.11	Shoulder fracture - open
S221000	Open fracture of proximal humerus, unspecified part
S221100	Open fracture proximal humerus, neck
S221200	Open fracture of proximal humerus, anatomical neck
S221300	Open fracture proximal humerus, greater tuberosity
S221400	Open fracture proximal humerus, head
S221500	Open fracture of humerus, upper epiphysis
S221600	Open fracture proximal humerus, three part
S221700	Open fracture proximal humerus, four part
S221z00	Open fracture of proximal humerus not otherwise specified
S222.00	Closed fracture of humerus, shaft or unspecified part
S222000	Closed fracture of humerus NOS
S222100	Closed fracture of humerus, shaft
S222z00	Closed fracture of humerus, shaft or unspecified part NOS
S223.00	Open fracture of humerus, shaft or unspecified part
S223000	Open fracture of humerus NOS
S223100	Open fracture of humerus, shaft
S223z00	Open fracture of humerus, shaft or unspecified part NOS
S224.00	Closed fracture of the distal humerus
S224.11	Elbow fracture - closed
S224000	Closed fracture of elbow, unspecified part

S224100	Closed fracture distal humerus, supracondylar
S224200	Closed fracture distal humerus, lateral condyle
S224300	Closed fracture distal humerus, medial condyle
S224400	Closed fracture of distal humerus, condyle(s) unspecified
S224500	Closed fracture of distal humerus, trochlea
S224600	Closed fracture distal humerus, lateral epicondyle
S224700	Closed fracture distal humerus, medial epicondyle
S224800	Closed fracture distal humerus, capitellum
S224900	Closed fracture distal humerus, bicondylar (T-Y fracture)
S224x00	Closed fracture of distal humerus, multiple
S224z00	Closed fracture of distal humerus, not otherwise specified
S225.00	Open fracture of the distal humerus
S225.11	Elbow fracture - open
S225000	Open fracture of elbow, unspecified part
S225100	Open fracture distal humerus, supracondylar
S225200	Open fracture distal humerus, lateral condyle
S225300	Open fracture distal humerus, medial condyle
S225400	Open fracture of distal humerus, condyle(s) unspecified
S225500	Open fracture of distal humerus, trochlea
S225600	Open fracture distal humerus, lateral epicondyle
S225700	Open fracture distal humerus, medial epicondyle
S225800	Open fracture distal humerus, capitellum
S225900	Open fracture distal humerus, bicondylar (T-Y fracture)
S225x00	Open fracture of distal humerus, multiple
S225z00	Open fracture of distal humerus, not otherwise specified
S226.00	Fracture of upper end of humerus
S227.00	Fracture of shaft of humerus
S228.00	Fracture of lower end of humerus
S22z.00	Fracture of humerus NOS
S23..00	Fracture of radius and ulna
S23..11	Forearm fracture
S230.00	Closed fracture of proximal radius and ulna
S230000	Closed fracture of proximal forearm, unspecified part

S230100	Closed fracture olecranon, extra-articular
S230200	Closed fracture of ulna, coronoid
S230300	Closed Monteggia's fracture
S230400	Closed fracture of proximal ulna, comminuted
S230500	Closed fracture of the proximal ulna
S230600	Closed fracture radius, head
S230700	Closed fracture radius, neck
S230711	Closed # radius neck
S230800	Closed fracture proximal radius, comminuted
S230900	Closed fracture of the proximal radius
S230A00	Closed fracture radius and ulna, proximal
S230B00	Closed fracture olecranon, intra-articular
S230z00	Closed fracture of proximal forearm not otherwise specified
S231.00	Open fracture of proximal radius and ulna
S231000	Open fracture of proximal forearm, unspecified
S231100	Open fracture olecranon, extra-articular
S231200	Open fracture of ulna, coronoid
S231300	Open Monteggia's fracture
S231500	Open fracture of the proximal ulna
S231600	Open fracture radial head
S231700	Open fracture radial neck
S231800	Open fracture proximal radius, comminuted
S231900	Open fracture of the proximal radius
S231A00	Open fracture radius and ulna, proximal
S231B00	Open fracture olecranon, intra-articular
S231z00	Open fracture of forearm, upper end, NOS
S232.00	Closed fracture of radius and ulna, shaft
S232000	Closed fracture of radius, shaft, unspecified
S232100	Closed fracture of the radial shaft
S232200	Closed fracture of the ulnar shaft
S232300	Closed fracture radius and ulna, middle
S232z00	Closed fracture of radius and ulna, shaft, NOS

S233.00	Open fracture of radius and ulna, shaft
S233000	Open fracture of radius, shaft, unspecified
S233100	Open fracture of the radial shaft
S233200	Open fracture of the ulnar shaft
S233300	Open fracture radius and ulna, middle
S233z00	Open fracture of radius and ulna, shaft, NOS
S234.00	Closed fracture of radius and ulna, lower end
S234.11	Wrist fracture - closed
S234000	Closed fracture of forearm, lower end, unspecified
S234100	Closed Colles' fracture
S234111	Smith's fracture - closed
S234200	Closed fracture of the distal radius, unspecified
S234211	Dupuytren's fracture, radius - closed
S234300	Closed fracture of ulna, styloid process
S234400	Closed fracture of ulna, lower epiphysis
S234500	Closed fracture distal ulna, unspecified
S234600	Closed fracture radius and ulna, distal
S234700	Closed Smith's fracture
S234800	Closed Galeazzi fracture
S234900	Closed volar Barton's fracture
S234911	Closed volar Barton's fracture-dislocation
S234912	Closed volar Barton fracture-subluxation
S234A00	Closd dorsal Barton's fracture
S234A11	Closed dorsal Barton's fracture-dislocation
S234B00	Closed fracture radial styloid
S234C00	Closed fracture distal radius, intra-articular, die-punch
S234D00	Closed fracture distal radius, extra-articular, other type
S234E00	Closed fracture distal radius, intra-articular, other type
S234F00	Closed Barton's fracture
S234G00	Greenstick fracture of distal radius
S234z00	Closed fracture of forearm, lower end, NOS
S235.00	Open fracture of radius and ulna, lower end
S235.11	Wrist fracture - open

S235000	Open fracture of forearm, lower end, unspecified
S235100	Open Colles' fracture
S235111	Smith's fracture - open
S235200	Open fracture of the distal radius, unspecified
S235211	Dupuytren's fracture, radius - open
S235300	Open fracture of ulna, styloid process
S235400	Open fracture of ulna, lower epiphysis
S235500	Open fracture distal ulna - other
S235600	Open fracture radius and ulna, distal
S235700	Open Smith's fracture
S235800	Open Galeazzi fracture
S235900	Open volar Barton's fracture
S235B00	Open fracture radial styloid
S235C00	Open fracture distal radius, intra-articular, die-punch
S235D00	Open fracture distal radius, extra-articular other type
S235E00	Open fracture distal radius, intra-articular other type
S235F00	Open Barton's fracture
S235z00	Open fracture of forearm, lower end, NOS
S236.00	Fracture of upper end of ulna
S237.00	Fracture of upper end of radius
S238.00	Fracture of shaft of ulna
S239.00	Fracture of shaft of radius
S23A.00	Fracture of shafts of both ulna and radius
S23B.00	Fracture of lower end of radius
S23C.00	Fracture of lower end of both ulna and radius
S23x.00	Closed fracture of radius and ulna, unspecified part
S23x000	Closed fracture of forearm, unspecified
S23x100	Closed fracture of radius (alone), unspecified
S23x111	Fracture of radius NOS
S23x200	Closed fracture of ulna (alone), unspecified
S23x211	Fracture of ulna NOS
S23x300	Closed fracture of the radius and ulna
S23xz00	Closed fracture of radius and ulna, NOS

S23y.00	Open fracture of radius and ulna, unspecified part
S23y000	Open fracture of forearm, unspecified
S23y100	Open fracture of radius (alone), unspecified
S23y200	Open fracture of ulna (alone), unspecified
S23y300	Open fracture of the radius and ulna
S23yz00	Open fracture of radius and ulna, NOS
S23z.00	Fracture of radius and ulna, NOS
S24..00	Fracture of carpal bone
S24..11	Hand fracture - carpal bone
S240.00	Closed fracture of carpal bone
S240000	Closed fracture of carpal bone, unspecified
S240100	Closed fracture of the scaphoid
S240200	Closed fracture lunate
S240300	Closed fracture triquetral
S240400	Closed fracture pisiform
S240500	Closed fracture trapezium
S240600	Closed fracture trapezoid
S240700	Closed fracture capitate
S240800	Closed fracture hamate
S240900	Closed fracture hamate, hook
S240A00	Closed fracture scaphoid, proximal pole
S240B00	Closed fracture scaphoid, waist, transverse
S240C00	Closed fracture scaphoid, waist, oblique
S240D00	Closed fracture scaphoid, waist, comminuted
S240E00	Closed fracture scaphoid, tuberosity
S240F00	Closed fracture carpal bones, multiple
S240y00	Closed fracture of other carpal bone
S240z00	Closed fracture of carpal bone NOS
S241.00	Open fracture of carpal bone
S241000	Open fracture of carpal bone, unspecified
S241100	Open fracture of the scaphoid
S241200	Open fracture lunate
S241300	Open fracture triquetral

S241400	Open fracture pisiform
S241500	Open fracture trapezium
S241600	Open fracture trapezoid
S241700	Open fracture capitate
S241800	Open fracture hamate
S241A00	Open fracture scaphoid, proximal pole
S241B00	Open fracture scaphoid, waist, transverse
S241C00	Open fracture scaphoid, waist, oblique
S241D00	Open fracture scaphoid, waist, comminuted
S241E00	Open fracture scaphoid, tuberosity
S241z00	Open fracture of carpal bone NOS
S242.00	Fracture at wrist and hand level
S242000	Fracture of scaphoid
S242100	Fracture of first metacarpal bone
S242200	Fracture of other metacarpal bone
S242300	Multiple fractures of metacarpal bones
S24z.00	Fracture of carpal bone NOS
S25..00	Fracture of metacarpal bone
S25..11	Hand fracture - metacarpal bone
S250.00	Closed fracture of metacarpal bone(s)
S250000	Closed fracture of metacarpal bone (s), site unspecified
S250100	Cls # thumb metacarpal base, intra-articular, Bennett
S250200	Closed fracture finger metacarpal base
S250300	Closed fracture finger metacarpal shaft
S250400	Closed fracture finger metacarpal neck
S250500	Closed fracture finger metacarpal head
S250600	Closed fracture finger metacarpal
S250700	Closed fracture finger metacarpal, multiple
S250800	Closed fracture of thumb metacarpal
S250900	Cls # thumb metacarpal base, intra-articular, Rolando
S250A00	Closed fracture thumb metacarpal shaft
S250B00	Closed fracture thumb metacarpal neck
S250C00	Closed fracture thumb metacarpal head

S250x00	Closed fractures of multiple sites of unspecified metacarpus
S250z00	Closed fracture of metacarpal bone(s) NOS
S251.00	Open fracture of metacarpal bone(s)
S251000	Open fracture of metacarpal bone(s), site unspecified
S251100	Opn # thumb metacarpal base, intra-articular, Bennett
S251200	Open fracture finger metacarpal base
S251300	Open fracture finger metacarpal shaft
S251400	Open fracture finger metacarpal neck
S251500	Open fracture finger metacarpal head
S251600	Open fracture finger metacarpal
S251700	Open fracture finger metacarpal, multiple
S251800	Open fracture of thumb metacarpal
S251900	Opn # thumb metacarpal base, intra-articular, Rolando
S251A00	Open fracture thumb metacarpal shaft
S251C00	Open fracture thumb metacarpal head
S251x00	Open fractures of multiple sites of unspecified metacarpus
S251z00	Open fracture of metacarpal bone(s) NOS
S252.00	Closed fracture sesamoid bone of hand
S253.00	Open fracture sesamoid bone of hand
S26..00	Fracture of one or more phalanges of hand
S26..11	Finger fracture
S26..12	Thumb fracture excluding base
S260.00	Closed fracture of one or more phalanges of hand
S260000	Closed fracture of phalanx or phalanges, unspecified
S260100	Clsd # mid/prox phalanx/phalanges, unspecified part
S260200	Cls # distal phalanx or phalanges, unspecified part
S260300	Closed fracture thumb proximal phalanx
S260400	Closed fracture thumb proximal phalanx, base
S260500	Closed fracture thumb proximal phalanx, shaft
S260600	Closed fracture thumb proximal phalanx, neck
S260700	Closed fracture thumb proximal phalanx, head
S260800	Closed fracture thumb distal phalanx

S260900	Closed fracture thumb distal phalanx, base
S260A00	Closed fracture thumb distal phalanx, shaft
S260B00	Closed fracture thumb distal phalanx, tuft
S260C00	Closed fracture thumb distal phalanx, mallet
S260D00	Closed fracture finger proximal phalanx
S260E00	Closed fracture finger proximal phalanx, base
S260F00	Closed fracture finger proximal phalanx, shaft
S260G00	Closed fracture finger proximal phalanx, neck
S260H00	Closed fracture finger proximal phalanx, head
S260J00	Closed fracture finger proximal phalanx, multiple
S260K00	Closed fracture finger middle phalanx
S260L00	Closed fracture finger middle phalanx, base
S260M00	Closed fracture finger middle phalanx, shaft
S260N00	Closed fracture finger middle phalanx, neck
S260P00	Closed fracture finger middle phalanx, head
S260Q00	Closed fracture finger middle phalanx, multiple
S260R00	Closed fracture finger distal phalanx
S260S00	Closed fracture finger distal phalanx, base
S260T00	Closed fracture finger distal phalanx, shaft
S260U00	Closed fracture finger distal phalanx, tuft
S260V00	Closed fracture finger distal phalanx, mallet
S260W00	Closed fracture finger distal phalanx, multiple
S260x00	Closed fractures of phalanx or phalanges, multiple sites
S260z00	Closed fracture of one or more phalanges of hand NOS
S261.00	Open fracture of one or more phalanges of hand
S261000	Open fracture of phalanx or phalanges, unspecified
S261100	Opn # mid/prox phalanx or phalanges, unspecified part
S261200	Opn # distal phalanx or phalanges, unspecified part
S261300	Open fracture thumb proximal phalanx
S261400	Open fracture thumb proximal phalanx, base
S261500	Open fracture thumb proximal phalanx, shaft
S261600	Open fracture thumb proximal phalanx, neck
S261700	Open fracture thumb proximal phalanx, head

S261800	Open fracture thumb distal phalanx
S261900	Open fracture thumb distal phalanx, base
S261A00	Open fracture thumb distal phalanx, shaft
S261B00	Open fracture thumb distal phalanx, tuft
S261C00	Open fracture thumb distal phalanx, mallet
S261D00	Open fracture finger proximal phalanx
S261E00	Open fracture finger proximal phalanx, base
S261F00	Open fracture finger proximal phalanx, shaft
S261G00	Open fracture finger proximal phalanx, neck
S261H00	Open fracture finger proximal phalanx, head
S261J00	Open fracture finger proximal phalanx, multiple
S261K00	Open fracture finger middle phalanx
S261L00	Open fracture finger middle phalanx, base
S261M00	Open fracture finger middle phalanx, shaft
S261N00	Open fracture finger middle phalanx, neck
S261P00	Open fracture finger middle phalanx, head
S261R00	Open fracture finger distal phalanx
S261S00	Open fracture finger distal phalanx, base
S261T00	Open fracture finger distal phalanx, shaft
S261U00	Open fracture finger distal phalanx, tuft
S261V00	Open fracture finger distal phalanx, mallet
S261W00	Open fracture finger distal phalanx, multiple
S261x00	Open fracture of phalanx or phalanges, multiple sites
S261z00	Open fracture of one or more phalanges of hand NOS
S262.00	Fracture of thumb
S263.00	Fracture of other finger
S264.00	Multiple fractures of fingers
S26z.00	Fracture of one or more phalanges of hand NOS
S27..00	Multiple fractures of hand bones
S270.00	Closed multiple fractures of hand bones
S271.00	Open multiple fractures of hand bones
S27z.00	Multiple fractures of hand bones NOS
S28..00	Ill-defined fractures of upper limb

S28..11	Ill-defined fracture of arm
S280.00	Closed ill-defined fractures of upper limb
S281.00	Open ill-defined fractures of upper limb
S28z.00	Ill-defined fractures of upper limb NOS
S29..00	Multiple # both upper limbs & upper limb with rib + sternum
S29..11	Multiple fractures of arm
S29..12	Multiple rib fractures
S29..13	Multiple fractures of sternum
S290.00	Closed multiple #upper limbs & upper limb with rib + sternum
S292.00	Multiple fractures of clavicle, scapula and humerus
S292000	Closed multiple fractures of clavicle, scapula and humerus
S292100	Open multiple fractures of clavicle, scapula and humerus
S293.00	Multiple fractures of forearm
S294.00	Fractures involving multiple regions of both upper limbs
S294000	Cl fractures involving multiple regions of both upper limbs
S29z.00	Multiple #upper limbs & upper limb with rib + sternum NOS
S2A..00	Fracture of upper limb, level unspecified
S2B..00	Fracture of bone of hand
S2z..00	Fracture of upper limb NOS
S3...00	Fracture of lower limb
S3...11	Leg fracture
S30..00	Fracture of neck of femur
S30..11	Hip fracture
S300.00	Closed fracture proximal femur, transcervical
S300000	Cls # prox femur, intracapsular section, unspecified
S300100	Closed fracture proximal femur, transepiphyseal
S300200	Closed fracture proximal femur, midcervical section
S300300	Closed fracture proximal femur, basicervical
S300311	Closed fracture, base of neck of femur
S300400	Closed fracture head of femur
S300500	Cls # prox femur, subcapital, Garden grade unspec.
S300600	Closed fracture proximal femur, subcapital, Garden grade I

S300700	Closed fracture proximal femur, subcapital, Garden grade II
S300800	Closed fracture proximal femur, subcapital, Garden grade III
S300900	Closed fracture proximal femur, subcapital, Garden grade IV
S300A00	Closed fracture of femur, upper epiphysis
S300y00	Closed fracture proximal femur, other transcervical
S300y11	Closed fracture of femur, subcapital
S300z00	Closed fracture proximal femur, transcervical, NOS
S301.00	Open fracture proximal femur, transcervical
S301000	Opn # proximal femur, intracapsular section, unspecified
S301100	Open fracture proximal femur, transepiphyseal
S301311	Open fracture base of neck of femur
S301400	Open fracture head, femur
S301500	Open fracture proximal femur,subcapital, Garden grade unspec
S301600	Open fracture proximal femur,subcapital, Garden grade I
S301700	Open fracture proximal femur,subcapital, Garden grade II
S301800	Open fracture proximal femur,subcapital, Garden grade III
S301900	Open fracture proximal femur,subcapital, Garden grade IV
S301A00	Open fracture of femur, upper epiphysis
S301y00	Open fracture proximal femur, other transcervical
S301y11	Open fracture of femur, subcapital
S302.00	Closed fracture of proximal femur, pertrochanteric
S302000	Cls # proximal femur, trochanteric section, unspecified
S302011	Closed fracture of femur, greater trochanter
S302012	Closed fracture of femur, lesser trochanter
S302100	Closed fracture proximal femur, intertrochanteric, two part
S302200	Closed fracture proximal femur, subtrochanteric
S302300	Cls # proximal femur, intertrochanteric, comminuted
S302400	Closed fracture of femur, intertrochanteric
S302z00	Cls # of proximal femur, pertrochanteric section, NOS
S303.00	Open fracture of proximal femur, pertrochanteric
S303000	Open # of proximal femur, trochanteric section, unspecified
S303011	Open fracture of femur, greater trochanter
S303100	Open fracture proximal femur, intertrochanteric, two part
S303200	Open fracture proximal femur, subtrochanteric
S303300	Open fracture proximal femur, intertrochanteric, comminuted
S303400	Open fracture of femur, intertrochanteric
S303z00	Open fracture of proximal femur, pertrochanteric, NOS
S304.00	Pertrochanteric fracture
S305.00	Subtrochanteric fracture
S30w.00	Closed fracture of unspecified proximal femur
S30x.00	Open fracture of unspecified proximal femur
S30y.00	Closed fracture of neck of femur NOS
S30y.11	Hip fracture NOS
S30z.00	Open fracture of neck of femur NOS
S31..00	Other fracture of femur
S310.00	Closed fracture of femur, shaft or unspecified part
S310000	Closed fracture of femur, unspecified part
S310011	Thigh fracture NOS
S310012	Upper leg fracture NOS
S310100	Closed fracture shaft of femur
S310z00	Closed fracture of shaft or unspecified part, NOS
S311.00	Open fracture of femur, shaft or unspecified part
S311000	Open fracture of femur, unspecified part
S311100	Open fracture shaft of femur
S311z00	Open fracture of femur, shaft or unspecified part, NOS
S312.00	Closed fracture distal femur
S312.11	Closed fracture of femur, distal end
S312000	Closed fracture of distal femur, unspecified
S312100	Closed fracture of femoral condyle, unspecified
S312200	Closed fracture of femur, lower epiphysis
S312300	Closed fracture distal femur, supracondylar
S312400	Closed fracture distal femur, medial condyle
S312500	Closed fracture distal femur, lateral condyle
S312600	Closed fracture distal femur, bicondylar (T-Y fracture)
S312x00	Closed fracture distal femur, comminuted/intra-articular
S312z00	Closed fracture of distal femur not otherwise specified
S313.00	Open fracture distal femur
S313.11	Open fracture of femur, distal end
S313000	Open fracture distal femur, unspecified
S313100	Open fracture of femoral condyle, unspecified
S313200	Open fracture of femur, lower epiphysis
S313300	Open fracture distal femur, supracondylar
S313400	Open fracture distal femur, medial condyle
S313500	Open fracture distal femur, lateral condyle
S313x00	Open fracture distal femur, comminuted/intra-articular
S313z00	Open fracture of distal femur not otherwise specified
S314.00	Fracture of shaft of femur
S315.00	Fracture of lower end of femur
S31z.00	Fracture of femur, NOS
S32..00	Fracture of patella
S32..11	#Knee-cap
S320.00	Closed fracture of the patella
S320000	Closed fracture patella, transverse
S320100	Closed fracture patella, proximal pole
S320200	Closed fracture patella, distal pole
S320300	Closed fracture patella, vertical
S320400	Closed fracture patella, comminuted (stellate)
S321.00	Open fracture of the patella
S321000	Open fracture patella, transverse
S321100	Open fracture patella, proximal pole
S321200	Open fracture patella, distal pole
S321400	Open fracture patella, comminuted (stellate)
S32z.00	Fracture of patella, NOS
S33..00	Fracture of tibia and fibula
S330.00	Closed fracture of tibia and fibula, proximal
S330000	Closed fracture of the proximal tibia

S330011	Closed fracture of tibial condyles
S330012	Closed fracture of tibial tuberosity
S330100	Closed fracture proximal fibula
S330200	Closed fracture of tibia and fibula, proximal
S330300	Closed fracture proximal tibia, medial condyle (plateau)
S330400	Closed fracture proximal tibia, lateral condyle (plateau)
S330500	Closed fracture proximal tibia, bicondylar
S330600	Closed fracture spine, tibia
S330700	Closed fracture tubercle, tibia
S330800	Closed fracture fibula, head
S330900	Closed fracture fibula, neck
S330z00	Closed fracture of tibia and fibula, proximal NOS
S331.00	Open fracture of tibia and fibula, proximal
S331000	Open fracture of the proximal tibia
S331011	Open fracture of tibial condyles
S331012	Open fracture of tibial tuberosity
S331100	Open fracture proximal fibula
S331200	Open fracture of tibia and fibula, proximal
S331300	Open fracture proximal tibia, medial condyle (plateau)
S331400	Open fracture proximal tibia, lateral condyle (plateau)
S331600	Open fracture spine, tibia
S331700	Open fracture tubercle, tibia
S331800	Open fracture fibula, head
S331900	Open fracture fibula, neck
S331A00	Open fracture tibial plateau
S331z00	Open fracture of tibia and fibula, proximal NOS
S332.00	Closed fracture of tibia/fibula, shaft
S332000	Closed fracture shaft of tibia
S332100	Closed fracture shaft of fibula
S332200	Closed fracture of tibia and fibula, shaft
S332z00	Closed fracture of tibia and fibula, shaft, NOS
S333.00	Open fracture of tibia/fibula, shaft
S333000	Open fracture shaft of tibia
S333100	Open fracture shaft of fibula
S333200	Open fracture of tibia and fibula, shaft
S333z00	Open fracture of tibia and fibula, shaft, NOS
S334.00	Closed fracture distal tibia
S334000	Closed fracture distal tibia, extra-articular
S334100	Closed fracture distal tibia, intra-articular
S335.00	Open fracture distal tibia
S335000	Open fracture distal tibia, extra-articular
S335100	Open fracture distal tibia, intra-articular
S336.00	Fracture of upper end of tibia
S336000	Fracture tibial plateau
S337.00	Fracture of shaft of tibia
S338.00	Fracture of lower end of tibia
S339.00	Fracture of fibula alone
S339000	Closed fracture of distal fibula
S339100	Open fracture of distal fibula
S33A.00	Fracture of tibia
S33B.00	Open fracture of distal tibia and fibula
S33C.00	Closed fracture of distal tibia and fibula
S33x.00	Closed fracture of tibia and fibula, unspecified part, NOS
S33x.11	Lower leg fracture NOS
S33x000	Closed fracture of tibia, unspecified part, NOS
S33x100	Closed fracture of fibula, unspecified part, NOS
S33x200	Closed fracture of tibia and fibula, unspecified part
S33xz00	Closed fracture of tibia and fibula, unspecified part, NOS
S33y.00	Open fracture of tibia and fibula, unspecified part, NOS
S33y000	Open fracture of tibia, unspecified part, NOS
S33y100	Open fracture of fibula, unspecified part, NOS
S33y200	Open fracture of tibia and fibula, unspecified part
S33yz00	Open fracture of tibia and fibula, unspecified part, NOS
S33z.00	Fracture of tibia and fibula, NOS
S34..00	Fracture of ankle
S340.00	Closed fracture ankle, medial malleolus
S341.00	Open fracture ankle, medial malleolus
S342.00	Closed fracture ankle, lateral malleolus
S342000	Closed fracture ankle, lateral malleolus, low
S342100	Closed fracture ankle, lateral malleolus, high
S343.00	Open fracture ankle, lateral malleolus
S343000	Open fracture ankle, lateral malleolus, low
S343100	Open fracture ankle, lateral malleolus, high
S344.00	Closed fracture ankle, bimalleolar
S344.11	Dupuytren's fracture, fibula
S344.12	Pott's fracture - ankle
S344000	Closed fracture ankle, bimalleolar, low fibular fracture
S344100	Closed fracture ankle, bimalleolar, high fibular fracture
S345.00	Open fracture ankle, bimalleolar
S345000	Open fracture ankle, bimalleolar, low fibular fracture
S345100	Open fracture ankle, bimalleolar, high fibular fracture
S346.00	Closed fracture ankle, trimalleolar
S346000	Closed fracture ankle, trimalleolar, low fibular fracture
S346100	Closed fracture ankle, trimalleolar, high fibular fracture
S347.00	Open fracture ankle, trimalleolar
S347000	Open fracture ankle, trimalleolar, low fibular fracture
S347100	Open fracture ankle, trimalleolar, high fibular fracture
S348.00	Fracture of medial malleolus
S349.00	Fracture of lateral malleolus
S34x.00	Closed fracture ankle, unspecified
S34y.00	Open fracture ankle, unspecified
S34z.00	Fracture of ankle, NOS
S35..00	Fracture of one or more tarsal and metatarsal bones
S35..11	Metatarsal bone fracture
S35..12	Tarsal bone fracture
S350.00	Closed fracture of calcaneus
S350.11	Heel bone fracture
S350.12	Os calcis fracture
S350000	Closed fracture calcaneus, extra-articular

S350100	Closed fracture calcaneus, intra-articular
S351.00	Open fracture of calcaneus
S351100	Open fractures calcaneus, intra-articular
S352.00	Closed fracture of other tarsal and metatarsal bones
S352.11	March fracture
S352000	Closed fracture of tarsal bone, unspecified
S352100	Closed fracture of talus
S352111	Closed fracture of astragalus
S352200	Closed fracture navicular
S352300	Closed fracture cuboid
S352400	Closed fracture medial cuneiform
S352500	Closed fracture intermediate cuneiform
S352600	Closed fracture lateral cuneiform
S352700	Closed fracture metatarsal
S352800	Closed fracture talus, head
S352900	Closed fracture talus, neck
S352A00	Closed fracture talus, body
S352B00	Closed fracture metatarsal base
S352C00	Closed fracture metatarsal shaft
S352D00	Closed fracture metatarsal neck
S352E00	Closed fracture metatarsal head
S352F00	Closed fracture metatarsal, multiple
S352G00	Closed tarsal fractures, multiple
S352H00	Closed fracture of cuneiforms
S352J00	Closed fracture of base of fifth metatarsal
S352z00	Closed fracture of one or more tarsal + metatarsal bones NOS
S353.00	Open fracture of other tarsal and metatarsal bones
S353000	Open fracture of tarsal bone, unspecified
S353100	Open fracture of talus
S353200	Open fracture navicular
S353300	Open fracture cuboid
S353400	Open fracture medial cuneiform

S353500	Open fracture intermediate cuneiform
S353700	Open fracture metatarsal
S353900	Open fracture talus, neck
S353A00	Open fracture talus, body
S353B00	Open fracture metatarsal base
S353C00	Open fracture metatarsal shaft
S353D00	Open fracture metatarsal neck
S353E00	Open fracture metatarsal head
S353F00	Open fracture metatarsal, multiple
S353H00	Open fracture cuneiforms
S353J00	Open fracture of base of fifth metatarsal
S353z00	Open fracture of tarsal and metatarsal bones NOS
S354.00	Fracture of calcaneus
S355.00	Fracture of talus
S356.00	Fracture of metatarsal bone
S35z.00	Fracture of tarsal and metatarsal bones NOS
S36..00	Fracture of one or more phalanges of foot
S36..11	Toe fracture
S360.00	Closed fracture of one or more phalanges of foot
S360000	Closed fracture proximal phalanx, toe
S360100	Closed fracture middle phalanx, toe
S360200	Closed fracture distal phalanx, toe
S360300	Closed fracture multiple phalanges, toe
S361.00	Open fracture of one or more phalanges of foot
S361000	Open fracture proximal phalanx, toe
S361100	Open fracture middle phalanx, toe
S361200	Open fracture distal phalanx, toe
S361300	Open fracture multiple phalanges, toe
S362.00	Fracture of great toe
S362000	Closed fracture of great toe
S362100	Open fracture of great toe
S363.00	Fracture of other toe
S36z.00	Fracture of one or more phalanges of foot NOS

S37..00	Fracture of lower limb, level unspecified
S370.00	Closed fracture of lower limb, level unspecified
S371.00	Open fracture of lower limb, level unspecified
S3X..00	Fracture of lower leg, part unspecified
S3x..00	Other, multiple and ill-defined fractures of lower limb
S3x0.00	Other, multiple and ill-defined closed fractures lower limb
S3x1.00	Other, multiple and ill-defined open fractures of lower limb
S3x2.00	Multiple fractures of femur
S3x3.00	Multiple fractures of lower leg
S3x4.00	Multiple fractures of foot
S3xz.00	Other, multiple and ill-defined fractures of lower limb NOS
S3y..00	Multiple #both legs, leg + arm ,leg + rib + sternum
S3y0.00	Multiple closed #both legs, leg + arm, leg + rib + sternum
S3yz.00	Multiple #both legs, leg + arm, leg + rib + sternum NOS
S3z..00	Fracture of unspecified bones
S3z..11	Fracture NOS
S3z0.00	Closed fracture of bones, unspecified
S3z0000	Greenstick fracture
S3z1.00	Open fracture of bones, unspecified
S3z2.00	Stress fracture
S3zz.00	Fracture of bones NOS
S4...13	Fracture dislocations and fracture subluxations
S4A..00	Fracture-dislocation or subluxation shoulder
S4A0.00	Closed fracture-dislocation shoulder
S4A0000	Closed fracture-dislocation shoulder joint
S4A0100	Closed fracture-dislocation acromio-clavicular joint
S4A1.00	Open fracture-dislocation shoulder
S4A1000	Open fracture-dislocation shoulder joint
S4A1100	Open fracture-dislocation acromio-clavicular joint
S4A2.00	Closed fracture-subluxation shoulder
S4A2000	Closed fracture-subluxation shoulder joint
S4A2100	Closed fracture-subluxation acromio-clavicular joint
S4A3100	Open fracture-subluxation acromio-clavicular joint

S4B..00	Fracture-dislocation or subluxation elbow
S4B0.00	Closed fracture-dislocation elbow
S4B0000	Closed fracture-dislocation elbow joint
S4B0100	Closed fracture-dislocation superior radio-ulnar joint
S4B1.00	Open fracture-dislocation elbow
S4B1000	Open fracture-dislocation elbow joint
S4B1100	Open fracture-dislocation superior radio-ulnar joint
S4B2.00	Closed fracture-subluxation elbow
S4B2000	Closed fracture-subluxation elbow joint
S4B2100	Closed fracture-subluxation superior radio-ulnar joint
S4B3.00	Open fracture-subluxation elbow
S4C..00	Fracture-dislocation or subluxation of wrist
S4C0.00	Closed fracture dislocation of wrist
S4C0000	Closed fracture-dislocation distal radio-ulnar joint
S4C0100	Closed fracture-dislocation radiocarpal joint
S4C0200	Closed fracture-dislocation mid carpal
S4C0300	Closed fracture-dislocation, carpometacarpal joint
S4C0400	Closed fracture-dislocation lunate (volar)
S4C0500	Closed fracture-dislocation peri-lunate (dorsal)
S4C0600	Closed fracture-dislocation peri-lunate trans-scaphoid
S4C1.00	Open fracture dislocation wrist
S4C1000	Open fracture-dislocation, distal radio-ulnar joint
S4C1100	Open fracture-dislocation radiocarpal joint
S4C1300	Open fracture-dislocation carpometacarpal joint
S4C1600	Open fracture-dislocation peri-lunate trans-scaphoid
S4C2.00	Closed fracture-subluxation of the wrist
S4C2000	Closed fracture-subluxation, distal radio-ulnar jt
S4C2100	Closed fracture-subluxation radiocarpal joint
S4C2200	Closed fracture-subluxation mid carpal
S4C2300	Closed fracture-subluxation, carpometacarpal joint
S4C2400	Closed fracture-subluxation lunate (volar)
S4C2600	Closed fracture-subluxation peri-lunate trans-scaphoid
S4C2y00	Closed fracture-subluxation other carpal

S4C3.00	Open fracture-subluxation of the wrist
S4C3000	Open fracture-subluxation, distal radio-ulnar joint
S4C3100	Open fracture-subluxation radiocarpal joint
S4C3300	Open fracture-subluxation, carpometacarpal joint
S4C3600	Open fracture-subluxation peri-lunate trans-scaphoid
S4D..00	Fracture-dislocation/subluxation finger/thumb
S4D0.00	Closed fracture-dislocation digit
S4D0000	Closed fracture-dislocation digit, unspecified
S4D0100	Closed fracture-dislocation, metacarpophalangeal joint
S4D0200	Closed fracture-dislocation IPJ, unspecified
S4D0300	Closed fracture-dislocation, distal interphalangeal joint
S4D0400	Closed fracture-dislocation, proximal interphalangeal joint
S4D0500	Closed fracture-dislocation, interphalangeal joint thumb
S4D0600	Closed fracture-dislocation multiple digits
S4D1.00	Open fracture-dislocation digit
S4D1000	Open fracture-dislocation digit, unspecified
S4D1100	Open fracture-dislocation, metacarpophalangeal joint
S4D1200	Open fracture-dislocation IPJ, unspecified
S4D1300	Open fracture-dislocation, distal interphalangeal joint
S4D1400	Open fracture-dislocation, proximal interphalangeal joint
S4D1500	Open fracture-dislocation, interphalangeal joint thumb
S4D1600	Open fracture-dislocation multiple digits
S4D2.00	Closed fracture-subluxation digit
S4D2000	Closed fracture-subluxation digit, unspecified
S4D2100	Closed fracture-subluxation, metacarpophalangeal joint
S4D2200	Closed fracture-subluxation IPJ, unspecified
S4D2300	Closed fracture-subluxation, distal interphalangeal joint
S4D2400	Closed fracture-subluxation, proximal interphalangeal joint
S4D2500	Closed fracture-subluxation, interphalangeal joint thumb
S4D2600	Closed fracture-subluxation multiple digits
S4D3.00	Open fracture-subluxation digit
S4D3100	Open fracture-subluxation, metacarpophalangeal joint
S4D3300	Open fracture-subluxation, distal interphalangeal joint

S4D3400	Open fracture-subluxation, proximal interphalangeal joint
S4D3500	Open fracture-subluxation, interphalangeal joint thumb
S4D3600	Open fracture-subluxation multiple digits
S4E..00	Fracture-dislocation or subluxation hip
S4E0.00	Closed fracture-dislocation, hip joint
S4E1.00	Open fracture-dislocation, hip joint
S4E2.00	Closed fracture-subluxation, hip joint
S4F..00	Fracture-dislocation or subluxation knee
S4F0.00	Closed fracture-dislocation, knee joint
S4F1.00	Open fracture-dislocation, knee joint
S4F2.00	Closed fracture-subluxation, knee joint
S4F3.00	Open fracture-subluxation, knee joint
S4F4.00	Closed fracture-dislocation, patello-femoral joint
S4F5.00	Open fracture-dislocation, patello-femoral joint
S4F6.00	Closed fracture-subluxation, patello-femoral joint
S4F7.00	Open fracture-subluxation, patello-femoral joint
S4G..00	Fracture-dislocation or subluxation ankle
S4G0.00	Closed fracture-dislocation, ankle joint
S4G1.00	Open fracture-dislocation, ankle joint
S4G2.00	Closed fracture-subluxation, ankle joint
S4G3.00	Open fracture-subluxation, ankle joint
S4H..00	Fracture-dislocation or subluxation foot
S4H0.00	Closed fracture-dislocation foot
S4H0000	Closed fracture-dislocation, subtalar joint
S4H0100	Closed fracture-dislocation, midtarsal joint
S4H0200	Closed fracture-dislocation, tarsometatarsal joint
S4H0300	Closed #-dislocation, metatarsophalangeal joint, single
S4H0400	Closed fracture-dislocation, IPJ, single toe
S4H0500	Closed #-dislocation, metatarsophalangeal joint, multiple
S4H0600	Closed fracture-dislocation, IPJ, multiple toes
S4H1.00	Open fracture-dislocation, foot
S4H1000	Open fracture-dislocation, subtalar joint
S4H1200	Open fracture-dislocation, tarsometatarsal joint

S4H1300	Open fracture-dislocation, metatarsophalangeal joint, single
S4H1400	Open fracture-dislocation, IPJ, single toe
S4H1500	Open #-dislocation, metatarsophalangeal joint, multiple
S4H1600	Open fracture-dislocation, IPJ, multiple toes
S4H2.00	Closed fracture-subluxation, foot
S4H2000	Closed fracture-subluxation, subtalar joint
S4H2100	Closed fracture-subluxation, midtarsal joint
S4H2200	Closed fracture-subluxation, tarsometatarsal joint
S4H2300	Closed #-subluxation, metatarsophalangeal joint, single
S4H2400	Closed fracture-subluxation, IPJ, single toe
S4H2500	Closed #-subluxation, metatarsophalangeal joint, multiple
S4H2600	Closed fracture-subluxation, IPJ, multiple toes
S4H3.00	Open fracture-subluxation, foot
S4H3300	Open fracture-subluxation, metatarsophalangeal joint, single
S4H3400	Open fracture-subluxation, IPJ, single toe
S4J..00	Other fracture-dislocation or subluxation
S4J0.00	Other closed fracture-dislocation
S4J0000	Closed fracture-dislocation of sternum
S4J0100	Closed fracture-dislocation of pelvis
S4J0200	Closed #-dislocation sterno-clavicular joint, anterior
S4J0300	Closed #-dislocation sterno-clavicular joint, posterior
S4J1.00	Other open fracture-dislocation
S4J1000	Open fracture-dislocation of sternum
S4J1100	Open fracture-dislocation of pelvis
S4J1200	Open fracture-dislocation sterno-clavicular joint, anterior
S4J2.00	Other closed fracture-subluxation
S4J2000	Closed fracture-subluxation of sternum
S4J2100	Closed fracture-subluxation of pelvis
S4J2200	Closed #-subluxation sterno-clavicular joint, anterior
S4J3000	Open fracture-subluxation of sternum
S4J3100	Open fracture-subluxation of pelvis
S836300	Broken tooth injury

S836311	Broken teeth injury without complication
S836700	Dislocation of tooth
S837300	Broken tooth injury with complication
S837311	Broken teeth injury with complication
SD92000	Fracture blister
SR1..00	Fractures involving multiple body regions
SR10.00	Fractures involving head with neck
SR10000	Closed fractures involving head with neck
SR11.00	Fractures involving thorax with lower back and pelvis
SR12.00	Fractures involving multiple regions of one upper limb
SR12000	Closed fractures involving multiple regions of one upp limb
SR13.00	Fractures involving multiple regions of one lower limb
SR14.00	Fractures involving multiple regions of both lower limbs
SR15.00	Fract invol multiple regions of up limb(s) with low limb(s)
SR15000	Cl fractures involving multiple regions upper with lower lmb
SR16.00	Fract invol thorax with lower back and pelvis with limb(s)
SR16000	Closed fracture inv thorax wth low back and pelvis and limbs
SR1z.00	Multiple fractures, unspecified
SR1z000	[X]Closed multiple fractures unspecified
SR1z100	[X]Open multiple fractures unspecified
Syu0400	[X]Fracture of skull and facial bones, part unspecified
Syu1500	[X]Fracture of other specified cervical vertebra
Syu1600	[X]Fracture of other parts of neck
Syu3400	[X]Fract of other and unspec parts of lumbar spine & pelvis
Syu4200	[X]Multiple fractures of clavicle, scapula and humerus
Syu4300	[X]Fracture of other parts of shoulder and upper arm
Syu4400	[X]Fracture of shoulder and upper arm, unspecified
Syu5300	[X]Fracture of other parts of forearm
Syu5400	[X]Fracture of forearm, unspecified
Syu6300	[X]Fracture of other carpal bone(s)
Syu6400	[X]Fracture of other metacarpal bone
Syu6500	[X]Fracture of other & unspecified parts of wrist and hand

Syu7200	[X]Fractures of other parts of femur
Syu8300	[X]Fractures of other parts of lower leg
Syu8D00	[X]Fracture of lower leg, part unspecified
Syu9400	[X]Fracture of other tarsal bones
TC7..00	Fracture, cause unspecified
Z6G1900	Fracture - traction
ZV54000	[V]Removal of internal orthopaedic fixation device
ZV57700	[V]Rehabilitation following fracture
ZV66400	[V]Convalescence after treatment of fracture
ZV67400	[V]Fracture follow-up
ZX1L800	Breaking own bones
ZX1L811	Snapping own bones
Zw01.00	[Q] Fractures involving the epiphyseal plate
Zw01000	[Q] Epiphyseal injury
Zw01100	[Q] Salter-Harris I
Zw01200	[Q] Salter-Harris II
Zw01300	[Q] Salter-Harris III
Zw01400	[Q] Salter-Harris IV
Zw01500	[Q] Salter-Harris V
Zw02.00	[Q] Fracture type qualifying terms
Zw02000	[Q] Avulsion
Zw02100	[Q] Buckle
Zw02200	[Q] Green stick
Zw02300	[Q] Osteochondral
Zw02400	[Q] Stress fracture
Zw02500	[Q] Refracture
Zw02700	[Q] Comminuted
Zw02800	[Q] Oblique
Zw02A00	[Q] Segmental - bone loss
Zw02B00	[Q] Spiral
Zw02C00	[Q] Transverse
Zw02E00	[Q] Open fracture grade 2
History of injury codes: excluded in sensitivity analysis	

14G7.00	H/O: hip fracture
14G8.00	H/O: vertebral fracture
14G9.00	H/O: fracture
14GA.00	H/O: non-vertebral fracture
Non-specific fixation codes: excluded in sensitivity analysis	
7J14.00	Fixation of mandible
7J14.11	Fixation of jaw NEC
7J14.12	Fixator of mandible
7J14000	Intermaxillary fixation of mandible
7J14100	Internal fixation of mandible NEC
7J14200	Extraoral fixation of mandible
7J14400	Internal fixation of mandible with plating system
7J14500	Internal fixation of mandible with wire
7J14600	Internal fixation of mandible with arch bars
7J14y00	Other specified fixation of mandible
7J14z00	Fixation of mandible NOS
7J15.00	Fixation of mid facial bones
7J15.11	Fixation of maxilla
7J15000	Intermaxillary fixation of maxilla
7J15100	Internal fixation of maxilla NEC
7J15200	Extraoral fixation of maxilla NEC
7J15400	Fixation of maxilla NEC
7J15500	Internal fixation of bone of face with plating system
7J15600	Internal fixation of bone of face with wire
7J15700	External fixation of bone of face
7J15y00	Other specified fixation of bone of face
7J15z00	Fixation of bone of face NOS
7K1P.00	Other fixation of bone
7K1P000	Application of internal fixator NEC
7K1P100	Application of external fixator NEC
7K1P111	Application of Anderson external fixator
7K1P112	Applicatin of Henderson external fixator
7K1P113	Application of Wagner external fixator

7K1P200	Adjustment to internal fixation device NEC
7K1P300	Adjustment to external fixator NEC
7K1P600	Internal fixation of bone NEC
7K1P700	External fixation of bone NEC
7K1PA00	Change of external fixator pin
7K1PE00	Insertion of intramedullary fixation and cementing of bone
7K1PF00	Application of external ring fixation to bone NEC
7K1Pw00	Other specified internal fixation of bone
7K1Px00	Internal fixation of bone NOS
7K1Py00	Other specified other fixation of bone
7K1Pz00	Other fixation of bone NOS
Late effects/sequelae: excluded from fracture definition	
SC00.00	Late effect of fracture of skull and face bones
SC00.11	Late effect of face fracture
SC00.12	Late effect of skull fracture
SC01.00	Late effect of fracture of spine/trunk without cord lesion
SC01000	Late effect of fracture of cervical vertebra
SC01100	Late effect of fracture of thoracic vertebra
SC01200	Late effect of fracture of lumbar vertebra
SC02.00	Late effect of fracture of arm
SC03.00	Late effect of fracture neck of femur
SC04.00	Late effect of other fracture of leg
SC05.00	Late effect of multiple and unspecified fracture of bones
SC0X.00	Sequelae of other fracture of thorax and pelvis
SC0z.11	Delayed union of fracture
SC3C000	Sequelae of fracture at wrist and hand level
SC3D400	Sequelae of fracture of femur
N338.00	Malunion and nonunion of fracture
N338000	Malunion of fracture
N338100	Pseudoarthrosis - fracture nonunion
N338111	Nonunion of fracture
N338200	Hypertrophic non-union of fracture
N338300	Atrophic non-union of fracture

N338400	Angular mal-union of fracture
N338500	Rotational mal-union of fracture
N338600	Delayed union of fracture
N338z00	Fracture malunion or nonunion NOS
Secondary procedures, not incident events: excluded from fracture definition	
7206200	Removal of fixation from fracture of orbit
7J14300	Removal of fixation from mandible
7J15300	Removal of fixation from midfacial bone
7J15311	Removal of fixation from maxilla
7J42C00	Revision to bedrest stabilisation of spinal fracture
7J42D00	Revision to collar stabilisation of spinal fracture
7J42G00	Revision to external fixation stabilisation spinal fracture
7J43900	Rvsn open reduc spinal fracture+internal fix+plate
7J43A00	Rvsn open reduc spinal fracture+internal fix+rod system
7J43C00	Rvsn open reduc spinal fracture+internal fix+internl fixator
7J43E00	Removal of fracture fixation device from spine
7K1H.00	Secondary open reduction of fracture of bone
7K1H.11	Revision to open reduction of fracture of bone
7K1H000	Second open reduct fract bone & intramedullary fixation HFQ
7K1H100	Second open reduct fract bone & extramedullary fixation HFQ
7K1H200	Secondary open reduction of intraarticular fracture of bone
7K1H400	Secondary open reduct fracture bone & external fixation HFQ
7K1H500	Revision to open red+ext fxtn of proximal femoral #
7K1H600	Revsn to opn red+int fxtn prox fem #+screw/nail device alone
7K1H700	Rvsn to opn red+int fxtn prox fem #+ scrw/nl+intramed device
7K1H800	Rvsn to opn red+int fxtn prox fem #+ scrw/nail+plate device
7K1H900	Revision to open reduction of fracture alone
7K1HA00	Revision to open reduction of # and cast immobilisation
7K1HB00	Revision to open reduction of # and functional bracing
7K1HE00	Revision to open reduction of fracture and external fixation

7K1HF00	Revision to open red #+other external immobilisation
7K1HG00	Revision to open red #+locked reamed intramed nail fxn
7K1HH00	Revision to open red #+locked unreamed intramed nail fxn
7K1HJ00	Revision to open red #+unlocked reamed intramed nail fxn
7K1HK00	Revision to open red #+unlocked unreamed intramed nail fxn
7K1HL00	Revision to open red #+int fxn+K-wire
7K1HM00	Revision to open red #+int fxn+tension band wiring
7K1HN00	Revision to open red #+int fxn+cerclage wiring
7K1HP00	Revision to open red #+int fxn+screw(s)
7K1HQ00	Revision to open red #+int fxn+plate
7K1HS00	Revision to open red #+other int fxn
7K1HT00	Revision to open red #+intramedullary nail fxn
7K1J800	Revisn to int fxn(no red) prox fem #+screw/nail device alone
7K1J900	Rvsn to int fxn(no red) prox fem #+screw/nail+intramed dev
7K1JA00	Revisn to int fxn(no red) prox fem #+screw/nail+plate device
7K1JE00	Rvsn to cls red+int fxn prox fem #+screw/nail device alone
7K1JF00	Rvsn cls red+int fxn prox fem #+screw/nail+intramed device
7K1JG00	Rvsn to cls red+int fxn prox fem #+screw/nail+plate device

7K1JJ00	Revision to wire fixation of fracture
7K1JL00	Revision to closed reduction of fracture and wire fixation
7K1HV00	Secondary open reduction # bone and internal fixation HFQ
7K1Hy00	Other specified secondary open reduction of fracture of bone
7K1Hz00	Secondary open reduction of fracture of bone NOS
7K1JZ00	Revision to closed reduction #+internal fixation with screws
7K1Ja00	Revision to closed reduction # + other internal fixation
7K1Jc00	Revision to closed reduction #+intramed nail fixation
7K1K200	Remanipulation of fracture of bone and external fixation HFQ
7K1K400	Revision to ext fxn(without reduction) proximal femoral #
7K1JU00	Revision cls reduction #+locked reamed intramed nail fxn
7K1JX00	Revision cls reduction #+unlocked unreamed intramed nail fxn
7K1JY00	Revision to closed reduction # + internal fixation with wire
7K1KA00	Revision to functional bracing of fracture
7K1KB00	Revision to external fixation of fracture
7K1KG00	Revision to closed reduction of # and external fixation
7K1KJ00	Revision to closed reduction of # + oth ext immobilisation
7K1L200	Revision to closed reduction of # and skeletal traction NEC
7K1L211	Remanipulation of fracture and skeletal traction NEC

7K1L300	Remanipulation of fracture of bone NEC
7K1LU00	Revision to closed reduction of # and cast immobilisation
7K1LX00	Revision to closed reduction of fracture alone
7K1La00	Revision to skin traction of fracture
7K1Lc00	Revision to cast immobilisation of fracture
7K1Lf00	Revision to arthroscopic reduction of fracture
7K1Lg00	Revision to arthroscopic reduction and fixation of fracture
7K1P400	Removal of internal fixation device NEC
7K1P500	Removal of external fixator NEC
7K1PC00	Removal of spinal fixation system
7K1PD00	Removal of Kirschner wire internal bone fixator
7K6H000	Revision to open reduction # dislocation+skeletal traction
7K6H200	Secondary open reduction fracture dislocation of joint NEC
7K6H400	Revision to closed reduction of fracture dislocation alone
7K6H411	Remanipulation of fracture dislocation alone
7K6H700	Secondary open reduction fracture disloc joint & fixation
7K6HW00	Revision to closed reduction # dislocation+other ext immobil
7K6HX00	Revision to open reduction fracture dislocation alone
7K6Hb00	Revision to open reduction of # dislocation+fixation+wire(s)

BURNS

Read code	Read code description
7G2C.00	Operations on burnt skin
7G2C.11	Operations on burnt skin including head or neck
7G2C000	Toilet or clean burnt skin of head or neck
7G2C100	Toilet or clean burnt skin NEC
7G2C200	Debridement of burnt skin of head and neck
7G2C300	Debridement of burnt skin NEC
7G2C400	Toilet to burnt skin of head or neck NEC
7G2C500	Tangent excision of burnt skin of head or neck
7G2C600	Tangent excision of burnt skin NEC
7G2C700	Escharotomy of burnt skin of head
7G2C900	Escharotomy of burnt skin of chest
7G2CA00	Escharotomy of burnt skin of arm
7G2CB00	Escharotomy of burnt skin of hand
7G2CC00	Escharotomy of burnt skin of leg
7G2CD00	Escharotomy of burnt skin of foot
7G2CE00	Removal of slough from burnt skin NEC
7G2CE11	Escharotomy of burnt skin NEC
7G2CG00	Dress burnt skin head or neck us vacuum assisted clos device
7G2CH00	Cleansing and sterilisation of burnt skin NEC
7G2Cy00	Other specified toilet to burnt skin
7G2Cz00	Toilet to burnt skin NOS
7G2E000	Dressing of burnt skin of head or neck
7G2E100	Dressing of burnt skin NEC
7G2E600	Attention to dressing of burn of head or neck
7G2E700	Attention to dressing of burnt skin NEC
7G2F.11	Exploration of skin wound or burn
7G2F200	Exploration of burnt skin of head or neck NEC
7G2F300	Exploration of burnt skin NEC
7G2Fs00	Exploration of burnt skin of head or neck OS
7G2Ft00	Exploration of burnt skin of head or neck NOS
7G2Fu00	Other specified exploration of burnt skin of other site
7G2Fv00	Exploration of burnt skin of other site NOS
81H2.00	Dressing of burn
8H15.00	Admit to burns unit
8H5E.00	Burns referral
9N0z.00	Seen in burns clinic
9b8A000	Burns care
R020100	[D]Burning of skin
SD...15	Friction burns
SD00.00	Abrasion or friction burn of head, without infection
SD00.11	Abrasion or friction burn of head without infection
SD00100	Abrasion/friction burn of neck, without infection
SD01.00	Abrasion or friction burn of head, infected
SD01.11	Abrasion or friction burn of head, infected
SD01z00	Abrasion or friction burn of head, infected, NOS
SD10B11	Abrasion or friction burn of testis without infection
SD10B12	Abrasion or friction burn of scrotum without infection
SD10z00	Abrasion/friction burn of trunk, without infection NOS
SD11.00	Abrasion or friction burn of trunk, infected
SD11B11	Abrasion or friction burn of scrotum, infected
SD11B12	Abrasion or friction burn of testis, infected
SD20.00	Abrasion/friction burn shoulder/upper arm without infection
SD20z00	Abrasion/friction burn shoulder/upper arm, no infection, NOS
SD21.00	Abrasion or friction burn of shoulder/upper arm, infected
SD21z00	Abrasion or friction burn shoulder/upper arm, infected, NOS
SD30.00	Abrasion or friction burn of lower arm, without infection
SD30z00	Abrasion/friction burn of lower arm, without infection NOS
SD31.00	Abrasion or friction burn of lower arm, infected
SD31z00	Abrasion or friction burn of lower arm, infected, NOS
SD40.00	Abrasion/friction burn of hand, without infection
SD41.00	Abrasion or friction burn of hand, infected
SD50.00	Abrasion/friction burn of finger, without infection
SD51.00	Abrasion or friction burn of finger, infected
SD60.00	Abrasion/friction burn of lower limb, without infection
SD60.11	Abrasion or friction burn of leg, without infection
SD60z00	Abrasion/friction burn of lower limb, without infection NOS
SD61.00	Abrasion or friction burn of lower limb, infected
SD61.11	Abrasion or friction burn of leg, infected
SD61z00	Abrasion or friction burn of lower limb, infected, NOS
SD70.00	Abrasion/friction burn of foot and toe, without infection
SD70.11	Abrasion or friction burn of heel, without infection
SD70.12	Abrasion or friction burn of toenail, without infection
SD71.00	Abrasion or friction burn of foot and toe, infected
SD71.11	Abrasion or friction burn of heel, infected
SD71.12	Abrasion or friction burn of toenail, infected
SD71z00	Abrasion or friction burn of foot and toe, infected, NOS
SD80000	Abrasion or friction burn of eyelids and periocular area
SD80011	Abrasion or friction burn of eyelid
SD90.00	Abrasion or friction burn, without infection, NOS
SD91.00	Abrasion or friction burn, infected, NOS
SH...00	Burns
SH...11	Scalds
SH0..00	Burn confined to eye and adnexa
SH0..11	Conjunctival burns
SH0..12	Corneal burns
SH0..13	Eyelid burns
SH0..14	Periocular burns
SH00.00	Chemical burn of eyelids and periocular area
SH01.00	Other burns of eyelids and periocular area
SH02.00	Alkaline chemical burn of cornea and conjunctival sac
SH03.00	Acid chemical burn of cornea and conjunctival sac

SH04.00	Other chemical burn of cornea and conjunctival sac
SH05.00	Burn resulting in eyeball rupture and destruction of eyeball
SH05000	Corrosion with resulting rupture and destruction of eyeball
SH0x.00	Burn of eyelid NOS
SH0y.00	Burn of cornea NOS
SH0z.00	Burn confined to eye and adnexa NOS
SH1..00	Burn of the face, head or neck
SH1..11	Face burns
SH1..12	Head burns
SH10.00	Unspecified thickness burn of the face, head or neck
SH10000	Unspecified thickness burn of unspecified part of face/head
SH10100	Unspecified thickness burn of the ear
SH10200	Unspecified thickness burn of the eye
SH10300	Unspecified thickness burn of the lip(s)
SH10400	Unspecified thickness burn of the chin
SH10500	Unspecified thickness burn of the nose
SH10600	Unspecified thickness burn of the scalp
SH10700	Unspecified thickness burn of the forehead
SH10800	Unspecified thickness burn of the cheek
SH10900	Unspecified thickness burn of the neck
SH10x00	Unspecified thickness burn multiple sites face, head or neck
SH10z00	Unspecified thickness burn of the face, head or neck NOS
SH11.00	Superficial burn of the face, head or neck
SH11.11	Erythema of head or neck, first degree burn
SH11000	Superficial burn of unspecified part of the face or head
SH11100	Superficial burn of the ear
SH11200	Superficial burn of the eye
SH11300	Superficial burn of the lip(s)
SH11400	Superficial burn of the chin
SH11500	Superficial burn of the nose
SH11600	Superficial burn of the scalp
SH11700	Superficial burn of the forehead
SH11800	Superficial burn of the cheek

SH11900	Superficial burn of the neck
SH11x00	Superficial burn of multiple sites of the face, head or neck
SH11z00	Superficial burn of the face, head or neck NOS
SH12.00	Partial thickness burn of the face, head or neck
SH12.11	Blister of face, head and neck, second degree burn
SH12000	Superficial part. thickness burn unspecified part face/head
SH12100	Superficial partial thickness burn of the ear
SH12111	Ear - 2nd degree burn
SH12200	Superficial partial thickness burn of the eye
SH12211	Eye - 2nd degree burn
SH12300	Superficial partial thickness burn of the lip(s)
SH12311	Lip - 2nd degree burn
SH12400	Superficial partial thickness burn of the chin
SH12411	Chin - 2nd degree burn
SH12500	Superficial partial thickness burn of the nose
SH12511	Nose - 2nd degree burn
SH12600	Superficial partial thickness burn of the scalp
SH12611	Scalp - 2nd degree burn
SH12700	Superficial partial thickness burn of the forehead
SH12711	Forehead - 2nd degree burn
SH12800	Superficial partial thickness burn of the cheek
SH12811	Cheek - 2nd degree burn
SH12900	Superficial partial thickness burn of the neck
SH12911	Neck - 2nd degree burn
SH12A00	Deep partial thickness burn of unspecified part of face/head
SH12B00	Deep partial thickness burn of the ear
SH12C00	Deep partial thickness burn of the eye
SH12D00	Deep partial thickness burn of the lip(s)
SH12E00	Deep partial thickness burn of the chin
SH12F00	Deep partial thickness burn of the nose
SH12G00	Deep partial thickness burn of the scalp
SH12H00	Deep partial thickness burn of the forehead
SH12J00	Deep partial thickness burn of the cheek

SH12K00	Deep partial thickness burn of the neck
SH12x00	Partial thickness burn of multiple sites face, head or neck
SH12z00	Partial thickness burn of the face, head or neck NOS
SH13.00	Full thickness burn of the face, head or neck
SH13000	Full thickness burn of unspecified part of the face or head
SH13100	Full thickness burn of the ear
SH13200	Full thickness burn of the eye
SH13300	Full thickness burn of the lip(s)
SH13400	Full thickness burn of the chin
SH13500	Full thickness burn of the nose
SH13600	Full thickness burn of the scalp
SH13700	Full thickness burn of the forehead
SH13800	Full thickness burn of the cheek
SH13900	Full thickness burn of the neck
SH13A00	Corrosion of third degree of head and neck
SH13x00	Full thickness burn of multiple sites of face, head or neck
SH13z00	Full thickness burn of the face, head or neck NOS
SH14.00	Deep full thick burn face/head/neck - without loss body part
SH14000	Deep full thick burn unspec.part face/head-no loss body part
SH14100	Deep full thickness burn of ear without loss of body part
SH14200	Deep full thickness burn of eye without loss of body part
SH14300	Deep full thickness burn of lip(s) without loss of body part
SH14400	Deep full thickness burn of chin without loss of body part
SH14500	Deep full thickness burn of nose without loss of body part
SH14600	Deep full thickness burn of scalp without loss of body part
SH14700	Deep full thickness burn forehead without loss of body part
SH14800	Deep full thickness burn of cheek without loss of body part
SH14900	Deep full thickness burn of neck without loss of body part
SH14x00	Deep full thickness burn multip sites face/head/neck- no BPL
SH14z00	Deep full thick burn, no loss body part, face/head/neck NOS
SH15.00	Deep full thick burn face/head/neck, with loss of body part
SH15000	Deep full thickness burn unspec part of face/head, with BPL

SH15100	Deep full thickness burn of the ear, with loss of body part
SH15200	Deep full thickness burn of the eye, with loss of body part
SH15300	Deep full thickness burn of lip(s), with loss of body part
SH15400	Deep full thickness burn of the chin, with loss of body part
SH15500	Deep full thickness burn of the nose, with loss of body part
SH15600	Deep full thickness burn of scalp, with loss of body part
SH15700	Deep full thickness burn of forehead, with loss of body part
SH15800	Deep full thickness burn of cheek, with loss of body part
SH15900	Deep full thickness burn of the neck, with loss of body part
SH15x00	Deep full thick burn multip parts face/head/neck - with BPL
SH15z00	Deep full thick burn, with loss body part,face/head/neck NOS
SH16.00	Corrosion of head and neck
SH16000	Corrosion of first degree of head and neck
SH1z.00	Burn of the face, head or neck NOS
SH2..00	Burn of the trunk
SH20.00	Unspecified thickness burn of the trunk
SH20000	Unspecified thickness burn of unspecified part of the trunk
SH20100	Unspecified thickness burn of the breast
SH20200	Unspecified thickness burn of the chest wall
SH20300	Unspecified thickness burn of the abdominal wall
SH20400	Unspecified thickness burn of the back (excluding buttock)
SH20500	Unspecified thickness burn of the buttock
SH20600	Unspecified thickness burn of the genitalia
SH20x00	Unspecified thickness burn of multiple sites of the trunk
SH20z00	Unspecified thickness burn of the trunk NOS
SH21.00	Superficial burn of the trunk
SH21.11	Erythema of trunk, 1st degree burn
SH21000	Superficial burn of unspecified part of the trunk
SH21100	Superficial burn of the breast
SH21200	Superficial burn of the chest wall
SH21300	Superficial burn of the abdominal wall
SH21400	Superficial burn of the back (excluding buttock)

SH21500	Superficial burn of the buttock
SH21600	Superficial burn of the genitalia
SH21x00	Superficial burn of multiple sites of the trunk
SH21z00	Superficial burn of the trunk NOS
SH22.00	Partial thickness burn of the trunk
SH22.11	Blister of trunk, second degree burn
SH22000	Superficial partial thickness burn unspecified part of trunk
SH22100	Superficial partial thickness burn of the breast
SH22200	Superficial partial thickness burn of the chest wall
SH22300	Superficial partial thickness burn of the abdominal wall
SH22400	Superficial partial thickness burn of back (excl buttock)
SH22500	Superficial partial thickness burn of the buttock
SH22600	Superficial partial thickness burn of the genitalia
SH22700	Deep partial thickness burn of the trunk, unspecified
SH22800	Deep partial thickness burn of the breast
SH22900	Deep partial thickness burn of the chest wall
SH22A00	Deep partial thickness burn of the abdominal wall
SH22B00	Deep partial thickness burn of the back (excluding buttock)
SH22C00	Deep partial thickness burn of the buttock
SH22D00	Deep partial thickness burn of the genitalia
SH22x00	Partial thickness burn of multiple sites of the trunk
SH22z00	Partial thickness burn of the trunk NOS
SH23.00	Full thickness burn of the trunk
SH23000	Full thickness burn of the trunk, unspecified
SH23100	Full thickness burn of the breast
SH23200	Full thickness burn of the chest wall
SH23300	Full thickness burn of the abdominal wall
SH23400	Full thickness burn of the back (excluding buttock)
SH23500	Full thickness burn of the buttock
SH23600	Full thickness burn of the genitalia
SH23x00	Full thickness burn of multiple sites of the trunk
SH23z00	Full thickness burn of the trunk NOS
SH24.00	Deep full thickness burn of trunk without loss of body part

SH24000	Deep full thickness burn of trunk unsp, no loss of body part
SH24100	Deep full thickness burn of breast without loss of body part
SH24200	Deep full thickness burn of chest without loss of body part
SH24300	Deep full thickness burn of abdom.wall, no loss of body part
SH24400	Deep full thickness burn of back without loss of body part
SH24500	Deep full thickness burn of buttock, no loss of body part
SH24600	Deep full thickness burn of genitalia, no loss of body part
SH24x00	Deep full thickness burn multiple sites trunk, no BPL
SH24z00	Deep full thickness burn of trunk, no loss of body part NOS
SH25.00	Deep full thickness burn of trunk, with loss of body part
SH25000	Deep full thickness burn of trunk unsp, with loss body part
SH25100	Deep full thickness burn of breast, with loss of body part
SH25200	Deep full thickness burn of chest, with loss of body part
SH25300	Deep full thickness burn of abd.wall, with loss of body part
SH25400	Deep full thickness burn of back, with loss of body part
SH25500	Deep full thickness burn of buttock, with loss of body part
SH25600	Deep full thickness burn of genitalia, with loss body part
SH25x00	Deep full thickness burn multiple sites trunk with BPL
SH25z00	Deep full thickness burn of trunk, with loss body part, NOS
SH26.00	Corrosion of unspecified degree of trunk
SH2z.00	Burn of the trunk NOS
SH3..00	Burn of the arm (excluding wrist and hand)
SH30.00	Unspecified thickness burn of the arm
SH30000	Unspecified thickness burn of the arm, unspecified
SH30100	Unspecified thickness burn of the forearm
SH30200	Unspecified thickness burn of the elbow
SH30300	Unspecified thickness burn of the upper arm
SH30400	Unspecified thickness burn of the axilla
SH30500	Unspecified thickness burn of the shoulder
SH30600	Unspecified thickness burn of the scapular region
SH30x00	Unspecified thickness burn of multiple sites of the arm
SH30z00	Unspecified thickness burn of the arm NOS
SH31.00	Superficial burn of the arm

SH31.11	Erythema of arm, first degree burn
SH31000	Superficial burn of the arm, unspecified
SH31100	Superficial burn of the forearm
SH31200	Superficial burn of the elbow
SH31300	Superficial burn of the upper arm
SH31400	Superficial burn of the axilla
SH31500	Superficial burn of the shoulder
SH31600	Superficial burn of the scapular region
SH31x00	Superficial burn of multiple sites of the arm
SH31z00	Superficial burn of the arm NOS
SH32.00	Partial thickness burn of the arm
SH32.11	Blister of arm, second degree burn
SH32000	Superficial partial thickness burn of the arm, unspecified
SH32100	Superficial partial thickness burn of the forearm
SH32200	Superficial partial thickness burn of the elbow
SH32300	Superficial partial thickness burn of the upper arm
SH32400	Superficial partial thickness burn of the axilla
SH32500	Superficial partial thickness burn of the shoulder
SH32600	Superficial partial thickness burn of scapular region
SH32700	Deep partial thickness burn of the arm, unspecified
SH32800	Deep partial thickness burn of the forearm
SH32900	Deep partial thickness burn of the elbow
SH32A00	Deep partial thickness burn of the upper arm
SH32B00	Deep partial thickness burn of the axilla
SH32C00	Deep partial thickness burn of the shoulder
SH32D00	Deep partial thickness burn of the scapular region
SH32x00	Partial thickness burn of multiple sites of the arm
SH32z00	Partial thickness burn of the arm NOS
SH33.00	Full thickness burn of the arm
SH33000	Full thickness burn of the arm, unspecified
SH33100	Full thickness burn of the forearm
SH33200	Full thickness burn of the elbow
SH33300	Full thickness burn of the upper arm

SH33400	Full thickness burn of the axilla
SH33500	Full thickness burn of the shoulder
SH33600	Full thickness burn of the scapular region
SH33x00	Full thickness burn of multiple sites of the arm
SH33z00	Full thickness burn of the arm NOS
SH34.00	Deep full thickness burn of arm without loss of body part
SH34000	Deep full thickness burn of arm unsp, no loss of body part
SH34100	Deep full thickness burn of forearm, no loss of body part
SH34200	Deep full thickness burn of elbow without loss of body part
SH34300	Deep full thickness burn of upper arm, no loss of body part
SH34400	Deep full thickness burn of axilla without loss of body part
SH34500	Deep full thickness burn of shoulder, no loss of body part
SH34600	Deep full thickness burn of scapular, no loss of body part
SH34x00	Deep full thickness burn of multiple sites of arm, no BPL
SH34z00	Deep full thickness burn without loss of body part-arm NOS
SH35.00	Deep full thickness burn of arm, with loss of body part
SH35000	Deep full thickness burn of arm unsp, with loss of body part
SH35100	Deep full thickness burn of forearm, with loss of body part
SH35200	Deep full thickness burn of elbow, with loss of body part
SH35300	Deep full thickness burn of upper arm,with loss of body part
SH35400	Deep full thickness burn of axilla, with loss of body part
SH35500	Deep full thickness burn of shoulder, with loss of body part
SH35600	Deep full thickness burn of scapular, with loss of body part
SH35x00	Deep full thickness burn of multiple sites of arm with BPL
SH35z00	Deep full thickness burn-, with loss of body part-arm NOS
SH36.00	Corros/unspecf degree/shoulder+upper limb,except wrist+hand
SH36000	Corrosion/1st degree shoulder+upper limb,except wrist+hand
SH36100	Corrosion/2nd degree/shoulder and upper limb exc wrist+hand
SH3z.00	Burn of the arm (excluding wrist and hand) NOS
SH4..00	Burn of the wrist(s) and hand(s)
SH40.00	Unspecified thickness burn of the wrist and hand

SH40.11	Unspecified degree burn of finger
SH40.12	Unspecified degree burn of hand
SH40.13	Unspecified degree burn of thumb
SH40.14	Unspecified degree burn of wrist
SH40000	Unspecified thickness burn of the hand, unspecified
SH40100	Unspecified thickness burn of a single finger
SH40200	Unspecified thickness burn of the thumb
SH40300	Unspecified thickness burn of more than one finger
SH40400	Unspecified thickness burn of the thumb and finger(s)
SH40500	Unspecified thickness burn of the palm of hand
SH40600	Unspecified thickness burn of the back of hand
SH40700	Unspecified thickness burn of the wrist
SH40x00	Unspecified thickness burn of multiple sites of wrist/hand
SH40z00	Unspecified thickness burn of the wrist or hand NOS
SH41.00	Superficial burn of the wrist and hand
SH41.11	Erythema of wrist and hand,first degree burn
SH41.12	First degree burn of finger
SH41.13	First degree burn of hand
SH41.14	First degree burn of thumb
SH41.15	First degree burn of wrist
SH41000	Superficial burn of the hand, unspecified
SH41100	Superficial burn of a single finger
SH41200	Superficial burn of the thumb
SH41300	Superficial burn of more than one finger
SH41400	Superficial burn of the thumb and finger(s)
SH41500	Superficial burn of the palm of hand
SH41600	Superficial burn of the back of hand
SH41700	Superficial burn of the wrist
SH41x00	First degree burn of multiple sites of the wrist or hand
SH41z00	Superficial burn of the wrist or hand NOS
SH42.00	Partial thickness burn of the wrist and hand
SH42.11	Blister of wrist and hand, second degree burn
SH42.12	Second degree burn of finger

SH42.13	Second degree burn of hand
SH42.14	Second degree burn of thumb
SH42.15	Second degree burn of wrist
SH42000	Superficial partial thickness burn of hand, unspecified
SH42100	Superficial partial thickness burn of a single finger
SH42200	Superficial partial thickness burn of the thumb
SH42300	Superficial partial thickness burn of more than one finger
SH42400	Superficial partial thickness burn of thumb and finger(s)
SH42500	Superficial partial thickness burn of palm of hand
SH42600	Superficial partial thickness burn of back of hand
SH42700	Superficial partial thickness burn of the wrist
SH42800	Deep partial thickness burn of the hand, unspecified
SH42900	Deep partial thickness burn of a single finger
SH42A00	Deep partial thickness burn of the thumb
SH42B00	Deep partial thickness burn of more than one finger
SH42C00	Deep partial thickness burn of the thumb and finger(s)
SH42D00	Deep partial thickness burn of the palm of hand
SH42E00	Deep partial thickness burn of back of hand
SH42F00	Deep partial thickness burn of wrist
SH42x00	Partial thickness burn of multiple sites of the wrist/hand
SH42z00	Partial thickness burn of the wrist or hand NOS
SH43.00	Full thickness burn of the wrist and hand
SH43.11	Third degree burn of finger
SH43.12	Third degree burn of hand
SH43.13	Third degree burn of thumb
SH43.14	Third degree burn of wrist
SH43000	Full thickness burn of the hand, unspecified
SH43100	Full thickness burn of a single finger
SH43200	Full thickness burn of the thumb
SH43300	Full thickness burn of more than one finger
SH43400	Full thickness burn of the thumb and finger(s)
SH43500	Full thickness burn of the palm of hand
SH43600	Full thickness burn of the back of hand

SH43700	Full thickness burn of the wrist
SH43x00	Full thickness burn of multiple sites of the wrist or hand
SH43z00	Full thickness burn of the wrist or hand NOS
SH44.00	Deep full thickness burn of wrist/hand, no loss of body part
SH44.11	Deep third degree burn of finger,without loss of a body part
SH44.12	Deep third degree burn of hand, without loss of a body part
SH44.13	Deep third degree burn of thumb, without loss of a body part
SH44.14	Deep third degree burn of wrist, without loss of a body part
SH44000	Deep full thickness burn of hand unsp, no loss of body part
SH44100	Deep full thickness burn of a finger, no loss of body part
SH44200	Deep full thickness burn of thumb without loss of body part
SH44300	Deep full thickness burn of >1 finger, no loss of body part
SH44400	Deep full thickness burn of thumb+fing, no loss of body part
SH44500	Deep full thickness burn of palm hand, no loss of body part
SH44600	Deep full thickness burn of back hand, no loss of body part
SH44700	Deep full thickness burn of wrist without loss of body part
SH44x00	Deep full thickness burn-multiple sites wrist/hand, no BPL
SH44z00	Deep full thickness burn of wrist/hand,no loss body part NOS
SH45.00	Deep full thickness burn of wrist/hand, with loss body part
SH45.11	Deep third degree burn of finger with loss of a body part
SH45.12	Deep third degree burn of hand with loss of a body part
SH45.13	Deep third degree burn of thumb with loss of a body part
SH45.14	Deep third degree burn of wrist with loss of a body part
SH45000	Deep full thickness burn of hand unsp, with loss body part
SH45100	Deep full thickness burn of a finger, with loss of body part
SH45200	Deep full thickness burn of thumb, with loss of body part
SH45300	Deep full thickness burn of >1 finger, with loss body part
SH45400	Deep full thickness burn of thumb+fing, with loss body part
SH45500	Deep full thickness burn of palm hand, with loss body part
SH45600	Deep full thickness burn of back hand, with loss body part
SH45700	Deep full thickness burn of wrist, with loss of body part
SH45x00	Deep full thickness burn-multiple sites wrist/hand with BPL

SH45z00	Deep full thickness burn wrist/hand, with loss body part NOS
SH46.00	Corrosion of wrist and hand
SH46000	Corrosion of first degree of wrist and hand
SH46100	Corrosion of second degree of wrist and hand
SH4z.00	Burn of wrist or hand NOS
SH5..00	Burn of lower limbs
SH5..11	Leg burns
SH50.00	Unspecified thickness burn of the leg
SH50000	Unspecified degree burn of the leg, unspecified
SH50100	Unspecified thickness burn of the toe(s)
SH50200	Unspecified thickness burn of the foot
SH50300	Unspecified thickness burn of the ankle
SH50400	Unspecified thickness burn of the lower leg
SH50500	Unspecified thickness burn of the knee
SH50600	Unspecified thickness burn of the thigh
SH50x00	Unspecified thickness burn of multiple sites of the leg
SH50z00	Unspecified thickness burn of the leg NOS
SH51.00	Superficial burn of the leg
SH51.11	Erythema of leg, first degree burn
SH51000	Superficial burn of the leg, unspecified
SH51100	Superficial burn of the toe(s)
SH51200	Superficial burn of the foot
SH51300	Superficial burn of the ankle
SH51400	Superficial burn of the lower leg
SH51500	Superficial burn of the knee
SH51600	Superficial burn of the thigh
SH51x00	Superficial burn of multiple sites of the leg
SH51z00	Superficial burn of the leg NOS
SH52.00	Partial thickness burn of the leg
SH52.11	Blister of leg, second degree burn
SH52000	Superficial partial thickness burn of the leg, unspecified
SH52100	Superficial partial thickness burn of the toe(s)

SH52200	Superficial partial thickness burn of the foot
SH52300	Superficial partial thickness burn of the ankle
SH52400	Superficial partial thickness burn of the lower leg
SH52500	Superficial partial thickness burn of the knee
SH52600	Superficial partial thickness burn of the thigh
SH52700	Deep partial thickness burn of the leg, unspecified
SH52800	Deep partial thickness burn of the toe(s)
SH52900	Deep partial thickness burn of the foot
SH52A00	Deep partial thickness burn of the ankle
SH52B00	Deep partial thickness burn of the lower leg
SH52C00	Deep partial thickness burn of the knee
SH52D00	Deep partial thickness burn of the thigh
SH52x00	Partial thickness burn of multiple sites of the leg
SH52z00	Partial thickness burn of the leg NOS
SH53.00	Full thickness burn of the leg
SH53000	Full thickness burn of the leg, unspecified
SH53100	Full thickness burn of the toe(s)
SH53200	Full thickness burn of the foot
SH53300	Full thickness burn of the ankle
SH53400	Full thickness burn of the lower leg
SH53500	Full thickness burn of the knee
SH53600	Full thickness burn of the thigh
SH53x00	Full thickness burn of multiple sites of the leg
SH53z00	Full thickness burn of the leg NOS
SH54.00	Deep full thickness burn of leg without loss of body part
SH54000	Deep full thickness burn of leg unsp, no loss of body part
SH54100	Deep full thickness burn of toe(s) without loss of body part
SH54200	Deep full thickness burn of foot without loss of body part
SH54300	Deep full thickness burn of ankle without loss of body part
SH54400	Deep full thickness burn of lower leg without loss of body
SH54500	Deep full thickness burn of knee without loss of body part
SH54600	Deep full thickness burn of thigh without loss of body part
SH54x00	Deep full thickness burn-mult.leg without loss of body part

SH54z00	Deep full thickness burn, no loss of body part, of leg NOS
SH55.00	Deep full thickness burn of leg, with loss of body part
SH55000	Deep full thickness burn of leg unspec, with loss body part
SH55100	Deep full thickness burn of toe(s), with loss of body part
SH55200	Deep full thickness burn of foot, with loss of body part
SH55300	Deep full thickness burn of ankle, with loss of body part
SH55400	Deep full thickness burn of lower leg, with loss body part
SH55500	Deep full thickness burn of knee, with loss of body part
SH55600	Deep full thickness burn of thigh, with loss of body part
SH55x00	Deep full thickness burn-mult.leg, with loss of body part
SH55z00	Deep full thickness burn, with loss of body part, of leg NOS
SH56.00	Burn and corrosion of hip and lower limb,except ankle & foot
SH56000	Corrosion of first degree of hip+lower limb,exc ankle + foot
SH56100	Corrosion/2nd degree/hip+lower limb,except ankle & foot
SH57.00	Corrosion of ankle and foot
SH57000	Corrosion of first degree of ankle and foot
SH57100	Corrosion of second degree of ankle and foot
SH5z.00	Burn of the lower limb NOS
SH6..00	Burn of multiple specified sites
SH60.00	Unspecified thickness burn of multiple specified sites
SH61.00	Superficial burn of multiple specified sites
SH62.00	Partial thickness burn of multiple specified sites
SH62000	Superficial partial thickness burn multiple specified sites
SH62100	Deep partial thickness burn of multiple specified sites
SH63.00	Full thickness burn of multiple specified sites
SH64.00	Deep full thickness burn multiple specified sites, no BPL
SH65.00	Deep full thickness burn multiple specified sites, with BPL
SH66000	Corros/multiple reg,no more than first-deg corros mentioned
SH66300	Corros/multi reg,at least one corros/third degree mentioned
SH6z.00	Burn of multiple specified sites NOS
SH6z000	Corrosion of first degree, body region unspecified

SH6z200	Corrosion of third degree, body region unspecified
SH7..00	Burn of internal organs
SH70.00	Burn of the mouth and pharynx
SH70000	Burn of the mouth, unspecified
SH70100	Burn of the gum
SH70200	Burn of the tongue
SH70300	Burn of the pharynx
SH70400	Corrosion of mouth and pharynx
SH70z00	Burn of the mouth or pharynx NOS
SH71.00	Burn of the larynx, trachea and lung
SH71000	Burn of the larynx
SH71100	Burn of the trachea
SH71200	Burn of the lung
SH71400	Corrosion involving larynx and trachea with lung
SH71X00	Corrosion of respiratory tract, part unspecified
SH71z00	Burn of the larynx, trachea or lung NOS
SH72.00	Burn of the oesophagus
SH73.00	Burn of the gastrointestinal tract
SH73000	Burn of the stomach
SH73100	Burn of the small intestine
SH73200	Burn of the colon
SH73300	Burn of the rectum
SH73z00	Burn of the gastrointestinal tract NOS
SH74.00	Burn of the vagina and uterus
SH74000	Burn of the vagina
SH74100	Burn of the uterus
SH74z00	Burn of the vagina or uterus NOS
SH7y.00	Burn of other internal organ
SH7z.00	Burn of internal organ NOS
SH8..00	Burns as a percentage of body surface (BS) involved
SH80.00	Burn involving <10% of body surface (BS)
SH80000	Burn:<10% of body surface, 10%/unspec BS full thickness
SH80100	Corrosions involving less than 10% of body surface

SH80z00	Burn:<10% of body surface NOS
SH81.00	Burn involving 10-19% of body surface (BS)
SH81000	Burn: 10-14% of body surface,<10%/unsp BS full thickness
SH81100	Burn: 10-14% of body surface, 10-14% BS full thickness
SH81200	Burn: 15-19% of body surface,<10%/unsp BS full thickness
SH81300	Burn: 15-19% of body surface, 10-19% BS full thickness
SH81400	Corrosions involving 10-19% of body surface
SH81z00	Burn: 10-19% of body surface NOS
SH82.00	Burn involving 20-29% of body surface (BS)
SH82000	Burn: 20-29% of body surface,<10%/unspec BS full thickness
SH82100	Burn: 20-29% of body surface, 10-19% BS full thickness
SH82200	Burn: 20-29% of body surface, 20-29% BS full thickness
SH82300	Corrosions involving 20-29% of body surface
SH82z00	Burn: 20-29% of body surface NOS
SH83.00	Burn involving 30-39% of body surface (BS)
SH83000	Burn: 30-39% of body surface,<10%/unspec BS full thickness
SH83100	Burn: 30-39% of body surface, 10-19% BS full thickness
SH83200	Burn: 30-39% of body surface, 20-29% BS full thickness
SH83300	Burn: 30-39% of body surface, 30-39% BS full thickness
SH83400	Corrosions involving 30-39% of body surface
SH83z00	Burn: 30-39% of body surface NOS
SH84.00	Burn involving 40-49% of body surface (BS)
SH84000	Burn: 40-49% of body surface,<10%/unspec BS full thickness
SH84100	Burn: 40-49% of body surface, 10-19% BS full thickness
SH84200	Burn: 40-49% of body surface, 20-29% BS full thickness
SH84300	Burn: 40-49% of body surface, 30-39% BS full thickness
SH84400	Burn: 40-49% of body surface, 40-49% BS full thickness
SH84500	Corrosions involving 40-49% of body surface
SH84z00	Burn: 40-49% of body surface NOS
SH85.00	Burn involving 50-59% of body surface (BS)
SH85000	Burn: 50-59% of body surface,<10%/unspec BS full thickness
SH85100	Burn: 50-59% of body surface, 10-19% BS full thickness
SH85200	Burn: 50-59% of body surface, 20-29% BS full thickness
SH85300	Burn: 50-59% of body surface, 30-39% BS full thickness
SH85400	Burn: 50-59% of body surface, 40-49% BS full thickness
SH85500	Burn: 50-59% of body surface, 50-59% BS full thickness
SH85600	Corrosions involving 50-59% of body surface
SH85z00	Burn: 50-59% of body surface NOS
SH86.00	Burn involving 60-69% of body surface (BS)
SH86000	Burn: 60-69% of body surface,<10%/unspec BS full thickness
SH86100	Burn: 60-69% of body surface, 10-19% BS full thickness
SH86200	Burn: 60-69% of body surface, 20-29% BS full thickness
SH86300	Burn: 60-69% of body surface, 30-39% BS full thickness
SH86400	Burn: 60-69% of body surface, 40-49% BS full thickness
SH86500	Burn: 60-69% of body surface, 50-59% BS full thickness
SH86600	Burn: 60-69% of body surface, 60-69% BS full thickness
SH86700	Corrosions involving 60-69% of body surface
SH86z00	Burn: 60-69% of body surface NOS
SH87.00	Burn involving 70-79% of body surface (BS)
SH87000	Burn: 70-79% of body surface,<10%/unspec BS full thickness
SH87100	Burn: 70-79% of body surface, 10-19% BS full thickness
SH87200	Burn: 70-79% of body surface, 20-29% BS full thickness
SH87300	Burn: 70-79% of body surface, 30-39% BS full thickness
SH87400	Burn: 70-79% of body surface, 40-49% BS full thickness
SH87500	Burn: 70-79% of body surface, 50-59% BS full thickness
SH87600	Burn: 70-79% of body surface, 60-69% BS full thickness
SH87700	Burn: 70-79% of body surface, 70-79% BS full thickness
SH87800	Corrosions involving 70-79% of body surface
SH87z00	Burn: 70-79% of body surface NOS
SH88.00	Burn involving 80-89% of body surface (BS)
SH88000	Burn: 80-89% of body surface,<10%/unspec BS full thickness
SH88100	Burn: 80-89% of body surface, 10-19% =full thickness
SH88200	Burn: 80-89% of body surface, 20-29% BS full thickness
SH88300	Burn: 80-89% of body surface, 30-39% BS full thickness
SH88400	Burn: 80-89% of body surface, 40-49% BS full thickness
SH88500	Burn: 80-89% of body surface, 50-59% BS full thickness
SH88600	Burn: 80-89% of body surface, 60-69% BS full thickness
SH88700	Burn: 80-89% of body surface, 70-79% BS full thickness
SH88800	Burn: 80-89% of body surface, 80-89% BS full thickness
SH88900	Corrosions involving 80-89% of body surface
SH88z00	Burn: 80-89% of body surface, NOS
SH89.00	Burn involving >90% of body surface (BS)
SH89000	Burn: >90% of body surface, <10%/unspec BS full thickness
SH89100	Burn: >90% of body surface, 10-19% BS full thickness
SH89200	Burn: >90% of body surface, 20-29% BS full thickness
SH89300	Burn: >90% of body surface, 30-39% BS full thickness
SH89400	Burn: >90% of body surface, 40-49% BS full thickness
SH89500	Burn: >90% of body surface, 50-59% BS full thickness
SH89600	Burn: >90% of body surface, 60-69% BS full thickness
SH89700	Burn: >90% of body surface, 70-79% BS full thickness
SH89800	Burn: >90% of body surface, 80-89% BS full thickness
SH89900	Burn: >90% of body surface, >90% BS full thickness
SH89z00	Burn: >90% of body surface NOS
SH8z.00	Burn as a percentage of body surface involved NOS
SH9..00	Burn - unspecified
SH90.00	Unspecified degree of burn NOS
SH91.00	Superficial burn NOS
SH91.11	First degree burn
SH92.00	Partial thickness burn NOS
SH92.11	Second degree burn
SH92000	Superficial partial thickness burn NOS
SH92100	Deep partial thickness burn NOS
SH93.00	Full thickness burn NOS
SH93.11	Third degree burn
SH94.00	Deep full thickness burn, without loss of body part, NOS
SH95.00	Deep full thickness burn, with loss of body part, NOS
SH9z.00	Burn - unspecified
SHz..00	Burns NOS
SyuD.00	[X]Burns and corrosions

SyuD000	[X]Burns of other parts of eye and adnexa
SyuD200	[X]Burn of other parts of respiratory tract
SyuD400	[X]Burn of other parts of alimentary tract
SyuD500	[X]Burns of other and unspecified internal organs
SyuD800	[X]Burns of mult reg, at least 1 burn of 3rd deg mentioned
SyuDA00	[X]Burn of unspecified body region, unspecified degree
SyuDD00	[X]Burn of respiratory tract, part unspecified
T03..00	Train accident involving explosion, fire or burning
T031.00	Train accident involving fire
T031000	Train accident involving fire, railway employee injured
T031100	Train accident involving fire, passenger injured
T031200	Train accident involving fire, pedestrian injured
T031300	Train accident involving fire, pedal cyclist injured
T031y00	Train accident involving fire, other spec person injured
T031z00	Train accident involving fire, unspecified person injured
T032.00	Train accident involving burning
T032000	Train accident involving burning, railway employee injured
T032100	Train accident involving burning, passenger injured
T032200	Train accident involving burning, pedestrian injured
T032300	Train accident involving burning, pedal cyclist injured
T032y00	Train accident involving burning, other spec person injured
T032z00	Train accident involving burning, unspecified person injured
T03z.00	Train accident involving explosion, fire or burning NOS
T03z000	Train accident with explosion/fire NOS, employee injured
T03z100	Train accident with explosion/fire NOS, passenger injured
T03z200	Train accident with explosion/fire NOS, pedestrian injured
T03z300	Train accident with explosion/fire NOS, cyclist injured
T03zy00	Train accident with explosion/fire NOS, other person injured
T03zz00	Train accident with explosion/fire NOS,unspec person injured
T338.00	Fire in road vehicle NEC
T338000	Fire in road vehicle NEC - pedestrian injured
T338100	Fire in road vehicle NEC - occupant of tram injured
T338y00	Fire in road vehicle NEC - other specified person injured
T338z00	Fire in road vehicle NEC - unspecified person injured
T461.00	Localised fire in watercraft
T461000	Localised fire in watercraft, occ small unpowered boat inj
T461100	Localised fire in watercraft, occ small powered boat injured
T461200	Localised fire in watercraft, crew other watercraft injured
T461300	Localised fire in watercraft, passenger other watercraft inj
T461400	Localised fire in watercraft, water skier injured
T461500	Localised fire in watercraft, swimmer injured
T461600	Localised fire in watercraft, docker or stevedore injured
T461y00	Localised fire in watercraft, other specified person injured
T461z00	Localised fire in watercraft, unspecified person injured
T504.00	Fire on aircraft while taking off
T504.11	Aircraft fire on takeoff
T504000	Aircraft fire on takeoff - occupant of spacecraft injured
T504100	Aircraft fire on takeoff - occupant of military aircraft inj
T504200	Aircraft fire on takeoff - crew comm aircraft surf/s injured
T504300	Aircraft fire on takeoff - other occ comm aircr surf/s inj
T504400	Aircraft fire on takeoff - occ comm surf/air aircraft inj
T504500	Aircraft fire on takeoff - occ other powered aircraft inj
T504600	Aircraft fire on takeoff - occupant unpowered aircraft inj
T504700	Aircraft fire on takeoff - parachutist injured
T504800	Aircraft fire on takeoff - ground crew/airline employee inj
T504z00	Aircraft fire on takeoff - other person injured
T505.00	Fire on aircraft while landing
T505000	Aircraft fire on landing - occupant of spacecraft injured
T505100	Aircraft fire on landing - occupant of military aircraft inj
T505200	Aircraft fire on landing - crew comm aircraft surf/s injured
T505300	Aircraft fire on landing - other occ comm aircr surf/s inj
T505400	Aircraft fire on landing - occ comm surf/air aircraft inj
T505500	Aircraft fire on landing - occ other powered aircraft inj
T505600	Aircraft fire on landing - occupant unpowered aircraft inj
T505700	Aircraft fire on landing - parachutist injured
T505800	Aircraft fire on landing - ground crew/airline employee inj
T505z00	Aircraft fire on landing - other person injured
T514.00	Fire on aircraft while in transit
T514000	Fire on aircraft-flying - occupant of spacecraft injured
T514100	Fire on aircraft-flying - occupant of military aircraft inj
T514200	Fire on aircraft-flying - crew comm aircraft surf/s injured
T514300	Fire on aircraft-flying - other occ comm aircraft surf/s inj
T514400	Fire on aircraft-flying - occ comm surf/air aircraft injured
T514500	Fire on aircraft-flying - occ other powered aircraft injured
T514600	Fire on aircraft-flying - occupant unpowered aircraft inj
T514700	Fire on aircraft-flying - parachutist injured
T514800	Fire on aircraft-flying - ground crew/airline employee inj
T514z00	Fire on aircraft-flying - other person injured
TD...00	Accidents caused by fire and flames
TD0..00	Conflagration in private dwelling
TD0..11	House fire
TD00500	Explosion caused by conflagration in house
TD01.00	Fumes from combustion of PVC in conflagration-private dwell
TD02.00	Carbon monoxide fumes from conflagration in private dwelling
TD02000	Carbon monoxide fumes from conflagration in apartment
TD02500	Carbon monoxide fumes from conflagration in house
TD02800	Carbon monoxide fumes from conflagration in private garage
TD02z00	Carbon monoxide fumes from conflagration private dwell NOS
TD03.00	Fumes NOS from conflagration in private dwelling
TD03000	Fumes NOS from conflagration in apartment
TD03500	Fumes NOS from conflagration in house
TD04.00	Smoke NOS from conflagration in private dwelling
TD04000	Smoke NOS from conflagration in apartment
TD04100	Smoke NOS from conflagration in boarding house
TD04200	Smoke NOS from conflagration in camping place
TD04300	Smoke NOS from conflagration in caravan

TD04400	Smoke NOS from conflagration in farmhouse
TD04500	Smoke NOS from conflagration in house
TD04600	Smoke NOS from conflagration in lodging house
TD04700	Smoke NOS from conflagration in mobile home
TD04800	Smoke NOS from conflagration in private garage
TD04900	Smoke NOS from conflagration in rooming house
TD04A00	Smoke NOS from conflagration in tenement
TD04z00	Smoke NOS from conflagration in private dwelling NOS
TD05.00	Burning caused by conflagration in private dwelling
TD05000	Burning caused by conflagration in apartment
TD05100	Burning caused by conflagration in boarding house
TD05200	Burning caused by conflagration in camping place
TD05300	Burning caused by conflagration in caravan
TD05400	Burning caused by conflagration in farmhouse
TD05500	Burning caused by conflagration in house
TD05600	Burning caused by conflagration in lodging house
TD05700	Burning caused by conflagration in mobile home
TD05800	Burning caused by conflagration in private garage
TD05900	Burning caused by conflagration in rooming house
TD05A00	Burning caused by conflagration in tenement
TD05z00	Burning caused by conflagration in private dwelling NOS
TD06100	Accident due to collapse of burning boarding house
TD07.00	Accident due to fall from burning private dwelling
TD07300	Accident due to fall from burning caravan
TD07500	Accident due to fall from burning house
TD08300	Hit by object falling from burning caravan
TD08400	Hit by object falling from burning farmhouse
TD09.00	Jump from burning private dwelling
TD09z00	Jump from burning private dwelling NOS
TD0z.00	Accidents caused by conflagration in private dwelling NOS
TD1..00	Conflagration in other building or structure
TD10.00	Explosion caused by conflagration - other building/structure
TD11.00	Fumes from combustion of PVC in fire, in other structure
TD12.00	Carbon monoxide fumes from fire in other structure/building
TD12z00	Carbon monoxide fumes from fire in structure or building NOS
TD13.00	Fumes NOS from conflagration in structure or building
TD13500	Fumes NOS from conflagration in factory
TD13z00	Fumes NOS from conflagration in structure or building NOS
TD14.00	Smoke NOS from conflagration in structure or building
TD14000	Smoke NOS from conflagration in barn
TD14100	Smoke NOS from conflagration in church
TD14200	Smoke NOS from conflagration in convalescent home
TD14300	Smoke NOS from conflagration in other residential home
TD14400	Smoke NOS from conflagration in dormitory of educat inst
TD14500	Smoke NOS from conflagration in factory
TD14600	Smoke NOS from conflagration in farm outbuilding
TD14700	Smoke NOS from conflagration in hospital
TD14800	Smoke NOS from conflagration in hotel
TD14900	Smoke NOS from conflagration in school
TD14A00	Smoke NOS from conflagration in store
TD14B00	Smoke NOS from conflagration in theatre
TD14z00	Smoke NOS from conflagration in structure or building NOS
TD15.00	Burning caused by conflagration in other structure/building
TD15000	Burning caused by conflagration in barn
TD15100	Burning caused by conflagration in church
TD15200	Burning caused by conflagration in convalescent home
TD15300	Burning caused by conflagration in other residential home
TD15400	Burning caused by fire in dormitory of educational inst
TD15500	Burning caused by conflagration in factory
TD15600	Burning caused by conflagration in farm outbuilding
TD15700	Burning caused by conflagration in hospital
TD15800	Burning caused by conflagration in hotel
TD15900	Burning caused by conflagration in school
TD15A00	Burning caused by conflagration in store
TD15B00	Burning caused by conflagration in theatre
TD15z00	Burning caused by conflagration in structure or building NOS
TD16.00	Accident due to collapse of other burning structure/building
TD17.00	Accident due to fall from other burning structure/building
TD18100	Hit by object falling from burning church
TD19.00	Jump from other burning structure or building
TD19100	Jump from burning church
TD19800	Jump from burning hotel
TD19z00	Jump from burning structure or building NOS
TD1y.00	Other accident due to fire in other structure/building
TD1y300	Other accident due to fire in other residential home
TD1y400	Other accident due to fire in dormitory of educational inst
TD1y600	Other accident resulting from fire in farm outbuilding
TD1yz00	Other accident due to fire in other structure/building NOS
TD1z.00	Accident caused by fire in other structure or building NOS
TD20.00	Uncontrolled fire in forest
TD21.00	Uncontrolled fire in grass
TD22.00	Uncontrolled fire in hay
TD23.00	Uncontrolled lumber fire
TD24.00	Uncontrolled fire in mine
TD25.00	Uncontrolled fire on prairie
TD26.00	Uncontrolled fire in stationary transport vehicle
TD27.00	Uncontrolled fire in tunnel
TD3..00	Accidents caused by clothes on fire, ACOF
TD30.00	Accid-clothes on fire from controlled fire-private dwelling
TD30000	ACOF-contr fire in private dwelling - normal charcoal fire
TD30100	ACOF-contr fire in private dwelling - normal coal fire
TD30200	ACOF-contr fire in private dwelling - normal electric fire
TD30300	ACOF-contr fire in private dwelling - normal gas fire
TD30400	ACOF-contr fire in private dwelling - normal wood fire
TD30500	ACOF-contr fire in private dwelling - brazier
TD30600	ACOF-contr fire in private dwelling - furnace
TD30700	ACOF-contr fire in private dwelling - stove

TD30z00	ACOF-contr fire in private dwelling - fireplace NOS
TD31.00	Accid-clothes on fire from controlled fire-other structure
TD31000	ACOF-contr fire in other structure - normal charcoal fire
TD31100	ACOF-contr fire in other structure - normal coal fire
TD31200	ACOF-contr fire in other structure - normal electric fire
TD31300	ACOF-contr fire in other structure - normal gas fire
TD31400	ACOF-contr fire in other structure - normal wood fire
TD31500	ACOF-contr fire in other structure - brazier
TD31600	ACOF-contr fire in other structure - furnace
TD31700	ACOF-contr fire in other structure - stove
TD31z00	ACOF-contr fire in other structure - fireplace NOS
TD32.00	Accid-clothes on fire from controlled fire in the open
TD32000	ACOF-controlled fire in the open due to bonfire
TD32100	ACOF-controlled fire in the open due to brazier
TD32200	ACOF-controlled fire in the open due to trash fire
TD32z00	Acc,caus clothes fire from contr fire, not in building,NOS
TD3y.00	Accident caused by clothes on fire from other sources
TD3y000	Accident caused by clothes on fire from blowlamp
TD3y100	Accident caused by clothes on fire from blowtorch
TD3y200	Accident caused by clothes on fire from burning bedspread
TD3y300	Accident caused by clothes on fire from candle
TD3y400	Accident caused by clothes on fire from cigar
TD3y500	Accident caused by clothes on fire from cigarette
TD3y600	Accident caused by clothes on fire from lighter
TD3y700	Accident caused by clothes on fire from matches
TD3y800	Accident caused by clothes on fire from pipe
TD3y900	Accident caused by clothes on fire from welding torch
TD3yz00	Accident caused by clothes on fire from source NOS
TD3z.00	Ignition of clothing NOS
TD41.00	Ignition of gasoline with ignition of clothing
TD42.00	Ignition of fat with ignition of clothing
TD44.00	Ignition of paraffin with ignition of clothing
TD45.00	Ignition of petrol with ignition of clothing

TD46.00	Ignition of liquid paraffin gas with ignition of clothing
TD4z.00	Ignition of highly inflammable material NOS
TD5..00	Accident caused by controlled fire in private dwelling
TD50.00	Accident caused by normal charcoal fire in private dwelling
TD51.00	Accident caused by normal coal fire in private dwelling
TD52.00	Accident caused by normal electric fire in private dwelling
TD53.00	Accident caused by normal gas fire in private dwelling
TD54.00	Accident caused by normal wood fire in private dwelling
TD57.00	Accident caused by cooker, unspecified, in private dwelling
TD57000	Accident caused by gas cooker in private dwelling
TD57200	Accident caused by electric cooker in private dwelling
TD57300	Accident by liquid paraffin gas cooker in private dwelling
TD5z.00	Accident caused by fireplace in private dwelling NOS
TD6..00	Accident caused by controlled fire other structure/building
TD60.00	Accident caused by normal charcoal fire other struct/build
TD61.00	Accident caused by normal coal fire in other struct/building
TD62.00	Accident caused by normal electric fire other struct/build
TD63.00	Accident caused by normal gas fire other structure/building
TD64.00	Accident caused by normal wood fire other structure/building
TD66.00	Accident caused by furnace in other structure or building
TD6z.00	Accident caused by fireplace in structure or building NOS
TD7..00	Accident caused by controlled fire in the open
TD70.00	Accident caused by controlled fire in the open, bonfire
TD71.00	Accident caused by controlled fire in the open, brazier
TD72.00	Accident caused by controlled fire in the open, trash fire
TD7z.00	Accident caused by flame from controlled fire in open NOS
TDy..00	Accident caused by other fire and flames
TDy0.00	Burning bedclothes
TDyy.00	Accident caused by other flame
TDyy200	Accident caused by candle
TDyy300	Accident caused by cigar
TDyy400	Accident caused by cigarette

TDyy500	Accident caused by lamp
TDyy600	Accident caused by lighter
TDyy800	Accident caused by pipe
TDyy900	Accident caused by welding torch
TDyyA00	Accident caused by fire in room NOS
TDyz.00	Accident caused by other flame or fire NOS
TDz..00	Accident caused by fire or flames NOS
TDz1.00	Accident caused by unspecified fire
TG30000	Accidentally burned by machinery
TG30900	Accident caused by fire starting in or on machinery
TG70.00	Accident caused by fireworks
TG72300	Accident caused by explosion of fire damp
TG8..00	Accidents caused by hot substance, caustic/corrosive, steam
TG80.00	Accidents caused by hot liquids and vapours,including steam
TG80000	Accidental burning/scalding caused by boiling water, unspec
TG80100	Accidental burning/scalding caused by boiling liquid, unspec
TG80200	Accidental burning or scalding caused by liquid metal
TG80300	Accidental burning or scalding caused by steam
TG80400	Accidental burning/scalding by boiling water from kettle
TG80500	Accidental burning/scalding by boiling water from saucepan
TG80600	Accidental burning or scalding caused by tea
TG80700	Accidental burning or scalding caused by coffee
TG80800	Accidental burning or scalding caused by chocolate
TG80900	Accidental burning or scalding caused by milk
TG80A00	Accidental burning/scalding caused by soup, stew or curries
TG80B00	Accidental burning or scalding caused by fat
TG80C00	Accidental burning or scalding caused by steam from kettle
TG80D00	Accidental burning or scalding by steam from car radiator
TG80y00	Accidental burning or scalding caused by other hot vapour
TG80z00	Accidental burning/scalding caused by hot liquid/vapour NOS
TG81.00	Accidental burning caused by caustic and corrosive substance

TG81000	Accidental burning caused by acid
TG81011	Accidental burning by Hydrofluoric acid
TG81100	Accidental burning caused by ammonia
TG81200	Accidental burning caused by caustic oven cleaner etc
TG81300	Accidental burning caused by lye
TG81400	Accidental burning caused by vitriol burning
TG81500	Accidental burning caused by hydrofluoric acid
TG81y00	Accidental burning caused by other caustic or corrosive
TG81z00	Accidental burning caused by caustic or corrosive NOS
TG8y.00	Accidental burning caused by other hot substance or object
TG8y000	Accid burning caused by heat from electric heating appliance
TG8y100	Accidental burning caused by light bulb
TG8y200	Accidental burning caused by steam pipe
TG8y300	Accidental burning or scalding caused by bitumen or tar
TG8y400	Accidental burning or scalding caused by plastic
TG8yz00	Accidental burning caused by hot object NOS
TG8z.00	Accident caused by hot substance,caustic/corrosive,steam NOS
TG9z000	Accidental burn or other injury from electric current NOS
TKx1.00	Suicide and selfinflicted injury by burns or fire
TLx0z00	Assault by homicidal burns NOS
TN81.00	Injury ?accidental, by burns or fire
TN82.00	Injury ?accidental, by scald
U16..00	[X]Exposure to smoke, fire and flames
U160.00	[X]Exposure to uncontrolled fire in building or structure
U160000	[X]Exposure to uncontr fire in building/structur occ home
U160100	[X]Exposur uncontr fire in buildng/structr occ resid instit
U160200	[X]Exposr uncontr fire bldng/struct sch oth ins/pub adm area
U160300	[X]Exposr uncntr fire in buildng/structr occ sport/athl area
U160400	[X]Exposur uncontr fire in buildng/structr occ street/h'way
U160500	[X]Exposr uncntr fire in buildng/structr occ trade/serv area
U160600	[X]Exposr uncntr fire in buildng/structr indust/constr area
U160700	[X]Exposure to uncontr fire in building/structur occ farm
U160y00	[X]Exposr uncntr fire in buildng/structr occ oth specif plce
U160z00	[X]Exposr uncntr fire in buildng/structr occ unspecif place
U161.00	[X]Exposure to uncontrolled fire not in building/structure
U161000	[X]Exposur uncontrol fire not in building/structure occ home
U161100	[X]Exposr uncontr fire not in buildng/structr occ resid inst
U161200	[X]Expos uncnt fire not bldng/strct sch oth ins/pub adm area
U161300	[X]Expos uncntr fire not in bldng/struct occ sport/athl area
U161400	[X]Expos uncntr fire not in buildng/structr occ street/h'way
U161500	[X]Expos uncntr fire not in bldng/struct occ trade/serv area
U161600	[X]Expos uncntr fire not bldng/struct occ indust/constr area
U161700	[X]Exposur uncontrol fire not in building/structure occ farm
U161y00	[X]Expos uncntr fire not in bldng/struct occ oth specif plce
U161z00	[X]Expos uncntr fire not in buildng/struct occ unspecif plce
U162.00	[X]Exposure to controlled fire in building or structure
U162000	[X]Exposure to controlld fire in building/structur occ home
U162100	[X]Exposur control fire in buildng/structr occ resid instit
U162200	[X]Exposr control fire bldng/struct sch oth ins/pub adm area
U162300	[X]Exposr contrl fire in buildng/structr occ sport/athl area
U162400	[X]Exposur control fire in buildng/structr occ street/h'way
U162500	[X]Exposr contrl fire in buildng/structr occ trade/serv area
U162600	[X]Exposur contrl fire in buildng/structr indust/constr area
U162700	[X]Exposure to control fire in building/structure occ farm
U162y00	[X]Exposr contrl fire in buildng/structr occ oth specif plce
U162z00	[X]Exposr contrl fire in buildng/structur occ unspecif place
U163.00	[X]Exposure to controlled fire, not in building / structure
U163000	[X]Exposur controlld fire not in building/structure occ home
U163011	[X]Exposure to bonfire
U163100	[X]Exposr control fire not in buildng/structr occ resid inst
U163200	[X]Expos cntrl fire not bldng/strct sch oth ins/pub adm area
U163300	[X]Expos contrl fire not in bldng/struct occ sport/athl area
U163500	[X]Expos contrl fire not in buildng/structr occ street/h'way
U163600	[X]Expos contrl fire not in bldng/struct occ trade/serv area
U163700	[X]Expos contrl fire not bldng/struct occ indust/constr area
U163800	[X]Exposure controll fire not in building/structure occ farm
U163y00	[X]Expos contrl fire not in bldng/struct occ oth specif plce
U163z00	[X]Expos contrl fire not in buildng/struct occ unspecif plce
U16y.00	[X]Exposure to other specified smoke, fire and flames
U16y000	[X]Exposure to oth specif smoke fire+flames occurrn at home
U16y100	[X]Exposr to oth specif smoke fire+flame occ resid instit'n
U16y200	[X]Expos oth specif smok fire+flam sch oth ins/pub adm area
U16y300	[X]Exposr oth specif smoke fire+flame occ sport/athlet area
U16y400	[X]Exposr to oth specif smoke fire+flame occ street/highway
U16y500	[X]Exposr oth specif smoke fire+flame occ trade/servce area
U16y600	[X]Exposr oth specif smok fire+flam occ industr/constr area
U16y700	[X]Exposure to oth specif smoke fire+flames occurrn on farm
U16yy00	[X]Exposur oth specif smoke fire+flame occ oth specif place
U16yz00	[X]Exposr oth specif smoke fire+flame occurrn unspecif plce
U16z.00	[X]Exposure to unspecified smoke, fire and flames
U16z000	[X]Exposure to unspecifd smoke fire/flames occurrn at home
U16z100	[X]Exposur unspecif smoke fire/flame occurrn resid instit'n
U16z200	[X]Exposr unspecif smoke fire/flame sch oth ins/pub adm area
U16z300	[X]Exposur unspecif smoke fire/flame occ sport/athlet area
U16z400	[X]Exposr unspecif smoke fire/flame occurrn on street/h'way
U16z500	[X]Exposur unspecif smoke fire/flame occ trade/service area
U16z600	[X]Exposur unspecif smoke fire/flame occ indust/constr area
U16z700	[X]Exposure to unspecifd smoke fire/flames occurrn on farm
U16zy00	[X]Exposr unspecif smoke fire/flame occurrn oth specif plce
U16zz00	[X]Exposur unspecif smoke fire/flame occurrn unspecif place
U17..00	[X]Contact with heat and hot substances
U17..11	[X]Cause of accident burn / scald
U170.00	[X]Contact with hot drinks, food, fats and cooking oils
U170000	[X]Contact with hot drink food fat+cooking oil occurrn home

U170200	[X]Cont hot drink food fat+cook oil sch oth ins/pub adm area
U170z00	[X]Contact hot drink food fat+cook oil occurrn unspecif plce
U171.00	[X]Contact with hot tap-water
U171000	[X]Contact with hot tap-water, occurrence at home
U172.00	[X]Contact with other hot fluids
U172000	[X]Contact with other hot fluids, occurrence at home
U172z00	[X]Contact with other hot fluids occurrn at unspecif place
U173.00	[X]Contact with steam and hot vapours
U173000	[X]Contact with steam and hot vapours, occurrence at home
U173200	[X]Contact with steam+hot vapour, sch oth inst/pub adm area
U173500	[X]Contact with steam+hot vapour occurrn trade/service area
U174.00	[X]Contact with hot air and gases
U175.00	[X]Contact with hot household appliances
U175000	[X]Contact with hot household appliances occurrence at home
U175600	[X]Contact wth hot househld applianc occ indust/constr area
U176.00	[X]Contact with hot heating appliances, radiators and pipes
U177000	[X]Contact with hot engines machinery+tools occurrn at home
U177500	[X]Contct wth hot engin machinry+tool occ trade/servce area
U178.00	[X]Contact with other hot metals

U178z00	[X]Contact with other hot metals occurrn at unspecif place
U17y.00	[X]Contact with other and unspecif heat and hot substances
U17y000	[X]Contact with oth+unspecif heat+hot substnc occurrn home
U17y600	[X]Contact oth+unspec heat+hot subst occ indust/constr area
U17yz00	[X]Contact oth+unspecif heat+hot substn occ unspecif place
U47..00	[X]Exposure to smoke, fire and flames, undetermined intent
U470.00	[X]Exposure to smoke fire+flame undeterm intent occ at home
U471.00	[X]Exposr to smoke fire+flam undet intent occ resid instit'n
U472.00	[X]Expos to smoke fir+flam undet intent sch/ins/pub adm area
U474.00	[X]Exposr to smoke fire+flam undet intent occ street/highway
U477.00	[X]Exposure to smoke fire+flame undeterm intent occ on farm
U47y.00	[X]Exposr to smoke fir+flam undet intent occ oth specif plce
U47z.00	[X]Exposr to smoke fir+flam undet intent occ unspecif place
Z1B1400	Attention to dressing of burnt skin
Z1B2100	Dressing of burnt skin
Z1B2111	Burn dressing
Z1B2200	Covering burnt skin with plastic bag
Z6G7H11	Frictions
Z6G7I00	Transverse frictions
Z6G7J11	DTF - Deep transverse frictions

Z6G7L00	Superficial frictions
ZQ3A.00	Assessment of burn injuries
ZQ3A.11	Assessment of levels of burns
ZX12.00	Burning self
ZX1I.00	Self-scalding
T410.00	Burned while ship on fire
Non-specific graft codes: excluded as sensitivity analysis	
7214100	Reconstruction of eyelid with skin graft
7.40E+03	Reconstruction of nose with skin graft
7400F00	Reconstruction of nose with composite skin graft
7411900	Reconstruction of defect of maxilla with skin graft
7G1..00	Skin flap and skin graft operations
7G1G.12	Thiersch free skin graft
7G1G.13	Split skin graft
7G1G200	Free skin graft
7G1G311	Free skin graft to head or neck
7G1G312	Thiersch free skin graft to head or neck
7G1H012	Full thickness skin graft to head or neck
7G1H112	Full thickness skin graft NEC
7G1L200	Integra skin graft
7G1y.00	Other specified skin flap or skin graft operations
7G1z.00	Skin flap and skin graft operations NOS

POISONINGS

Read code	Read code description
14K1.00	Intentional overdose of prescription only medication
1JP..00	Suspected drug overdose
44W8100	Lithium level high - toxic
44WA100	Salicylate level abnormal
44WB100	Paracetamol level abnormal
44X..00	Blood toxic substance levels
761H300	Administration of activated charcoal
E014.00	Pathological alcohol intoxication
E014.11	Drunkenness - pathological
E022.00	Pathological drug intoxication
E230.00	Acute alcoholic intoxication in alcoholism
E230.11	Alcohol dependence with acute alcoholic intoxication
E230000	Acute alcoholic intoxication, unspecified, in alcoholism
E230100	Continuous acute alcoholic intoxication in alcoholism
E230200	Episodic acute alcoholic intoxication in alcoholism
E230z00	Acute alcoholic intoxication in alcoholism NOS
E250.11	Drunkenness NOS
E250.14	Intoxication - alcohol
Eu10000	[X]Mental & behav dis due to use alcohol: acute intoxication
Eu10011	[X]Acute alcoholic drunkenness
Eu11000	[X]Mental & behav dis due to use opioids: acute intoxication
Eu12000	[X]Mental & behav dis due cannabinoids: acute intoxication
Eu13000	[X]Mental & behav dis due seds/hypntcs: acute intoxication
Eu14000	[X]Mental & behav dis due to use cocaine: acute intoxication
Eu15000	[X]Mnt/beh dis due oth stim inc caffein: acute intoxication
Eu16000	[X]Mental & behav dis due hallucinogens: acute intoxicatn
Eu18000	[X]Mental & behav dis due vol solvents: acute intoxication
Eu1A000	[X]Ment behav dis due use crack cocaine: acute intoxication
F036000	Toxic encephalitis due to lead
F036100	Toxic encephalitis due to mercury
F036200	Toxic encephalitis due to thallium
F377.00	Other toxic agent polyneuropathy
SL...00	Poisoning
SL...11	Biological substance poisoning
SL...12	Drug poisoning
SL...13	Medicinal poisoning
SL...14	Overdose of biological substance
SL...15	Overdose of drug
SL...16	Poisoning by drug and biological substances
SL0..00	Antibiotic poisoning
SL00.00	Penicillin poisoning
SL00000	Ampicillin poisoning
SL00300	Penicillin G poisoning
SL00z00	Penicillin poisoning NOS
SL01.00	Antifungal antibiotic poisoning
SL01000	Amphotericin B poisoning
SL01100	Griseofulvin poisoning
SL01200	Nystatin poisoning
SL02000	Chloramphenicol poisoning
SL03.00	Erythromycin and macrolide poisoning
SL03000	Erythromycin poisoning
SL03100	Oleandomycin poisoning
SL04.00	Tetracycline group poisoning
SL04000	Tetracycline poisoning
SL04100	Doxycycline poisoning
SL04200	Minocycline poisoning
SL04300	Oxytetracycline poisoning
SL04z00	Tetracycline group poisoning NOS
SL05000	Cefalexin poisoning
SL06200	Rifampicin poisoning
SL06300	Streptomycin poisoning
SL07100	Dactinomycin poisoning
SL07200	Bleomycin poisoning
SL07300	Daunorubicin poisoning
SL07400	Mitomycin poisoning
SL0y.00	Other specific antibiotic poisoning
SL0z.00	Antibiotic poisoning NOS
SL1..00	Other anti-infective poisoning
SL10.00	Sulphonamide poisoning
SL10000	Sulfadiazine poisoning
SL11.00	Arsenical anti-infective poisoning
SL12200	Lead compound poisoning
SL12300	Mercury compound poisoning
SL12z00	Heavy metal anti-infective poisoning NOS
SL13.11	Hydroxyquinoline poisoning
SL13000	Chiniofon poisoning
SL14.00	Antimalarial drug poisoning
SL14000	Chloroquine poisoning
SL14300	Proguanil poisoning
SL14500	Quinine poisoning
SL14z00	Antimalarial drug poisoning NOS
SL15.00	Other antiprotozoal drug poisoning
SL16.00	Anthelmintic drug poisoning
SL16200	Tiabendazole poisoning
SL1x000	Ethambutol poisoning
SL1x200	Isoniazid poisoning
SL1x300	Para-aminosalicylic acid poisoning
SL1x400	Sulphone poisoning
SL1y000	Flucytosine poisoning
SL1y100	Nitrofuran derivative poisoning
SL1z.00	Anti-infective poisoning NOS
SL2..00	Hormone and synthetic substitute poisoning

SL20.00	Adrenal cortico-steroid poisoning
SL20000	Cortisone derivative poisoning
SL20300	Poisoning by glucocorticoids and synthetic analogues
SL20z00	Adrenal cortico-steroid poisoning NOS
SL21.00	Androgen and anabolic poisoning
SL21.11	Anabolic steroid poisoning
SL21.12	Androgen poisoning
SL21100	Nandrolone poisoning
SL21200	Oxymetholone poisoning
SL21300	Testosterone poisoning
SL21z00	Androgen or anabolic poisoning NOS
SL22.00	Ovarian hormone and synthetic substitute poisoning
SL22000	Oral contraceptive poisoning
SL22100	Oestrogen poisoning
SL22200	Combined oestrogen and progesterone poisoning
SL22300	Progestogen poisoning
SL22z00	Ovarian hormone poisoning NOS
SL23.00	Insulins and antidiabetic poisoning
SL23000	Acetohexamide poisoning
SL23100	Biguanide poisoning
SL23400	Insulin poisoning
SL24.00	Anterior pituitary hormone poisoning
SL24000	Corticotropin poisoning
SL24011	ACTH - adrenocorticotropic hormone poisoning
SL24100	Gonadotrophin poisoning
SL24211	Growth hormone poisoning
SL27.00	Thyroid hormone and thyroid derivatives poisoning
SL27100	Levothyroxine sodium poisoning
SL27300	Thyroglobulin poisoning
SL27z00	Thyroid hormone and thyroid derivative poisoning NOS
SL28.00	Antithyroid agent poisoning
SL28000	Iodide poisoning
SL29.00	Poisoning by mineralocorticoids and their antagonists
SL2y.00	Other hormone or synthetic derivative poisoning
SL3..00	Poisoning by primarily systemic agents
SL30.00	Antiallergic and antiemetic drug poisoning
SL30.12	Antiemetic poisoning
SL30.13	Antihistamine poisoning
SL30000	Chlorphenamine poisoning
SL30100	Diphenhydramine poisoning
SL30400	Tripelennamine poisoning
SL30x00	Other antihistamine poisoning
SL31.00	Antineoplastic and immunosuppressive poisoning
SL31.12	Immunosuppressive poisoning
SL31000	Azathioprine poisoning
SL31200	Chlorambucil poisoning
SL31300	Cyclophosphamide poisoning
SL31400	Cytarabine poisoning
SL31600	Mercaptopurine poisoning
SL31z00	Antineoplastic or immunosuppressive poisoning NOS
SL32.00	Acidifying agent poisoning
SL34.00	Enzyme poisoning NEC
SL34000	Penicillinase poisoning
SL35.00	Vitamin poisoning NEC
SL35000	Vitamin A poisoning
SL35z00	Vitamin poisoning NOS
SL3y.00	Other systemic agent poisoning
SL3y000	Heavy metal agonist poisoning
SL3z.00	Systemic agent poisoning NOS
SL4..00	Agents affecting blood constituents, causing poisoning
SL40.00	Iron and iron compound poisoning
SL40000	Ferric salt poisoning
SL40100	Ferrous sulphate poisoning
SL40z00	Iron and iron compound poisoning NOS
SL41000	Folic acid poisoning
SL42.00	Anticoagulant poisoning
SL42000	Coumarin poisoning
SL42100	Heparin poisoning
SL42300	Warfarin sodium poisoning
SL42400	Warfarin poisoning
SL42z00	Anticoagulant poisoning NOS
SL44200	Streptokinase poisoning
SL44300	Urokinase poisoning
SL45.00	Anticoagulant agonist poisoning
SL45100	Protamine sulphate poisoning
SL45z00	Anticoagulant agonist poisoning NOS
SL47.00	Natural blood and blood product poisoning
SL47000	Blood plasma poisoning
SL47100	Human fibrinogen poisoning
SL47300	Whole blood poisoning
SL47z00	Natural blood or blood product poisoning NOS
SL4y100	Plasma expander poisoning
SL4z.00	Blood agent poisoning NOS
SL5..00	Analgesic, antipyretic and antirheumatic drug poisoning
SL5..11	Analgesic poisoning
SL5..12	Antipyretic poisoning
SL50.00	Opiate and narcotic poisoning
SL50.11	Narcotic poisoning
SL50.12	Opiate poisoning
SL50000	Unspecified opium poisoning
SL50100	Heroin poisoning
SL50200	Methadone poisoning
SL50300	Codeine (methylmorphine) poisoning
SL50400	Meperidine (pethidine) poisoning
SL50500	Morphine poisoning
SL50600	Dextropropoxyphene poisoning
SL50700	Dihydrocodeine poisoning
SL50z00	Opiate or narcotic poisoning NOS
SL51.00	Salicylate poisoning

SL51000	Aspirin poisoning
SL51100	Salicylic acid salt poisoning
SL51z00	Salicylate poisoning NOS
SL52.00	Aromatic analgesic poisoning NEC
SL52100	Paracetamol poisoning
SL52200	Phenacetin poisoning
SL52z00	Aromatic analgesic poisoning NOS
SL53.00	Pyrazole derivative poisoning
SL53100	Phenylbutazone poisoning
SL54.00	Antirheumatic poisoning
SL54000	Gold salt poisoning
SL54100	Indometacin poisoning
SL54200	Ibuprofen poisoning
SL54300	Naproxen poisoning
SL54400	Mefenamic acid poisoning
SL54z00	Antirheumatic poisoning NOS
SL5x.00	Other non-narcotic analgesic poisoning
SL5xz00	Non-narcotic analgesic poisoning NOS
SL5y.00	Other analgesic and antipyretic poisoning
SL5y100	Analgesic poisoning, NEC
SL5y200	Antipyretic poisoning, NEC
SL5yz00	Other analgesic or antipyretic poisoning NOS
SL5z.00	Analgesic, antipyretic or antirheumatic poisoning NOS
SL6..00	Anticonvulsant and antiParkinsonian drug poisoning
SL6..11	Anticonvulsant poisoning
SL60000	Paramethadione poisoning
SL60100	Trimethadione poisoning
SL61.00	Hydantoin derivative poisoning
SL61000	Phenytoin poisoning
SL6x.00	Other anticonvulsant poisoning
SL6x000	Primidone poisoning
SL6x100	Poisoning by carbamazepine
SL6xz00	Anticonvulsant poisoning NOS
SL6y.00	Antiparkinsonism drug poisoning
SL6y000	Amantadine poisoning
SL6y100	Ethopropazine poisoning
SL6y200	Levodopa (L-dopa) poisoning
SL6yz00	Antiparkinsonian drug poisoning NOS
SL6z.00	Anticonvulsant or antiparkinsonian drug poisoning NOS
SL7..00	Sedative and hypnotic drug poisoning
SL7..11	Hypnotic poisoning
SL7..12	Sedative poisoning
SL70.00	Barbiturate poisoning
SL70000	Amobarbital poisoning
SL70100	Barbitone poisoning
SL70200	Butabarbitone poisoning
SL70300	Pentobarbitone poisoning
SL70400	Phenobarbital poisoning
SL70500	Secobarbital poisoning
SL70z00	Barbiturate poisoning NOS
SL71.00	Chloral hydrate poisoning
SL76.00	Mixed sedative poisoning NEC
SL7y.00	Other sedative and hypnotic poisoning
SL7z.00	Sedative and hypnotic drug poisoning NOS
SL7z.11	Sleeping drug poisoning
SL9..00	Psychotropic agent poisoning
SL9..11	Tranquilliser poisoning
SL90.00	Antidepressant poisoning
SL90000	Amitriptyline poisoning
SL90100	Imipramine poisoning
SL90200	Monoamine oxidase inhibitor poisoning
SL90211	MAOI - monoamine oxidase inhibitor poisoning
SL90300	Trazodone poisoning
SL90z00	Anti-depressant poisoning NOS
SL91.00	Phenothiazine poisoning
SL91000	Chlorpromazine poisoning
SL91100	Fluphenazine poisoning
SL91200	Prochlorperazine poisoning
SL91300	Promazine poisoning
SL91400	Thioridazine poisoning
SL92000	Haloperidol poisoning
SL92200	Trifluperidol poisoning
SL93.00	Other antipsychotics/neuroleptics/tranquilliser poisoning
SL94.00	Benzodiazepine poisoning
SL94000	Chlordiazepoxide poisoning
SL94100	Diazepam poisoning
SL94200	Flurazepam poisoning
SL94300	Lorazepam poisoning
SL94400	Medazepam poisoning
SL94500	Nitrazepam poisoning
SL94600	Poisoning by temazepam
SL94z00	Benzodiazepine poisoning NOS
SL95.00	Other tranquilliser poisoning
SL95000	Hydroxyzine poisoning
SL95100	Meprobamate poisoning
SL95z00	Tranquilliser poisoning NOS
SL96.00	Hallucinogen poisoning
SL96000	Cannabis poisoning
SL96100	Lysergide (LSD) poisoning
SL96200	Marihuana poisoning
SL96400	Psilocybin poisoning
SL96z00	Hallucinogen poisoning NOS
SL97.00	Psychostimulant poisoning
SL97.11	Stimulant poisoning
SL97000	Amfetamine poisoning
SL97011	Amphetamine poisoning
SL97100	Caffeine poisoning
SL97200	Ecstasy poisoning
SL9y.00	Other psychotropic agent poisoning

SL9z.00	Psychotropic agent poisoning NOS
SLA..00	Central nervous system stimulant poisoning
SLA0.00	Analeptic poisoning
SLA0000	Lobeline poisoning
SLA1.00	Opiate antagonist poisoning
SLA1z00	Opiate antagonist poisoning NOS
SLAy.00	Other central nervous system stimulant poisoning
SLAz.00	Central nervous system stimulant poisoning NOS
SLB..00	Autonomic nervous system drug poisoning
SLB0.00	Parasympathomimetic poisoning
SLB0.11	Cholinergic poisoning
SLB0000	Acetylcholine poisoning
SLB0100	Anticholinesterase poisoning
SLB0200	Pilocarpine poisoning
SLB1000	Atropine poisoning
SLB1200	Hyoscine poisoning
SLB1400	Caramiphen poisoning
SLB2.00	Sympathomimetic poisoning
SLB2.11	Adrenergic poisoning
SLB2100	Noradrenalin poisoning
SLB3000	Phenoxybenzamine poisoning
SLC..00	Cardiovascular drug poisoning
SLC0.00	Cardiac rhythm drug poisoning
SLC0100	Procainamide poisoning
SLC0200	Propranolol poisoning
SLC0400	Beta blocker poisoning
SLC1.00	Cardiac glycoside poisoning
SLC1000	Digoxin poisoning
SLC1100	Other digitalis glycoside poisoning
SLC2.00	Antilipaemic and antiarteriosclerotic poisoning
SLC3.00	Ganglion-blocker poisoning
SLC3z00	Ganglion-blocker poisoning NOS
SLC4.00	Coronary vasodilator poisoning

SLC4000	Dipyridamole poisoning
SLC4100	Nitrate poisoning
SLC5.00	Other vasodilator poisoning
SLC5000	Cyclandelate poisoning
SLC5200	Papaverine poisoning
SLC6.00	Other hypertensive agent poisoning
SLC6000	Clonidine poisoning
SLC6400	Poisoning by angiotensin-converting-enzyme inhibitors
SLC6z00	Hypertensive agent poisoning NOS
SLC7000	Sodium morrhuate poisoning
SLC7100	Zinc salt poisoning
SLC8000	Adrenochrome poisoning
SLC9.00	Poisoning by calcium-channel blockers
SLCz.00	Cardiovascular agent poisoning NOS
SLD..00	Gastrointestinal agent poisoning
SLD0.00	Anti-gastric acid drug poisoning
SLD0.11	Antacid drug poisoning
SLD0000	Aluminium hydroxide poisoning
SLD0100	Magnesium trisilicate poisoning
SLD0200	Poisoning by histamine H2-receptor antagonists
SLD0z00	Antacid drug poisoning NOS
SLD1.00	Irritant cathartic poisoning
SLD1200	Phenolphthalein poisoning
SLD2.00	Emollient cathartic poisoning
SLD2000	Dioctyl sulphosuccinate poisoning
SLD3.00	Other cathartic poisoning
SLD3000	Magnesium sulphate poisoning
SLD3100	Poisoning by saline and osmotic laxatives
SLD4.00	Digestant poisoning
SLD4000	Pancreatin poisoning
SLD4100	Papain poisoning
SLD5.00	Antidiarrhoeal poisoning
SLD5z00	Antidiarrhoeal poisoning NOS

SLD6.00	Emetic drug poisoning
SLDy.00	Other gastrointestinal agent poisoning
SLDz.00	Gastrointestinal agent poisoning NOS
SLE..00	Water, mineral and urate metabolism poisoning
SLE..11	Diuretic poisoning
SLE1100	Theophylline poisoning
SLE2000	Acetazolamide poisoning
SLE3000	Benzothiazide poisoning
SLE4000	Ethacrynic acid poisoning
SLE4100	Furosemide poisoning
SLE4z00	Other diuretic poisoning NOS
SLE5.00	Electrolyte agent poisoning
SLE6.00	Other mineral salt poisoning NEC
SLE7.00	Uric acid drug poisoning
SLE7.11	Urate metabolism drug poisoning
SLE7000	Allopurinol poisoning
SLE7100	Colchicine poisoning
SLEz.00	Water, mineral or uric acid metabolism poisoning NOS
SLF..11	Muscle drug poisoning
SLF..12	Respiratory system drug poisoning
SLF0000	Ergot alkaloid poisoning
SLF0200	Prostaglandin poisoning
SLF1100	Orciprenaline poisoning
SLF2.00	Skeletal muscle relaxant poisoning
SLF3.00	Other muscle drug poisoning
SLF4000	Dextromethorphan poisoning
SLF4z00	Antitussive poisoning NOS
SLF5.00	Expectorant poisoning
SLF5200	Terpin hydrate poisoning
SLF6.00	Anti-common cold drug poisoning
SLF7000	Aminophylline poisoning
SLF7100	Salbutamol poisoning
SLF7z00	Antiasthmatic poisoning NOS

SLFy.00	Other respiratory system drug poisoning
SLG..00	Eye, otorhinolaryngological, skin and dental drug poisoning
SLG..12	Eye drug poisoning
SLG0.00	Local anti-infective and anti-inflammatory poisoning
SLG2.00	Local astringent and detergent poisoning
SLG2.11	Local astringent poisoning
SLG2.12	Local detergent poisoning
SLG3.00	Emollients, demulcents and protectant poisoning
SLG4.00	Hair treatment poisoning
SLG4.12	Keratoplastic poisoning
SLG5.00	Eye drug poisoning NEC
SLG5z00	Eye drug poisoning NOS
SLG6.00	Ear, nose and throat drug poisoning NEC
SLG7.00	Topical dental drug poisoning
SLGx.00	Other skin and mucous membrane drug poisoning
SLH..00	Other and unspecified drug and medicament poisoning
SLH0000	Central appetite depressant poisoning
SLH2.11	Chelating agent poisoning
SLH3.00	Alcohol deterrent poisoning
SLHy.00	Other drug and medicament poisoning OS
SLHyz00	Other drug and medicament poisoning NOS
SLHz.00	Drug and medicament poisoning NOS
SLX..00	Poisoning by oth & unspec antipsychotics & neuroleptics
SLz..00	Drug, medicament or biological substance poisoning NOS
SM...00	Nonmedicinal agent causing toxic effects
SM0..00	Alcohol causing toxic effect
SM00.00	Ethyl alcohol causing toxic effect
SM00000	Ethanol causing toxic effect
SM00100	Denatured alcohol causing toxic effect
SM00z00	Ethyl alcohol causing toxic effect NOS
SM01.00	Methyl alcohol causing toxic effect
SM01000	Methanol causing toxic effect
SM01100	Wood alcohol causing toxic effect
SM02.00	Isopropyl alcohol causing toxic effect
SM02200	Rubbing alcohol causing toxic effect
SM03000	Amyl alcohol causing toxic effect
SM03100	Butyl alcohol causing toxic effect
SM03z00	Fusel oil causing toxic effect NOS
SM0y.00	Other alcohol causing toxic effect
SM0z.00	Alcohol causing toxic effect NOS
SM1..00	Petroleum product causing toxic effect
SM10.00	Petrol unspecified causing toxic effect
SM12.00	Kerosene causing toxic effect
SM13.00	Paraffin wax causing toxic effect
SM14.00	Petroleum ether causing toxic effect
SM15.00	Toxic effect of homologues of benzene
SM1z.00	Petroleum product causing toxic effect NOS
SM2..00	Other solvents causing toxic effect
SM20.00	Benzene causing toxic effect
SM21.00	Carbon tetrachloride causing toxic effect
SM23000	Tetrachloroethylene causing toxic effect
SM23100	Trichloroethylene causing toxic effect
SM23200	Toxic effect of chloroform
SM2y.00	Other solvents causing toxic effect
SM2y000	Acetone causing toxic effect
SM2y100	Toxic effect of dichloromethane
SM2yz00	Other solvents causing toxic effect NOS
SM2z.00	Solvents causing toxic effect NOS
SM3..00	Corrosives/acids/caustic alkalis causing toxic effect
SM30000	Phenol causing toxic effect
SM30z00	Corrosive aromatics causing toxic effect NOS
SM31.00	Acids causing toxic effect
SM31000	Hydrochloric acid causing toxic effect
SM31100	Nitric acid causing toxic effect
SM31200	Sulphuric acid causing toxic effect
SM31z00	Acids causing toxic effect NOS
SM32.00	Caustic alkalis causing toxic effect
SM32000	Lye causing toxic effect
SM32100	Potassium hydroxide causing toxic effect
SM32200	Sodium hydroxide causing toxic effect
SM32z00	Caustic alkalis causing toxic effect NOS
SM3z.00	Corrosive/acid/caustic alkali causing toxic effect NOS
SM4..00	Lead and lead compounds causing toxic effect
SM41000	Lead acetate causing toxic effect
SM4z.00	Lead compound causing toxic effect NOS
SM5..00	Other metals causing toxic effect
SM50.00	Mercury causing toxic effect
SM50.11	Pink disease
SM51.00	Arsenic causing toxic effect
SM53.00	Beryllium causing toxic effect
SM55.00	Cadmium causing toxic effect
SM56.00	Chromium causing toxic effect
SM57.00	Toxic effect of tin and its compounds
SM58.00	Toxic effect of phosphorus and its compounds
SM59.00	Aluminium intoxication
SM5y.00	Other metals causing toxic effect OS
SM5y200	Iron compounds causing toxic effect
SM5y300	Nickel compounds causing toxic effect
SM5yz00	Other metals causing toxic effect NOS
SM5z.00	Metals causing toxic effect NOS
SM6..00	Carbon monoxide causing toxic effect
SM7..00	Other gases, fumes or vapours causing toxic effect
SM70.00	Liquefied petrol gas causing toxic effect
SM70000	Butane causing toxic effect
SM70100	Propane causing toxic effect
SM71.00	Other hydrocarbon gas causing toxic effect
SM72.00	Nitrogen oxides causing toxic effect
SM72000	Nitrogen dioxide causing toxic effect
SM73.00	Sulphur dioxide causing toxic effect

SM74.00	Freon causing toxic effect
SM75.00	Lacrimogenic gas causing toxic effect
SM75.11	Tear gas toxic effect
SM75100	Chloroacetophenone causing toxic effect
SM75z00	Lacrimogenic gas causing toxic effect NOS
SM76.00	Chlorine gas causing toxic effect
SM78.00	Toxic effect of fluorine gas and hydrogen fluoride
SM79.00	Toxic effect of hydrogen sulfide
SM7A.00	Toxic effect of carbon dioxide
SM7y.00	Other gas, fume or vapour causing toxic effect
SM7y000	Phosgene causing toxic effect
SM7y100	Polyester fume causing toxic effect
SM7y200	Smoke inhalation
SM7yz00	Other gas, fume and vapour causing toxic effect NOS
SM7z.00	Gases, fumes or vapours causing toxic effect NOS
SM7z.11	Smoke inhalation
SM8..00	Noxious substance eaten as food causing toxic effect
SM80.00	Fish and shellfish causing toxic effect
SM80.11	Fish toxic effect
SM80.12	Shellfish toxic effect
SM80000	Toxic effect of ciguatera fish poisoning
SM80100	Toxic effect of scombroid fish poisoning
SM80W00	Toxic effect of unspecified seafood
SM80X00	Toxic effect of other fish and shellfish poisoning
SM81.00	Mushrooms causing toxic effect
SM82.00	Berries and other plants causing toxic effect
SM82.11	Berries - toxic effect
SM82.12	Plants - toxic effect
SM8y.00	Other noxious substance eaten as food causing toxic effect
SM8z.00	Noxious substance eaten as food causing toxic effect NOS
SM9..00	Other nonmedicinal substances causing toxic effect
SM90.00	Cyanides and hydrocyanic acid causing toxic effect
SM90000	Potassium cyanide causing toxic effect

SM90z00	Cyanides causing toxic effect NOS
SM91.00	Strychnine and salts causing toxic effect
SM92.00	Chlorinated hydrocarbon causing toxic effect
SM92200	DDT causing toxic effect
SM93.00	Organophosphate and carbamate causing toxic effect
SM93000	Carbaryl causing toxic effect
SM93200	Malathion causing toxic effect
SM93500	Phosdrin causing toxic effect
SM93z00	Organophosphate and carbamate causing toxic effect NOS
SM94.00	Other pesticides causing toxic effect NEC
SM95.00	Venom causing toxic effect
SM95000	Snake venom causing toxic effect
SM95100	Lizard venom causing toxic effect
SM95200	Spider venom causing toxic effect
SM95300	Tick paralysis causing toxic effect
SM95400	Toxic effect of venom of scorpion
SM95500	Insect venom causing toxic effect
SM95600	Toxic effect of other arthropods
SM95z00	Venom causing toxic effect NOS
SM96.00	Soap and detergent causing toxic effect
SM96.11	Detergent toxic effect
SM96.12	Soap - toxic effect
SM97.00	Aflatoxin and other mycotoxin causing toxic effect
SM98.00	Toxic effect of herbicides and fungicides
SM9A.00	Toxic effect of rodenticides
SM9B.00	Toxic effect of contact with other venomous animals
SM9B000	Toxic effect of contact with fish
SM9B100	Toxic effect of contact with other marine animals
SM9X.00	Toxic effect of nitroglycerin & oth nitric acids & ester
SM9y.00	Other substance causing toxic effect
SM9z.00	Unspecified substance causing toxic effect NOS
SMB..00	Toxic effect of formaldehyde
SMC..00	Toxic effect of tobacco and nicotine

SMX..00	Toxic effect of paints and dyes, NEC
SMz..00	Non-medicinal agent causing toxic effect NOS
SP35000	Intoxication by serum
SyuF.00	[X]Poisoning by drugs and biological substances
SyuFA00	[X]Poisoning by other analgesics, not elsewhere classified
SyuFM00	[X]Poisoning by other psychotropic drugs, NEC
SyuFW00	[X]Poisoning by other laxatives, incl intestin atonia drugs
SyuFc00	[X]Poisoning by oth & unspecif drugs & biologic substances
SyuG.00	[X]Toxic effects of substances chiefly nonmedicinal source
SyuG000	[X]Toxic effect of other alcohols
SyuG700	[X]Toxic effects of other specified gases, fumes & vapours
SyuG800	[X]Toxic effect of other insecticides
SyuGC00	[X]Toxic effect of other ingested (parts of) plant(s)
SyuGF00	[X]Toxic effect of contact with other venomous animals
SyuGH00	[X]Toxic effect of paints and dyes, NEC
SyuGJ00	[X]Toxic effect of other specified substances
SyuGL00	[X]Toxic effect of unspecified seafood
Sz...00	Injury and poisoning NOS
T....00	Causes of injury and poisoning
T180.00	MVTA - accid poisoning - exhaust gas of moving motor vehicle
T180100	MVTA-acc pois-exhaust-mov veh- motor vehicle passenger inj
T250.00	MVNTA - accid pois exhaust fume - moving MV,ex off-road MV
T250000	MVNTA-accid exhaust fume pois - motor vehicle driver injured
T250100	MVNTA-accid exhaust fume pois - motor vehicle passenger inj
T250600	MVNTA-accid exhaust fume pois - pedal cyclist injured
T470.00	Accidental poisoning by gases or fumes on ship
T77z.00	Accident/poisoning occurred in residential institution NOS
T8...00	Accidental poisoning by drugs, medicines and biologicals
T8...11	Cause of overdose - accidental
T80..00	Accidental poisoning by analgesics,antipyretic,antirheumatic
T800.00	Accidental poisoning by heroin
T800.11	Accidental poisoning by diamorphine
T801.00	Accidental poisoning by methadone

T802.00	Accidental poisoning by other opiates
T802000	Accidental poisoning by codeine
T802100	Accidental poisoning by pethidine
T802200	Accidental poisoning by morphine
T802300	Accidental poisoning by opium
T802z00	Accidental poisoning by other opiates NOS
T803.00	Accidental poisoning by salicylates
T803000	Accidental poisoning by aspirin
T803z00	Accidental poisoning by salicylates NOS
T804.00	Accidental poisoning by aromatic analgesics NEC
T804100	Accidental poisoning by paracetamol
T804200	Accidental poisoning by phenacetin
T805.00	Accidental poisoning by pyrazole derivatives
T805100	Accidental poisoning by phenylbutazone
T806.00	Accidental poisoning by antirheumatics
T806000	Accidental poisoning by gold salts
T806100	Accidental poisoning by indomethacin
T806200	Accidental poisoning by naproxen
T806300	Accidental poisoning by ibuprofen
T806z00	Accidental poisoning by antirheumatics NOS
T807.00	Accidental poisoning by other non-narcotic analgesics
T807z00	Accidental poisoning by non-narcotic analgesics NOS
T80y.00	Accidental poisoning by oth analgesics,antipyretic,antirheum
T80y000	Accidental poisoning by pentazocine
T80yz00	Accidental poisoning-oth analgesic,antipyretic,antirheum NOS
T80z.00	Accidental poisoning by analgesics,antipyretic,antirheum NOS
T81..00	Accidental poisoning by barbiturates
T811.00	Accidental poisoning by barbitone
T813.00	Accidental poisoning by pentobarbitone
T814.00	Accidental poisoning by phenobarbitone
T815.00	Accidental poisoning by quinalbarbitone
T81z.00	Accidental poisoning by barbiturates NOS
T82..00	Accidental poisoning by other sedatives and hypnotics

T820.00	Accidental poisoning by chloral hydrate
T822.00	Accidental poisoning by bromine compounds
T822000	Accidental poisoning by bromides
T823.00	Accidental poisoning by methaqualone compounds
T825.00	Accidental poisoning by mixed sedatives NEC
T82y.00	Accidental poisoning by other sedatives and hypnotics OS
T82z.00	Accidental poisoning by sedatives and hypnotics NOS
T83..00	Accidental poisoning by tranquillisers
T830.00	Accidental poisoning by phenothiazine-based tranquillisers
T830000	Accidental poisoning by chlorpromazine
T830200	Accidental poisoning by prochlorperazine
T830300	Accidental poisoning by promazine
T830z00	Accidental poisoning- phenothiazine-based tranquillisers NOS
T831000	Accidental poisoning by haloperidol
T832.00	Accidental poisoning by benzodiazepine-based tranquillisers
T832000	Accidental poisoning by chlordiazepoxide
T832100	Accidental poisoning by diazepam
T832300	Accidental poisoning by lorazepam
T832400	Accidental poisoning by medazepam
T832500	Accidental poisoning by nitrazepam
T832z00	Accidental poisoning- benzodiazepine-based tranquilliser NOS
T83y.00	Accidental poisoning by other tranquillisers
T83yz00	Accidental poisoning by other tranquillisers NOS
T83z.00	Accidental poisoning by tranquillisers NOS
T84..00	Accidental poisoning by other psychotropic agents
T840.00	Accidental poisoning by antidepressants
T840000	Accidental poisoning by amitriptyline
T840100	Accidental poisoning by imipramine
T840200	Accidental poisoning by monoamine oxidase inhibitors
T840z00	Accidental poisoning by antidepressants NOS
T841.00	Accidental poisoning by hallucinogens
T841000	Accidental poisoning by cannabis derivatives
T841100	Accidental poisoning by lysergide, LSD

T841z00	Accidental poisoning by hallucinogen NOS
T842000	Accidental poisoning by amphetamine
T842100	Accidental poisoning by caffeine
T843100	Accidental poisoning by opiate antagonists
T84z.00	Accidental poisoning by psychotropic agents NOS
T85..00	Accidental poisoning by other drugs acting on nervous system
T850.00	Accidental poisoning by anticonvulsant + anti-parkinson drug
T850.11	Accidental poisoning by anticonvulsant
T850.12	Accidental poisoning by anti-parkinsonism drug
T850z00	Accidental poisoning by anticonvulsant/anti-parkin drug NOS
T851.00	Accidental poisoning by oth central nervous syst depressants
T852.00	Accidental poisoning by local anaesthetic
T852000	Accidental poisoning by cocaine
T852100	Accidental poisoning by lignocaine
T853.00	Accidental poisoning by cholinergics
T854.00	Accidental poisoning by anticholinergics
T854000	Accidental poisoning by atropine
T854200	Accidental poisoning by hyoscine
T855000	Accidental poisoning by adrenalin
T855100	Accidental poisoning by noradrenalin
T85y.00	Accid. poisoning by other drugs acting on nervous system OS
T85z.00	Accidental poisoning by drugs acting on nervous system NOS
T86..00	Accidental poisoning by antibiotics
T87..00	Accidental poisoning by anti-infectives
T88..00	Accidental poisoning by other drugs
T880.00	Accidental poisoning by hormones and synthetic substitutes
T881.00	Accidental poisoning by primarily systemic agents
T882.00	Accidental poisoning by drugs affecting blood constituents
T883.00	Accidental poisoning by cardiovascular system drugs
T884.00	Accidental poisoning by gastrointestinal system drugs
T885.00	Accidental poisoning by water,mineral,uric acid metab drugs
T886.00	Accidental poisoning by muscle + respiratory system drugs
T887000	Accidental poisoning by skin drugs

T887100	Accidental poisoning by mucous membrane drugs
T887200	Accidental poisoning by ophthalmological drugs
T887300	Accidental poisoning by otorhinolaryngological drugs
T887400	Accidental poisoning by dental drugs
T887z00	Accidental poisoning by skin, eye, ENT and dental drug NOS
T88y.00	Accidental poisoning by other drugs OS
T88y000	Accidental poisoning by central appetite depressants
T88yz00	Accidental poisoning by other drugs NOS
T88z.00	Accidental poisoning by unspecified drugs
T8z..00	Accidental poisoning by drugs NOS
T9...00	Accidental poisoning by other non-drug substances
T90..00	Accidental poisoning by alcohol, NEC
T900.00	Accidental poisoning by alcoholic beverages
T901.00	Accidental poisoning by other ethyl alcohol and its products
T901100	Accidental poisoning by methylated spirit
T901300	Accidental poisoning by ethanol, NOS
T901z00	Accidental poisoning by ethyl alcohol NOS
T902.00	Accidental poisoning by methyl alcohol
T902000	Accidental poisoning by methanol
T903100	Accidental poisoning by isopropanol
T903300	Accidental poisoning by secondary propyl alcohol
T90y.00	Accidental poisoning by other alcohols
T90z.00	Accidental poisoning by alcohol NOS
T91..00	Accidental poisoning by household agents
T910.00	Accidental poisoning by synthetic detergents and shampoos
T911.00	Accidental poisoning by soap products
T912.00	Accidental poisoning by polishes
T913.00	Accidental poisoning by other cleaning agents
T913000	Accidental poisoning by scouring agents
T913z00	Accidental poisoning by other cleaning agents NOS
T914.00	Accidental poisoning by disinfectants
T915.00	Accidental poisoning by lead paints
T916.00	Accidental poisoning by other paints and varnishes

T916000	Accidental poisoning by lacquers
T916200	Accidental poisoning by non-lead paints
T916300	Accidental poisoning by white washes
T916z00	Accidental poisoning by paint or varnish NOS
T91z.00	Accidental poisoning by household agents NOS
T92..00	Accidental poisoning by petrol products
T920.00	Accidental poisoning by petroleum solvents
T920200	Accidental poisoning by petroleum naphtha
T920z00	Accidental poisoning by petrol solvents NOS
T921.00	Accidental poisoning by petrol fuels and cleaners
T921.12	Accidental poisoning by petroleum fuels
T921100	Accidental poisoning by gas oils
T921200	Accidental poisoning by petrol
T921300	Accidental poisoning by kerosene
T921z00	Accidental poisoning by petrol fuel or cleaner NOS
T922.00	Accidental poisoning by lubricating oils
T923.00	Accidental poisoning by petroleum solids
T923000	Accidental poisoning by paraffin wax
T923z00	Accidental poisoning by petrol solids NOS
T924.00	Accidental poisoning by other solvents
T924000	Accidental poisoning by benzene
T924z00	Accidental poisoning by other solvents NOS
T92z.00	Accidental poisoning by solvent NOS
T93..00	Accidental poisoning by agricultural chemical preparations
T930.00	Accidental poisoning by organochlorine insecticides
T930100	Accidental poisoning by chlordane
T930200	Accidental poisoning by DDT
T930300	Accidental poisoning by dieldrin
T930500	Accidental poisoning by toxaphene
T931.00	Accidental poisoning by organophosphorus insecticides
T931300	Accidental poisoning by malathion
T931z00	Accidental poisoning by organophosphorus insecticides NOS
T932.00	Accidental poisoning by carbamates

T932100	Accidental poisoning by carbaryl
T932200	Accidental poisoning by propoxur
T934.00	Accidental poisoning by other insecticides
T934z00	Accidental poisoning by insecticides NOS
T935.00	Accidental poisoning by herbicides
T935200	Accidental poisoning by chlorates
T935300	Accidental poisoning by diquat
T935400	Accidental poisoning by mixtures herbicides+plant food etc
T935500	Accidental poisoning by paraquat
T935z00	Accidental poisoning by herbicides NOS
T936.00	Accidental poisoning by fungicides
T936000	Accidental poisoning by organic mercurials
T936z00	Accidental poisoning by fungicides NOS
T937.00	Accidental poisoning by rodenticides
T937100	Accidental poisoning by squill and derivatives
T937200	Accidental poisoning by thallium
T937300	Accidental poisoning by warfarin
T937400	Accidental poisoning by zinc phosphide
T937z00	Accidental poisoning by rodenticides NOS
T938.00	Accidental poisoning by fumigants
T938000	Accidental poisoning by cyanides
T938100	Accidental poisoning by methyl bromide
T938200	Accidental poisoning by phosphine
T93z.00	Accidental poisoning agricultural chemical preparations NOS
T94..00	Accidental poisoning by corrosives and caustics NEC
T940.00	Accidental poisoning by corrosive aromatics
T940011	Accidental poisoning by phenol
T941.00	Accidental poisoning by acids
T941000	Accidental poisoning by hydrochloric acid
T941100	Accidental poisoning by nitric acid
T941200	Accidental poisoning by sulphuric acid
T941z00	Accidental poisoning by acids NOS
T942.00	Accidental poisoning by caustic alkalis

T942000	Accidental poisoning by sodium hydroxide
T942z00	Accidental poisoning by caustic alkalis NOS
T94y.00	Accidental poisoning by other corrosives and caustics
T94z.00	Accidental poisoning by corrosives and caustics NOS
T95..00	Accidental poisoning from foodstuffs and poisonous plants
T950.00	Accidental poisoning from meat
T951.00	Accidental poisoning from shellfish
T952.00	Accidental poisoning from other fish
T953.00	Accidental poisoning from berries and seeds
T953000	Accidental poisoning from berries
T953100	Accidental poisoning from seeds
T953z00	Accidental poisoning from berries or seeds NOS
T954.00	Accidental poisoning from other plants
T955.00	Accidental poisoning from mushrooms and other fungi
T955000	Accidental poisoning from mushrooms
T955y00	Accidental poisoning from other fungi
T955z00	Accidental poisoning from mushrooms and fungi NOS
T95y.00	Accidental poisoning by other foods
T95z.00	Accidental poisoning by foodstuffs and poisonous plants NOS
T96..00	Accidental poisoning by other solid and liquid substances
T960.00	Accidental poisoning by lead and its compounds and fumes
T960000	Accidental poisoning by lead, unspecified
T960z00	Accidental poisoning by lead, NOS
T961.00	Accidental poisoning by mercury and its compounds and fumes
T961000	Accidental poisoning by mercury, unspecified
T961200	Accidental poisoning by mercury fumes
T961z00	Accidental poisoning by mercury, NOS
T963.00	Accidental poisoning by arsenic and its compounds and fumes
T963000	Accidental poisoning by arsenic, unspecified
T963100	Accidental poisoning by arsenic compounds
T964.00	Accidental poisoning by other metals + compounds and fumes
T964000	Accidental poisoning by beryllium and its compounds
T964100	Accidental poisoning by brass fumes
T964200	Accidental poisoning by cadmium and its compounds
T964300	Accidental poisoning by copper salts
T964400	Accidental poisoning by iron compounds
T964500	Accidental poisoning by manganese and its compounds
T964600	Accidental poisoning by nickel compounds
T964700	Accidental poisoning by thallium compounds
T964z00	Accidental poisoning by metals + compounds and fumes NOS
T965000	Accidental poisoning by plant food
T965100	Accidental poisoning by fertilisers
T965z00	Accidental poisoning by plant foods and fertilisers NOS
T966.00	Accidental poisoning by glues and adhesives
T966000	Accidental poisoning by glues
T966y00	Accidental poisoning by other adhesives
T966z00	Accidental poisoning by glues and adhesives NOS
T967.00	Accidental poisoning by cosmetics
T96y.00	Accidental poisoning by other solid and liquid substances OS
T96z.00	Accidental poisoning by solid and liquid substances NOS
T97..00	Accidental poisoning by gas distributed by pipeline
T970.00	Accidental poisoning by carbon monoxide from piped gas
T971.00	Accidental poisoning by coal gas NOS
T973.00	Accidental poisoning by piped natural gas
T98..00	Accidental poisoning by other utility gas + carbon monoxide
T980100	Accidental poisoning by butane
T980200	Accidental poisoning by propane
T981.00	Accidental poisoning by other utility gas
T981300	Accidental poisoning by heating gas NOS
T981400	Accidental poisoning by cooking gas NOS
T981z00	Accidental poisoning by utility gas NOS
T982.00	Accidental poisoning by motor vehicle exhaust gas
T982100	Accidental poisoning by exhaust gas from gas engine
T982z00	Accidental poisoning by exhaust gas from motor vehicle NOS
T983.00	Accidental poisoning by carbon monoxide-other domestic fuel
T983000	Accidental poisoning by CO- coal in domestic stove/fireplace
T983100	Accidental poisoning by CO- coke in domestic stove/fireplace
T983300	Accidental poisoning by CO- kerosene in domestic stove/fire
T983z00	Accidental poisoning by carbon monoxide - domestic fuel NOS
T98y.00	Accidental poisoning by carbon monoxide from other sources
T98y000	Accidental poisoning by CO - blast furnace gas
T98y100	Accidental poisoning by CO - kiln vapour
T98y200	Accidental poisoning by CO - fuels in industrial use
T98yz00	Accidental poisoning by carbon monoxide from oth source NOS
T98z.00	Accidental poisoning by carbon monoxide NOS
T99..00	Accidental poisoning by other gases and vapours
T990.00	Accidental poisoning by nitrogen oxides
T991.00	Accidental poisoning by sulphur dioxide
T993000	Accidental poisoning by bromobenzyl cyanide
T99y.00	Accidental poisoning by other gases and vapours OS
T99y000	Accidental poisoning by chlorine
T99yz00	Accidental poisoning by other gases and vapours NOS
T99z.00	Accidental poisoning by gases and vapours NOS
T9z..00	Accidental poisoning NOS
TE57.00	Toxic reactions caused by other plants
TJF5000	Adverse reaction to acetylcysteine
TJF5100	Adverse reaction to ipecacuanha
TK...11	Cause of overdose - deliberate
TK...13	Poisoning - self-inflicted
TK0..00	Suicide + selfinflicted poisoning by solid/liquid substances
TK00.00	Suicide + selfinflicted poisoning by analgesic/antipyretic
TK01.00	Suicide + selfinflicted poisoning by barbiturates
TK01000	Suicide and self inflicted injury by Amylobarbitone
TK01100	Suicide and self inflicted injury by Barbitone
TK01400	Suicide and self inflicted injury by Phenobarbitone
TK01z00	Suicide and self inflicted injury by barbiturates
TK02.00	Suicide + selfinflicted poisoning by oth sedatives/hypnotics
TK03.00	Suicide + selfinflicted poisoning tranquilliser/psychotropic
TK04.00	Suicide + selfinflicted poisoning by other drugs/medicines

TK05.00	Suicide + selfinflicted poisoning by drug or medicine NOS
TK06.00	Suicide + selfinflicted poisoning by agricultural chemical
TK07.00	Suicide + selfinflicted poisoning by corrosive/caustic subst
TK0z.00	Suicide + selfinflicted poisoning by solid/liquid subst NOS
TK1..00	Suicide + selfinflicted poisoning by gases in domestic use
TK10.00	Suicide + selfinflicted poisoning by gas via pipeline
TK11.00	Suicide + selfinflicted poisoning by liquified petrol gas
TK1y.00	Suicide and selfinflicted poisoning by other utility gas
TK1z.00	Suicide + selfinflicted poisoning by domestic gases NOS
TK2..00	Suicide + selfinflicted poisoning by other gases and vapours
TK20.00	Suicide + selfinflicted poisoning by motor veh exhaust gas
TK21.00	Suicide and selfinflicted poisoning by other carbon monoxide
TK2y.00	Suicide + selfinflicted poisoning by other gases and vapours
TK2z.00	Suicide + selfinflicted poisoning by gases and vapours NOS
TL1..00	Assault by corrosive or caustic substance, except poisoning
TL2..00	Assault by poisoning
TL20.00	Assault by poisoning by drugs or medicines
TL22.00	Assault by poisoning by other gases or vapours
TL2z.00	Assault by poisoning NOS
TM21.00	Injury due to legal intervention by poisoning by gas
TN...11	Poisoning undetermined - accidentally or purposely inflicted
TN0..00	Injury ?accidental, poisoning by solid/liquid substances
TN00.00	Injury ?accidental, poisoning by analgesic or anti-pyretic
TN01300	Injury ?accidental poisoning by Pentobarbitone
TN02.00	Injury ?accidental, poisoning by other sedative/hypnotic
TN04.00	Injury ?accidental, poisoning by other spec drug/medicament
TN05.00	Injury ?accidental, poisoning by drug or medicament NOS
TN06.00	Injury ?accidental, poisoning by corrosive/caustic substance
TN07.00	Injury ?accidental, poisoning by agricultural chemicals
TN08.00	Injury ?accidental, poisoning by arsenic or its compounds
TN0z.00	Injury ?accidental, poisoning by solid or liquid subst NOS
TN1..00	Injury ?accidental, poisoning by gases in domestic use
TN11.00	Injury ?accidental, poisoning by liquid petrol gas

TN1z.00	Injury ?accidental, poisoning by gas in domestic use NOS
TN2..00	Injury ?accidental, poisoning by other gases
TN20.00	Injury ?accidental, poisoning by motor vehicle exhaust gas
TN21.00	Injury ?accidental, poisoning by other carbon monoxide
TN2y.00	Injury ?accidental, poisoning by other spec gas or vapour
TN87.00	Injury ?accidental, by caustic substances, except poisoning
U1A..00	[X]Accidental poisoning by + exposure to noxious substances
U1A..11	[X]Accidental drug / other poisoning
U1A..12	[X]Accidental drug overdose / other poisoning
U1A0.00	[X]Accident poisoning/exposure to nonopioid analgesic
U1A0.11	[X]Accidental poisoning with paracetamol
U1A0.12	[X]Accidental poisoning with ibuprofen
U1A0.13	[X]Accidental poisoning with aspirin
U1A0000	[X]Accident poison/exposure to nonopioid analgesic at home
U1A0z00	[X]Accid poison/expos to nonopioid analgesic unspecif place
U1A1.00	[X]Accident poisoning/exposure to antiepileptic
U1A1000	[X]Accident poison/exposure to antiepileptic at home
U1A2.00	[X]Accident poisoning/exposure to sedative hypnotic
U1A2.11	[X]Accidental poisoning with sleeping tablets
U1A2.12	[X]Accidental poisoning with diazepam
U1A2.13	[X]Accidental poisoning with temazepam
U1A2.15	[X]Accidental poisoning with nitrazepam
U1A2.16	[X]Accidental poisoning with benzodiazepine
U1A2000	[X]Accident poison/exposure to sedative hypnotic at home
U1A2z00	[X]Accid poison/expos to sedative hypnotic unspecif place
U1A3.00	[X]Accident poisoning/exposure to antiparkinson drug
U1A3500	[X]Accid poison/expos antiparkinson drug trade/service area
U1A4.00	[X]Accident poisoning/exposure to psychotropic drug
U1A4.11	[X]Accidental poisoning with antidepressant
U1A4.12	[X]Accidental poisoning with amitriptyline
U1A4.13	[X]Accidental poisoning with SSRI
U1A4000	[X]Accident poison/exposure to psychotropic drug at home
U1A4100	[X]Accid poison/expos to psychotropic drug at res institut

U1A4200	[X]Acc poison/expos psychotropic drug school/pub admin area
U1A5.00	[X]Accident poisoning/exposure to narcotic drug
U1A5.11	[X]Accidental poisoning with heroin
U1A5000	[X]Accident poison/exposure to narcotic drug at home
U1A5z00	[X]Accid poison/expos to narcotic drug unspecif place
U1A6.00	[X]Accident poisoning/exposure to hallucinogen
U1A7.00	[X]Accident poisoning/exposure to oth autonomic drug
U1A7z00	[X]Accid poison/expos to oth autonomic drug unspecif place
U1A8.00	[X]Accident poison/exposure to other/unspec drug/medicament
U1A8000	[X]Accident poison/exposure to oth/unsp drug/medicam home
U1A8100	[X]Accid poison/expos to oth/unsp drug/medicam res institut
U1A8600	[X]Acc pois/expos oth/unsp drug/medic indust/construct area
U1A8y00	[X]Accid pois/expos to oth/unsp drug/medic other spec place
U1A8z00	[X]Accid poison/expos to oth/unsp drug/medic unspecif place
U1A9.00	[X]Accident poisoning/exposure to alcohol
U1A9000	[X]Accident poison/exposure to alcohol at home
U1A9200	[X]Acc poison/expos alcohol school/pub admin area
U1A9300	[X]Accid pois/expos alcohol in sport/athletic area
U1A9400	[X]Accid poison/expos alcohol in street/highway
U1A9500	[X]Accid poison/expos alcohol trade/service area
U1A9y00	[X]Accid pois/expos to alcohol other spec place
U1A9z00	[X]Accid poison/expos to alcohol unspecif place
U1AA.00	[X]Accid poison/exposure to organ solvent,halogen hydrocarb
U1AA.11	[X]Accidental poisoning from glue solvent
U1AA000	[X]Accid poison/expos organ solvent,halogen hydrocarb, home
U1AA100	[X]Acc poison/expos org solvent,halogen hydrocarb,res instit
U1AB.00	[X]Accident poisoning/exposure to other gas/vapour
U1AB.11	[X]Accidental carbon monoxide poisoning
U1AB000	[X]Accident poison/exposure to other gas/vapour at home
U1AB600	[X]Acc pois/expos other gas/vapour indust/construct area
U1AB700	[X]Accident poison/exposure to other gas/vapour on farm
U1ABy00	[X]Accid pois/expos to other gas/vapour other spec place

U1ABz00	[X]Accid poison/expos to other gas/vapour unspecif place
U1AC.00	[X]Accident poisoning/exposure to pesticide
U1AC.11	[X]Accidental poisoning with weedkiller
U1AC.12	[X]Accidental poisoning with paraquat
U1AC000	[X]Accident poison/exposure to pesticide at home
U1AD.00	[X]Accidental poisoning by and exposure to amfetamine
U1AD000	[X]Accident poisoning by and exposure to amphetamine - home
U1AD200	[X]Acc pois/expo to amphet - sch, other inst+pub admin area
U1ADz00	[X]Acc poison by and exposure to amphetamine - unspec places
U1Ay.00	[X]Accident poisoning/exposure to unspecif chemical
U1Ay000	[X]Accident poison/exposure to unspecif chemical at home
U1Ay200	[X]Acc poison/expos unspecif chemical school/pub admin area
U1Ay500	[X]Accid poison/expos unspecif chemical trade/service area
U1Ay600	[X]Acc pois/expos unspecif chemical indust/construct area
U1Ay700	[X]Accident poison/exposure to unspecif chemical on farm
U1Ayy00	[X]Accid pois/expos to unspecif chemical other spec place
U1Ayz00	[X]Accid poison/expos to unspecif chemical unspecif place
U20..00	[X]Intentional self poisoning/exposure to noxious substances
U20..11	[X]Deliberate drug overdose / other poisoning
U200.00	[X]Intent self poison/exposure to nonopioid analgesic
U200.11	[X]Overdose - paracetamol
U200.12	[X]Overdose - ibuprofen
U200.13	[X]Overdose - aspirin
U200000	[X]Int self poison/exposure to nonopioid analgesic at home
U200100	[X]Intent self poison nonopioid analgesic at res institut
U200400	[X]Intent self pois nonopioid analgesic in street/highway
U200500	[X]Intent self pois nonopioid analgesic trade/service area
U200600	[X]Int self pois nonopioid analgesic indust/construct area
U200y00	[X]Int self poison nonopioid analgesic other spec place
U200z00	[X]Intent self poison nonopioid analgesic unspecif place
U201.00	[X]Intent self poison/exposure to antiepileptic
U201000	[X]Int self poison/exposure to antiepileptic at home
U201z00	[X]Intent self poison antiepileptic unspecif place
U202.00	[X]Intent self poison/exposure to sedative hypnotic
U202.11	[X]Overdose - sleeping tabs
U202.12	[X]Overdose - diazepam
U202.13	[X]Overdose - temazepam
U202.15	[X]Overdose - nitrazepam
U202.16	[X]Overdose - benzodiazepine
U202.17	[X]Overdose - barbiturate
U202.18	[X]Overdose - amobarbital
U202000	[X]Int self poison/exposure to sedative hypnotic at home
U202400	[X]Intent self pois sedative hypnotic in street/highway
U202y00	[X]Int self poison sedative hypnotic other spec place
U202z00	[X]Intent self poison sedative hypnotic unspecif place
U204.00	[X]Intent self poison/exposure to psychotropic drug
U204.11	[X]Overdose - antidepressant
U204.12	[X]Overdose - amitriptyline
U204.13	[X]Overdose - SSRI
U204000	[X]Int self poison/exposure to psychotropic drug at home
U204100	[X]Intent self poison psychotropic drug at res institut
U204y00	[X]Int self poison psychotropic drug other spec place
U204z00	[X]Intent self poison psychotropic drug unspecif place
U205.00	[X]Intent self poison/exposure to narcotic drug
U205.11	[X]Overdose - heroin
U205000	[X]Int self poison/exposure to narcotic drug at home
U205y00	[X]Int self poison narcotic drug other spec place
U205z00	[X]Intent self poison narcotic drug unspecif place
U206.00	[X]Intent self poison/exposure to hallucinogen
U206000	[X]Int self poison/exposure to hallucinogen at home
U206400	[X]Intent self pois hallucinogen in street/highway
U207.00	[X]Intent self poison/exposure to oth autonomic drug
U207000	[X]Int self poison/exposure to oth autonomic drug at home
U207z00	[X]Intent self poison oth autonomic drug unspecif place
U208.00	[X]Int self poison/exposure to other/unspec drug/medicament
U208000	[X]Int self poison/exposure to oth/unsp drug/medicam home
U208400	[X]Intent self pois oth/unsp drug/medic in street/highway
U208y00	[X]Int self poison oth/unsp drug/medic other spec place
U208z00	[X]Intent self poison oth/unsp drug/medic unspecif place
U209.00	[X]Intent self poison/exposure to alcohol
U209000	[X]Int self poison/exposure to alcohol at home
U209y00	[X]Int self poison alcohol other spec place
U209z00	[X]Intent self poison alcohol unspecif place
U20A.00	[X]Intentional self poison organ solvent,halogen hydrocarb
U20A.11	[X]Self poisoning from glue solvent
U20A000	[X]Intent self pois organ solvent,halogen hydrocarb, home
U20A400	[X]Int self poison org solvent,halogen hydrocarb,in highway
U20Az00	[X]Int self pois org solv,halogen hydrocarb, unspec place
U20B.00	[X]Intent self poison/exposure to other gas/vapour
U20B.11	[X]Self carbon monoxide poisoning
U20B000	[X]Int self poison/exposure to other gas/vapour at home
U20B200	[X]Int self poison other gas/vapour school/pub admin area
U20By00	[X]Int self poison other gas/vapour other spec place
U20Bz00	[X]Intent self poison other gas/vapour unspecif place
U20C.00	[X]Intent self poison/exposure to pesticide
U20C.11	[X]Self poisoning with weedkiller
U20C.12	[X]Self poisoning with paraquat
U20C000	[X]Int self poison/exposure to pesticide at home
U20Cy00	[X]Int self poison pesticide other spec place
U20y.00	[X]Intent self poison/exposure to unspecif chemical
U20y000	[X]Int self poison/exposure to unspecif chemical at home
U20y200	[X]Int self poison unspecif chemical school/pub admin area
U20yz00	[X]Intent self poison unspecif chemical unspecif place
U30..00	[X]Assault by drugs, medicaments and biological substances
U30..11	[X]Deliberate drug poisoning
U302.00	[X]Assault drug medicam+biolog subs occ sch/ins/pub adm area
U32..00	[X]Assault by pesticide

U321.00	[X]Assault by pesticides occurrn in residential institution
U327.00	[X]Assault by pesticides, occurrence on farm
U32z.00	[X]Assault by pesticides, occurrence at unspecified place
U33..00	[X]Assault by gases and vapours
U330.00	[X]Assault by gases and vapours, occurrence at home
U332.00	[X]Assault by gas+vapour occ school oth inst/pub admin area
U33z.00	[X]Assault by gases and vapour occurrn at unspecified place
U34..00	[X]Assault by other specified chemicals+noxious substances
U35..00	[X]Assault by unspecified chemical or noxious substance
U350.00	[X]Assault by unspecif chemical/noxious substance occ home
U354.00	[X]Assault unspecif chemical/noxous subst occ street/highway
U35z.00	[X]Assault unspecif chemicl/noxous subst occ unspecif place
U40..00	[X]Poisoning/expos to noxious substance,undetermined intent
U400.00	[X]Poisoning/exposure, ? intent, to nonopioid analgesic
U402.00	[X]Poisoning/exposure, ? intent, to sedative hypnotic
U402z00	[X]Pois/expos ?intent to sedative hypnotic unspecif place
U404.00	[X]Poisoning/exposure, ? intent, to psychotropic drug
U404300	[X]Pois/exp ?intent psychotropic drug in sport/athletic area
U405.00	[X]Poisoning/exposure, ? intent, to narcotic drug
U406y00	[X]Pois/exp ?intent to hallucinogen other spec place

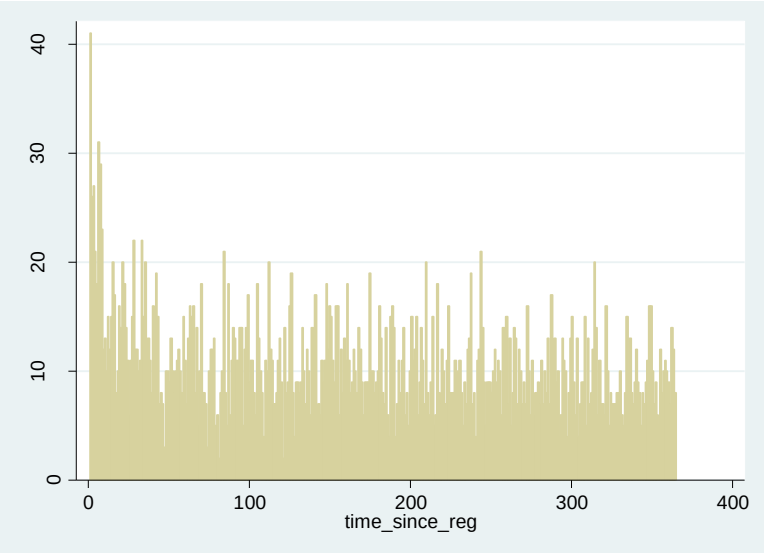
U408.00	[X]Poison/exposure, ?intent, to other/unspec drug/medicament
U408000	[X]Poison/exposure ?intent, to oth/unsp drug/medicam home
U408z00	[X]Pois/expos ?intent to oth/unsp drug/medic unspecif place
U409.00	[X]Poisoning/exposure, ? intent, to alcohol
U409000	[X]Poison/exposure ?intent, to alcohol at home
U409200	[X]Pois/exp ?intent alcohol school/pub admin area
U409400	[X]Pois/expos ?intent alcohol in street/highway
U409z00	[X]Pois/expos ?intent to alcohol unspecif place
U40A.00	[X]Pois/exposure,?intent,to organ solvent,halogen hydrocarb
U40A300	[X]Pois/exp ?intent org solvent,halogen hydrocarb,sport area
U40B.00	[X]Poisoning/exposure, ? intent, to other gas/vapour
U40B400	[X]Pois/expos ?intent other gas/vapour in street/highway
U40C.00	[X]Poisoning/exposure, ? intent, to pesticide
U40C000	[X]Poison/exposure ?intent, to pesticide at home
U40y.00	[X]Poisoning/exposure, ? intent, to unspecif chemical
U40y000	[X]Poison/exposure ?intent, to unspecif chemical at home
U40y400	[X]Pois/expos ?intent unspecif chemical in street/highway
U40y600	[X]Poison/expos ?intent unspec chemic indust/construct area
U40yy00	[X]Pois/exp ?intent to unspecif chemical other spec place

U40yz00	[X]Pois/expos ?intent to unspecif chemical unspecif place
U60F412	[X] Adverse reaction to acetylcysteine
U81..00	[X]Evid of alcohol involv determind by level of intoxication
ZV71A00	[V]Obs for suspected toxic effect from ingested substance
ZX1P.00	Swallowing substances
History of injury codes: excluded as sensitivity analysis	
14K..00	H/O: poisoning
14K0.00	H/O: repeated overdose
ZV15600	[V]Personal history of poisoning
Non-specific poisoning codes: excluded as sensitivity analysis	
S....00	Injury and poisoning
Tz...00	Causes of injury and poisoning NOS
Late effects: excluded from definition of incident poisonings	
TH02.00	Late effects of accidental poisoning
SC...00	Late effects injury/poisoning/toxic effects/external causes
SC40.00	Late effect of poison drug/medicament/biological substance
SC41.00	Late effect of poison due to nonmedical substance
SC41.11	Late effect of poison
SCz..00	Late effect injury/poison/toxin effect/external cause NOS

Appendix 4: Excluding codes referring to non-incident injuries- history of injury codes

The figure below shows the distribution of history of injury codes following GP registration. While there is a small spike of these codes after registration, the overall frequency of these codes is low, and they were used throughout the first year following registration. Codes referring to a history of injury were therefore only excluded if entered within the first two weeks of GP registration.

Distribution of history of injury Read codes following GP registration, 0-365 days

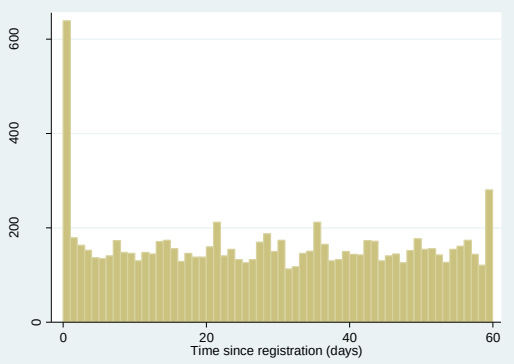


Appendix 5: Excluding injury events occurring prior to registration

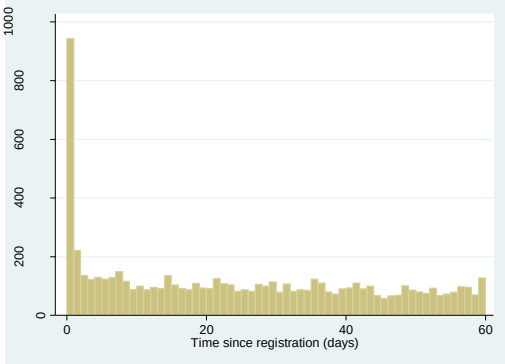
Injuries recorded upon registration at a GP practice could refer to past events. The figures below show the distribution of injury Read codes entered in the medical record after the date of GP registration according to the age of children and young people. For each age group there was a notable spike of injury Read codes entered on the day of registration, with older age groups (over 15 years old) having spikes of a greater magnitude. Through examining these distributions, any injury records entered on the day of registration were excluded.

Distribution of injury Read codes entered onto medical record following registration, 0-60 days (for those patients where GP registration was the start of follow up)

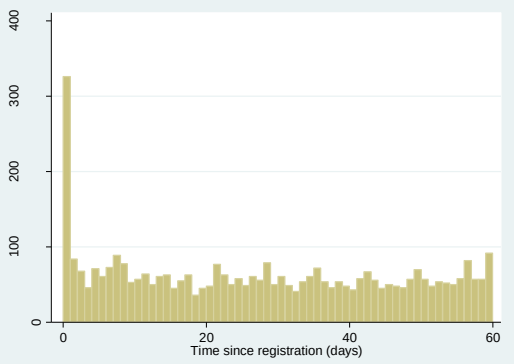
0-4 year olds



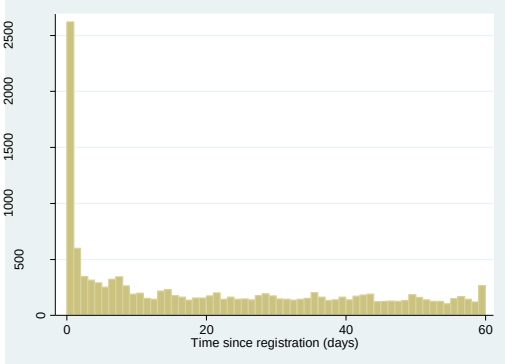
15-19 year olds



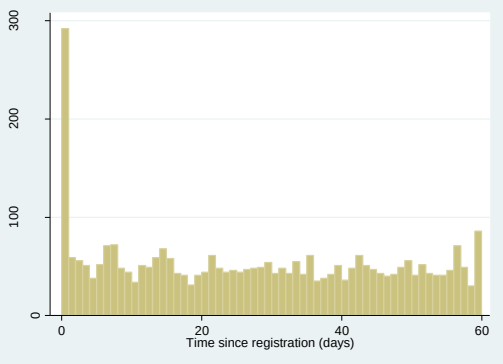
5-9 year olds



20-24 year olds



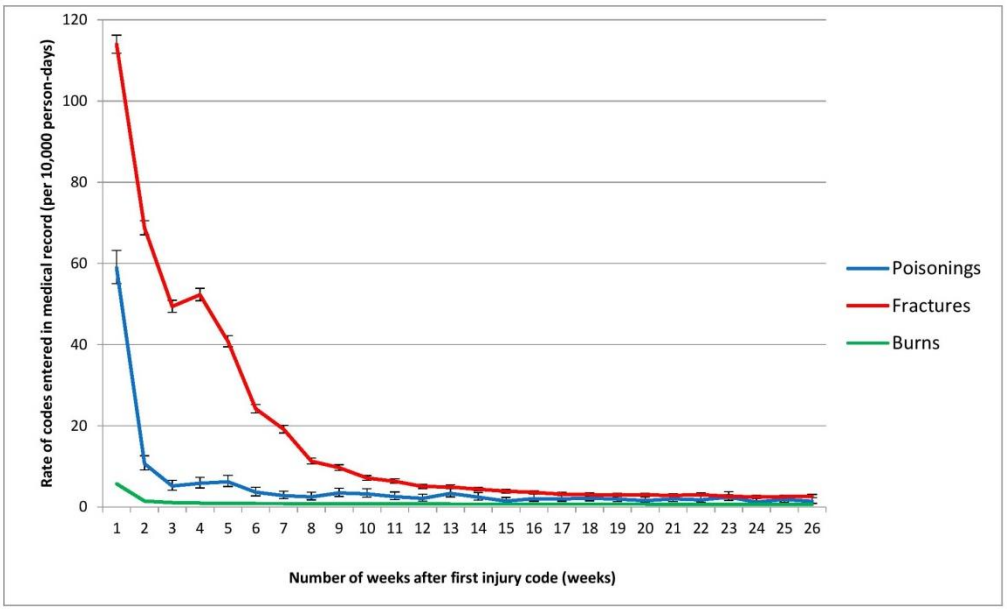
10-14 year olds



Appendix 6: Identifying time-windows to define incident injury events

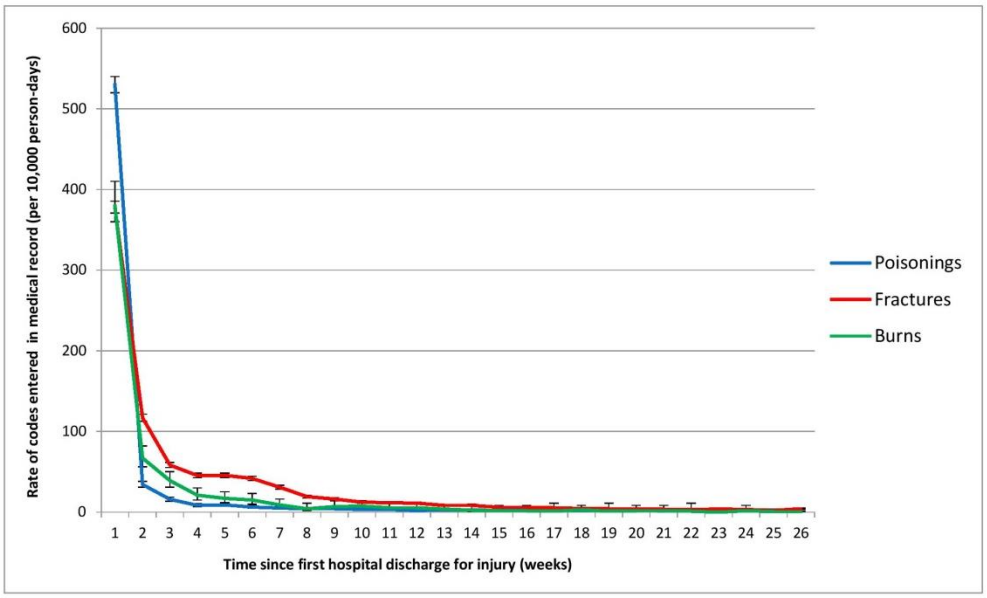
Rates of Read codes entered in CPRD following the first poisoning, fracture or burn code

First injury code recorded in CPRD



This figure shows rates of injury Read codes entered in the primary care record after the first Read code for an injury of the same type. This assisted with the identification of time-window 1 for each injury type, which looks at the time from the first code in CPRD to all subsequent CPRD records.

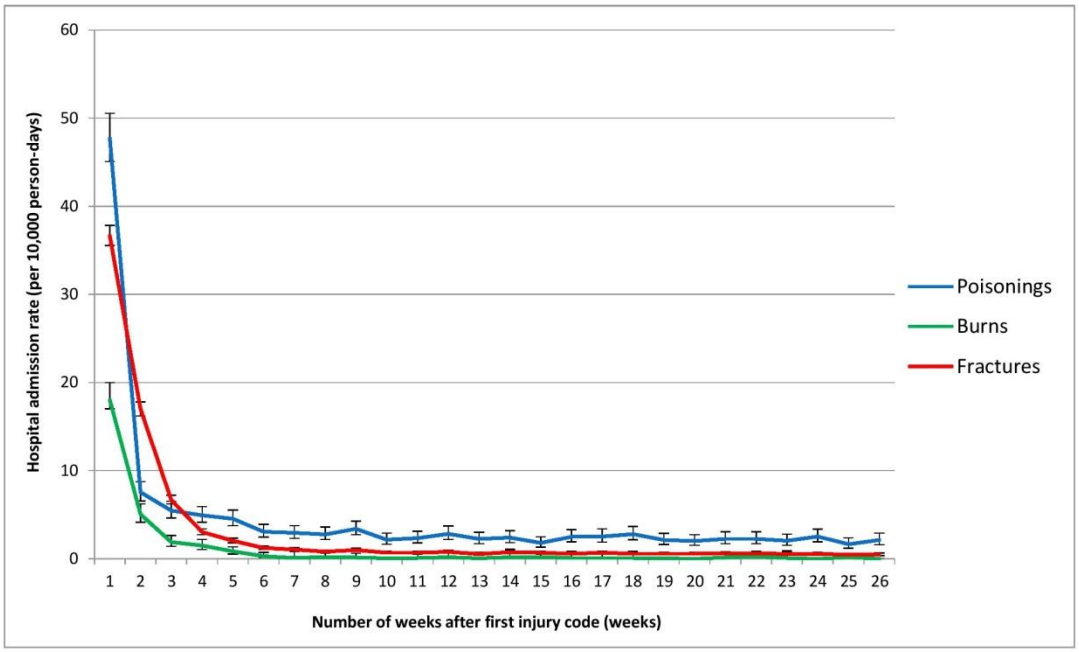
First injury code recorded in HES



This figure shows rates of injury Read codes entered in the primary care record after the first record for an injury of the same type, when the first record was a hospital admission. This assisted with the identification of time-window 2 for each injury type, which looks at the time from the first injury record (when the first record was a hospital admission) to all subsequent CPRD records.

Hospital admission rate after the date of the first poisoning, fracture or burn event

Hospitalisation rate



This figure shows rates of injury hospital admissions after the first record (in either CPRD or HES) for an injury of the same type. This assisted in the identification of time-window 3 for each injury type, which looks at the time from the first injury record (in either CPRD or HES) to any subsequent hospital admissions (e.g. child re-admitted to hospital for same injury).

Appendix 7: ICD-10 code list defining serious injuries

(based on the work by Cryer *et al* and Injury Observatory for England(242, 243))

S02	Fracture of skull and facial bones
S020	Fracture of vault of skull
S021	Fracture of base of skull
S023	Fracture of orbital floor
S024	Fracture of malar and maxillary bones
S026	Fracture of mandible
S027	Multiple fractures involving skull and facial bones
S028	Fractures of other skull and facial bones
S029	Fracture of skull and facial bones, part unspecified
S040	Injury of optic nerve and pathways
S06	Intracranial injury
S060	Concussion
S061	Traumatic cerebral oedema
S062	Diffuse brain injury
S063	Focal brain injury
S064	Epidural haemorrhage
S065	Traumatic subdural haemorrhage
S066	Traumatic subarachnoid haemorrhage
S067	Intracranial injury with prolonged coma
S068	Other intracranial injuries
S069	Intracranial injury, unspecified
S070	Crushing injury of face
S110	Open wound involving larynx and trachea
S12	Fracture of neck
S120	Fracture of first cervical vertebra
S121	Fracture of second cervical vertebra
S122	Fracture of other specified cervical vertebra
S127	Multiple fractures of cervical spine
S128	Fracture of other parts of neck
S129	Fracture of neck, part unspecified
S131	Dislocation of cervical vertebra
S14	Injury of nerves and spinal cord at neck level
S140	Concussion and oedema of cervical spinal cord
S141	Other and unspecified injuries of cervical spinal cord
S142	Injury of nerve root of cervical spine
S143	Injury of brachial plexus
S144	Injury of peripheral nerves of neck
S145	Injury of cervical sympathetic nerves
S146	Injury of other and unspecified nerves of neck
S150	Injury of carotid artery
S151	Injury of vertebral artery
S153	Injury of internal jugular vein
S157	Injury of multiple blood vessels at neck level
S158	Injury of other blood vessels at neck level
S179	Crushing injury of neck, part unspecified
S220	Fracture of thoracic vertebra
S221	Multiple fractures of thoracic spine
S222	Fracture of sternum
S224	Multiple fractures of ribs
S225	Flail chest
S231	Dislocation of thoracic vertebra
S24	Injury of nerves and spinal cord at thorax level
S240	Concussion and oedema of thoracic spinal cord
S241	Other and unspecified injuries of thoracic spinal cord
S242	Injury of nerve root of thoracic spine
S243	Injury of peripheral nerves of thorax
S244	Injury of thoracic sympathetic nerves
S245	Injury of other nerves of thorax
S246	Injury of unspecified nerve of thorax
S25	Injury of blood vessels of thorax
S250	Injury of thoracic aorta
S251	Injury of innominate or subclavian artery
S252	Injury of superior vena cava
S253	Injury of innominate or subclavian vein
S254	Injury of pulmonary blood vessels
S255	Injury of intercostal blood vessels
S257	Injury of multiple blood vessels of thorax
S258	Injury of other blood vessels of thorax
S259	Injury of unspecified blood vessel of thorax
S26	Injury of heart
S260	Injury of heart with haemopericardium
S268	Other injuries of heart
S269	Injury of heart, unspecified
S27	Injury of other and unspecified intrathoracic organs
S270	Traumatic pneumothorax
S271	Traumatic haemothorax
S272	Traumatic haemopneumothorax
S273	Other injuries of lung
S274	Injury of bronchus
S275	Injury of thoracic trachea
S276	Injury of pleura
S277	Multiple injuries of intrathoracic organs
S278	Injury of other specified intrathoracic organs
S279	Injury of unspecified intrathoracic organ
S28	Crushing injury of thorax and traumatic amputation of part of thorax
S280	Crushed chest
S281	Traumatic amputation of part of thorax

S318	Open wound of other and unspecified parts of abdomen
S32	Fracture of lumbar spine and pelvis
S320	Fracture of lumbar vertebra
S321	Fracture of sacrum
S323	Fracture of ilium
S324	Fracture of acetabulum
S325	Fracture of pubis
S327	Multiple fractures of lumbar spine and pelvis
S328	Fracture of other and unspecified parts of lumbar spine and pelvis
S332	Dislocation of sacroiliac and sacrococcygeal joint
S34	Injury of nerves and lumbar spinal cord at abdomen, lower back and pelvis level
S340	Concussion and oedema of lumbar spinal cord
S341	Other injury of lumbar spinal cord
S342	Injury of nerve root of lumbar and sacral spine
S343	Injury of cauda equina
S344	Injury of lumbosacral plexus
S345	Injury of lumbar, sacral and pelvic sympathetic nerves
S35	Injury of blood vessels at abdomen, lower back and pelvis level
S350	Injury of abdominal aorta
S351	Injury of inferior vena cava
S352	Injury of coeliac or mesenteric artery
S353	Injury of portal or splenic vein
S354	Injury of renal blood vessels
S355	Injury of iliac blood vessels
S357	Injury of multiple blood vessels at abdomen, lower back and pelvis level
S358	Injury of other blood vessels at abdomen, lower back and pelvis level
S359	Injury of unspecified blood vessel at abdomen, lower back and pelvis level
S36	Injury of intra-abdominal organs
S360	Injury of spleen
S361	Injury of liver or gallbladder
S362	Injury of pancreas
S363	Injury of stomach
S364	Injury of small intestine
S365	Injury of colon
S366	Injury of rectum
S367	Injury of multiple intra-abdominal organs
S368	Injury of other intra-abdominal organs
S369	Injury of unspecified intra-abdominal organ
S37	Injury of urinary and pelvic organs
S370	Injury of kidney
S371	Injury of ureter
S372	Injury of bladder
S373	Injury of urethra
S374	Injury of ovary
S375	Injury of fallopian tube
S376	Injury of uterus
S377	Injury of multiple pelvic organs
S378	Injury of other pelvic organs
S379	Injury of unspecified pelvic organ
S38	Crushing injury and traumatic amputation of part of abdomen, lower back and pelvis
S380	Crushing injury of external genital organs
S381	Crushing injury of other and unspecified parts of abdomen, lower back and pelvis
S382	Traumatic amputation of external genital organs
S383	Traumatic amputation of other and unspecified parts of abdomen, lower back and pelvis
S427	Multiple fractures of clavicle, scapula and humerus
S429	Fracture of shoulder girdle, part unspecified
S443	Injury of axillary nerve
S450	Injury of axillary artery
S48	Traumatic amputation of shoulder and upper arm
S480	Traumatic amputation at shoulder joint
S481	Traumatic amputation at level between shoulder and elbow
S489	Traumatic amputation of shoulder and upper arm, level unspecified
S58	Traumatic amputation of forearm
S580	Traumatic amputation at elbow level
S581	Traumatic amputation at level between elbow and wrist
S589	Traumatic amputation of forearm, level unspecified
S68	Traumatic amputation of wrist and hand
S680	Traumatic amputation of thumb (complete)(partial)
S681	Traumatic amputation of other single finger (complete)(partial)
S682	Traumatic amputation of two or more fingers alone (complete)(partial)
S683	Combined traumatic amputation of (part of) finger(s) with other parts of wrist and hand
S684	Traumatic amputation of hand at wrist level
S688	Traumatic amputation of other parts of wrist and hand
S689	Traumatic amputation of wrist and hand, level unspecified
S72	Fracture of femur
S720	Fracture of neck of femur
S721	Pertrochanteric fracture
S722	Subtrochanteric fracture
S723	Fracture of shaft of femur
S724	Fracture of lower end of femur
S727	Multiple fractures of femur
S728	Fractures of other parts of femur
S729	Fracture of femur, part unspecified
S730	Dislocation of hip
S78	Traumatic amputation of hip and thigh
S780	Traumatic amputation at hip joint
S781	Traumatic amputation at level between hip and knee
S789	Traumatic amputation of hip and thigh, level unspecified
S88	Traumatic amputation of lower leg

S880	Traumatic amputation at knee level
S881	Traumatic amputation at level between knee and ankle
S889	Traumatic amputation of lower leg, level unspecified
S933	Dislocation of other and unspecified parts of foot
S98	Traumatic amputation of ankle and foot
S980	Traumatic amputation of foot at ankle level
S981	Traumatic amputation of one toe
S982	Traumatic amputation of two or more toes
S983	Traumatic amputation of other parts of foot
S984	Traumatic amputation of foot, level unspecified
T016	Open wounds involving multiple regions of upper limb(s) with lower limb(s)
T018	Open wounds involving other combinations of body regions
T019	Multiple open wounds, unspecified
T02	Fractures involving multiple body regions
T020	Fractures involving head with neck
T021	Fractures involving thorax with lower back and pelvis
T022	Fractures involving multiple regions of one upper limb
T023	Fractures involving multiple regions of one lower limb
T024	Fractures involving multiple regions of both upper limbs
T025	Fractures involving multiple regions of both lower limbs
T026	Fractures involving multiple regions of upper limb(s) with lower limb(s)
T027	Fractures involving thorax with lower back and pelvis with limb(s)
T028	Fractures involving other combinations of body regions
T029	Multiple fractures, unspecified
T04	Crushing injuries involving multiple body regions
T040	Crushing injuries involving head with neck
T041	Crushing injuries involving thorax with abdomen, lower back and pelvis
T042	Crushing injuries involving multiple regions of upper limb(s)
T043	Crushing injuries involving multiple regions of lower limb(s)
T044	Crushing injuries involving multiple regions of upper limb(s) with lower limb(s)
T047	Crushing injuries of thorax with abdomen, lower back and pelvis with limb(s)
T048	Crushing injuries involving other combinations of body regions
T049	Multiple crushing injuries, unspecified
T05	Traumatic amputations involving multiple body regions
T050	Traumatic amputation of both hands
T051	Traumatic amputation of one hand and other arm [any level, except hand]
T052	Traumatic amputation of both arms [any level]
T053	Traumatic amputation of both feet
T054	Traumatic amputation of one foot and other leg [any level, except foot]
T055	Traumatic amputation of both legs [any level]
T056	Traumatic amputation of upper and lower limbs, any combination [any level]
T058	Traumatic amputations involving other combinations of body regions
T059	Multiple traumatic amputations, unspecified
T06	Other injuries involving multiple body regions, not elsewhere classified
T060	Injuries of brain and cranial nerves with injuries of nerves and spinal cord at neck level
T061	Injuries of nerves and spinal cord involving other multiple body regions
T062	Injuries of nerves involving multiple body regions
T063	Injuries of blood vessels involving multiple body regions
T064	Injuries of muscles and tendons involving multiple body regions
T065	Injuries of intrathoracic organs with intra-abdominal and pelvic organs
T068	Other specified injuries involving multiple body regions
T09	Other injuries of spine and trunk, level unspecified
T10	Fracture of upper limb, level unspecified
T11	Other injuries of upper limb, level unspecified
T13	Other injuries of lower limb, level unspecified
T14	Injury of unspecified body region
T17	Foreign body in respiratory tract
T203	Burn of third degree of head and neck
T210	Burn of unspecified degree of trunk
T211	Burn of first degree of trunk
T212	Burn of second degree of trunk
T213	Burn of third degree of trunk
T223	Burn of third degree of shoulder and upper limb, except wrist and hand
T264	Burn of eye and adnexa, part unspecified
T270	Burn of larynx and trachea
T271	Burn involving larynx and trachea with lung
T280	Burn of mouth and pharynx
T281	Burn of oesophagus
T290	Burns of multiple regions, unspecified degree
T293	Burns of multiple regions, at least one burn of third degree mentioned
T311	Burns involving 10-19% of body surface
T312	Burns involving 20-29% of body surface
T313	Burns involving 30-39% of body surface
T314	Burns involving 40-49% of body surface
T315	Burns involving 50-59% of body surface
T316	Burns involving 60-69% of body surface
T317	Burns involving 70-79% of body surface
T318	Burns involving 80-89% of body surface
T319	Burns involving 90% or more of body surface
T462	Poisoning: Other antidysrhythmic drugs, not elsewhere classified
T467	Poisoning: Peripheral vasodilators
T493	Poisoning: Emollients, demulcents and protectants
T504	Poisoning: Drugs affecting uric acid metabolism
T603	Toxic effect: Herbicides and fungicides
T68	Hypothermia
T71	Asphyxiation

Appendix 8: Read code lists for mental illnesses

SCHIZOPHRENIA

E10..00	Schizophrenic disorders
E100.00	Simple schizophrenia
E100.11	Schizophrenia simplex
E100000	Unspecified schizophrenia
E100100	Subchronic schizophrenia
E100200	Chronic schizophrenic
E100300	Acute exacerbation of subchronic schizophrenia
E100400	Acute exacerbation of chronic schizophrenia
E100500	Schizophrenia in remission
E100z00	Simple schizophrenia NOS
E101.00	Hebephrenic schizophrenia
E101000	Unspecified hebephrenic schizophrenia
E101400	Acute exacerbation of chronic hebephrenic schizophrenia
E101500	Hebephrenic schizophrenia in remission
E101z00	Hebephrenic schizophrenia NOS
E102.00	Catatonic schizophrenia
E102000	Unspecified catatonic schizophrenia
E102100	Subchronic catatonic schizophrenia
E102500	Catatonic schizophrenia in remission
E102z00	Catatonic schizophrenia NOS
E103.00	Paranoid schizophrenia
E103000	Unspecified paranoid schizophrenia
E103100	Subchronic paranoid schizophrenia
E103200	Chronic paranoid schizophrenia
E103300	Acute exacerbation of subchronic paranoid schizophrenia
E103400	Acute exacerbation of chronic paranoid schizophrenia
E103500	Paranoid schizophrenia in remission
E103z00	Paranoid schizophrenia NOS
E104.00	Acute schizophrenic episode
E104.11	Oneirophrenia
E105.00	Latent schizophrenia
E105000	Unspecified latent schizophrenia
E105200	Chronic latent schizophrenia
E105500	Latent schizophrenia in remission
E105z00	Latent schizophrenia NOS
E106.00	Residual schizophrenia
E107.00	Schizo-affective schizophrenia
E107.11	Cyclic schizophrenia
E107000	Unspecified schizo-affective schizophrenia
E107100	Subchronic schizo-affective schizophrenia
E107200	Chronic schizo-affective schizophrenia
E107300	Acute exacerbation subchronic schizo-affective schizophrenia
E107400	Acute exacerbation of chronic schizo-affective schizophrenia
E107500	Schizo-affective schizophrenia in remission
E107z00	Schizo-affective schizophrenia NOS
E10y.00	Other schizophrenia
E10y.11	Cenesthopathic schizophrenia
E10y000	Atypical schizophrenia
E10y100	Coenesthopathic schizophrenia
E10yz00	Other schizophrenia NOS
E10z.00	Schizophrenia NOS
Eu20.00	[X]Schizophrenia
Eu20000	[X]Paranoid schizophrenia
Eu20011	[X]Paraphrenic schizophrenia
Eu20100	[X]Hebephrenic schizophrenia
Eu20111	[X]Disorganised schizophrenia
Eu20200	[X]Catatonic schizophrenia
Eu20211	[X]Catatonic stupor
Eu20212	[X]Schizophrenic catalepsy
Eu20213	[X]Schizophrenic catatonia
Eu20214	[X]Schizophrenic flexibilatis cerea
Eu20300	[X]Undifferentiated schizophrenia
Eu20311	[X]Atypical schizophrenia
Eu20400	[X]Post-schizophrenic depression
Eu20500	[X]Residual schizophrenia
Eu20511	[X]Chronic undifferentiated schizophrenia
Eu20600	[X]Simple schizophrenia
Eu20y00	[X]Other schizophrenia
Eu20y12	[X]Schizophreniform disord NOS
Eu20y13	[X]Schizophrenifrm psychos NOS
Eu20z00	[X]Schizophrenia, unspecified
Eu21.00	[X]Schizotypal disorder
Eu21.11	[X]Latent schizophrenic reaction
Eu21.12	[X]Borderline schizophrenia
Eu21.13	[X]Latent schizophrenia
Eu21.14	[X]Prepsychotic schizophrenia
Eu21.15	[X]Prodromal schizophrenia
Eu21.16	[X]Pseudoneurotic schizophrenia
Eu21.17	[X]Pseudopsychopathic schizophrenia
Eu21.18	[X]Schizotypal personality disorder
Eu25.00	[X]Schizoaffective disorders
Eu25000	[X]Schizoaffective disorder, manic type
Eu25011	[X]Schizoaffective psychosis, manic type
Eu25012	[X]Schizophreniform psychosis, manic type
Eu25100	[X]Schizoaffective disorder, depressive type
Eu25111	[X]Schizoaffective psychosis, depressive type
Eu25112	[X]Schizophreniform psychosis, depressive type
Eu25200	[X]Schizoaffective disorder, mixed type
Eu25211	[X]Cyclic schizophrenia
Eu25212	[X]Mixed schizophrenic and affective psychosis
Eu25y00	[X]Other schizoaffective disorders
Eu25z00	[X]Schizoaffective disorder, unspecified
Eu25z11	[X]Schizoaffective psychosis NOS

BIPOLAR DISORDER READ CODES

E11..11	Bipolar psychoses
E114.00	Bipolar affective disorder, currently manic
E114.11	Manic-depressive - now manic
E114000	Bipolar affective disorder, currently manic, unspecified
E114100	Bipolar affective disorder, currently manic, mild
E114200	Bipolar affective disorder, currently manic, moderate
E114300	Bipolar affect disord, currently manic, severe, no psychosis
E114400	Bipolar affect disord, currently manic,severe with psychosis
E114500	Bipolar affect disord,currently manic, part/unspec remission
E114600	Bipolar affective disorder, currently manic, full remission
E114z00	Bipolar affective disorder, currently manic, NOS
E115.00	Bipolar affective disorder, currently depressed
E115.11	Manic-depressive - now depressed
E115000	Bipolar affective disorder, currently depressed, unspecified
E115100	Bipolar affective disorder, currently depressed, mild
E115200	Bipolar affective disorder, currently depressed, moderate
E115300	Bipolar affect disord, now depressed, severe, no psychosis
E115400	Bipolar affect disord, now depressed, severe with psychosis
E115500	Bipolar affect disord, now depressed, part/unspec remission
E115600	Bipolar affective disorder, now depressed, in full remission
E115z00	Bipolar affective disorder, currently depressed, NOS
E116.00	Mixed bipolar affective disorder
E116000	Mixed bipolar affective disorder, unspecified
E116100	Mixed bipolar affective disorder, mild
E116200	Mixed bipolar affective disorder, moderate
E116300	Mixed bipolar affective disorder, severe, without psychosis
E116400	Mixed bipolar affective disorder, severe, with psychosis
E116500	Mixed bipolar affective disorder, partial/unspec remission
E116600	Mixed bipolar affective disorder, in full remission
E116z00	Mixed bipolar affective disorder, NOS
E117.00	Unspecified bipolar affective disorder
E117000	Unspecified bipolar affective disorder, unspecified
E117100	Unspecified bipolar affective disorder, mild
E117200	Unspecified bipolar affective disorder, moderate
E117300	Unspecified bipolar affective disorder, severe, no psychosis
E117400	Unspecified bipolar affective disorder,severe with psychosis
E117500	Unspecified bipolar affect disord, partial/unspec remission
E117600	Unspecified bipolar affective disorder, in full remission
E117z00	Unspecified bipolar affective disorder, NOS
E11y.00	Other and unspecified manic-depressive psychoses
E11y000	Unspecified manic-depressive psychoses
E11y100	Atypical manic disorder
E11y300	Other mixed manic-depressive psychoses
E11yz00	Other and unspecified manic-depressive psychoses NOS
Eu30.11	[X]Bipolar disorder, single manic episode
Eu31.00	[X]Bipolar affective disorder
Eu31.11	[X]Manic-depressive illness
Eu31.12	[X]Manic-depressive psychosis
Eu31.13	[X]Manic-depressive reaction
Eu31000	[X]Bipolar affective disorder, current episode hypomanic
Eu31100	[X]Bipolar affect disorder cur epi manic wout psychotic symp
Eu31200	[X]Bipolar affect disorder cur epi manic with psychotic symp
Eu31300	[X]Bipolar affect disorder cur epi mild or moderate depressn
Eu31400	[X]Bipol aff disord, curr epis sev depress, no psychot symp
Eu31500	[X]Bipolar affect dis cur epi severe depres with psyc symp
Eu31600	[X]Bipolar affective disorder, current episode mixed
Eu31700	[X]Bipolar affective disorder, currently in remission
Eu31800	[X]Bipolar affective disorder type I
Eu31900	[X]Bipolar affective disorder type II
Eu31911	[X]Bipolar II disorder
Eu31y00	[X]Other bipolar affective disorders
Eu31y11	[X]Bipolar II disorder
Eu31y12	[X]Recurrent manic episodes
Eu31z00	[X]Bipolar affective disorder, unspecified

DEPRESSION READ CODES

E112200	Single major depressive episode, moderate
Eu92000	[X]Depressive conduct disorder
E112500	Single major depressive episode, partial or unspec remission
E113z00	Recurrent major depressive episode NOS
E2B..00	Depressive disorder NEC
E112.11	Agitated depression
E204.11	Postnatal depression
Eu32.13	[X]Single episode of reactive depression
Eu33.14	[X]Seasonal depressive disorder
E113700	Recurrent depression
E113300	Recurrent major depressive episodes, severe, no psychosis
Eu33.12	[X]Recurrent episodes of psychogenic depression
Eu33.00	[X]Recurrent depressive disorder
Eu32B00	[X]Antenatal depression
Eu32z13	[X]Prolonged single episode of reactive depression
Eu32.00	[X]Depressive episode
8BK0.00	Depression management programme
Eu32z14	[X] Reactive depression NOS
E112000	Single major depressive episode, unspecified
Eu32213	[X]Single episode vital depression w'out psychotic symptoms
Eu32.11	[X]Single episode of depressive reaction
Eu32y00	[X]Other depressive episodes
Eu33z11	[X]Monopolar depression NOS
Eu33211	[X]Endogenous depression without psychotic symptoms
Eu32211	[X]Single episode agitated depressn w'out psychotic symptoms
Eu41200	[X]Mixed anxiety and depressive disorder
Eu34113	[X]Neurotic depression
Eu34114	[X]Persistent anxiety depression

E112.14	Endogenous depression
Eu34.00	[X]Persistent mood affective disorders
E11..12	Depressive psychoses
Eu33.15	[X]SAD - Seasonal affective disorder
Eu32z12	[X]Depressive disorder NOS
Eu32900	[X]Single major depr ep, severe with psych, psych in remiss
E113000	Recurrent major depressive episodes, unspecified
Eu33214	[X]Vital depression, recurrent without psychotic symptoms
Eu32A00	[X]Recurr major depr ep, severe with psych, psych in remiss
Eu32700	[X]Major depression, severe without psychotic symptoms
Eu32z11	[X]Depression NOS
Eu32500	[X]Major depression, mild
E291.00	Prolonged depressive reaction
Eu32212	[X]Single episode major depression w'out psychotic symptoms
Eu32y11	[X]Atypical depression
Eu41211	[X]Mild anxiety depression
E113100	Recurrent major depressive episodes, mild
Eu33100	[X]Recurrent depressive disorder, current episode moderate
E2B1.00	Chronic depression
E11z200	Masked depression
Eu34y00	[X]Other persistent mood affective disorders
Eu32400	[X]Mild depression
Eu32000	[X]Mild depressive episode
62T1.00	Puerperal depression
Eu32600	[X]Major depression, moderately severe
E113.11	Endogenous depression - recurrent
Eu32y12	[X]Single episode of masked depression NOS
Eu53011	[X]Postnatal depression NOS

Eu33y00	[X]Other recurrent depressive disorders
Eu33000	[X]Recurrent depressive disorder, current episode mild
Eu33200	[X]Recurr depress disorder cur epi severe without psyc sympt
8CAa.00	Patient given advice about management of depression
E211200	Depressive personality disorder
E11y200	Atypical depressive disorder
8HHq.00	Referral for guided self-help for depression
Eu32314	[X]Single episode of reactive depressive psychosis
Eu33.13	[X]Recurrent episodes of reactive depression
E204.00	Neurotic depression reactive type
E112.13	Endogenous depression first episode
E113200	Recurrent major depressive episodes, moderate
E113.00	Recurrent major depressive episode
E135.00	Agitated depression
Eu34111	[X]Depressive neurosis
Eu33.11	[X]Recurrent episodes of depressive reaction
E113500	Recurrent major depressive episodes,partial/unspec remission
E112100	Single major depressive episode, mild
Eu33212	[X]Major depression, recurrent without psychotic symptoms
E112.00	Single major depressive episode
Eu32.12	[X]Single episode of psychogenic depression
Eu32100	[X]Moderate depressive episode
Eu3y111	[X]Recurrent brief depressive episodes
E200300	Anxiety with depression
Eu53012	[X]Postpartum depression NOS
Eu34z00	[X]Persistent mood affective disorder, unspecified
E112.12	Endogenous depression first episode
6G00.00	Postnatal depression counselling

R007z13	[D]Postoperative depression
Eu32200	[X]Severe depressive episode without psychotic symptoms
E118.00	Seasonal affective disorder
Eu32z00	[X]Depressive episode, unspecified
Eu33z00	[X]Recurrent depressive disorder, unspecified
E112300	Single major depressive episode, severe, without psychosis
E2B0.00	Postviral depression
E112z00	Single major depressive episode NOS
E130.11	Psychotic reactive depression
Eu33313	[X]Recurr severe episodes/major depression+psychotic symptom
E113400	Recurrent major depressive episodes, severe, with psychosis
Eu32312	[X]Single episode of psychogenic depressive psychosis
Eu33300	[X]Recurrent depress disorder cur epi severe with psyc symp
Eu33316	[X]Recurrent severe episodes/reactive depressive psychosis
Eu32311	[X]Single episode of major depression and psychotic symptoms
Eu32300	[X]Severe depressive episode with psychotic symptoms
E112400	Single major depressive episode, severe, with psychosis
Eu33311	[X]Endogenous depression with psychotic symptoms
Eu33315	[X]Recurrent severe episodes of psychotic depression
E130.00	Reactive depressive psychosis
Eu32800	[X]Major depression, severe with psychotic symptoms

Eu32313	[X]Single episode of psychotic depression
Eu33314	[X]Recurr severe episodes/psychogenic depressive psychosis
Screening/diagnostic tools: only included if outcome of tool indicates patient has depression	
ZRrc.11	SDS - Zung self-rating depression scale
388Z.00	Depression anxiety stress scales depression score
ZRrY.00	WHO depression scale
38Dp.00	HAMD - Hamilton rating scale for depression
ZRBY.00	Edinburgh postnatal depression scale
ZRBY.11	EPDS - Edinburgh postnatal depression scale
38Dq.00	MADRS - Montgomery-Asberg depression rating scale
388f.00	Patient health questionnaire (PHQ-9) score
ZRrc.00	Zung self-rating depression scale
ZRLr.00	Hospital anxiety and depression scale
ZRLr.11	HAD - Hospital anxiety and depression scale
ZR8..11	DSRS - Depression self rating scale
ZR7..00	Depression anxiety scale
3885	Edinburgh postnatal depression scale
ZRLU.12	HRSD - Hamilton rating scale for depression
ZRLU.11	HAMD - Hamilton rating scale for depression
388P.00	HAD scale: depression score
388J.00	Hospital anxiety and depression scale
ZRLU.00	Hamilton rating scale for depression
388g.00	Beck depression inventory second edition score
ZRVM.00	Leeds scale for the self-assessment of anxiety & depression
ZR8..00	Depression self rating scale
ZRLr.12	HADS - Hospital anxiety and depression scale

Clinical review codes: excluded as part of sensitivity analysis	
9H92.00	Depression interim review
9Ov2.00	Depression monitoring third letter
9Ov4.00	Depression monitoring telephone invite
9Ov3.00	Depression monitoring verbal invite
9Ov1.00	Depression monitoring second letter
9H91.00	Depression medication review
9Ov0.00	Depression monitoring first letter
9HA0.00	On depression register
9Ov..00	Depression monitoring administration
9H90.00	Depression annual review
Symptom codes: excluded as a sensitivity analysis	
1B17.00	Depressed
1BP0.00	Loss of interest in previously enjoyable activity
1BT..00	Depressed mood
1BT..11	Low mood
2257	O/E - depressed
1BI..00	Blunted affect
1BU..00	Loss of hope for the future
1B17.11	C/O - feeling depressed
1BT..12	Sad mood
1B1U.11	Depressive symptoms
1BQ..00	Loss of capacity for enjoyment
1B1U.00	Symptoms of depression
History of depression code: excluded from depression definition as likely to indicate previous illness	
1465	H/O: depression

ANXIETY

Eu34111	[X]Depressive neurosis
E200000	Anxiety state unspecified
E200300	Anxiety with depression
E200.00	Anxiety states
Eu41z11	[X]Anxiety NOS
E200500	Recurrent anxiety
Eu41211	[X]Mild anxiety depression
Eu41300	[X]Other mixed anxiety disorders
Z4L1.00	Anxiety counselling
Eu34113	[X]Neurotic depression
Eu41.00	[X]Other anxiety disorders
Eu41z00	[X]Anxiety disorder, unspecified
E200400	Chronic anxiety
Eu41100	[X]Generalized anxiety disorder
Eu41y11	[X]Anxiety hysteria
E200200	Generalised anxiety disorder
Eu41113	[X]Anxiety state
Eu51511	[X]Dream anxiety disorder
Eu34114	[X]Persistant anxiety depression
Eu41111	[X]Anxiety neurosis
Eu41112	[X]Anxiety reaction
E200z00	Anxiety state NOS
Eu41200	[X]Mixed anxiety and depressive disorder
Eu41y00	[X]Other specified anxiety disorders
8G94.00	Anxiety management training
Eu41012	[X]Panic state
Eu41011	[X]Panic attack
1B1V.00	C/O - panic attack
225J.00	O/E - panic attack
E200111	Panic attack
E200100	Panic disorder

Eu40012	[X]Panic disorder with agoraphobia
Eu41000	[X]Panic disorder [episodic paroxysmal anxiety]
Eu40300	[X]Needle phobia
E202E00	Fear of pregnancy
E202400	Social phobia, fear of public speaking
Eu40211	[X]Acrophobia
Eu40z11	[X]Phobia NOS
Eu40200	[X]Specific (isolated) phobias
E202B00	Cancer phobia
Eu40y00	[X]Other phobic anxiety disorders
E202z00	Phobic disorder NOS
E202.12	Phobic anxiety
Eu40000	[X]Agoraphobia
Eu40z00	[X]Phobic anxiety disorder, unspecified
Eu40214	[X]Simple phobia
Eu40112	[X]Social neurosis
E202800	Claustrophobia
E202D00	Fear of death
Eu40.00	[X]Phobic anxiety disorders
E202100	Agoraphobia with panic attacks
E202A00	Fear of flying
Eu40213	[X]Claustrophobia
E202C00	Dental phobia
E202500	Social phobia, fear of public washing
E202000	Phobia unspecified
E202200	Agoraphobia without mention of panic attacks
Eu40z12	[X]Phobic state NOS
E202.00	Phobic disorders
Eu40212	[X]Animal phobias
E202900	Fear of crowds
E202600	Acrophobia

Eu40011	[X]Agoraphobia without history of panic disorder
Eu40100	[X]Social phobias
E202.11	Social phobic disorders
E202z11	Weight fixation
E202700	Animal phobia
E202300	Social phobia, fear of eating in public
Screening/diagnostic tools: only included if outcome of tool indicates patient has anxiety	
ZRre.00	Zung's self-rating anxiety scale
ZRLr.00	Hospital anxiety and depression scale
388a.00	Depression anxiety stress scales stress score
ZRLr.12	HADS - Hospital anxiety and depression scale
ZRrd.00	Zung's anxiety status inventory
388b.00	Depression anxiety stress scales anxiety score
388w.11	GAD-7 score
388w.00	Generalised anxiety disorder 7 item score
ZR7..00	Depression anxiety scale
ZRre.11	SASZ - Zung's self-rating anxiety scal
388N.00	HAD scale: anxiety score
ZRVM.00	Leeds scale for the self-assessment of anxiety & depression
ZRLr.11	HAD - Hospital anxiety and depression scale
Symptom codes: excluded as a sensitivity analysis	
1B13.11	Anxiousness - symptom
1B12.12	Tension - nervous
1B12.11	'Nerves'
1B13.00	Anxiousness
1BK..00	Worried
1B12.00	'Nerves' - nervousness
2258	O/E - anxious
1B13.12	Anxious

Appendix 9: Read code list for intentional injuries/assault

14X5.00	Victim of physical abuse
14X6.00	Victim of sexual abuse
14X7.00	Victim of emotional abuse
14XD.00	History of domestic abuse
1J3..00	Suspected child abuse
1JE..00	Suspected assault - allegation made
63CB.00	Risk of non-accidental injury
69A6.00	Exam. for alleged rape
SN55.00	Child maltreatment syndrome
SN55000	Emotional maltreatment of child
SN55011	Emotional deprivation of child
SN55012	Emotional abuse of child
SN55100	Nutritional maltreatment of child
SN55111	Nutritional deprivation of child
SN55112	Malnutrition in child maltreatment syndrome
SN55200	Non-accidental injury to child
SN55211	NAI - non-accidental injury to child
SN55212	Physical injury to child
SN55300	Battered baby or child syndrome NOS
SN55311	Battered baby syndrome NOS
SN55312	Battered child syndrome NOS
SN55400	Multiple deprivation of child
SN55500	Physical abuse of child
SN55z00	Child maltreatment syndrome NOS
SN55z11	Child abuse NEC
SN55z12	Child deprivation syndrome
SN55z13	Neglect affecting child NEC
SN56.00	Adult maltreatment syndrome
SN56000	Battered person unspecified, syndrome
SN56100	Battered woman, unspecified
SN56200	Battered man, unspecified
SN56300	Battered wife
SN56400	Battered husband
SN56500	Psychologically abused elderly person
SN56z00	Adult maltreatment syndrome NOS
SN57.00	Maltreatment syndromes
SN57000	Neglect or abandonment
SN57100	Sexual abuse
SN57200	Child affected by Munchausen's by proxy
TE40.11	Accident due to abandonment of helpless person
TE40.12	Accident due to neglect of helpless person
TE40000	Accident due to abandonment of newborn
TE40300	Accident due to neglect of elderly person
TE40400	Exposure to weather conditions resulting from abandonment
TL...00	Homicide and injury purposely inflicted by other persons
TL...11	Mugged
TL0..00	Homicide and assault by fight, brawl and rape
TL00.00	Homicide or assault by unarmed fight or brawl
TL01.00	Homicide or assault by rape
TL01.11	Sexual assault
TL0z.00	Homicide or assault by fight, brawl or rape NOS
TL1..00	Assault by corrosive or caustic substance, except poisoning
TL10.00	Assault by acid
TL11.00	Assault by caustic substance
TL1z.00	Assault by corrosive substance NOS
TL2..00	Assault by poisoning
TL20.00	Assault by poisoning by drugs or medicines
TL22.00	Assault by poisoning by other gases or vapours
TL2z.00	Assault by poisoning NOS
TL3..00	Assault by hanging and strangulation
TL31.00	Assault by hanging
TL32.00	Assault by strangulation
TL33.00	Assault by suffocation
TL4..00	Assault by drowning
TL5..00	Assault by firearms and explosives
TL50.00	Assault by handgun
TL50000	Assault by pistol
TL50100	Assault by revolver
TL50z00	Assault by handgun NOS
TL51.00	Assault by shotgun
TL53.00	Assault by military firearms
TL54.00	Assault by other firearms
TL55.00	Assault by antipersonnel bomb
TL56.00	Assault by petrol bomb
TL57.00	Assault by letter bomb
TL5x.00	Deliberate shooting NOS
TL5y000	Assault by bomb in car
TL5y100	Assault by bomb in house
TL5yy00	Assault by bomb NOS
TL5z.00	Assault by explosive NOS
TL6..00	Assault by cutting and stabbing instruments
TL60.00	Homicidal cut of any part of body
TL61.00	Homicidal puncture of any part of body
TL62.00	Homicidal stab of any part of body
TL63.00	Cut in fight
TL64.00	Stabbed in fight
TL6z.00	Assault by cutting or stabbing NOS
TL7..00	Child battering and other maltreatment
TL70.00	Child battering or other maltreatment by parent
TL7y.00	Child battering or other maltreatment by other spec person
TL7z.00	Child battering or other maltreatment by person NOS
TL9..00	Homicide
TLx..00	Assault by other means

TLx0.00	Assault by fire
TLx0000	Assault by arson
TLx0z00	Assault by homicidal burns NOS
TLx1.00	Assault by pushing from high place
TLx2.00	Assault by striking by blunt or thrown object
TLx2000	Assault by striking by blunt object
TLx2100	Assault by striking by thrown object
TLx2z00	Assault by striking by blunt or thrown object NOS
TLx3.00	Assault by hot liquid
TLx4.00	Assault by criminal neglect
TLx4000	Abandonment of child with intent to injure or kill
TLx4100	Abandonment of infant with intent to injure or kill
TLx4z00	Abandonment of helpless person NOS
TLxy.00	Assault by other specified means
TLxy000	Assault by bite of human being
TLxyz00	Assault by other means NOS
TLxz.00	Assault by unspecified means
TLxz000	Manslaughter, nonaccidental, NOS
TLxz100	Assassination attempt NOS
TLxz200	Assassination successful NOS
TLxz300	Murder attempt NOS
TLxz400	Murder successful NOS
TLxzz00	Assault by means NOS
TLz..00	Homicide or assault NOS
U3...00	[X]Assault
U3...11	[X]NAI - Non accidental injury
U3...12	[X]Homicide
U3...13	[X]Murder
U3...14	[X]Mugged
U3...15	[X]Attacked
U30..00	[X]Assault by drugs, medicaments and biological substances
U30..11	[X]Deliberate drug poisoning
U302.00	[X]Assault drug medicam+biolog subs occ sch/ins/pub adm area
U31..00	[X]Assault by corrosive substance
U32..00	[X]Assault by pesticide
U321.00	[X]Assault by pesticides occurrn in residential institution
U327.00	[X]Assault by pesticides, occurrence on farm
U32z.00	[X]Assault by pesticides, occurrence at unspecified place
U33..00	[X]Assault by gases and vapours
U330.00	[X]Assault by gases and vapours, occurrence at home
U332.00	[X]Assault by gas+vapour occ school oth inst/pub admin area
U33z.00	[X]Assault by gases and vapour occurrn at unspecified place
U34..00	[X]Assault by other specified chemicals+noxious substances
U35..00	[X]Assault by unspecified chemical or noxious substance
U350.00	[X]Assault by unspecif chemical/noxious substance occ home
U354.00	[X]Assault unspecif chemical/noxous subst occ street/highway
U35z.00	[X]Assault unspecif chemicl/noxous subst occ unspecif place
U36..00	[X]Assault by hanging, strangulation and suffocation
U36..11	[X]Strangled
U36..12	[X]Smothered / suffocated
U360.00	[X]Assault by hanging strangulatn+suffocatn occurrn at home
U362.00	[X]Assault hanging strangul+suffoc occ sch/ins/pub adm area
U364.00	[X]Assault by hanging strangl+suffoc occurrn street/highway
U365.00	[X]Assault by hanging strangul+suffoc occ trade/servce area
U38..00	[X]Assault by handgun discharge
U38..11	[X]Intentionally shot with handgun
U38..12	[X]Assault - gun, handgun
U380.00	[X]Assault by handgun discharge, occurrence at home
U384.00	[X]Assault by handgun discharge occurrenc on street/highway
U38y.00	[X]Assault by handgun discharge occurrenc oth specif place
U38z.00	[X]Assault by handgun discharge occurrenc at unspecif place
U39..00	[X]Assault by rifle, shotgun and larger firearm discharge
U39..11	[X]Intentionally shot with shotgun
U39..12	[X]Assault - gun, larger gun
U390.00	[X]Assault by rifl shotgun+larger firearm disch occ at home
U3A..00	[X]Assault by other and unspecified firearm discharge
U3A0.00	[X]Assault by oth+unspecif firearm discharge occurrn home
U3A4.00	[X]Assault oth+unsp firearm discharge occ on street/highway
U3Ay.00	[X]Assault oth+unsp firearm discharge occ oth specif place
U3Az.00	[X]Assault oth+unsp firearm discharge occ unspecified place
U3B..00	[X]Assault by explosive material
U3B6.00	[X]Assault by explosive material occurrn indust/constr area
U3By.00	[X]Assault by explosive material occurrn other specif place
U3C..00	[X]Assault by smoke, fire and flames
U3D..00	[X]Assault by steam, hot vapours and hot objects
U3E..00	[X]Assault by sharp object
U3E..11	[X]Stabbing
U3E0.00	[X]Assault by sharp object, occurrence at home
U3E1.00	[X]Assault by sharp object occurrn in resident institution
U3E2.00	[X]Assault by sharp object occ at sch oth ins/pub adm area

U3E3.00	[X]Assault by sharp object occurrn at sports/athletics area
U3E4.00	[X]Assault by sharp object, occurrence on street / highway
U3E5.00	[X]Assault by sharp object occurrence at trade/service area
U3Ey.00	[X]Assault by sharp object occurrn at other specified place
U3Ez.00	[X]Assault by sharp object, occurrence at unspecified place
U3F..00	[X]Assault by blunt object
U3F0.00	[X]Assault by blunt object, occurrence at home
U3F1.00	[X]Assault by blunt object occurrn in resident institution
U3F2.00	[X]Assault by blunt object occ at sch oth ins/pub adm area
U3F3.00	[X]Assault by blunt object occurrn at sports/athletics area
U3F4.00	[X]Assault by blunt object, occurrence on street / highway
U3F5.00	[X]Assault by blunt object occurrence at trade/service area
U3Fy.00	[X]Assault by blunt object occurrn at other specified place
U3Fz.00	[X]Assault by blunt object, occurrence at unspecified place
U3G..00	[X]Assault by pushing from high place
U3G2.00	[X]Assault by push fr high plce occ sch oth ins/pub adm area
U3Gy.00	[X]Assault by push from high place occurrn oth specif place
U3H..00	[X]Assault by pushing / placing victim before moving object
U3H0.00	[X]Assault by push/plac victm befor movng obj occurrn home
U3Hy.00	[X]Asslt by push/plac victm befr mov obj occ oth specif plce
U3J..00	[X]Assault by crashing of motor vehicle
U3J4.00	[X]Assault by crash of motor vehicle occ on street/highway

U3K..00	[X]Assault by bodily force
U3K..11	[X] Assault by fight
U3K0.00	[X]Assault by bodily force, occurrence at home
U3K1.00	[X]Assault by bodily force occurrn in residential institut'n
U3K2.00	[X]Assault by bodily force occurrn sch oth ins/pub adm area
U3K3.00	[X]Assault by bodily force, occurrence at sport/athlet area
U3K4.00	[X]Assault by bodily force, occurrence on street / highway
U3K5.00	[X]Assault by bodily force occurrence at trade/service area
U3K7.00	[X]Assault by bodily force, occurrence on farm
U3Ky.00	[X]Assault by bodily force occurrn at other specified place
U3Kz.00	[X]Assault by bodily force, occurrence at unspecified place
U3L..00	[X]Sexual assault by bodily force
U3L..11	[X]Rape
U3L..12	[X]Attempted rape
U3L0.00	[X]Sexual assault by bodily force, occurrence at home
U3L1.00	[X]Sexual assault by bodily force occurrn resident instit'n
U3L2.00	[X]Sexual assault by bodil forc occ sch oth ins/pub adm area
U3L4.00	[X]Sexual assault by bodily force occurrn on street/highway
U3L5.00	[X]Sexual assault by bodily force occurrn trade/servce area
U3L6.00	[X]Sexual assault by bodily force occurrn indust/constr area
U3Ly.00	[X]Sexual assault by bodily force occurrn oth specif place
U3Lz.00	[X]Sexual assault by bodily force occurrn unspecified place
U3M..00	[X]Neglect and abandonment
U3M0.00	[X]Neglect and abandonment, by spouse or partner

U3M1.00	[X]Neglect and abandonment, by parent
U3M2.00	[X]Neglect and abandonment, by acquaintance or friend
U3My.00	[X]Neglect and abandonment, by other specified persons
U3N..00	[X]Other maltreatment syndromes
U3N0.00	[X]Other maltreatment syndromes, by spouse or partner
U3N1.00	[X]Other maltreatment syndromes, by parent
U3N2.00	[X]Other maltreatment syndromes, by acquaintance or friend
U3N3.00	[X]Other maltreatment syndromes, by official authorities
U3Ny.00	[X]Other maltreatment syndromes, by other specified persons
U3P..00	[X]Maltreatment
U3P0.00	[X]Maltreatment, by spouse or partner
U3y..00	[X]Assault by other specified means
U3y0.00	[X]Assault by other specified means, occurrence at home
U3y1.00	[X]Assault by oth specif means occurrn resident institution
U3y2.00	[X]Assault by oth specif means occ sch oth ins/pub adm area
U3y3.00	[X]Assault by oth specif means occurrn sports/athletic area
U3y4.00	[X]Assault by othr specif means occurrn on street / highway
U3yy.00	[X]Assault by other specif means occurrn other specif place
U3yz.00	[X]Assault by other specif means occurrn unspecified place
U3z..00	[X]Assault by unspecified means
U3z0.00	[X]Assault by unspecified means, occurrence at home
U3z1.00	[X]Assault by unspecified means occurrn resident institut'n
U3z2.00	[X]Assault by unspecified means occ sch oth ins/pub adm area
U3z4.00	[X]Assault by unspecified means occurrn on street /

	highway
U3zy.00	[X]Assault by unspecified means occurrn other specif place
U3zz.00	[X]Assault by unspecified means occurrn at unspecif place
Z352.11	Child abuse investigation
Z41..00	Abuse counselling
Z411.00	Sexual abuse counselling
Z412.00	Physical abuse counselling
Z413.00	Verbal abuse counselling
Z414.00	Racial abuse counselling
Z415.00	Domestic abuse counselling
ZV4F900	[V]Probs rel alleg sex abuse child by pers out prim sup grp
ZV4G400	[V]Problem relatd/alleg sex abuse cld by person prim sup grp
ZV4G500	[V]Problems related to alleged physical abuse of child
ZV4H300	[V]Emotional neglect of child
ZV4H400	[V]Other problems related to neglect in upbringing
ZV61200	[V]Child abuse
ZV61212	[V]Child neglect
ZV71500	[V]Observation following alleged rape or seduction
ZV71511	[V]Observation following alleged rape
ZVu4B00	[X]Other problems related to neglect in upbringing

Appendix 10: Read code list suggestive of maltreatment

Published Read code list developed by Woodman *et al* (253).

Read code	Read code description
13G4.00	Social worker involved
13HP600	Violence between parents
13I9.00	Fostering of child
13IB.00	Child in care
13IB000	Child in foster care
13IB100	Looked after child
13IC.00	Child on 'at risk' register
13ICZ00	Child on 'at risk' regist NOS
13IF.00	Child at risk
13IF.11	Vulnerable child
13IM.00	Child on protection register
13IQ.00	Vulnerable child in family
13IS.00	Child in need
13IV.00	Looked after child - Children (Scotland) Act 1995
13Id.00	On child protection register
13If.00	Child is cause for concern
13Ih.00	Subject to supervision order under Children Act 1989
13Ii.00	Subject to care order under Children Act 1989
13Ii000	Subject to care order under section 20 of Children Act 1989
13Ii100	Subject to care order under section 21 of Children Act 1989
13Ii200	Subject to care order under section 25 of Children Act 1989
13Ii300	Subject to care order under section 31 of Children Act 1989
13Ij.00	Subject to interim care order under Children Act 1989
13Ij000	Sub to interim care order under section 38 Children Act 1989
13Ij100	Emergency protective order section 44 Children Act 1989
13Il.00	Subject to interim supervision order under Children Act 1989
13Ip.00	Family is cause for concern
13Iv.00	Subject to child protection plan
13VF.00	At risk violence in the home
13W..11	Family problems
13W3.00	Child abuse in family
13WT.00	Child protection observation
13WT000	Child protection category
13WT100	Child protection category emotional
13WT200	Child protection category physical
13WT300	Child protection category sexual
13WT400	Child protection category neglect
13WX.00	Child is cause for safeguarding concern
13ZR.00	At risk of emotional/psychological abuse
13ZT.00	At risk of physical abuse
13ZV.00	At risk of neglect by others
13ZW.00	At risk of sexual abuse
14X..00	History of abuse
14X0.00	History of physical abuse
14X1.00	History of sexual abuse
14X2.00	History of emotional abuse
14X3.00	History of domestic violence
14X5.00	Victim of physical abuse
14X6.00	Victim of sexual abuse
14X7.00	Victim of emotional abuse
14X8.00	Victim of domestic violence
14XD.00	History of domestic abuse
14XE.00	History of being victim of domestic violence
1BE1.00	Problem situation
3874	Multidisciplinary case conference
3875	Social services case conference
3879	Review case conference
38C0.00	Child in care health assessment
38C0000	Looked after child initial health assessment
38C0100	Looked after child health assessment 6 month review
38C0200	Looked after child health assessment annual review
38C0300	Looked after child sexual health risk assessment completed
625..00	A/N care: social risk
64RA.00	Child: social services
64RA.11	Child referral-social services
64c..00	Child protection procedure
6982	Fostering medical examination
8CM5.00	Child in need plan
8CM6.00	Child protection plan
8H75.00	Refer to social worker
8HHB.00	Referral to Social Services
9F2..00	Child at risk-case conference
9F21.00	Child at risk conf attend >1hr
9F22.00	Child at risk conf attend <1hr
9F2Z.00	Child at risk case conf NOS
9F3..00	Child into care examination
9F3..11	Care: child into - exam admin
9F31.00	Child into care exam done
9F32.00	Child to care exam fee to SS
9F3Z.00	Child to care exam NOS
9N26.00	Seen by social worker
9NDA.00	Report received from social services
9NNV.00	Under care of social services
Z331.00	Child protection plan
Z35..00	Child protection procedure
Z351.00	Immediate protection of child

Z352.00	Child protection investigation
Z352.11	Child abuse investigation
Z353.00	Provision of accommodation
Z353100	Child accommodated
Z353111	Entry into accommodation
Z353200	Child taken into care
Z41..00	Abuse counselling
Z411.00	Sexual abuse counselling
Z412.00	Physical abuse counselling

Appendix 11: ICD-10 codes indicating intentional injury/maltreatment

Based on the code lists developed by McKenzie et al (343)

ICD-10	ICD-10 code description
T74	Maltreatment syndromes
T74.0	Neglect or abandonment
T74.1	Physical abuse
T74.2	Sexual abuse
T74.3	Psychological abuse
T74.8	Other maltreatment syndromes
T74.9	Maltreatment syndrome, unspecified
X85	Assault by drugs, medicaments and biological substances
X86	Assault by corrosive substance
X87	Assault by pesticides
X88	Assault by gases and vapours
X89	Assault by other specified chemicals and noxious substances
X90	Assault by unspecified chemical or noxious substance
X91	Assault by hanging, strangulation and suffocation
X92	Assault by drowning and submersion
X93	Assault by handgun discharge
X94	Assault by rifle, shotgun and larger firearm discharge
X95	Assault by other and unspecified firearm discharge
X96	Assault by explosive material
X97	Assault by smoke, fire and flames
X98	Assault by steam, hot vapours and hot objects
X99	Assault by sharp object
Y00	Assault by blunt object
Y01	Assault by pushing from high place
Y02	Assault by pushing or placing victim before moving object
Y03	Assault by crashing of motor vehicle
Y04	Assault by bodily force
Y05	Sexual assault by bodily force
Y06	Neglect and abandonment
Y07	Other maltreatment
Y08	Assault by other specified means
Y09	Assault by unspecified means
Y09.0	Assault by unspecified means
Z04.4	Examination and observation following alleged rape and seduction
Z04.5	Examination and observation following other inflicted injury
Z61.4	Problems related to alleged sexual abuse of child by person within primary support group
Z61.5	Problems related to alleged sexual abuse of child by person outside primary support group
Z61.6	Problems related to alleged physical abuse of child
Z62.0	Inadequate parental supervision and control
Z62.3	Hostility towards and scapegoating of child
Z62.4	Emotional neglect of child
Z62.5	Other problems related to neglect in upbringing
Z62.6	Inappropriate parental pressure and other abnormal qualities of upbringing

Appendix 12: Perinatal depression and child injury: assessing the impact of potential confounders on adjusted incidence rate ratios in Poisson regression model

		Neither AN/PN	AN IRR (95% CI)	PN IRR (95% CI)	Both AN & PN IRR (95% CI)	Does adjusting for the covariate reduce the IRR by 10%?
POISONINGS	***a priori*: calendar year, region and SES**	1	1.74 (1.39-2.18)	1.55 (1.39-1.72)	1.89 (1.61-2.23)	
	+Adjusted for child sex	1	1.74 (1.39-2.18)	1.55 (1.39-1.72)	1.89 (1.61-2.23)	None of these covariates changed the IRR by 10% or more
	+Adjusted for child age at injury	1	1.75 (1.40-2.18)	1.54 (1.39-1.72)	1.90 (1.61-2.23)	
	+Adjusted for maternal age at delivery	1	1.71 (1.37-2.14)	1.50 (1.35-1.67)	1.89 (1.61-2.23)	
	+Adjusted for number of older children/siblings	1	1.73 (1.39-2.17)	1.55 (1.39-1.72)	1.89 (1.60-2.22)	
	+Adjusted for total number of children aged <5 in household	1	1.73 (1.39-2.17)	1.54 (1.39-1.72)	1.89 (1.60-2.22)	
	+Adjusted for maternal alcohol misuse	1	1.72 (1.38-2.15)	1.53 (1.38-1.71)	1.85 (1.57-2.18)	
	+Adjusted for maternal drug misuse	1	1.73 (1.38-2.16)	1.54 (1.39-1.72)	1.87 (1.59-2.21)	
FRACTURES	***a priori*: calendar year, region and SES**	1	1.08 (0.90-1.30)	1.15 (1.07-1.25)	1.14 (0.99-1.30)	
	+Adjusted for child sex	1	1.08 (0.90-1.30)	1.15 (1.07-1.25)	1.14 (0.99-1.30)	None of these covariates changed the IRR by 10% or more
	+Adjusted for child age at injury	1	1.11 (0.92-1.32)	1.15 (1.06-1.24)	1.18 (1.03-1.34)	
	+Adjusted for maternal age at delivery	1	1.08 (0.90-1.30)	1.15 (1.06-1.24)	1.14 (1.00-1.30)	
	+Adjusted for number of older children/siblings	1	1.07 (0.89-1.28)	1.15 (1.06-1.24)	1.11 (0.97-1.27)	
	+Adjusted for total number of children aged <5 in household	1	1.09 (0.91-1.31)	1.16 (1.07-1.25)	1.14 (1.00-1.30)	
	+Adjusted for maternal alcohol misuse	1	1.08 (0.90-1.29)	1.15 (1.06-1.24)	1.12 (0.98-1.28)	
	+Adjusted for maternal drug misuse	1	1.08 (0.90-1.30)	1.15 (1.07-1.25)	1.13 (0.99-1.29)	
BURNS	***a priori*: calendar year, region and SES**	1	1.33 (1.09-1.62)	1.30 (1.19-1.43)	1.33 (1.14-1.54)	
	+Adjusted for child sex	1	1.33 (1.09-1.62)	1.31 (1.19-1.43)	1.33 (1.14-1.54)	None of these covariates changed the IRR by 10% or more
	+Adjusted for child age at injury	1	1.32 (1.08-1.61)	1.30 (1.19-1.43)	1.30 (1.12-1.52)	
	+Adjusted for maternal age at delivery	1	1.31 (1.07-1.60)	1.27 (1.16-1.39)	1.33 (1.14-1.54)	
	+Adjusted for number of older children/siblings	1	1.32 (1.08-1.61)	1.31 (1.19-1.43)	1.32 (1.13-1.53)	
	+Adjusted for total number of children aged <5 in household	1	1.32 (1.09-1.61)	1.30 (1.19-1.42)	1.32 (1.14-1.54)	
	+Adjusted for maternal alcohol misuse	1	1.32 (1.08-1.61)	1.30 (1.19-1.42)	1.31 (1.13-1.53)	
	+Adjusted for maternal drug misuse	1	1.33 (1.09-1.62)	1.30 (1.19-1.43)	1.32 (1.14-1.54)	
SERIOUS INJURIES	***a priori*: calendar year, region and SES**	1	1.74 (1.20-2.53)	1.00 (0.81-1.24)	1.93 (1.47-2.53)	
	+Adjusted for child sex	1	1.74 (1.20-2.53)	1.00 (0.81-1.24)	1.93 (1.47-2.53)	None of these covariates changed the IRR by 10% or more
	+Adjusted for child age at injury	1	1.72 (1.18-2.49)	1.00 (0.81-1.24)	1.88 (1.43-2.46)	
	+Adjusted for maternal age at delivery	1	1.73 (1.19-2.51)	0.98 (0.79-1.22)	1.94 (1.48-2.54)	
	+Adjusted for number of older children/siblings	1	1.73 (1.19-2.51)	1.00 (0.81-1.24)	1.90 (1.45-2.49)	
	+Adjusted for total number of children aged <5 in household	1	1.74 (1.20-2.52)	1.00 (0.81-1.24)	1.93 (1.47-2.53)	
	+Adjusted for maternal alcohol misuse	1	1.75 (1.21-2.54)	1.01 (0.81-1.25)	1.95 (1.49-2.56)	
	+Adjusted for maternal drug misuse	1	1.75 (1.21-2.54)	1.00 (0.81-1.24)	1.95 (1.48-2.55)	

SERIOUS FRACTURES	***a priori*: calendar year, region and SES**	1	1.87 (1.10-3.20)	1.21 (0.90-1.62)	2.12 (1.44-3.12)	
	+Adjusted for child sex	1	1.87 (1.10-3.20)	1.21 (0.90-1.62)	2.12 (1.44-3.13)	None of these covariates changed the IRR by 10% or more
	+Adjusted for child age at injury	1	1.83 (1.07-3.12)	1.21 (0.90-1.62)	2.04 (1.39-3.01)	
	+Adjusted for maternal age at delivery	1	1.86 (1.09-3.17)	1.18 (0.88-1.58)	2.12 (1.44-3.13)	
	+Adjusted for number of older children/siblings	1	1.86 (1.09-3.18)	1.20 (0.90-1.61)	2.10 (1.42-3.09)	
	+Adjusted for total number of children aged <5 in household	1	1.87 (1.10-3.20)	1.20 (0.90-1.62)	2.12 (1.44-3.12)	
	+Adjusted for maternal alcohol misuse	1	1.89 (1.11-3.23)	1.21 (0.91-1.63)	2.16 (1.46-3.18)	
	+Adjusted for maternal drug misuse	1	1.88 (1.10-3.21)	1.21 (0.90-1.62)	2.13 (1.44-3.14)	
SERIOUS BURNS	***a priori*: calendar year, region and SES**	1	1.72 (0.88-3.36)	0.86 (0.57-1.30)	2.04 (1.28-3.27)	
	+Adjusted for child sex	1	1.72 (0.88-3.36)	0.86 (0.57-1.30)	2.04 (1.28-3.27)	None of these covariates changed the IRR by 10% or more
	+Adjusted for child age at injury	1	1.70 (0.87-3.31)	0.86 (0.57-1.30)	1.97 (1.23-3.16)	
	+Adjusted for maternal age at delivery	1	1.71 (0.88-3.33)	0.84 (0.55-1.27)	2.05 (1.28-3.28)	
	+Adjusted for number of older children/siblings	1	1.70 (0.87-3.31)	0.86 (0.57-1.30)	2.01 (1.26-3.22)	
	+Adjusted for total number of children aged <5 in household	1	1.72 (0.88-3.34)	0.86 (0.57-1.30)	2.04 (1.27-3.26)	
	+Adjusted for maternal alcohol misuse	1	1.74 (0.89-3.39)	0.86 (0.57-1.31)	2.08 (1.30-3.33)	
	+Adjusted for maternal drug misuse	1	1.74 (0.89-3.39)	0.86 (0.57-1.31)	2.08 (1.30-3.33)	

Appendix 13: Maternal depression/anxiety episodes and rates of child injury: assessing the impact of potential confounders on adjusted incidence rate ratios in Poisson regression model

	Assessment of potential confounders*	Neither AN/PN	Depression IRR (95% CI)	Dep + anx IRR (95% CI)	Anxiety IRR (95% CI)	Impact of adjusting
POISONINGS	***a priori*: calendar year, region and SES**	1	1.52 (1.31-1.76)	2.30 (1.93-2.75)	1.63 (1.09-2.43)	
	+Adjusted for child sex	1	1.52 (1.31-1.76)	2.30 (1.93-2.75)	1.63 (1.09-2.43)	None of these potential confounders changed the IRR by >=10%
	+Adjusted for child age at injury	1	1.50 (1.30-1.74)	2.22 (1.86-2.65)	1.59 (1.07-2.38)	
	+Adjusted for maternal age at delivery	1	1.52 (1.31-1.77)	2.32 (1.94-2.77)	1.64 (1.10-2.46)	
	+Adjusted for number of older children/siblings	1	1.52 (1.31-1.76)	2.30 (1.93-2.75)	1.62 (1.09-2.43)	
	+Adjusted for total number of children aged <5 in household	1	1.52 (1.30-1.76)	2.30 (1.92-2.74)	1.62 (1.08-2.42)	
	+Adjusted for maternal alcohol misuse	1	1.50 (1.29-1.74)	2.25 (1.88-2.69)	1.61 (1.08-2.41)	
	+Adjusted for maternal drug misuse	1	1.51 (1.30-1.75)	2.27 (1.90-2.72)	1.62 (1.08-2.42)	
FRACTURES	***a priori*: calendar year, region and SES**	1	1.15 (1.03-1.28)	1.24 (1.06-1.44)	0.87 (0.61-1.23)	
	+Adjusted for child sex	1	1.15 (1.02-1.28)	1.24 (1.06-1.44)	0.87 (0.61-1.22)	None of these potential confounders changed the IRR by >=10%
	+Adjusted for child age at injury	1	1.12 (1.00-1.25)	1.16 (1.00-1.36)	0.80 (0.57-1.14)	
	+Adjusted for maternal age at delivery	1	1.15 (1.03-1.28)	1.24 (1.06-1.44)	0.86 (0.61-1.22)	
	+Adjusted for number of older children/siblings	1	1.13 (1.01-1.27)	1.22 (1.05-1.43)	0.86 (0.61-1.21)	
	+Adjusted for total number of children aged <5 in household	1	1.15 (1.03-1.29)	1.25 (1.07-1.45)	0.87 (0.62-1.24)	
	+Adjusted for maternal alcohol misuse	1	1.14 (1.02-1.27)	1.22 (1.05-1.43)	0.86 (0.61-1.22)	
	+Adjusted for maternal drug misuse	1	1.14 (1.02-1.28)	1.23 (1.06-1.44)	0.87 (0.61-1.22)	
BURNS	***a priori*: calendar year, region and SES**	1	1.31 (1.15-1.48)	1.53 (1.29-1.81)	1.47 (1.05-2.05)	
	+Adjusted for child sex	1	1.30 (1.15-1.48)	1.53 (1.29-1.81)	1.47 (1.05-2.04)	None of these potential confounders changed the IRR by >=10%
	+Adjusted for child age at injury	1	1.31 (1.15-1.48)	1.54 (1.30-1.82)	1.51 (1.08-2.10)	
	+Adjusted for maternal age at delivery	1	1.31 (1.16-1.49)	1.54 (1.30-1.82)	1.48 (1.06-2.06)	
	+Adjusted for number of older children/siblings	1	1.31 (1.15-1.48)	1.53 (1.29-1.81)	1.46 (1.05-2.04)	
	+Adjusted for total number of children aged <5 in household	1	1.31 (1.15-1.48)	1.52 (1.29-1.80)	1.46 (1.05-2.04)	
	+Adjusted for maternal alcohol misuse	1	1.30 (1.14-1.47)	1.51 (1.27-1.79)	1.46 (1.05-2.04)	
	+Adjusted for maternal drug misuse	1	1.30 (1.15-1.48)	1.52 (1.28-1.80)	1.47 (1.05-2.05)	
SERIOUS INJURIES	***a priori*: calendar year, region and SES**	1	1.25 (0.95-1.65)	0.95 (0.60-1.50)	0.95 (0.39-2.29)	
	+Adjusted for child sex	1	1.25 (0.95-1.65)	0.95 (0.60-1.50)	0.95 (0.39-2.28)	None of these potential confounders changed the IRR by >=10%
	+Adjusted for child age at injury	1	1.27 (0.96-1.67)	0.98 (0.62-1.55)	1.00 (0.42-2.42)	
	+Adjusted for maternal age at delivery	1	1.26 (0.96-1.66)	0.95 (0.61-1.51)	0.96 (0.40-2.30)	
	+Adjusted for number of older children/siblings	1	1.25 (0.95-1.64)	0.94 (0.60-1.49)	0.94 (0.39-2.27)	
	+Adjusted for total number of children aged <5 in household	1	1.26 (0.95-1.65)	0.95 (0.60-1.50)	0.95 (0.39-2.29)	
	+Adjusted for maternal alcohol misuse	1	1.26 (0.96-1.66)	0.96 (0.61-1.51)	0.95 (0.40-2.30)	
	+Adjusted for maternal drug misuse	1	1.26 (0.95-1.66)	0.95 (0.60-1.51)	0.95 (0.39-2.29)	

**Each variable was added to the model containing the a priori confounders to assess whether it changed the aIRR by 10% or more.*

Appendix 14: Length of exposed and unexposed follow-up time for poisoning, fracture, burn and serious injury self-controlled case series analyses

	Child's exposure to maternal depression and/or anxiety between birth and end of follow-up	Number of children (%)	Median number of days unexposed (IQR)	Median number of days exposed to maternal depression/anxiety (IQR)	Ratio of unexposed: exposed time[#]
POISONINGS	Maternal depression alone	616 (24.6)	1293 (856-1607)	324 (150-656)	4.0
	Anxiety alone	138 (5.5)	1553 (1104-1668)	150 (149-299)	10.4
	Both depression and anxiety*	329 (13.2)	944 (486-1282)	714 (430-1191)	1.3
FRACTURES	Maternal depression alone	1,215 (20.8)	1301 (804-1587)	329 (150-644)	4.0
	Anxiety alone	275 (4.7)	1589 (1279-1668)	150 (149-292)	10.6
	Both depression and anxiety*	480 (8.2)	899 (420-1359)	683 (391-1148)	1.3
BURNS	Maternal depression alone	872 (21.5)	1222 (695-1557)	314 (150-639)	3.9
	Anxiety alone	209 (5.2)	1518 (1037-1668)	150 (149-299)	10.1
	Both depression and anxiety*	420 (10.4)	872 (346-1311)	648 (367-1136)	1.3
SERIOUS INJURIES	Maternal depression alone	205 (22.6)	1162 (473-1536)	299 (155-572)	3.9
	Anxiety alone	40 (4.4)	1416 (928-1668)	151 (149-351)	9.4
	Both depression and anxiety*	75 (8.3)	998 (508-1402)	533 (299-903)	1.9

**Mothers in this group could have had one or more episode of depression with anxiety, OR multiple separate episodes of depression with anxiety, depression alone or anxiety alone*

#The length of exposed compared to unexposed time is important in a SCCS analysis as this is a within person design comparing rates in these exposed and unexposed periods.