The epidemiology of injuries in epilepsy and attention deficit-hyperactivity disorder (ADHD) in children and young people using the Clinical Practice Research Datalink (CPRD) and linked data

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Abstract

Background

Injuries are a leading cause of morbidity and mortality in children and young people (CYP) throughout the world and in the UK. Detailed estimates of the risk of specific injuries, namely fractures, thermal injuries and poisonings, are not available for CYP with specific medical conditions, such as epilepsy or attention deficit-hyperactivity disorder (ADHD) in the English primary care population. To date there has been no description of the recording of ADHD by general practitioners (GPs) in English primary care according to people's area-level social deprivation and strategic health authority (SHA) region.

Objectives

1. To define a cohort of CYP with epilepsy from the UK primary care population.
2. To estimate the risk of specific injuries, namely fractures, thermal injuries and poisonings in CYP with epilepsy compared to CYP without epilepsy.
3. To define and describe the cumulative administrative prevalence of ADHD in CYP in English primary care overall and by age, sex, SHA region, deprivation and calendar time.
4. To estimate the risk of specific injuries, namely fractures, thermal injuries and poisonings in CYP with ADHD compared to CYP without ADHD.

Methods

This thesis describes work conducted using a large primary care dataset (the Clinical Practice Research Datalink (CPRD)) containing GP medical records and, for a proportion, linked hospital records from the hospital episodes statistics (HES) database. Firstly, the CPRD was used to define a cohort of CYP with epilepsy and CYP without epilepsy. The GP medical records for this cohort were used to estimate the risk of fractures, thermal injuries and poisonings, in CYP with epilepsy compared to CYP without epilepsy. The rates of injuries were estimated by age and sex. For a proportion of people in this study, the effect on estimates of using linked hospital medical records in addition to the GP medical records was evaluated. Secondly, the administrative prevalence of ADHD recorded by GPs was defined for CYP in England by identifying a cohort of CYP in the CPRD with GP medical records linked to hospital medical records. The cumulative administrative prevalence of ADHD was estimated overall and by age, sex, SHA region, deprivation and calendar time. Thirdly, the GP medical records and linked hospital medical records for the cohort of CYP with ADHD was used to estimate the risk of fractures, thermal injuries and poisonings, in CYP with ADHD compared to CYP without ADHD. The rates of injuries were estimated by age, sex and deprivation.

Findings

CYP with epilepsy are at greater risk of fractures, thermal injuries and poisonings compared to CYP without epilepsy. In CYP with epilepsy the incidence of fractures is 18% higher, thermal injuries is 50% higher and poisonings 147% higher than in CYP without epilepsy, with the increased risk being restricted to medicinal poisonings. Among young adults with

epilepsy, aged 19 to 24 years, the incidence rate of medicinal poisoning is four-fold that of the general population of the same age. Using GP medical records and linked hospital medical records may improve the ascertainment of injuries. For example, if hospital medical records are used in addition to GP medical records to ascertain femur fractures, a further 33% of fractures may be ascertained compared to using GP medical records alone. In comparison, if hospital medical records were used without GP medical records, 10% of femur fractures may not be ascertained. However, this increased ascertainment of injuries is unlikely to alter the estimates of risk of injuries in people with epilepsy when compared to people without epilepsy (e.g. risk of long bone fractures: using hospital and GP medical records, hazard ratio (HR)=1.25 (95% confidence interval (95%CI) 1.07 to 1.46) vs. using GP medical records alone, HR=1.23 (95%CI 1.10 to 1.38)).

The administrative prevalence of ADHD in CYP aged 3 to 17 years old in English GP medical records is 0.88% (95% confidence interval (95%CI) 0.87 to 0.89). The prevalence of ADHD recorded by GPs is around five times greater in males than in females. The administrative prevalence of ADHD appears to increase with age, with the lowest prevalence in 3 to 4 year-olds (0.02 (95%CI 0.02 to 0.03)) and the highest prevalence in 15 to 17 year olds (1.38 (95%CI 1.36 to 1.40)). The administrative prevalence of ADHD is twice as high in CYP from the most deprived areas compared to CYP from the least deprived areas (1.14% (95%CI 1.12 to 1.16) in the most deprived areas to 0.64% (95%CI 0.63 to 0.65) in the least deprived areas)).

CYP with ADHD are at greater risk of fractures, thermal injuries and poisonings compared CYP without ADHD. In CYP with ADHD the incidence of fractures is 28% higher, thermal injuries is 104% higher and poisonings is 300% higher than in CYP without ADHD.

Conclusions

CYP with epilepsy and ADHD have an increased risk of fracture, thermal injury and poisoning compared to CYP without these conditions. For both conditions the risk of poisoning is higher than the risk of fractures or thermal injuries. The administrative prevalence of ADHD is lower than estimates of community prevalence ascertained from studies not using primary care data. The prevalence of ADHD varied with deprivation, being almost twice as high in CYP from the most deprived areas compared to CYP from the least deprived areas.

Future research is required to explore the circumstances surrounding injuries in CYP with and without epilepsy and ADHD. Future research is also required to explore the effect of treating epilepsy and ADHD with medication on injury risk. Research is required to explore the effect of the severity of epilepsy and ADHD on estimated risks of injuries. Future research exploring potential under-diagnosis or under-recording of diagnosis of ADHD in CYP in primary care is needed.

CYP with epilepsy and ADHD and their parents should be provided with evidence-based injury prevention interventions because work in this thesis has demonstrated they are at higher risk of injury than the general population of CYP. Health care professionals working with CYP; child and adolescent mental health services; child education or care practitioners;

and other agencies and organisations with an injury prevention role, should be made aware of the increased risk of injury in CYP with epilepsy and ADHD. Commissioners of health services for CYP should ensure service specifications include injury prevention training and provision for evidence-based injury prevention interventions.

Publications from thesis

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2. Prasad, V, West, J, Kendrick, D & Sayal, K. (2012). Risk of fracture in children with epilepsy: a cohort study using the general practice research database. Injury prevention, 18(S1)A100. doi: 10.1136/injuryprev-2012-040590d.12

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Abbreviations

Full term	Abbreviation
95% confidence interval	95%CI
Anti-epileptic drug	AED
Applied Social Sciences Index and Abstracts	ASSIA
Attention deficit-hyperactivity disorder	ADHD
Cerebral palsy	CP
Children and young people	CYP
Clinical Commissioning Group	CCG
Clinical Practice Research Datalink	CPRD
Conduct disorder	CD
Diagnostic Statistical Manual of Mental Disorders	DSM
Disability adjusted life years	DALYs
Finished consultant episode	FCE
General Practitioner	GP
Hazard ratio	HR
Home Accident Surveillance System	HASS
Hospital Episodes Statistics	HES
Incidence rate ratio	IRR
Index of multiple deprivation	IMD
Injury severity score	ISS
International Classification of Disease	ICD
Interquartile range	IQR
Leisure Accident Surveillance System	LASS
Likelihood ratio test	LRT
Lower super output area	LSOA
Medical Research Council	MRC
Office for National Statistics	ONS
Oppositional defiant disorder	ODD
Person years at risk	pyar
Prevalence rate ratio	PRR
Rate ratio	RR
Royal Society for the Prevention of Accidents	ROSPA
Strategic Health Authority	SHA
The Health Improvement Network	THIN
United States of America	USA
Web-based Injury Statistics Query and Reporting System	WISQARS

1 Introduction

This thesis aims to estimate the risk of fractures, thermal injuries and poisonings in two cohorts of children and young people (CYP) in the English primary care population with two specific conditions, namely epilepsy and attention deficit-hyperactivity disorder (ADHD). Using the published literature, this chapter will describe the importance and epidemiology of injuries in CYP (section 1.1), define epilepsy in CYP (section 1.2), describe the epidemiology of epilepsy and injuries in CYP (section 1.3), define ADHD (section 1.4), describe the epidemiology of ADHD and injuries in CYP (section 1.5) and, finally, outline the research questions in this thesis (section 1.6).

1.1 Injury in children and young people

1.1.1 Definition of injury

There has been debate in the academic literature about the definition of an injury[1-3]. In the absence of an internationally agreed definition of an injury, in this thesis an injury is defined as a sudden unintentional physical damage due to energy (mechanical, thermal, chemical or radiation), or introduction of a foreign substance into the body, that exceeds the threshold of physiological tolerance or the lack of a vital element, such as oxygen[4]. Three specific types of injuries are described below.

1.1.1.1 Fracture

A fracture is defined as a break in a bone[5] resulting from excessive force[4].

1.1.1.2 Thermal injury

A thermal injury (or thermal burn) is defined as exposure to a source of energy or substance that may cause damage to the skin or other body tissues[6].

1.1.1.3 Poisoning

A poisoning is defined as the unintentional inhalation, ingestion, injection or absorption of an exogenous substance that results in harm to the body tissues[6].

1.1.2 Epidemiology of injury in children and young people

Both worldwide[7] and in the UK, injuries are a leading cause of morbidity and mortality in CYP[8]. It is not easy to quantify the number of injuries that occur in CYP in the UK due to a lack of published data or ongoing surveillance. However, estimates of the number of injuries occurring in the UK may be made from hospital admissions data and emergency department attendance data. The chief medical officer has noted in her recent report that unintentional injuries in England accounted for 135,000 admissions to hospital in under fourteen-year-olds in 2011/12 and that 6,000 children were admitted for at least three days for severe injuries[9]. Injuries in CYP have a physical, psychological and economic burden on CYP as well as their families and carers[9].

Hospital admissions for England are recorded in the Hospital Episodes Statistics (HES) data. In the HES data, hospital admissions result in finished consultant episodes (FCE), which reflect the number of periods of care completed with an individual specialist doctor (consultant). The

number of FCE's only slightly exceeds the number of in-patient admissions because in most cases only one consultant cares for a particular patient during the course of one admission. For example, in one full year from April 2012 to March 2013 there were a total of 17,715,000 FCE's resulting in a diagnosis of any kind compared to 15,146,000 hospital admissions in all ages[10]. The number of FCE's for injuries in people under 24 years old in the same one year period from April 2012 to March 2013 was 584,000[10]. In a separate study using HES data in CYP aged under sixteen years old, Edwards et al. reported average annual admission rates for injuries of 1340 (95%CI 1337 to 1344) per 100,000 CYP in England between April 1999 and March 2004[11].

The Royal Society for the Prevention of Accidents (ROSPA) have two linked databases, the Home Accident Surveillance System (HASS) and the Leisure Accident Surveillance System (LASS), last updated in 2002, that have been used to estimate national rates of attendances to UK emergency departments.[12] Based on HASS and LASS, the estimated number of emergency department attendances for injuries in CYP aged 1 to 24 years old in the UK in 2002 was 2.8 million attendances[13] out of a population of 17.8 million CYP[14], which equates to an annual rate of injuries of 15,700 per 100,000 CYP. A smaller study based on emergency department attendances at a single hospital in Scotland reported a similar annual rate of injuries in under 7-year-olds of 14,400 per 100,000 CYP between 1997 and 2001[15]. However, because people from any given area may choose to attend various emergency departments it is hard to define the hospital catchment area with accuracy and this might have resulted measurement error.

It is known that the epidemiology of injury varies by age group as CYP mature with age[8 15-17]. There is also a difference between the sexes. Over the age of one year old, boys are more likely than girls to sustain injuries, especially as teenagers[17-19]. Boys are also more likely than girls to die from their injuries in all ages except in infancy[20].

The epidemiology of injuries varies by socioeconomic deprivation. For example, in a study of injuries resulting in hospital admission using HES data, Edwards et al. reported that the rate of hospital admissions for serious injuries is greater in areas of greater deprivation, with a rate of injuries in people from the most deprived areas two to five times greater than in the least deprived areas[11]. A study in the Trent region of England in under 14-year-olds reported that hospital admission rates were higher for all injuries and also for more severe injuries in people from more deprived areas, with a higher gradient in under 4-year-olds compared to 5 to 14-year-olds[21]. In under 5-year-olds, a recent study by Orton et al. conducted in primary care data between 1990 to 2009 reported a greater incidence of injuries from deprived households compared to less deprived households [22]. Orton et al. found that the gradient of a higher incidence rate for injuries with CYP from more deprived households remained throughout the period from 1990 to 2009 despite an overall reduction in the incidence of injuries over that time[22].

Over the last twenty years the number of deaths in CYP due to injuries has been declining in the UK[23 24]. This is likely to be due to a range of factors, such as a reduction in road injuries, e.g. due to improved car safety, and improvements in legislation, e.g. in relation to fire safety and housing[24-26].

Recently, however, the chief medical officer commented on the fact that death rates from injuries have not fallen in the most deprived CYP and are 13 times higher than in the least deprived[9]. Therefore, despite injury rates in CYP declining, mainly due to a reduction in road traffic accidents, non-fatal unintentional injuries remain an important public health problem[27].

There may be varying reasons why CYP and their parents attend a health care professional after sustaining an injury. For example, previous work has found that CYP who live further away from a hospital emergency department are less likely to present with their injuries[28]. In this work Lyons et al. described how parents of CYP living further away from a hospital are less likely to attend after an injury[28]. Another study of reasons why parents attend the emergency department for CYP's injuries found parents were more likely to attend the hospital emergency department if they: perceived the injury to be more serious; were more worried about the injury; were less educated; had fewer other children[29]. Similarly it is likely that decisions determining whether or not a CYP is admitted overnight in hospital are influenced by the perceived severity of the injury[30], parental education and prior experience of dealing with sick children[29].

1.1.2.1 Fracture

Using HES data, the number of FCE's for fractures in people under 24 years old from April 2012 to March 2013 was 189,400[10]. The estimated number of emergency department attendances for fractures in people under 24 years old in 2002 was 374,000 attendances[13]. The only known population-based study reporting overall fracture incidence in CYP from

the UK was conducted in the CPRD in CYP aged under 18 years and estimated the overall incidence rate of fractures to be 133.1/10,000 person years at risk (pyar) between 1988-1998[31]. Fracture risk varies by sex, with boys at greater risk than girls[31 32]. As with injuries overall, risk of fracture varies by age group, with younger teenage girls and older teenage boys at greatest risk[31]. The age-specific incidence of fractures varies by sex, with a peak earlier in girls (age 11 years) than in boys (age 14 years)[31]. Fractures vary by health region in the UK, with CYP in the South East having the lowest risk and Northern Ireland and Wales having the highest risk[31]. Reasons for the regional variation in fracture risk are not completely explained by differences in deprivation between the regions.

As with injuries overall, the risk of fracture varies by deprivation and CYP from more deprived areas have a greater risk of fracture than CYP from less deprived areas[22 33]. For example, in under 5-year-olds Orton et al. reported an IRR comparing CYP from the most deprived quintile to the least deprived of 1.11 (95% confidence interval (95%CI) 1.06 to 1.16) for fractures[22].

1.1.2.1.1 Subgroups

Fracture rates vary by the type of fracture involved and, in CYP, forearm fractures occur most commonly[31]. Fractures of the wrist, hand, foot, ankle, rib and patella are more common than the humerus, hip, tibia/fibula, skull, clavicle and scapula[31]. There has been debate about which fractures might indicate a severe injury[30 34 35]. For example, a severe injury may be described by a scoring system, such as the injury severity score (ISS),

which is an anatomical scoring system based on which parts of the body have been injured in a patient with multiple injuries[36]. It is important to be able to define a severe injury because such injuries can predict which patients will have poorer outcomes, such as greater morbidity/mortality and a longer stay in hospital or a greater risk of operative interventions. Recent work by Cryer et al. has shown that if the incidence of long bone fractures (such as hip and femur) are measured in a population of people with fractures, there is a high level of agreement with other measures of injury severity (such as the ISS or length of hospital admission), including in CYP under 19-years-old[30]. Therefore, in research studies where other measures of injury severity are not easily available estimating rates of long bone fractures might help to define which people have sustained a severe injury.

1.1.2.2 Thermal injuries

Using HES data, the number of FCE's for thermal injuries in people under 24 years old from April 2012 to March 2013 was 22,000[10]. The estimated number of emergency department attendances for thermal injuries in people under 24 years old in 2002 was 60,000 attendances[13]. Recently Baker et al. used linked primary care and hospital records and reported an incidence of 35.8 (95%CI 35.4 to 36.1) thermal injuries per 10,000 person years in CYP under 24 years old[37]. Baker et al. reported the peak age for incidence of thermal injuries to be at one year old (118 per 10,000 person years) with a gradual decline in incidence by the age of 6 years to approximately 30 per 10,000 person years up to the age of 24 years[37]. Using hospital admissions data for thermal injuries between 1991 to 2010,

There are few studies describing how the incidence of thermal injuries vary by sex in the UK population. However, Brewster et al. reported the annual age-specific rate of hospital admissions from 1991 to 2010 as a proportion of the UK population in males to be greater than girls in all age groups below 24 years old, with a peak in 1 to 4-year-old boys (approximately 121 per 100,000 people) and under 1 year-old girls (approximately 93 per 100,000 people) but with least difference in 5 to 9-year olds (approximately 17 per 100,000 people in boys and 15 per 100,000 people in girls)[38]. In CYP under 15 years old in the Trent region the IRR for thermal injuries comparing CYP from the most deprived areas to the least deprived was 3.49 (95%CI 2.81 to 4.34), adjusting for rurality, sex, ethnicity and distance from the nearest hospital[21]. In under 5 year-olds, Orton et al. reported an IRR for thermal injuries comparing CYP from the most deprived quintile to the least deprived of 1.72 (95%CI 1.61 to 1.84)[22]. The rate of thermal injuries has reduced over time due to a greater use of smoke detectors, regulation of hot water temperatures, flame resistant sleepwear for CYP and improvements in electrical wiring[39].

1.1.2.3 Poisonings

Using HES data, the number of FCE's for poisonings in people under 24 years old from April 2012 to March 2013 was 87,000[10]. The estimated number of emergency department attendances for poisonings in people under 24 years old in 2002 was 25,000 attendances[13]. Baker et al. reported the incidence of poisonings in CYP under 24 years old to be 41.9 (95%CI 41.4 to 42.4) per 10,000 person years with a peak at age 2 years and a second peak at 18 years old[37]. In a study using UK primary care

data in under 5-year olds, sex was not found to be a risk factor for poisonings[40]. However, in a study of fatal poisonings, which included both intentional and unintentional poisonings, in CYP aged under 14 years old in Scotland concluded that males were over three times more likely to die of a poisoning than females, especially in the 1 to 4-year olds (males were nine times more likely to die than females) and 10 to 14-year-olds (males were three times more likely to die than females)[41]. In CYP under 15 years old in the Trent region the IRR for poisonings comparing CYP from the most deprived areas to the least deprived was 2.98 (95%CI 2.65 to 3.34), adjusting for rurality, sex, ethnicity and distance from the nearest hospital[21]. Orton et al. reported an IRR of poisonings in under five-year-olds from deprived households compared to less deprived households of 1.72 (95%CI 1.61 to 1.84)[22].

1.1.3 Costs

It is not easy to report estimates of the cost of injuries in CYP because few studies have estimated this. In the UK, the Child Accident Prevention Trust reported that the National Health Service (NHS) spends an estimated £131 million per year on emergency hospital admissions because of unintentional childhood injuries[42]. More recently Public Health England have stated that in under five-year-olds the short-term average cost of an individual injury of any type is £2,494[43]. Recently the chief medical officer wrote about the cost of a specific type of injury, severe traumatic brain injuries, as an example and estimated the cost for healthcare, social care, social security costs and productivity losses at £2.24 billion annually[9]. In the United States of America (USA), the Web-based Injury Statistics

Query and Reporting System (WISQARS) uses national data to estimate the cost of injuries[44]. Estimates of the cost of injuries are available for: deaths due to injuries; non-fatal injuries resulting in admission to hospital; and non-fatal injuries treated in the emergency department resulting in the patient being sent home. For fatal injuries, it was estimated that the combined costs due to medical care and loss of work due to injuries in CYP aged less than 24 years old was 27.9 billion US dollars (18.3 billion sterling pounds) in 2010[44]. For non-fatal injuries, it was estimated that the combined costs due to medical care and loss of work due to injuries in CYP aged less than 24 years old was 39.9 billion US dollars (26.3 billion sterling pounds)[44]. For non-fatal injuries seen and treated in the emergency department, it was estimated that the combined costs due to medical care and loss of work due to injuries in people aged less than 24 years old was 65.4 billion US dollars (43 billion sterling pounds)[44].

1.1.3.1 Fracture

The WISQARS data from the USA was used to estimate the cost of fractures in 2010. For fatal injuries, it was estimated that the combined costs due to medical care and loss of work due to fractures in people aged less than 24 years old was 670 million US dollars (440 million sterling pounds)[44]. For non-fatal injuries, it was estimated that the combined costs due to medical care and loss of work due to fractures in people aged less than 24 years old was 16.1 billion US dollars (10.6 billion sterling pounds)[44]. For non-fatal injuries seen and treated in the emergency department, it was estimated that the combined costs due to medical care

and loss of work due to fractures in people aged less than 24 years old was 16.3 billion US dollars (10.7 billion sterling pounds)[44].

1.1.3.2 Thermal injuries

In the UK, the Child Accident Prevention Trust estimated that the cost to the NHS of thermal injuries resulting in hospital admissions in England in 2008-09 was over £2 million[45]. In the USA, the WISQARS data from the USA was used to estimate the cost of thermal injuries in 2010. For fatal injuries, it was estimated that the combined costs due to medical care and loss of work due to thermal injuries in people aged less than 24 years old was 375 million US dollars (247 million sterling pounds)[44]. For non-fatal injuries, it was estimated that the combined costs due to medical care and loss of work due to thermal injuries in people aged less than 24 years old was 586 million US dollars (386 million sterling pounds)[44]. For non-fatal injuries seen and treated in the emergency department, it was estimated that the combined costs due to medical care and loss of work due to thermal injuries in people aged less than 24 years old was 1.1 billion US dollars (692 million sterling pounds)[44].

1.1.3.3 Poisonings

The WISQARS data from the USA was used to estimate the cost of poisonings in 2010. For fatal injuries, it was estimated that the combined costs due to medical care and loss of work due to poisonings in people aged less than 24 years old was 6 billion US dollars (3.9 billion sterling pounds)[44]. For non-fatal injuries, it was estimated that the combined costs due to medical care and loss of work due to poisonings in people aged less than 24 years old was 460 million US dollars (305 million sterling

pounds)[44]. For non-fatal injuries seen and treated in the emergency department, it was estimated that the combined costs due to medical care and loss of work due to poisonings in people aged less than 24 years old was 320 million US dollars (211 million sterling pounds)[44].

1.1.4 Summary

Injuries in CYP are a leading cause of morbidity and mortality worldwide and in the UK. Fractures, thermal injuries and poisonings are common types of injuries which account for a significant burden to the NHS in the UK.

1.2 Epilepsy in children and young people

1.2.1 Definition of epilepsy

Epilepsy is a chronic neurological condition causing unprovoked recurrent seizures due to excessive cerebral neurological activity[46-48]. Treatment for epilepsy is aimed at control of seizure symptoms[49]. Not all people with epilepsy will require medication but for people who require it anti-epileptic drugs (AEDs) are commenced in secondary care and ongoing treatment is provided by the GP[50].

1.2.2 Epidemiology of epilepsy

Epilepsy is common, overall affecting approximately 5 to 10 per 1000 people in high income countries worldwide[51] and 5 per 1000 people in Europe[52]. Epilepsy is a significant burden on the National Health Service (NHS), with 16,000 hospital admissions in England in people less than 24 years old in 2012-13[10]. In 2002, a study using the Clinical Practice

Research Datalink (CPRD) reported age-specific prevalence in males of: 2.1 per 1000 in under 4-year-olds, 4.2 per 1000 in 5 to 15-year-olds, and 6.3 per 1000 in 16 to 24-year-olds; and in females of: 1.3 per 1000 in under 4-year-olds, 4.0 per 1000 in five to 15-year-olds, and 6.8 per 1000 in 16 to 24-year-olds[53].

1.2.2.1 Differences by deprivation

A large Swedish database study conducted in over one million CYP aged 2 to 17 years old suggested that CYP from areas of high deprivation were fifteen percent more likely to be diagnosed with epilepsy than people from areas of low deprivation[54]. Similarly a smaller study of one hundred and ninety people of all ages from twenty general practices in London and the South East of England showed that the incidence of epilepsy in people from the least deprived areas was more than twice that in the least deprived areas[55].

1.2.2.2 Comorbid conditions

A comorbid condition is a medical condition that is diagnosed in addition to the main medical condition of interest. A comorbid medical condition may mean that CYP with epilepsy have additional risk factors for injury. For example, CYP with epilepsy are commonly diagnosed with other conditions, such as: behaviour disorder[56], learning disability[57-59], ADHD[56 60-62] and cerebral palsy (CP)[60 62 63]. For example, a recent meta-analysis of forty-six studies published from 1970 to 2003; including 2,434 CYP with epilepsy aged 4 to 21 years, found that CYP with epilepsy are at a higher risk of a range of psychopathology, including behaviour problems, thought problems, social problems and attention problems than CYP without

epilepsy[56]. A study of European surveillance data including 9,654 CYP born with CP between 1976 and 1998 showed that 3,424 (35%) of CYP had epilepsy in addition to CP[63].

1.3 Epilepsy and injuries in children and young people

1.3.1 Relationship of injuries to epilepsy

In order to identify published studies describing the relationship between epilepsy and injuries, a search was conducted in Medline (from 1948 to August 2014); Embase (from 1974 to August 2014); PsycINFO (from 1806 to August 2014); CINAHL (from 1982 to August 2014); and ASSIA (Applied Social Sciences Index and Abstracts) (from 1987 to August 2014). The following search strategy was used in Medline and a similar search strategy was adapted for use in the other databases: (*terms describing epilepsy*) and (*terms describing injuries*) and (*terms describing systematic reviews*). The full search strategy used in Medline is described in appendix 6.1 (Table 6-1). After duplicate records were removed, a total of eight hundred and eighty-one titles remained. The titles and abstracts were reviewed to identify studies describing the relationship between epilepsy and injuries. Sixty-one full papers were obtained. After reviewing the full papers, thirty-four studies were identified that reported on the risk of injuries in people with epilepsy: twelve cohort studies (Table 1-1); three case control studies (Table 1-2) and nineteen cross-sectional studies (Table 1-3).

1.3.1.1 Cohort studies describing the relationship between epilepsy and injuries

It was difficult to summarise absolute differences in the incidence rates of specific injuries in CYP with epilepsy compared to CYP without epilepsy due to differences in the study populations, age ranges and methods between different studies. However, Table 1-1[64-75] summarises the cohort studies describing the relationship between epilepsy and all injuries over time. Overall studies consistently reported that people with epilepsy had a higher risk of injuries than people without epilepsy but not all studies reported rates of injuries in people without epilepsy for comparison. Studies also rarely reported estimates of rates of injuries or reported rates of specific injuries, especially for poisonings. For example, a study of patients referred to an epilepsy clinic in Iran only described findings in adults[72]. The study from Iran estimated that the risk of all injuries in people with epilepsy was around three times greater than in people without epilepsy. However, it is probable that people with epilepsy referred to an epilepsy clinic have a greater risk of injuries than people with epilepsy in the community because their severe epilepsy may be the cause of them being referred to the clinic. One of the studies in the table reported injury rates in patients attending outpatient clinics in hospital[64] without reference to a group of people without epilepsy, meaning it was not possible to quantify the risk of injuries in people with epilepsy compared to people without. Studies recruiting people from a referral population, such as hospital outpatient clinics, may also have sampled a group of people with a different severity of epilepsy symptoms (usually more severe) than the population of people who are living in the

community under the care of GPs (or family doctors). The study by Blackman in the USA reported similar numbers of injuries in CYP with epilepsy to CYP without epilepsy but it was unclear how CYP were recruited to this study[65]. A population based study from Canada provided some evidence that the risk of injuries is greater in people with epilepsy[69] but the estimated risk for fractures, thermal injuries and poisonings was not reported. A prospective European study using diaries to prospectively record illnesses and all injury types in all ages (above 5 years old) found a non-significant increase in risk of injuries between epilepsy and control participants[70]. A study in the CPRD in the UK showed that people with epilepsy may have a risk of fractures that is approximately twice that of people without epilepsy but this study was in people of all ages and did not adjust estimates for social deprivation[68]. A further study in CPRD did not include people without epilepsy but instead investigated whether fracture risk varies by type of anti-epilepsy drug and found that there was a greater risk of hip fractures with liver enzyme inducing AEDs compared to non-liver enzyme inducing AEDs (hazard ratio (HR)=1.22 (95%CI 1.12 to 1.34) in females; HR=1.09 (95%CI 0.98 to 1.20) in males)[67].

Table 1-1 Cohort studies describing the relationship between epilepsy and injuries over time

First author	Year published	Setting and country	Ages (duration of follow-up)	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Strzelczyk[64]	2014	Outpatients from GP's, neurologists and an epilepsy centre, Germany	Adults (3 months)	276 outpatients and 96 inpatients with epilepsy.	50 out of 276 (18.1%) of outpatients had an epilepsy-related injury (including: 8 fractures and 2 thermal injuries). 9 out of 96 inpatients had a seizure-related fracture and other seizure-related lacerations. Rates not reported.
Asadi-Pooya[72]	2012	Patients referred to epilepsy clinic, Iran	>18Y (12 months)	264 people with epilepsy and 289 healthy controls.	Relative risk of injuries in people with epilepsy compared to controls was RR=3.42 (95%CI 2.50 to 4.69)
Blackman [65]	2011	Recruitment source unclear, USA	3-17Y (12 months)	150 pairs enrolled with 47 out of 150 completing survey.	Children with epilepsy had similar numbers of injuries to children without (271 vs. 218 respectively). Rates not reported. Injuries included minor burns and sport-related injuries but fractures or poisonings not mentioned.

Note: arranged in reverse order of when data was last collected (if known). Where the dates of data collection were not known, the date of publication was used.

First author	Year published	Setting and country	Ages (duration of follow-up)	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Gniatkowska-Nowakowska [66]	2010	Outpatients attending a neurology and epileptology clinic, Poland	7-16Y (5 years)	126 children with epilepsy and 132 children attending with headaches.	Fracture risk was two times greater (RR=2.26) in children with epilepsy than in children without.
Nicholas [67]	2013	CPRD, UK	All ages (15 years)	63 259 people in 1993-2008.	7356 fractures (including 788 hip fractures) in 63 259 people. Risk of fracture with liver enzyme inducing drugs was compared to non-liver enzyme inducing drugs, rather than a group without epilepsy. HR=1.22 (95%CI 1.12 to 1.34) in females; HR=1.09 (95%CI 0.98 to 1.20) in males.

Note: arranged in reverse order of when data was last collected (if known). Where the dates of data collection were not known, the date of publication was used.

First author	Year published	Setting and country	Ages (duration of follow-up)	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Yiengprugsawan[74]	2012	National cohort study reported injuries in last 12 months, Thailand	15Y to adult	87 134 people starting in 2005	Epilepsy was a risk factor for any type of injury (OR=3.02)
Kwon[75]	2010	Linked medical records databases, Canada	All ages	8 890 people with epilepsy and 26 670 people without in 1996 to 2003.	One-year incidence of one or more injuries 20.6% in people with epilepsy vs. 16.1% in people without. Fracture rates were higher in people with epilepsy, e.g. head and skull fracture (OR=2.6 (95%CI 1.6 to 4.2)); neck/thoracic/trunk fracture (OR=2.2 (95%CI 1.6 to 3.2)); upper limb fracture (OR=1.3 (95%CI 1.0 to 1.6)); lower limb fracture (OR=1.8 (95%CI 1.4 to 2.3)). Thermal injuries in people with epilepsy vs. people without OR=1.3 (95%CI 0.9 to 1.9).
Tellez-Zenteno [73]	2008	Door-to-door Canadian Community Health Survey, Canada	Adults	130 882 people, including 835 with epilepsy and 130047 without in 2000-2001.	Injuries in the last twelve months were similar in people with epilepsy vs. people without (RR=1.1 (95%CI 0.90 to 1.3)). Orthopaedic injuries were the most frequent in both groups but the number reported was similar in people with epilepsy and people without.

Note: arranged in reverse order of when data was last collected (if known). Where the dates of data collection were not known, the date of publication was used.

First author	Year published	Setting and country	Ages (duration of follow-up)	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Souverein [68]	2005	CPRD, UK	All ages (8 years)	40 485 people with epilepsy and 80 970 people without in 1990 to 1998.	The incidence of fractures was nearly twice as high in people with epilepsy compared to those without (incidence rate ratio=1.89 (95%CI 1.81 to 1.98)).
Camfield [69]	2014	Nova Scotia Childhood Epilepsy population-based cohort, Canada	Ages not stated (child-hood onset epilepsy) Average follow-up of 27 years.	600 eligible patients. 433 (72% were contacted). Seizure onset in 1977-1989.	15 (19%) had a fracture. 4 (5%) had a thermal injury. Rates not reported.
Beghi [70]	2002	Patients enrolled via recruiting centres across Europe (Germany, The Netherlands, England, Italy, Portugal, Russia, Estonia, Slovenia)	$\geq$ 5Y (2 years)	951 people with epilepsy and 909 without in 1993-96	199 people with epilepsy and 124 people without had 270 and 140 injuries respectively. Cumulative probability of injuries in people with epilepsy was 17 and 27% by 12 and 24 months respectively (vs. 12 and 17% in people without epilepsy).
Lawn [71]	2004	Medical records database, USA	All ages (15 to 24 years)	247 people diagnosed with epilepsy in 1975-1984.	62 seizure-related injuries in 39 people (or one injury in every 44 person-years at risk).

Note: arranged in reverse order of when data was last collected (if known). Where the dates of data collection were not known, the date of publication was used.

1.3.1.2 Case control studies describing the relationship between epilepsy and injuries

Table 1-2 summarises case control studies which estimate the risk of injuries in people with epilepsy[76-78]. A study in Australia used medication records from patients admitted to hospital and found that the risk of thermal injuries was around three times greater in people with epilepsy compared to people without but CYP were not included in this study[76]. A study of hip fractures using a hip fracture register in Denmark in all ages found that the use of AEDs above and beyond epilepsy diagnosis may increase the risk of hip fracture by around thirty percent[77]. The only case control study in the UK population was a study using the CPRD that found that AED use is associated with an increased risk of fractures but this was in all ages (odds ratio (OR)=4.15 (95%CI 2.71 to 6.34) in people using AEDs for greater than 12 years compared to people not using AEDs)[78].

Table 1-2 Case control studies describing the relationship between epilepsy and injuries over time

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Ansari[76]	2008	Victorian admitted episodes dataset (medical records database), Australia	≥18Y	6 491 cases with thermal injuries and 6491 controls (patients admitted to hospital) without thermal injuries in 2000-05.	Thermal injuries were associated with epilepsy, (OR=2.97 (95%CI 1.82 to 4.84)).
Tsiropoulos[77]	2008	Medical records of patients on a hip fracture register, Denmark	All ages	7557 patients with a hip fracture, 27 575 controls without a hip fracture in 1996-2004.	Ever use of an AED increased fracture risk (OR=1.31 (95%CI 1.16 to 1.48)).
Souverein[78]	2006	CPRD, UK	All ages	1 018 cases with a fracture and 1 842 matched controls without a fracture nested in a cohort of 40 485 people with epilepsy in 1990-98.	Greater rate of fractures in people using AED with strongest association for people using AED for more than 12Y (OR=4.15 (95%CI 2.71 to 6.34)). The risk of fracture was greater with greater exposure to AED's (p for trend <0.001). No comparison with people without epilepsy.

Note: arranged in reverse order of when data was last collected (if known). Where the dates of data collection were not known, the date of publication was used.

1.3.1.3 Cross-sectional studies describing the relationship between epilepsy and injuries

Table 1-3 [80-95] summarises cross-sectional studies which estimate the risk of injuries in people with epilepsy. There were variable findings with respect to the estimated risk of injuries in people with epilepsy and not all studies compared the risk of injuries in people with epilepsy to a group of people without epilepsy. Studies which use an interview or survey to assess past injuries may be affected by recall bias, whereby people with epilepsy are more likely to remember having injury than people without. For example, D'Souza et al. conducted interviews to record past injuries and estimated that around a fifth of people of all ages with epilepsy had an injury in the past[79]. However, there was no comparison group without epilepsy to allow a comparison to people without epilepsy who may be less likely to recall their injuries.

Studies which did not report odds ratios with estimates of confidence comparing people with epilepsy to people without but instead reported proportions of people with epilepsy who had an injury of any type were excluded from the results. For example, a community-based study by Baca et al. found that CYP with and without epilepsy had a similar risk of all injuries to CYP without if head injuries were excluded[80]. Baca et al. used siblings as controls and asked participants about their lifetime history of injuries. The measure used for injury may have over-estimated injury risk in both groups but this does not explain why there was a similar risk for injuries in both people with epilepsy and people without. Another study reported as a conference abstract using siblings without epilepsy as

controls in a hospital in India found that CYP with epilepsy had a greater risk of injuries (around twice as high as CYP without epilepsy) but there was limited information about recruitment of CYP and how the study was conducted[81].

Table 1-3 Cross-sectional studies describing the relationship between epilepsy and injuries over time

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Baca[80]	2013	Community-based cohort of adolescents, USA.	<18Y	501 people with epilepsy matched to 210 children who did not have epilepsy.	Half of the children with epilepsy reported ever having an injury serious enough to need medical attention. 126 (25.2%) children with epilepsy had fractures; 40 (8%) had thermal injuries. A similar proportion of children with uncomplicated epilepsy had injuries compared to children without epilepsy (excluding head injuries). Only proportions reported.
Sajjan[81]	2013	Hospital, India	2-16Y	440 children (208 with epilepsy and 212 siblings without epilepsy).	21 children with epilepsy (10.1%) and 10 without (4.7%) had an injury. 9 out of 21 injuries (4.32%) were related to seizures. Of the injuries in children with epilepsy 11.5% had fractures. Of injuries in children without epilepsy no fractures were recorded. Amongst injuries in children with epilepsy no thermal injuries were reported vs. thermal injuries in 20% of children without epilepsy who had injuries. Only proportions reported.

Note: arranged in reverse order of when data was last collected (if known). Where the dates of data collection were not known, the date of publication was used.

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
D'Souza[79]	2011	Australian national prescription database used to recruit patients to a register, Australia	All ages	1180 people on register, of whom 997 completed interviews.	The proportion of people reporting an injury in their lifetime was as follows: any injury 203 (20.4%). Of the injuries, 6.0% were thermal injuries. Only proportions reported.
Ahmad[82]	2012	People attending the outpatient epilepsy clinics at hospital, Australia	$\geq$ 16Y	150 AED users vs. 506 non-AED users in 2009-10.	Users of AED's were more likely to have injuries, e.g. spine fracture (OR=3.92 (95%CI 1.08 to 14.16)); clavicle fracture (OR=3.75 (95%CI 1.24 to 11.34)); ankle fracture (OR=2.34 (95%CI 1.01 to 5.42)); fractures overall (OR=2.64 (95%CI 1.29 to 5.43)). Non-seizure-related fractures occurred more than seizure related fractures whilst on treatment.
Birinus[83]	2012	Hospital outpatients, Nigeria	14-85Y	87 consecutive patients in 2010	2 (2.3%) had a fracture. Only proportions reported.

Note: arranged in reverse order of when data was last collected (if known). Where the dates of data collection were not known, the date of publication was used.

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Tiamkao [84]	2009	Consecutive patients with epilepsy attending outpatient clinics, Thailand	Adults	300 consecutive people of whom 247 were eligible for inclusion.	91 people had a seizure-related injury.
Sapna[85]	2008	Outpatients attending an epilepsy clinic, India	Adults	255 patients with epilepsy in 2007.	44.8% of people had one or more injury in the preceding twelve months; 7.8% had sustained an accident. Thermal injuries accounted for 2.5% of the accidents.
Buffo [86]	2008	Outpatients in a paediatric epilepsy clinic, Brazil	<18Y	100 consecutive children with epilepsy in 2005-06.	44 people had a seizure-related injury.
Ting [87]	2010	Children newly diagnosed in a hospital department, Hong Kong	<18Y	122 children completed survey in 2002-03.	11 (9%) of children had a seizure-related injury.

Note: arranged in reverse order of when data was last collected (if known). Where the dates of data collection were not known, the date of publication was used.

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Kirsch [88]	2001	Paediatric neurology database of a hospital, Canada	5-16Y	25 out of 31 people with epilepsy agreed to take part with 25 controls.	No significant differences in injury numbers between cases and controls.
Neufeld [89]	2000	Consecutive outpatients with epilepsy and controls (patients' relatives or visitors to the hospital), Israel	Adults	145 people with epilepsy and 145 controls.	27 people with seizures and epilepsy had an injury vs. 20 people without epilepsy had an injury. People without seizures with epilepsy did not have any injuries.
Neufeld [90]	1999	Consecutive patients and their caretakers or relatives, Israel	Adults	298 people with epilepsy and 298 controls.	One seizure-related injury every 21 person-years. 17% were fractures and dislocations. 6% were thermal injuries.

Note: arranged in reverse order of when data was last collected (if known). Where the dates of data collection were not known, the date of publication was used.

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Buck[91]	1997	Patients selected from GP medical records for postal survey, UK	All ages	344 people who had at least one seizure in the past year.	16% of people who had a seizure in the previous year had a thermal injury; 6% had a fracture.
Kirby[92]	1995	Emergency department, Canada	All ages	560 people attending after a seizure in 1990-91.	84 out of 560 (15%) had an injury or death.
Doneva[93]	2014	Consecutive patients with epilepsy excluding those with newly diagnosed epilepsy, Macedonia	<18Y	298 patients.	39.9% had at least one injury due to seizures. 10% had a thermal injury and 8% had a fracture or dislocation.
Saengsuwan[94]	2014	Patients randomly recruited from University epilepsy clinic, Thailand	Adults	203 patients with epilepsy	25.6% of people had been involved in falls associated with an injury.

Note: arranged in reverse order of when data was last collected (if known). Where the dates of data collection were not known, the date of publication was used.

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Okumusi [95]	2013	Outpatients, Canada	Adults	763 patients interviewed in 2011-2012.	76 (9.96%) patients had seizure-related trauma. People who had an injury had a higher frequency of seizures (p=0.001).
Bellon [96]	2013	2010 Australian Epilepsy Longitudinal Survey distributed to people on the Australian Epilepsy Research Register, Australia	All ages	343 responses (55% response rate) in 2010.	188 (55%) reported an injury as a result of a seizure. 49 (26%) reported fractures. 17 (9%) reported thermal injuries.
Mollaoglu [97]	2013	Outpatients attending a neurology clinic in hospital, Turkey	Adults	126 patients in 2009-10.	82.5% had an injury due to a seizure. 24% of those had a thermal injury; 21.2% an orthopaedic injury.

Note: arranged in reverse order of when data was last collected (if known). Where the dates of data collection were not known, the date of publication was used.

1.3.2 Summary

In summary, detailed and reliable estimates of the risk of fractures, thermal injuries and poisonings are not available for the UK primary care population of CYP known to have epilepsy. There are likely to be confounders, such as age, sex, region, deprivation and ADHD that have not been adjusted for in previous studies. There is an absence of evidence from all published studies reporting associations between epilepsy and fractures, thermal injuries or poisonings in CYP with epilepsy compared to CYP without epilepsy, which is an important gap in the evidence. However, the literature implies that CYP with epilepsy are at an increased risk of injuries compared to CYP without epilepsy but the findings from the literature are inconsistent and lacking in detail about the estimated risk of specific injuries, such as fractures, thermal injuries and poisonings in CYP. CYP with epilepsy, their parents, health professionals and other members of the community would benefit from detailed estimates of the risk of specific injuries in CYP with epilepsy compared to CYP without because this would help to make informed decisions about care, supervision and lifestyle.

1.4 Attention deficit-hyperactivity disorder (ADHD) in children and young people

1.4.1 Definition of ADHD

ADHD is a mental health problem reflecting developmentally inappropriate levels of hyperactivity, impulsivity and inattention with evidence of pervasive impairment in multiple settings (e.g. school and home)[98]. There

are two main systems used to classify ADHD. In North America the Diagnostic and Statistical Manual of Mental Disorders (DSM-V)[99] is used and contains a more inclusive definition of ADHD in which a minimum of six symptoms from either of two sub-types (inattentive and hyperactive-impulsive) are required to make the diagnosis (e.g. talking excessively or fidgeting with hands or feet[100]). DSM-V replaced the previous version of the DSM (DSM-IV[101]) and requires onset of symptoms before the age of 12 years, rather than the age of 7 years in DSM-IV[102]. In contrast, the International Classification of Diseases system (ICD-10) describes criteria for a more severe subgroup of people who have hyperkinetic disorders (i.e. similar to combined sub-type ADHD)[103].

In the UK, in order to receive a diagnosis of ADHD a referral to a specialist is required for a clinical diagnosis to be made[98 104]. The National Institute for Health and Clinical Excellence (NICE) has published guidelines on ADHD and include detailed guidance about the definition and diagnosis of this condition which all health professionals are advised to follow[98]. In order to obtain a diagnosis a CYP with suspected ADHD would be referred to a specialist in secondary care. Usually this referral will be made by a GP. The specialist will use a combination of DSM and ICD criteria and obtain information from the CYP, carer and other services (such as education) before coming to a clinical diagnosis.

As ADHD is a developmental disorder, it is likely that people with ADHD have the disorder from a young age. The NICE guidelines state that a diagnosis of ADHD is usually appropriate only above age 3 years[98]. However, there may be a delay in diagnosing the condition because of the

time taken between initial symptoms presenting and a final diagnosis from a specialist[98 104].

1.4.2 Epidemiology of ADHD

1.4.2.1 Prevalence

Prevalence is defined as the number of people with a given disease expressed as a proportion of the whole population at risk of the disease[105]. Prevalence is a useful measure when describing the burden of a chronic disease which is present from an early age such as ADHD. Point prevalence is defined as the number of people with a given disease expressed as a proportion of the whole population at a set point in time[105]. Period prevalence is defined as the number of people with the disease over a period of time, e.g. over one year, expressed as a proportion of the whole population at risk over the same time. Point prevalence is a suitable measure of prevalence for a condition that remains at a stable level in the population and is not subject to rapid changes, e.g. as would be the case if the disease caused death and removal from the population soon after being identified[105]. Cumulative prevalence implies that the disease has been diagnosed at any time in the past and is a suitable measure for a condition that causes symptoms up to the present time.

1.4.2.1.1 Search strategy

In order to identify published systematic reviews describing the prevalence of ADHD a series of searches were conducted using the following databases: Medline; Embase (biomedical and pharmaceutical database); PsycINFO (behavioural sciences and mental health database); CINAHL

(nursing journals and publications); and ASSIA (applied social sciences index and abstracts). The following search strategy was used in Medline (from the date of inception, 1946 in the case of Medline, to August 2014) and a similar search strategy was adapted for use in the other databases (from the date of inception to August 2014): (*terms describing systematic reviews*) and (*terms describing ADHD*) and (*terms describing prevalence*). The full search strategies used in each database are described in appendix 6.1. The search terms describing systematic reviews were taken from the website of the Scottish Intercollegiate Guidelines Network[106]. Search terms describing systematic reviews were used because this would lead to a full summary of studies that had been published in the past without the need to summarise individual studies. After duplicate records were removed, a total of 308 titles remained. The titles and abstracts were reviewed to identify systematic reviews summarising the prevalence of ADHD. Seventeen full papers were obtained from which five papers reported on the prevalence of ADHD. These reviews identified were published between 2007[107] and 2014[108].

1.4.2.1.2 Community prevalence

Community prevalence describes the number of people in a representative sample of the whole population with ADHD, according to predefined criteria, usually DSM or ICD criteria. The advantage of community prevalence is that the estimates are not affected by people in the population who have ADHD but are as yet undiagnosed or unknown to have ADHD. Furthermore, community prevalence is less likely to be affected by under-ascertainment, e.g. where parents of people with ADHD

may incorrectly remember that a health professional said their child has ADHD even though they did not fulfil the formal diagnostic criteria.

The first review by Polanczyk et al. was in 2007 and estimated the global prevalence of ADHD to be 5.29%[107]. Secondly, a recent systematic review by Willcutt on the global community prevalence of ADHD based on DSM-IV symptoms from parent ratings, teacher ratings or best estimate diagnostic procedures, estimated that the prevalence of ADHD in CYP is between 5.9% to 7.1%[109]. Thirdly, a systematic review by Erskine et al. in 2013 estimated the global prevalence of ADHD in people aged 5 to 19 years to be 2.2% (95%CI 2.0-2.3)[110].

Erskine et al. were more conservative in their estimates of ADHD for two main reasons. Firstly, Erskine et al. applied a greater weight in the analysis to studies where evidence was required from more than one informant to identify a case of ADHD. Erskine et al. estimated the global community prevalence of ADHD in all ages in 1990, 2005 and 2010 and found that the peak prevalence of ADHD is in 9 year-old children and that the prevalence decreases after this age down to negligible levels in people above 30 years old[110]. Secondly, the population of subjects included in the meta-analysis contained more adolescents (12 to 18 years old), in whom the prevalence of ADHD is lower than in younger children,[110] than the previous systematic review by Polanczyk et al. in 2007[107].

The fourth systematic review[108] describing the community prevalence of ADHD in CYP updated the two previous systematic reviews from 2007[107] and 2012[109] and included one hundred and fifty-four studies in total. Polanczyk et al. included studies from 1985 to 2012 describing the

prevalence of ADHD based on either DSM or ICD diagnostic criteria in people aged 18 years or younger[108]. Polanczyk et al. concluded that the world-wide community prevalence of ADHD is neither associated with the geographical location nor the year of the study and is approximately 5%, with estimates remaining stable in the last three decades[108]. Variation in reports of the estimated prevalence of ADHD was explained by differences in methodology between studies[108]. Polanczyk et al. described the prevalence of ADHD according to whether a person ever had ADHD during their lifetime and did not report prevalence by age, sex or deprivation.

The fifth and final paper to be found in the search for review of the community prevalence of ADHD described the global burden of ADHD. ADHD represents a significant burden to health globally. This was recently described for the first time in the Global Burden of Disease study 2010, published in 2014, in which the number of disability adjusted life years (DALYs) was estimated in people of all ages in order to estimate the number of years people with ADHD live with disability and thus morbidity[111]. ADHD was reported to contribute 491,500 DALYs; the 98th highest cause for global DALYs[111]. However, the global DALYs for ADHD were significantly higher for males compared to females (e.g. for age 10 to 14 years, approximately 120,000 DALYs in males compared to 30,000 DALYs in females) [111]. The DALYs for ADHD peaked at age 10 to 14 years and accounted for 0.23% (95%CI 0.15 to 0.35) of global DALYs.

Papers quoted in the most recent systematic review published in 2014 were published as recently as 2012. In order to identify studies that were published after 2012 a further search was conducted in Medline, Embase,

PsycINFO, CINAHL and ASSIA without the filter for systematic reviews. The search aimed to identify papers published after 2012 and up to August 2014 in the English language describing the community prevalence of ADHD in the UK. The search strategy was similar to the previous search described above but instead of search terms describing systematic reviews, search terms were used for studies in the UK. No further studies were identified using this search.

1.4.2.1.3 Clinically recorded (administrative) prevalence

In contrast to community prevalence, administrative prevalence is defined as the number of people with diagnosed and/or recorded ADHD in their medical records as a proportion of the whole population. Studies of the administrative prevalence of ADHD give rise to lower estimates than studies of community prevalence. However, it is administrative prevalence that is recorded by GPs and knowledge of the administrative prevalence of ADHD would allow GPs and health care managers to assess the burden of ADHD in primary care and thereby plan health services appropriately. In order to identify published studies describing the administrative prevalence of ADHD, a separate search was conducted in Medline; Embase; PsycINFO; CINAHL; and ASSIA. The following search strategy was used in Medline and a similar search strategy was adapted for use in the other databases: (*terms describing diagnosis or prescribing*) and (*terms describing ADHD*) and (*terms describing prevalence*) not (*terms describing systematic reviews*). Systematic reviews were excluded in this search to ensure all studies describing the administrative prevalence of ADHD were found because restricting to systematic reviews increased the

number of reviews of the community prevalence of ADHD in the previous review. It was hypothesised that this was as a result of the key words for prevalence not being specific enough to separate studies of community prevalence from administrative prevalence. The full search strategy used in Medline is described in appendix 6.1 (Table 6-7). After duplicate records were removed, a total of nine hundred and two titles remained. The titles and abstracts were reviewed to identify studies estimating the administrative prevalence of ADHD. One hundred and six full papers were obtained of which thirty-seven studies were identified that reported on the administrative prevalence of ADHD: fifteen studies conducted in the USA (Table 1-4); fifteen studies conducted outside the USA and UK (Table 1-5) and seven studies conducted in the UK (Table 1-6).

1.4.2.1.3.1 Global administrative prevalence of ADHD

The administrative prevalence of ADHD has been rising throughout the world over time, with the largest proportion of studies (fifteen out of thirty-seven) published from the United States of America (USA). Studies that reported the prevalence of ADHD in the USA are summarised in Table 1-4[112-126]. Whilst it is difficult to make direct comparisons between studies, because of differences in the way in which administrative prevalence was defined and estimated, the administrative prevalence based on prescriptions ranged from 0.6% (in under 18 year-olds in 1987)[122] to 10% (in 7 to 11 year-olds in 1995 to 1996)[121]. The administrative prevalence based on diagnosis ranged from 0.93% (in 2 to 5 year-olds in 2002)[115] to 4.5% (in 5 to 18 year-olds in 1995)[124]. The overall trend of an increase in the prevalence of ADHD over time was reported in all studies and the peak of ADHD prevalence by age group was consistently in the range of 10 to 14 years old. The prevalence quoted by LeFever et al. of 10% appears to be higher than other studies around the same time and this may reflect a regional difference in the prevalence of ADHD within one region of the USA[121].

Table 1-4 The clinical prevalence of ADHD reported in studies conducted in the USA

First author	Year published	Year start	Year end	Ages	Prevalence % (Year, if applicable) and case definition
Tian [112]	2013	2008	2010	4-40Y	1.9% (2008); 2.5% (2010) by diagnosis. 2.4% (2008); 3.5% (2010) by prescription.
McDonald [113]	2013	2008	2008	0-17Y	2.5% (2008) based on prescription
Zuvekas [114]	2012	2008	2008	0-18Y	2.4% (1996); 3.5% (2008) based on prescriptions
Fontanella [115]	2014	2002	2008	2-5Y	0.93% (2002); 1.31% (2008) based on diagnosis
Castle [116]	2007	2000	2005	0-19Y	4.4% based on prescriptions
Brinker [117]	2007	2004	2004	1-20Y	3.7% based on prescriptions
Habel [118]	2005	1996	2000	2-18Y	1.86% (1996); 1.93%(2000) based on prescriptions
Goldstein [119]	2001	1999	1999	5-11Y	1.39% based on prescriptions
Lin [120]	2005	1990	1997	All ages	3.8% (1997) based on prescription of amphetamines (not methylphenidate) in 10-14Y olds
LeFever [121]	1999	1995	1996	7-11Y	8% and 10% based on prescriptions in two separate cities.
Olfson [122]	2002	1987	1996	0-18Y	0.6% (1987); 2.4% (1996) based on prescriptions
Zito [123]	2000	1991	1995	2-19Y	Increasing prevalence of prescribing over time in all age groups. E.g. in one programme stimulant prevalence in preschoolers was 1.2% in 1995.
Robison [124]	1999	1990	1995	5-18Y	2.8% (1995) based on prescriptions; 4.5% (1995) based on diagnosis; 3.4% based on diagnosis and prescription (1995)
Safer [125]	1994	1971	1993	5-18Y	2.1% (1975); 3.6% (1993) in elementary pupils. 0.22% (1983); 0.70% (1993) in senior pupils. Based on prescriptions
Rappley [126]	1995	1992	1992	0-19Y	1.1% based on prescriptions

Table 1-5 summarises studies on the administrative prevalence of ADHD conducted globally outside of the USA and the UK[61 127-140]. It shows that in all countries except Israel the prevalence estimates were lower than in the USA. The administrative prevalence based on prescriptions ranged from 0.19% (in under 19 year-olds in 1990)[128] to 2.5% (in under 18 year-olds in 2004)[131]. The administrative prevalence based on diagnosis ranged from 0.06% (under 18 year-olds in 1996)[130] to 12.6% (in 6 to 13 year-olds in 2003 to 2009)[61]. Two of the studies using Israeli health insurance data reported prevalence estimates that were higher than the other countries in the table: Fogelman et al. reported prevalence in Kibbutzim areas of 5.99% based on prescriptions[132]; Cohen et al. 12.6% based on a diagnosis[61]. It is possible that these high estimates of prevalence from Israel reflect a selected population of people with access to health insurance that are not reflective of the population of the country at large, especially since Fogelman et al. reported a prevalence of ADHD based on prescriptions of only 0.20% in Arab areas[132]. Consistent with the trend in calendar time seen in estimates of prevalence in the USA, the other worldwide prevalence estimates showed a trend for increasing prevalence with time.

Table 1-5 The clinical prevalence of ADHD reported in studies conducted outside the USA and UK

First author	Year published	Country	Year start	Year end	Ages	Prevalence % (Year, if applicable) and case definition
Pottegard [129]	2012	Denmark	1995	2011	All ages	Increasing prevalence with calendar year based on prescriptions. Peak prevalence 2.4% in 13-17Y old males in 2011
Dalsgaard [127]	2013	Denmark	1990	2010	0-20Y	1.56% based on prescriptions
Zetterqvist [138]	2013	Sweden	2006	2009	8-14Y	0.66% (2006); 1.26% (2009) based on prescriptions
Cohen [61]	2013	Israel	2003	2009	6-13Y	12.6% based on diagnosis
Zoega [139]	2011	Denmark, Finland, Iceland, Norway, Sweden	2007	2007	7-15Y	1.1% based on prescriptions
Hodgkins [133]	2011	Netherlands	2000	2007	6-17Y	1.1% (2000); 2.1% (2007) based on prescriptions
Schubert [134]	2010	Germany	2000	2007	<18Y	1.06% (2007) based on prescriptions
Kraut [140]	2013	Germany	2004	2006	3-17Y	1.5% (2005) based on prescriptions
Lindemann [136]	2012	Germany	2004	2006	3-17Y	2.5% (2005) based on diagnosis and prescriptions
Gumy [135]	2010	Switzerland	2002	2005	5-14Y	0.74% (2002); 1.02% (2005) based on prescriptions
Chien [130]	2012	Taiwan	1996	2005	<18Y	0.06% (1996); 1.64% (2005) based on diagnosis
Preen [137]	2007	Australia	2004	2004	3-17Y	2.4% based on prescriptions
Vinker [131]	2006	Israel	1998	2004	0-18Y	0.7% (1998); 2.5% (2004) based on prescriptions
Fogelman [132]	2003	Israel	1999	2001	0-18Y	5.99% in Kibbutzim; 0.20% in Arab areas based on prescriptions
Miller [128]	2001	Canada	1990	1996	0-19Y	0.19% (1990); 1.1% (1996) based on prescriptions

1.4.2.1.3.2 UK administrative prevalence of ADHD

Table 1-6 summarises studies on the administrative prevalence of ADHD conducted in the UK[141-145]. The administrative prevalence based on prescriptions ranged from 0.003% (in under 19 year-olds in 1992)[146] to 0.92% (in under 6 to 12 year-olds in 2008)[143]. There were no studies from the UK which estimated the administrative prevalence of ADHD based only on diagnosis. The administrative prevalence based on diagnosis and/or prescription ranged from 0.19% (in 6 to 17 year-olds in 1998)[142] to 0.76% (in 5 to 15 year-olds in 2011 to 2012)[141]. In keeping with the findings from the rest of the world, the administrative prevalence of ADHD has been increasing with calendar time. All seven studies have been conducted using two UK primary care databases, CPRD and the Health Improvement Network (THIN) databases[143 147]. For example, McCarthy et al. used data from THIN to describe the prevalence of ADHD. However, McCarthy et al. did not report estimates by social deprivation[143]. Estimates for the prevalence of ADHD between 2003 to 2008 were 0.73% in 6 to 12 year-olds, 0.57% in 13 to 17 year-olds and 0.06% in 18 to 24 year-olds[143]. The CPRD has also been used to study ADHD in CYP and adults[144 147], including a study by Jick et al. on the prevalence of ADHD[147] and a study by McCarthy et al. on the discontinuation of medication for ADHD when people reach adulthood[144]. However, Jick et al. only described the prevalence of ADHD in boys aged 5 to 14 years and estimated the prevalence at one time point in 1999 of 0.53%[147].

Table 1-6 The clinical prevalence of ADHD reported in studies conducted in the UK

First author	Year published	Country	Year start	Year end	Ages	Prevalence % (Year, if applicable) and case definition
O'Leary [141]	2014	UK	2010	2012	5-15Y	0.75% (2010-11); 0.76% (2011-12) based on diagnosis and prescription
Holden [142]	2013	UK	1998	2010	6-17Y	0.19% (1998); 0.55% (2006); 0.51% (2009) based on diagnosis and/or prescription
McCarthy [143]	2012	UK	2003	2008	6-12Y	0.48% (2003); 0.92% (2008) based on prescriptions
McCarthy [144]	2009	UK	1999	2006	15-21Y	0.09% (1999); 0.51% (2006) based on prescriptions in males
Wong [145]	2009	UK	2001	2004	15-21Y	0.03% (1999); 0.2% (2006) based on prescriptions
Hsia [146]	2009	UK	1992	2001	<19Y	0.003% (1992); 0.29% (2001) based on prescriptions
Jick [147]	2004	UK	1999	1999	5-14Y	0.53% (1999) based on prescriptions in males

1.4.2.1.3.3 Regional UK administrative prevalence of ADHD

A UK study described regional variation in the prescriptions for methylphenidate, with the highest rate of prescriptions reported for the Wirral Primary Care Trust (in the North-West of England) but this study only counted the number of prescriptions issued without reporting the number of CYP for whom these prescriptions were issued[148]. The study used government prescription data from community-based prescriptions (attempts to contact the author for further information on methodology were unsuccessful).

1.4.3 Time trends

Although the community prevalence of ADHD has remained stable over time, the administrative prevalence of ADHD has been increasing, as described above. The reasons for the increasing administrative prevalence of ADHD are likely to be better identification and awareness of the condition and better access to diagnosis and treatment for people with ADHD. However, some recent studies have suggested that the increase in the administrative prevalence of ADHD has been levelling off in the past few years, for example Holden et al.'s study in the UK from the CPRD (Table 1-6) suggested that after 2007 the prevalence of diagnosed ADHD has fallen[142].

1.4.4 Age

Most studies reported that the age at which the prevalence of ADHD is at its peak is around 6 to 11 years old[117 120 127 130]. For example, the recent systematic review by Erskine et al. reported that the peak in community

prevalence for ADHD was approximately at 9 years old[110]. Globally the DALYs due to ADHD peak in the 10 to 14 year-old age group[111]. In the UK, findings for the pattern of prevalence were similar to other studies around the world with a trend for decreasing prescriptions after the age of 15 years[144].

1.4.5 Sex

Globally, males have consistently been shown to have a higher prevalence of ADHD than females[109-111] but the sex ratio has varied between studies, depending on the age groups included, the country and the year data were collected. A summary of the estimated ratio for community prevalence in males compared to females quoted in two recent global systematic reviews was between two to three males for every female with ADHD[109 110]. Estimates for the sex ratio comparing males to females for the administrative prevalence of ADHD have been greater, for example a USA health insurance based study estimated that 3.3 males for every female have ADHD based on prescriptions in 1996 to 2000[118]. Some studies have suggested that the administrative prevalence of ADHD over time has been increasing faster in females than in males; for example studies based on prescriptions in the USA[116], Switzerland[135], the Netherlands[133] and Sweden[149]. However, other studies, such as one based on prescriptions from the Netherlands[150], have implied that the administrative prevalence of ADHD has been rising faster in boys than in girls. This study estimated that there were three to eight times more boys than girls with prescriptions to treat ADHD[150]. Similarly a study based on diagnosis and

prescription data from Germany estimated the prevalence in males to be three to four times greater than in females[136].

Within the UK, a study conducted using the CPRD based on prescriptions estimated that in people under 19 years the male to female ratio of the prevalence of ADHD increased over time between 1992 and 2001[146]. In contrast, another more recent study using the CPRD based on diagnoses and prescriptions estimated that in CYP aged 6 to 17 years the male to female ratio of the prevalence of ADHD reduced over time, ranging from 8.4 in 1999 to 5.8 in 2009[142]. In a third study, using THIN data in people aged 6 to 17 years, the male to female ratio also reduced from 6.6 in 2003 to 5.5 in 2008 in people aged 6 to 12 years and from 9.8 in 2003 to 6.3 in 2008 in people aged 13 to 17 years[143]. Collectively, the findings of these three studies suggest that prescribing prevalence was increasing mostly in males from 1992 to 2001 but that recording is likely to have increased in females in more recent years. In keeping with these three studies, a study conducted in THIN in 2010 to 2012 concluded that males are five times more likely to be diagnosed with ADHD than females[141].

1.4.6 Differences by deprivation

Different studies have used different measures of socio-economic deprivation. For example studies may use measures of household income[151-153]. However, the Index of Multiple Deprivation (IMD) score uses a combination of measures including seven domains: income; employment; health and disability; education, skills and training, barriers to housing and services, living environment; crime[154]. The IMD scores are grouped into quintiles, which allow people to be grouped into five

categories of deprivation, relative to others. Willcutt reported a limited number of studies in a systematic review in 2012 that stratified estimates of global community prevalence of ADHD according to socio-economic deprivation[109]. Within the studies reported by Willcutt findings indicated that individuals from families defined as more deprived were between one and a half times and four times more likely to have ADHD than individuals from families defined as less deprived[109]. In the USA a nationwide survey reported that areas with greater measures of deprivation have a higher prevalence of ADHD compared to areas with lower measures of deprivation[155].

Globally, findings from studies reporting on the administrative prevalence of ADHD by deprivation are not as consistent as the studies on community prevalence. Whilst most studies outside the USA imply that there is an increase in diagnosed/treated ADHD with greater deprivation[156], there are notable exceptions in some USA-based studies, in which families with a higher income may have a greater prevalence of ADHD[151 152]. For example, in the study by Getahun, CYP from high income households in the USA had a greater prevalence based on diagnosis of ADHD than people from lower income households amongst the study population, all of whom had health insurance[152]. The findings for how prevalence of ADHD varies between private and public health insurance status are less clear. For example, a household survey with pharmacy data on 2.8 million CYP from the USA in 2008 found that CYP without insurance had a drug-treated prevalence of ADHD of 1.3%, compared to CYP with private insurance of 3.4% and CYP with public insurance of 4.3%[114]. There are few studies globally which do not find an association between the administrative

prevalence of ADHD and deprivation. For example, an Australian study which defined cases of ADHD by parent-report did not find an association between family income and ADHD[153]. Similarly another Australian study based on the prescribing prevalence of ADHD did not find an association with defined/measured deprivation[157]. It is possible that universal access to health care in Australia allows people to obtain a diagnosis and treatment for ADHD equally, regardless of measured deprivation.

In the UK, a cohort study on the community prevalence of ADHD found that families with a child with ADHD, measured by parental report, with a lower income had a greater prevalence of ADHD than families with a higher income[158]. A further study of USA primary school children found that children from the lowest income quintile had the greatest probability of having a diagnosis of ADHD compared to the middle income quintile (OR=2.54)[159]. A study by Apouey found that the community prevalence of ADHD is associated with low family income[160] and Apperley et al. described a higher prevalence of ADHD in people with greater measured deprivation in a clinic-based population of CYP[161]. This cross sectional survey by Apperley et al. found that 44.4% of people with ADHD were from the most deprived area-level quintile[161]. A community prevalence survey from school children in England and Wales did not find an association between hyperactivity and measured deprivation but this study used the school's address to define the area-level deprivation so this might not accurately reflect the deprivation of the CYP concerned[162]. No published reports of large population-based studies in the UK describing the prevalence of ADHD by deprivation in CYP were found.

1.4.7 Differences by region

Studies on regional variation in the prevalence of ADHD in the UK are rare. For example, a study on 1069 CYP in the Liverpool area, in the North-West of England, with a clinical diagnosis of ADHD investigated the association between the prevalence of ADHD, diagnosed by DSM-IV criteria, and the IMD 2007 scores[154] relating to lower superior output areas (LSOAs)[163]. LSOA's refer to areas composed of postcode areas and average around 1500 residents per LSOA[164]. Although the study was set in a single city which is relatively deprived, the study found strong evidence for increased rates of clinically diagnosed ADHD in areas of greater deprivation (Spearman's correlation for prevalence of ADHD and IMD2007 rank=-0.9395, $p<0.001$)[163].

1.4.8 Comorbid conditions

A community-based study of four hundred and nine school children from Sweden estimated that 87% of children with ADHD had one or more comorbid diagnosis; 67% had at least two diagnoses[165]. The comorbid diagnoses in this study were: developmental disorders, including mental retardation (13%); reading/writing disorder (40%); developmental coordination disorder (47%); psychiatric disorders, including oppositional defiant disorder (ODD) (60%); tic disorders (33%); Asperger's syndrome (7%)[165]. A review article also concluded that ADHD may also be comorbid with conduct disorder (CD), ODD, mood disorders, learning disabilities, academic underachievement, risk of substance abuse and Tourette's disorder[166]. CD is a diagnosis describing chronic extreme behaviour problems involving antisocial, criminal or substance abuse behaviours[98].

ODD is a pattern of disobedient, hostile and defiant behaviour towards people in positions of authority[98].

1.4.9 Costs

Total spending on methylphenidate, a drug used to treat ADHD, in England was just under £2 million on a total GP registered population of 55 million adults (£0.035 per person) or 10 million CYP (£0.20 per under-14) based on a study of prescribing data in English General Practice[167]. A study conducted in the CPRD estimated that the mean annual total healthcare costs for people of all ages with ADHD were higher than for people without, for example £1,327 per year in people with ADHD vs. £328 per year for people without in the first year of the study[142].

1.4.10 Medication for the treatment of ADHD

Not all people with ADHD require medication and the current NICE guidelines recommend medication as a first-line treatment for people with severe symptoms and impairment[98]. Although medication is initially prescribed in secondary care, ongoing prescriptions are often provided by the GP[98]. Guidelines suggest that the prescriptions should be continued as long as they are effective but a recent study suggested that use of medication often ceases when children reach adulthood, perhaps due to a lack of care pathways for adults with ADHD or a reluctance of GPs to prescribe[168]. The usual drugs of choice to treat ADHD are: methylphenidate, often first line and the commonest to be used[168]; dexamfetamine; and atomoxetine[98]. Methylphenidate and atomoxetine are not recommended for children under 6 years old and atomoxetine is also licensed for use in adults if it was started in childhood[98]. The prescribing of

stimulant drugs to treat ADHD has increased in England in recent years, with 220,000 prescriptions for methylphenidate and dexamphetamine in 1998, costing five million pounds and 418,300 prescriptions in 2004, costing thirteen million pounds[98]. In May 2004 atomoxetine was licensed and there were 15,500 prescriptions dispensed, costing 1.2 million pounds[98].

1.4.11 Summary

ADHD is a mental health disorder defined according to DSM and ICD criteria. Diagnosis in the UK is made by specialists in secondary care and ongoing care and treatment are provided by GPs in primary care. The community prevalence of ADHD globally and in the UK is estimated to be between 2 to 5%. Estimates of the clinically recorded (administrative prevalence) vary worldwide, with the highest estimates coming from the USA[121] and Israel[61]. Estimates of the administrative prevalence of ADHD in the UK range from 0.003% in under nineteen-year-olds in 1992[146] to 0.92% in six to twelve-year-olds in 2008[143]. There is a lack of studies which describe how the administrative prevalence of ADHD varies by age, sex, deprivation, region and calendar time in English primary care.

1.5 ADHD and injuries in children and young people

1.5.1 Relationship of injuries to ADHD

In order to identify published studies describing the relationship between childhood ADHD and injuries, a search was conducted in Medline (from 1948 to August 2014); Embase (from 1974 to August 2014); PsycINFO (from 1806 to August 2014); CINAHL (from 1982 to August 2014); and ASSIA (from 1987 to August 2014). The following search strategy was used in Medline and a similar search strategy was adapted for use in the other databases: (*terms describing ADHD*) and (*terms describing injuries*) and (*terms describing systematic reviews*). In keeping with the search strategy to identify literature reporting estimates of community prevalence (reported in section 1.4.2.1) search terms were used to restrict to systematic reviews. However, in all databases except CINAHL there were no results if the search was restricted to systematic reviews. Furthermore, the search result in CINAHL was similar whether or not the results were restricted to systematic reviews. Therefore searches were repeated without restricting to systematic reviews. The full search strategy used in Medline is described in appendix 6.1 (Table 6-8). After duplicate records were removed, a total of one hundred and eighty-three titles remained. The titles and abstracts were reviewed and ninety-five full papers were obtained. After reviewing full papers, forty-seven studies were identified that reported on the risk of injuries in CYP with ADHD: seventeen cohort studies (Table 1-7); twenty-nine control studies (Table 1-8) and five cross-sectional studies (Table 1-9).

1.5.1.1 Cohort studies describing the relationship between ADHD and injuries

A direct comparison of studies estimating the risk of injuries in CYP with ADHD was difficult due to differences in the study populations, comparisons described and outcomes estimated. Table 1-7[169-185] summarises the cohort studies describing the relationship between ADHD and injuries over time. Most studies report the risk of unintentional injuries without breaking down estimates for specific injury types. Even those studies that report the risk of specific injury types do not classify injuries in the same way, making comparison between studies difficult. The studies with comparisons between CYP with ADHD compared to CYP without ADHD indicate that the risk of injury is approximately one and a half to two times greater in CYP with ADHD compared to CYP without[174 176 177 180 185 186]. Studies which use hospital-based recording of injuries would be expected to estimate the risk of more severe injuries in contrast to community-based studies that would estimate the risk of all injuries, regardless of severity.

There have been studies of the association between ADHD and injuries in the UK, such as a self-controlled case series analysis which showed medication reduced the risk of injuries but that failed to adjust for deprivation and did not have a comparison population of children without ADHD[172]. Keenan et al. showed that having a head injury or a thermal injury prior to age two years was associated with a two-fold increase in the probability of a child later developing ADHD compared to a child who did not present with these injuries[178]. Other studies used hospital

populations and showed there may be an increase in risk of injuries in ADHD but the case definition did not require a full diagnosis of ADHD but instead used symptoms of 'overactivity' thus making it hard to extrapolate findings to children with diagnosed ADHD[183-185]. The small cohort study in London by Davidson et al. found no association between hyperactivity and injury risk amongst boys aged 6 to 8 years old[183].

Table 1-7 Cohort studies describing the relationship between ADHD and injuries over time

First author	Year published	Setting and country (Bold indicates UK)	Ages (Duration of follow-up)	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Chen [169]	2014	Healthcare data, USA	<18Y (8 years)	527 children (311 on ADHD medication; 216 not on medication) in 2002-2010	27 (5.1%) had at least one injury. 11 (5.09%) without medication had an injury. 16 (5.14%) on medication had an injury.
Dalsgaard [170]	2014	Medical records, Denmark	0-5Y for injuries and 5-16Y for ADHD treatment (up to 20 years)	11553 with ADHD, 61% treated with stimulants in 1990-2001	Injury before age 5 years associated with an increased probability of later stimulant treatment in ADHD (OR=1.09 (95%CI 1.01 to 1.21)). With each injury, the probability increased by 3%. Relation between ADHD and injuries not described.
Man [171]	2014	Electronic medical records, Hong Kong	6-19Y (13 years)	5178 children with at least one attendance for injury and at least one prescription for methylphenidate in 2001-2013	Injury incidence IRR=0.91 (95%CI 0.86 to 0.97) comparing periods on medication to periods off medication.
Raman [172]	2013	**THIN, UK**	1-18Y (15 years)	328 with ADHD in 1993-2008	IRR=0.68(0.50-0.91) comparing periods of time on medication to periods of time off medication in children with ADHD.
van den Ban [173]	2014	PHARMO record linkage database, Holland	0-18Y (10 years)	150,000	IRR for incidence of hospital admissions two times higher in ADHD vs controls (IRR=2.2(95%CI 1.6 to 2.9)).
Kang [174]	2013	Taiwan	4-12Y (3 years)	3616 with ADHD 18080 non-ADHD (whole database of 1000000 people)	Injury rates were greater in people with ADHD compared to people without ADHD, HR=1.64(1.50-1.79)

First author	Year published	Setting and country (Bold indicates UK)	Ages (Duration of follow-up)	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Schmedt [175]	2013	German Pharmacoepidemiological Research Database (GePaRD) in Germany	3-17 (1 to 3 years)Y	37650 children with ADHD in 2005-07	2186 had an injury diagnosis. OR of injury whilst on treatment was 0.86 (95%CI 0.73 to 1.02) when comparing periods on medication to periods off mediation (self-controlled case series design) and 0.98 (95%CI 0.76 to 1.28) when using a case crossover design.
Tai [176]	2013	Taiwan	6-18Y (4 years)	1965 with ADHD 7860 non-ADHD	2 to 5 fold higher risk of injuries and overall injury. Multivariate results (adjusted for anxiolytics/hypnotic use, antipsychotic use, antidepressant use, physical comorbidity) OR=1.22(1.01-1.49) for fracture upper limb, 1.60(1.27-2.02) for burns, 1.27(0.97-1.65) for fracture lower limb, 1.12(0.74-1.70) for poisoning, 1.13(0.57-2.22) for fracture of skull (excluding vault/base), 1.09(0.50-2.38) for fracture of neck and trunk, 2.36(0.73-7.63) for fracture of skull vault/base
Merrill [177]	2009	Deseret Mutual Benefit Administrators (DMBA) claims database USA	0-64Y (7 years)	4,490,378 in database in total, of which 2,186 had ADHD	Fracture of skull, neck and trunk RR=2.05(1.32-3.18) comparing ADHD to non-ADHD. Fracture of upper/lower limb RR=1.63(1.34-1.98). Burns RR=1.96(1.09-3.55).

First author	Year published	Setting and country (Bold indicates UK)	Ages (Duration of follow-up)	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Keenan [178]	2008	**THIN - UK primary care data**	0-10Y (Up to 10 years)	62088 children in 1988-2003.	Head injury before age 2 years vs burn injury before 2 years vs neither injury before 2 years: 2782 (4.5%) had a head injury; 1116 (1.8%) had a burn injury. Adjusted relative risk for developing ADHD compared to all other children (with neither injury) similar in head injury and burn injury groups (approximately 2).
Marcus [179]	2008	Health insurance data USA	6-17Y (3 years)	11,770 with ADHD	13.5% of patients had a fracture, 3.7% a poisoning, 2.0% a burn. Rate of injury 0.230(0.222-0.238) per year.
Spinks [180]	2008	Primary school children in Brisbane, Australia	5-12Y (1 year)	811 children in 2001-04	Children with high hyperactivity scores at increased risk of all injuries (OR=1.98 (95%CI 1.48 to 2.64)); medically treated injuries (OR=1.56 (95%CI 1.01 to 2.43)).
Schwebel [181]	2007	Summer camp for children with ADHD in USA.	6-13Y (6 weeks)	22 children (20 had ADHD and 2 had ODD)	Symptoms of ADHD not associated with inury incidence but ODD and CD were. Rate ratio not reported.

First author	Year published	Setting and country (Bold indicates UK)	Ages (Duration of follow-up)	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Lage [182]	2004	Health insurance data USA	6-12Y (1 year)	1775 (344 immediate release MPH vs. 1431 extended release MPH)	OR=0.58(0.35-0.95) for accident/injury comparing people on extended release MPH to those on immediate release MPH.
Davidson [183]	1992	**Community sample in London, UK**	6-8Y (16 months)	1296 boys in 1980	Most injuries were lacerations (41.1%), with fractures 5.1%. No increased risk in injury in hyperactive boys.
Davidson [184]	1988	**Hospital records in UK**	5-8Y (3 years)	951 children	Small effect of injuries with certain behaviours but not overactivity (e.g. for 'overactivity' the attributable risk was 0.6 (95%CI 0.01 to 2.0) in boys and -0.9 (95%CI -0.08 to -1.7) in girls)
Bijur [185]	1986	**British Births Survey, UK**	5Y (five years)	11966 preschool children born 1970. Parents interviewed in 1975.	Comparing those with a high score on the 'overactive scale' compared to those with a low score for the risk of (1) hospitalised injury: RR=2.2 (95%CI 1.7 to 2.8) (2) non-hospitalised injury: RR=1.4 (95%CI 1.3 to 1.5)

1.5.1.2 Case control studies describing the relationship between ADHD and injuries

Table 1-8 summarises case control studies which estimate the odds of injuries in CYP with ADHD[186-214]. All studies except one[214] reported an association between ADHD and injuries. Not all studies reported odds ratios and instead reported statistical associations between ADHD symptoms and patients presenting with injuries, e.g. stating that trauma symptoms are higher in children who have been injured[187 188]. Studies which rely on retrospective reports of injuries from parents may overestimate the odds of injuries in people with ADHD because parents of CYP with behaviour problems are more likely to remember injuries that they may otherwise fail to report. For example, a case control study in Canadian pre-schoolers found parents of CYP with ADHD were more likely to report behaviours that increase injury risk than parents of controls, but attendance rates at emergency departments were similar in cases and controls, suggesting there may have been recall bias in reporting of behaviours that increase injury risk[199]. Alternatively CYP may have more risky behaviours but they or their carers act to reduce the risk by altering their exposure to risks so the injuries do not occur.

A large British cohort study of 5 to 15 year-old CYP found ADHD was associated with an increased risk of fractures occurring at any point during a child's life (OR=1.7 (95%CI 1.2 to 2.4))[206]. However, risk was not measured separately pre- and post-ADHD diagnosis; hence recall and ascertainment biases may have occurred. A Canadian database study by Miller et al. found a relationship between ADHD and increased use of in-patient and ambulatory care services for all injuries (OR ranged from 1.5 to 2 for CYP on methylphenidate treatment

compared to CYP not on methylphenidate treatment)[211]. Although some confounding variables were adjusted for in the study by Miller et al.[204 211], other important confounders were not, including comorbid diagnoses and prescribed medications, which may partially explain the relationship between ADHD and injuries. Past studies have found that certain conditions may confound the association between ADHD and injuries, for example a cohort study in Australia found that people with intellectual disabilities are at an increased risk of injuries, especially people with epilepsy or ADHD symptoms[212].

Table 1-8 Case control studies describing the relationship between ADHD and injuries over time

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Gokcen [187]	2013	OPD, Turkey	4-18Y	92 children admitted to orthopaedic OPD and 60 controls in 2012-2013	ADHD symptoms higher in patients with trauma. ADHD symptoms higher in those with repetitive injuries than those without repetitive injuries. Only p value <0.05 reported (no OR stated).
Ertan [188]	2012	ED, Turkey	3-17Y	55 children with trauma 53 without	Trauma related ED visit more likely in children with ADHD symptoms. OR not reported. P=0.025 for t-test.
Silva [189]	2012	Hospital data, Australia	<18Y	12218 children with ADHD and 28079 controls matched on ethnicity (non-indigineous), age, gender and postcode.	Children under age 4 years (later diagnosed with ADHD) more likely to be admitted with injuries. Cases less than one year old more likely to be admitted with a burn (OR=2.04 (95%CI 1.18 to 3.55)); poisoning (OR=2.59 (95%CI 1.11 to 5.71)); intracranial injury (OR=2.63 (95%CI 1.59 to 4.37)). Also children 2-4 years who were subsequently diagnosed with ADHD were at higher risk of poisoning, motor accidents, falls.

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Karazsia [190]	2012	Primary care paediatric patients USA	2-5Y	114 mothers of children	The increased risk of injury in boys is explained by hyperactivity/inattention and not sex alone. (OR=1.25 for the increase in risk of injury with hyperactivity/inattention)
Schwebel[191]	2011	Community sample from an existing cohort, USA	11Y	4745 fifth graders	Injury risk higher with ADHD symptoms OR=1.22(1.10-1.35). Greater symptoms associated with greater injury risk. CD not associated with injuries.
Shilon [192]	2011	Telephone interviews but recruitment unclear, Israel	6-17Y	29 ADHD vs 29 non-ADHD	Unintentional injuries more common in ADHD compared with non-affected siblings. 13 injuries vs 6 injuries in ADHD vs controls. OR not reported.
Glania [193]	2010	High school children in Greece	12-15Y	1516 high school children	Risk of injury in hyperactivity symptoms was double compared to children without hyperactivity symptoms. Hyperactivity risk factor for minor injuries and attendance at ED with injury. OR stated as the risk of CYP without hyperactivity compared to CYP with hyperactivity was 0.52 (95%CI 0.40 to 0.68)
Maxson [194]	2009	Children admitted to hospital, USA	6-12Y	133 with injuries and 157 without injuries.	Injured patients more likely to screen positive for ADHD symptoms OR=3.25(1.57-6.72)

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Uslu [195]	2008	Children attending the outpatient clinic of the hospital, Turkey	5-16Y	72 consecutive children treated in the in-patient and out-patient departments of a hospital vs 33 without fractures.	Children treated for fractures had higher scores for ADHD symptoms than children not treated for fractures.
Garzon [196]	2008	Parents of children attending ED, USA	25-59M	124 parents of children with injuries and controls who had attended for non-injury reasons	Children with ODD and ADHD have more injury-risk-taking behaviours OR=7.68(2.25-26.25) and OR=4.87(1.17-20.28), repectively.
Pittsenbarger [197]	2008	Children attending ED, USA	5-18Y	82 children with an injury and 82 children without an injury	The rate of ADHD symptoms was the same in the two groups (9.8%).

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Rowe [200]	2007	Community sample from an existing cohort in USA	8-17Y	2822 children from 1412 families	Risk of injury in ADHD was 10% greater compared to those without ADHD, OR=1.10(1.03-1.17)
Lee [198]	2008	National survey data from USA.	3-5Y	191 with ADHD. 13398 controls in 2003-04.	Odds ratio for injury was 2.74 (95%CI 1.63 to 4.59) comparing ADHD to controls, adjusting for sex, age, number of children in household, race, family poverty.
Byrne [199]	2003	Preschoolers recruited from referral population (for the ADHD group) and recruited from schools (controls), Canada	3-6Y	48 preschoolers	58.3% of preschoolers with ADHD exhibited behaviour that increased injury risk vs none of the controls. No actual increase in injuries necessitating ED attendance in children with ADHD.

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Sabuncuoglu [201]	2007	Child psychiatry clinic, Turkey	8-17Y	475 consecutive children	Compared to children without ADHD symptoms, children with ADHD symptoms were more likely to report a traumatic dental injury (OR=17.4 (95%CI 4.1 to 73.6))
Lam [202]	2006	High school children from China.	13-17Y	1429 students	Odds for injury in those with high ADHD symptoms was 1.68(1.18-2.40) compared to those with low ADHD symptoms.
Pastor [203]	2006	National Health Interview Surveys from USA	6-17Y	3741 children with ADHD vs 48243 non-ADHD	Adjusted OR=1.83(1.48-2.26) in ADHD vs non-ADHD for injury
Lam [204]	2005	In-patient hospital data from New South Wales, Australia	5-15Y	18729 children and adolescents	ADHD and suicide/self harm OR=6.27(2.76-14.26); assault OR=3.05(1.31-7.06); other injuries OR=1.00
Swensen [205]	2004	Health insurance data USA	All ages	1308 with ADHD vs. 1308 without	OR=1.68 comparing people of all ages with ADHD to those without for the risk of accidents.
Rowe [206]	2004	**1999 British Child and Adolescent Mental Health Survey**	5-15Y	Over 10000 children	ADHD related to fractures (OR=1.7 (95%CI 1.2 to 2.4)), thermal injuries (OR=1.5 (95%CI 0.7 to 2.9) and poisonings (OR=1.2 (95%CI 0.5 to 2.6)) after adjusting for comorbid psychopathology and psychosocial risk factors.

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Brehaut [186]	2003	Health data from British Columbia, Canada	<19Y	16806 people with ADHD and 1 million people without ADHD	Injury was higher in people with ADHD compared to people without (OR=1.67 (95%CI 1.54 to 1.81), when classified by type of injury (e.g. fractures, burns); OR=1.52 (95%CI 1.40 to 1.66), when classified by cause of injury (e.g. falls, drowning)). OR for fractures adjusting for age, sex, SES and region was 1.42 (95%CI 1.27 to 1.58)). Poisoning adjusted OR=2.67 (95%CI 2.16 to 3.30). Burns adjusted OR=1.99 (95%CI 1.31 to 3.02).
Byrne [199]	2003	Preschoolers recruited from referral population (for the ADHD group) and recruited from schools (controls), Canada	3-6Y	48 preschoolers	58.3% of preschoolers with ADHD exhibited behaviour that increased injury risk vs none of the controls. No actual increase in injuries necessitating ED attendance in children with ADHD.

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Hoare [207]	2003	Referral population, UK	<14Y	196 consecutive referrals to OPD with controls selected from a referral population (with other conditions) in 1998	OR for injury in ADHD vs controls was 1.42 (95%CI 1.13 to 1.78)
Schwebel [208]	2002	Referral population, USA	47-68M	79 consectutive clinic referral patients and 76 demographically-matched boys without disruptive behaviour.	Similar injury rates in those with comorbid ODD and ADHD (25%) vs ODD not ADHD (33%), p=0.46.
Xiang [209]	2005	National Health Interview Survey in USA	5-17Y	57909 children (603 with ADHD) in 2000-02	Nonfatal injuries in the last 3 months. A higher percentage with ADHD than people without a disability had injuries (4.5% vs 2.5% in health children). Adjusting for SES, the risk was significantly higher. (OR=1.65 (95%CI 1.04 to 2.61)).

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Lam [210]	2002	Medical records database New South Wales, Australaia	16-19Y	47120 people admitted due to accidental or self-inflicted injuries in 1996-2000	Most injuries related to road injuries (20.9%); accidental falls (15.3%); assaults (8.2%); misadventure due to medical treatment (8.0%); suicide and self-harm (7.7%). 158 (0.3%) had diagnosed ADHD. Reports on the odds of being diagnosed with ADHD on admission with injury. E.g. self-harm or drug overdose 12 times and 3 times more likely to be diagnosed with ADHD than other forms of injury. Road traffic and accidental falls around half and one third as likely than other types of injury to be diagnosed with ADHD (OR=0.5 (95%CI 0.30 to 0.81)); (OR=0.28(95%CI 0.15 to 0.56)).
Miller [211]	2004	Health and administrative database in Canada	<19Y	17000 people with ADHD and 1 million without ADHD in 1990-96.	Prevalence of service use was higher amongst the ADHD group (except for critical care services in the chronic MPH group). OR ranges from 1.5 to 2 for MPH (nonchronic or chronic) vs no MPH groups for injury-related services (which means Xray, laceration, cast)

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Sherrard [212]	2002	Australian Child and Adolescent Development programme, Australia	5-29Y	465 people in 1990-1996	Pscychopathology (OR=3.4); epilepsy (OR=2.4) associated with injury in people with IQ<70. People with ADHD symptoms are especially at risk of injury. (OR=2.34 (95%CI 1.28 to 4.29)) adjusting for epilepsy and psychosocial comorbidity
DiScala [213]	1998	Medical records from National Paediatric Trauma Registry, USA	5-14Y	240 with ADHD and 21902 without ADHD in 1988-96.	OR adjusted for age and sex for pedestrian injuries OR=1.69 (95%CI 1.26 to 2.26) comparing ADHD to no ADHD children. For severe (ISS 20-75) OR=2.29 (95%CI 1.54 to 3.39)
Bijur[214]	1988	Child Health and Education study in UK	5-10Y	10934 children in UK in 1975.	There was no significant association between aggressive and overactive behaviours and injury history.

1.5.1.3 Cross-sectional studies describing the relationship between ADHD and injuries

Table 1-9 summarises cross-sectional studies which estimate the risk of injuries in CYP with ADHD[215-219]. Cross-sectional studies may provide a comparison of the association between injuries and ADHD at one point in time. Therefore caution must be exercised in interpreting the findings of these studies. However, within these studies the findings are mixed. For example, in a survey of French school children, depending on whether hyperactivity was measured by child report or parent report, children reporting hyperactivity were twice as likely to have been injured but when hyperactivity was measured by parent report there was no association[215]. Cross-sectional studies reported associations between behaviour symptoms as well as diagnosed ADHD and injuries. Four studies reported findings from referred populations or hospital populations [190 216-219]. However, studies that rely on referred patients may not be representative of the CYP in the primary care population who are diagnosed with ADHD and measuring ADHD symptoms may overestimate the prevalence of clinically diagnosed ADHD in the study population. One study used a community based population from a school to measure ADHD symptoms and estimate the risk of injuries[215].

Table 1-9 Cross-sectional studies describing the relationship between ADHD and injuries over time

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Constant [215]	2014	School children in France	6-11Y	1258 children	Parents estimate more behaviour problems and hyperactivity than children but underestimate emotional symptoms compared to children. Unintentional injury in previous 1Y in 14.6% of children and twice as high in children reporting hyperactivity/inattention. However, if measured by parent-report then association not present.
Amanullah [216]	2013	People attending paediatric ED.USA	8-17Y	811 children	152 (18.7%) had ADHD. 319 (31.9%) were injured. Children with ADHD were no more likely to present with injury vs illness than children without ADHD (37.5% vs 39.5%, p=0.6).

First author	Year published	Setting and country	Ages	Numbers and types of participants or observations (dates of study if known)	Summary of findings
Ayaz [217]	2013	Referral patients in hospital in Turkey	6-18Y	1430 children. 187 with injury; 1247 without injury.	Injury group had higher scores for ADHD symptoms (but only p values are given).
Taner [218]	2007	Children with musculoskeletal trauma in Turkey.	7-12Y	125 children	65 out of 125 (52%) had ADHD. 35 out of 46 needed orthopaedic intervention after the injury (76%). 30 out of 79 (37%) with simple trauma needed no orthopaedic intervention and had ADHD.
Schwebel [219]	2006	Children referred to paediatric behaviour disorders clinic in USA.	5-11Y	29 children referred to clinic, observed in simulated environment.	ADHD symptoms were not associated with children's dangerous behaviour in the simualted environment. (correlation coefficient 0.19 with p value reported as 'not significant') where 1 indicates perfect correlation and 0 indicates no correlation.

1.5.2 Summary

In summary, detailed and reliable estimates of the risk of fractures, thermal injuries and poisonings are not available for the UK primary care population known to have ADHD. There are likely to be confounding conditions, such as ODD, deprivation, age, sex and region that have not been adjusted for in previous studies. It is important to know if ADHD does increase the risk of injury as treatment or injury prevention interventions may reduce this risk.

1.6 Databases to be used for the studies in this thesis

The CPRD mentioned in Section 1.1.2 above contains the primary care medical records of approximately 12 million people (66 million person years of follow-up) from 625 GP practices, and representing 8% of the UK population[220]. The data collected are audited regularly and subjected to quality checks (e.g. ensuring that a minimum of 95% of patient encounter events are recorded, validation checks and audits[221]. Previous systematic reviews have shown that the CPRD is a valid and reliable source of data for research[222 223].For example, a recent systematic review of validation studies of the CPRD reported that a median (range) 81.00 (39-100)% of nervous system diagnoses and 89.52 (73-100)% of injury diagnoses were confirmed by GP record request, algorithm and manual review[222]. The CPRD contains information on consultations with the GP, hospital attendances and admissions coded using Read codes[224] as well as information on prescriptions[49]. Read codes use a system similar to the ICD

system[224]. The medical records can be searched for diagnostic codes and medication codes describing prescribed medication. In order to maintain anonymity, an individual's name, address, date of birth and (for children) month of birth is withheld by CPRD.

The HES data mentioned in section 1.1.2 above records data on overnight admissions to hospital for patients in England. HES data is collected for administrative purposes but allows researchers to identify details of a person's admissions to hospital for overnight stays including for treatment and for operations. HES data include diagnosis codes, using the ICD version 10[103], and procedure codes, using the Office of Population Censuses and Surveys (OPCS-4) version 4[225] from inpatient admissions to hospital in England. HES data has been used for research on injuries such as hip fractures[226] because serious injuries such as hip fractures are likely to result in a person being admitted overnight to hospital and to have an operation. HES data are unlikely to be useful for identifying injuries that do not result in an overnight hospital admission.

CPRD and HES have been linked in around half of the English practices that contribute data to the CPRD. The first complete year with HES-linked data was 1998 and the last year complete year that HES-linked data were available for the work in this thesis was 2012. The link between CPRD and HES practices was based on individual GP practices consenting to the link[220] but previous work has shown that the HES-linked population is similar to the overall CPRD population in terms of age, sex and region[227].

1.7 Outline and research questions in the thesis

This thesis describes three linked studies designed to describe the risk of injuries in two specific cohorts of CYP in the primary care population. In order to accurately estimate the risk of injuries in a population of CYP with epilepsy compared to the general population, firstly a cohort of CYP with epilepsy was defined using the CPRD and the risk of injuries in this cohort was compared to a population of CYP without epilepsy. Secondly, a cohort of CYP with ADHD was defined using the CPRD. Thirdly, the risk of injuries in the cohort of CYP with ADHD was compared to a population of CYP without ADHD using both the CPRD and HES-linked data. This work is described under the following chapter headings:

1. Study to estimate the risk of fractures, thermal injuries and poisonings in children and young people aged 1 to 24 years with epilepsy compared to people without. (Chapter 2)
2. What is the prevalence of attention-deficit hyperactivity disorder (ADHD) in children and young people under 18 years old in the Clinical Practice Research Datalink (CPRD)? (Chapter 3)
3. What is the risk of fractures, thermal injuries and poisonings in children and young people with attention-deficit hyperactivity disorder (ADHD) compared to children and young people without aged between 3 and 17 years old in the Clinical Practice Research Datalink (CPRD)? (Chapter 4)

1.8 Rationale for how the proposed work fits with the overall aims of the thesis

At the outset of the work contributing to this thesis it was aimed to estimate the risk of fractures, thermal injuries and poisonings in CYP with ADHD. The method proposed was to use the CPRD within which linked hospital records were available. In order to explore the feasibility of using the CPRD and the effect of using linked hospital data to describe the epidemiology of fractures, thermal injuries and poisonings it was necessary to show that the CPRD could be confidently used to estimate the risk of injuries using these data because this had not been done in the population of CYP before. Epilepsy was chosen for the first study as it is a chronic neurological condition which is well described in terms of epidemiology and the risk of injuries in epilepsy has been estimated using the CPRD in all ages Once the CPRD had been used to estimate the risk of fractures, thermal injuries and poisonings in CYP with epilepsy compared to CYP without epilepsy it was shown that the risk of injuries could be estimated using this method. Further work was then done to describe a population of CYP in the CPRD with ADHD because this had not been done in this way before. Once a population of CYP with ADHD was identified and the variation in the prevalence of ADHD by age, sex, deprivation and region was described, the risk of fractures, thermal injuries and poisonings was estimated using the CPRD and linked hospital medical records.

2 Study to estimate the risk of fractures, thermal injuries and poisonings in children and young people aged 1 to 24 years with epilepsy compared to people without.

This chapter describes the process by which a cohort of CYP with epilepsy was defined using the CPRD and a cohort study conducted to describe the relationship between epilepsy and injuries, namely: fractures; thermal injuries; poisonings, using the CPRD.

2.1 Background

As described in section 1.2.1, epilepsy is a common neurological condition in the UK affecting 5 per 1000 people[52]. Worldwide and in the UK, injuries are a leading cause of morbidity and mortality in CYP[228] and are a financial burden to the health care system[229]. Since both epilepsy and injuries are common in CYP, it is important to have accurate estimates of the risk of injuries in order to inform CYP, their parents and health professionals.

Previous studies, mainly in adults, suggest epilepsy is associated with an increased risk of injuries,[90 230] thought to be due to the seizures themselves, and adverse effects of AED's[78 231]. Earlier studies on epilepsy and injuries may have overestimated injury risk by using populations with more severe epilepsy, such as institutionalised adults[232], or people in epilepsy clinics[230]. Questionnaire-based studies ascertaining injury retrospectively are subject to recall bias, with caregivers or relatives are more likely to recall an injury if the participant has epilepsy[90]. Few studies

have measured the rate of injuries prospectively in the general population[70 71 233]. A prospective European study in over 5 year-olds found no increased injury risk associated with epilepsy[70], whilst a US study concluded the risk of serious injuries in epilepsy is minor[71] and a UK study using the Clinical Practice Research Datalink (CPRD) reported the risk of fracture in people with epilepsy to be double compared to people without epilepsy[68]. However, none of these studies focused on CYP with epilepsy; hence there is a lack of data for informing people with epilepsy about injury risk. Therefore, this chapter investigates whether CYP with epilepsy are at an increased risk of fracture, thermal injury, or poisoning compared to people without epilepsy and estimated the risk of injury up to five years after diagnosis with epilepsy.

2.2 Aims

To explore associations between epilepsy and fractures, thermal injuries and poisonings in CYP.

2.3 Objectives

To estimate the risk of injury (for fractures, thermal injuries and poisonings), using the General Practice (GP) medical records of people aged 1 to 24 years old from the Clinical Practice Research Datalink (CPRD) from 1st January 1987 up to 31st December 2009, comparing people with epilepsy to people without. The risk of the first injury to occur (defined as the first injury recorded after CYP commence in the study) was estimated separately for:

1. fractures.

2. fractures occurring within five years of the first record of epilepsy.
3. thermal injuries.
4. thermal injuries occurring within five years of the first record of epilepsy.
5. poisonings
6. poisonings occurring within five years of the first record of epilepsy.

2.4 Methods

2.4.1 Study design

Historical cohort study.

2.4.2 Study population

The study population consisted of CYP with epilepsy (exposed), and CYP without epilepsy (unexposed). The data management for the people with epilepsy will now be described.

2.4.2.1 Extracting information on people with epilepsy from the CPRD

Previously data was available to academic researchers under a licence from the Medical Research Council (MRC). The data obtained for the study in chapter 2 of this thesis were obtained under the MRC licence provided by CPRD. Data were available from the date of inception of the CPRD (1st January 1987)[234] up to 31st December 2009 (the last complete year at the time the data were extracted for this study). Data were delivered in flat files and required cleaning. For example, variables in the dataset which were not required were dropped from the data and variables that were

numerical but not recognised by the software as numbers ('string variables') were converted to numbers ('destringed').

People were taken from the CPRD, which has been described in section 1.6 above and therefore the description will not be repeated here.

Epilepsy prescriptions are likely to be well recorded because hospital specialists diagnose the condition and on-going prescriptions are provided by the GP[49 53]. Code lists used to search the records were drawn up by myself (a GP) and reviewed by a senior clinical academic colleague (also a GP). The code list for epilepsy was also compared with that of another PhD student (MA) and the code list for injuries were compared with that of a Masters in Public Health student (RB). Inconsistencies were resolved by discussion with the senior clinical academic colleague and a consensus was reached. Descriptions for each Read code are available in the appendices, grouped according to the variable in the final dataset that they were used to create (see appendices 6.13 and 6.14).

Data were provided to me by CPRD in which CYP with epilepsy were frequency matched by practice and age with up to five people without epilepsy. For the purpose of matching, age was described as age at the end of the CPRD registration period in bands of: 0-4; 5-9; 10-14; 15-19; 20-24 years. Frequency matching was used rather than individual matching because this enabled adjustment of estimates for the effect of age band and practice.

2.4.2.1.1 Data management – generation of study cohort

Data were delivered in flat files representing all aspects of the GP record.

2.4.2.1.1.1 Flow of data and definition of study population

Figure 2-1 shows how individual data files were merged in order to create a final dataset for the study population. Data in individual flat files were labelled and prepared, e.g. where the date of birth was withheld, 1st July was used. Each time that two data files were merged together a variable common to both data files was used to perform the merge.

Diagnosis codes for epilepsy were merged with the clinical file (which contained all diagnosis codes on the GP record). The resulting file was merged with the patient file (which contained individual-specific information, such as year of birth) using a unique identity number.

The process was repeated with the epilepsy drug codes. The data in the files were arranged in date order, with the earliest diagnosis code or drug code first and only the first row of data was retained. The resulting files were merged together to create a dataset with one line of data per person. The file was then merged with the practice file to give practice-level information (such as the date the practice joined the CPRD).

Figure 2-1 Data management: Defining people with epilepsy and people without (*Italics* – indicate variable on which files merged)

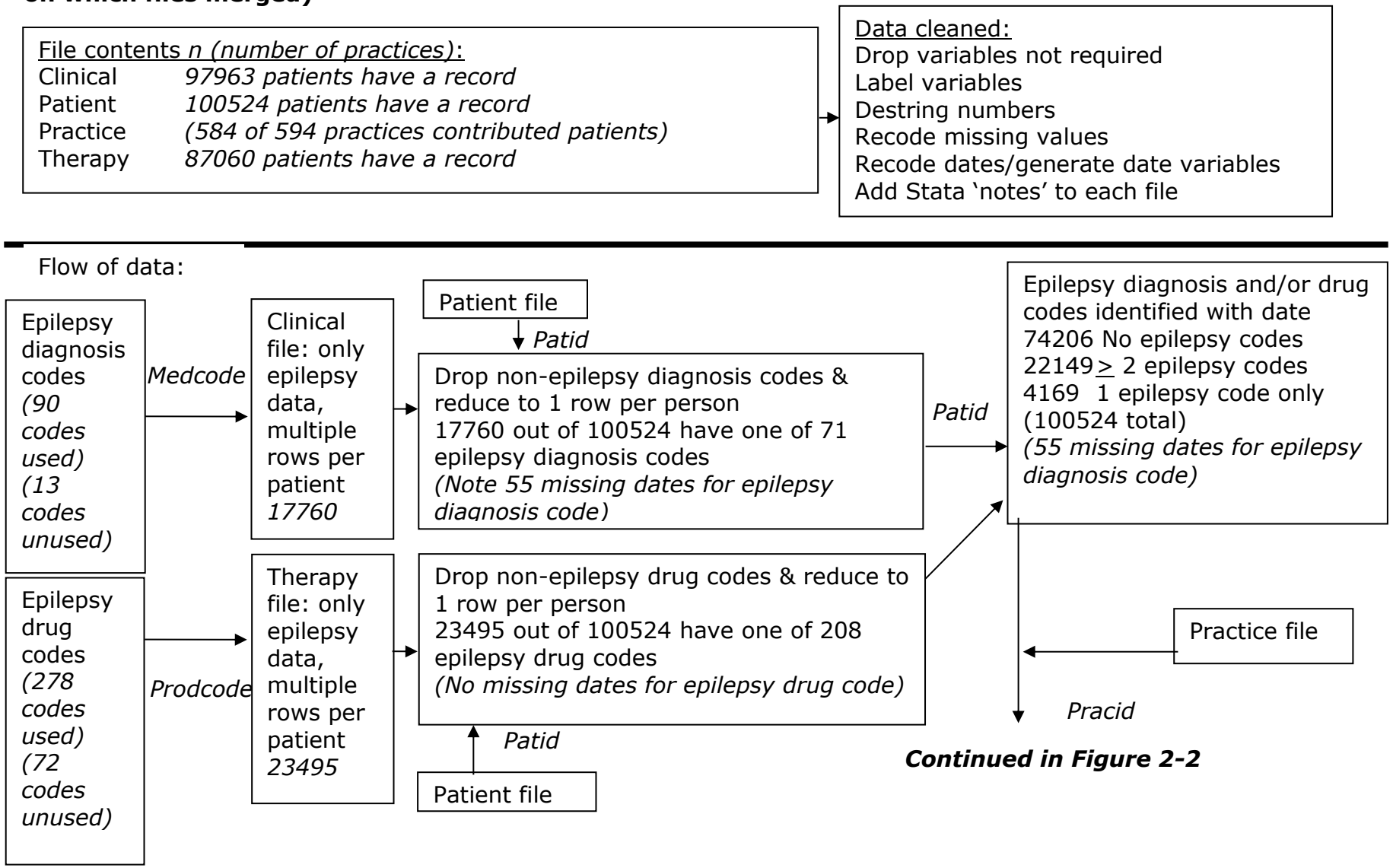


Figure 2-2 shows how the cohort was subdivided. People with no evidence of epilepsy were placed into the non-epilepsy cohort (n=74,206). People with at least two codes for epilepsy were placed in the epilepsy cohort (n=22,143). People with only one code for epilepsy (including people with two epilepsy codes but where the date was missing for one or both codes) were placed in the 'one epilepsy code only' group (n=4,175).

Figure 2-2 How the cohort was subdivided into groups

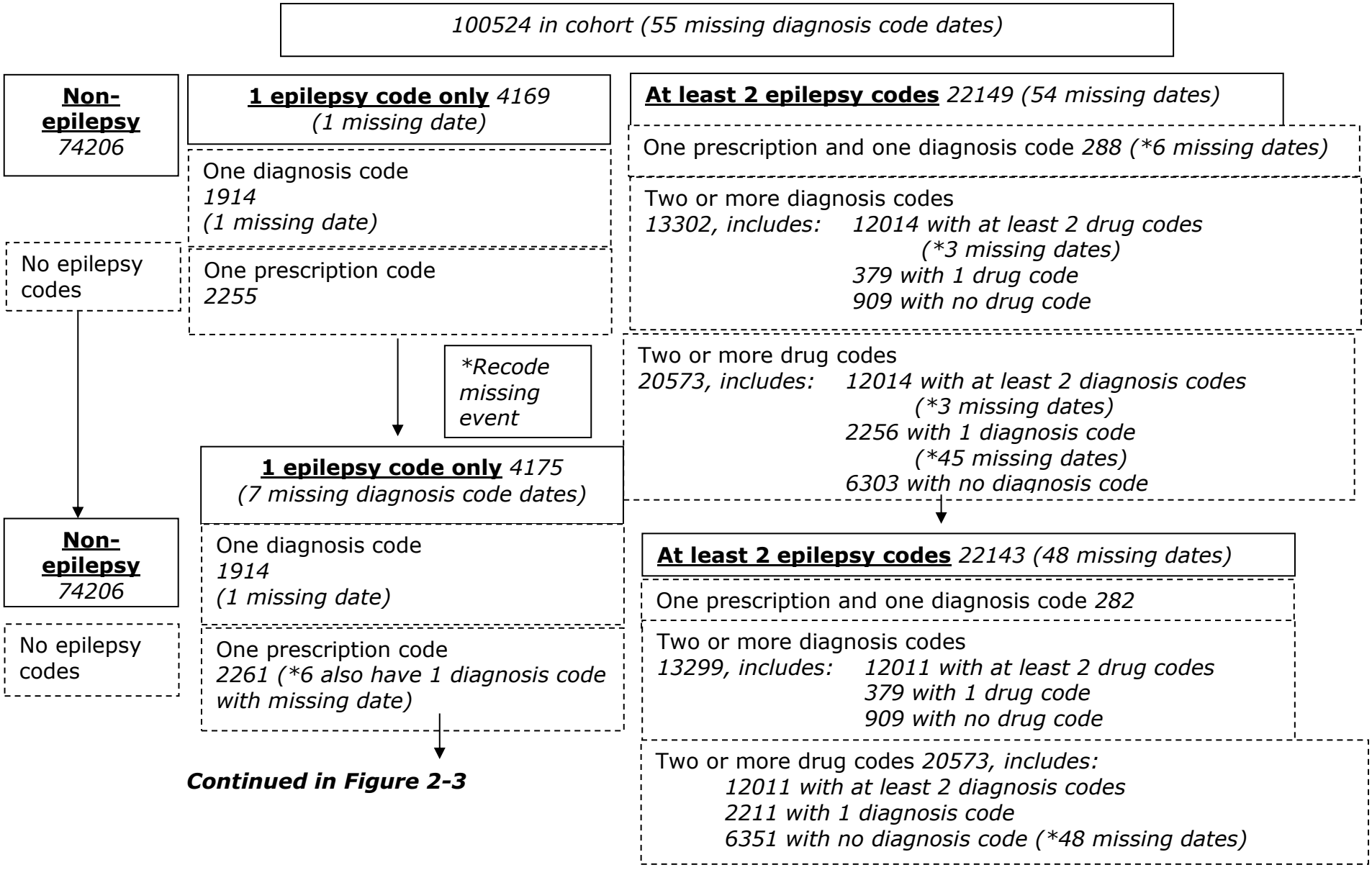


Figure 2-3 shows how epilepsy groups were defined, as follows. Group: A - at least two drug and at least two diagnosis codes (n=12,011); B – at least two diagnosis codes (n=1,288); C – at least two drug codes (n=8,562); D – one drug and one diagnosis code (282); E – only one drug code or only one diagnosis code or one drug code with a diagnosis code with missing date (n=4,175).

Figure 2-3 How epilepsy groups were defined

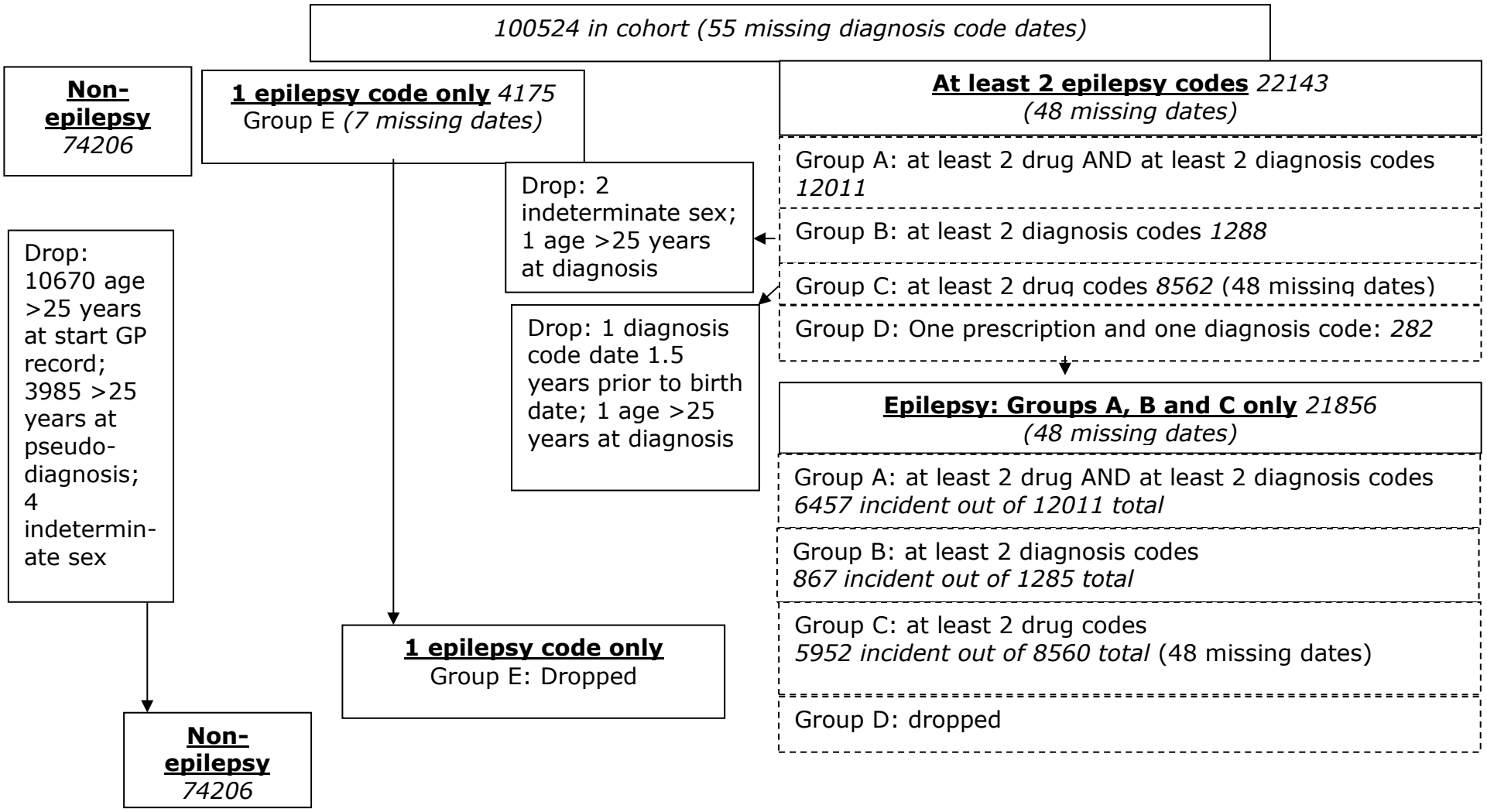
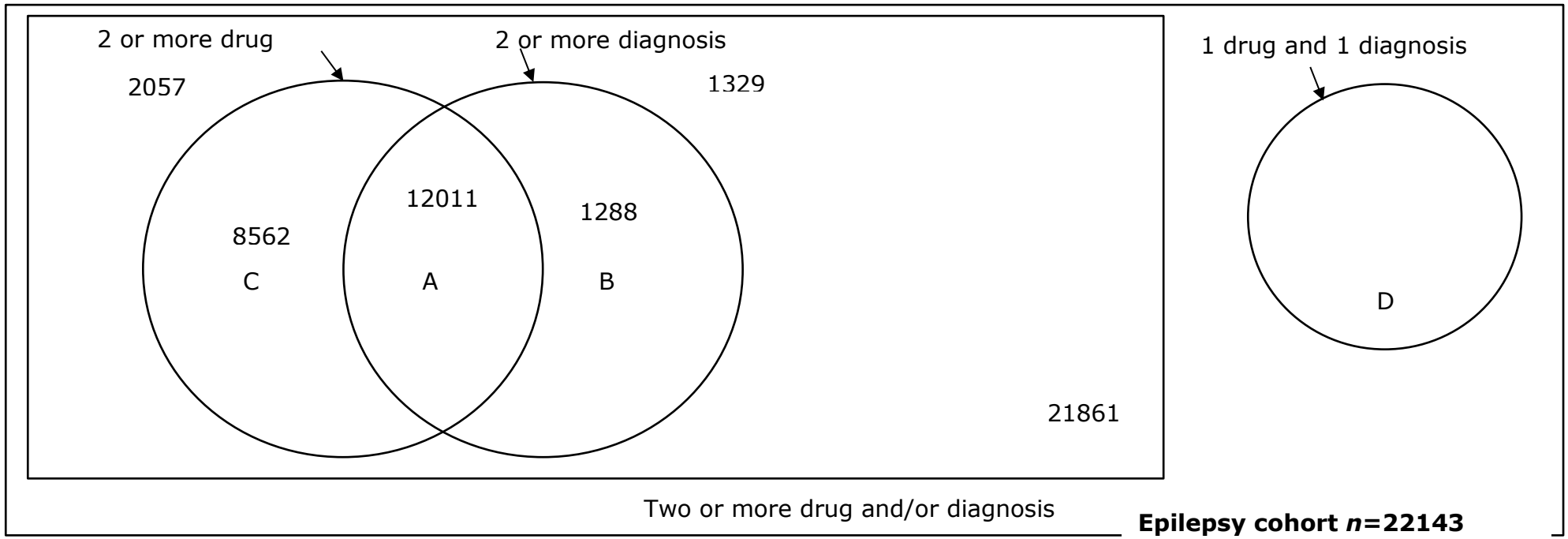


Figure 2-4 shows the distribution of people with epilepsy in groups A to D in a Venn diagram. As it could not be certain that people in group D had epilepsy, these individuals were dropped from the study cohort (n=4,457) (Figure 2-3). Individuals with other data inconsistencies (such as indeterminate sex) were also dropped (n=8)

Figure 2-4 Definition of children and young people with epilepsy (Groups A to D) (after recoding people with missing dates)

Group A: at least two drug codes and at least two diagnosis codes
Group B: at least two diagnosis codes
Group C: at least two drug codes
Group D: at least one drug and one diagnosis code

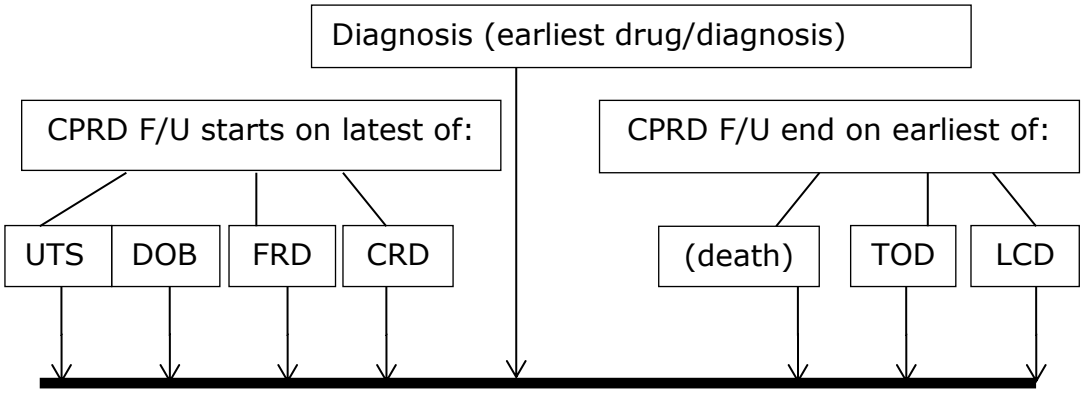


* 48 missing event dates in diagnostic codes

2.4.2.1.1.2 Definition of dates

People from the CPRD aged 0 to 24 years, between 1st January 1987 to 31st December 2009 inclusively contributed data. Dates were defined as follows (Figure 2-5).

Figure 2-5 How dates were defined in the cohort



Note: CPRD F/U, CPRD follow-up; UTS, up-to-standard; DOB, date of birth; FRD, first registration date; CRD, current registration date; TOD, transfer out date; LCD, last collection date.

2.4.2.1.1.3 Start of CPRD follow-up

CPRD follow-up was the total potential duration of follow-up available in a person's GP record. CPRD follow-up started with the latest of: the practice data being up-to-standard (UTS); the person's first registration date with the practice (FRD); the person's current registration date, in cases where they have left and re-joined the practice (CRD). The 'UTS' date is defined as the date on which a GP practice's data are regarded as of sufficient quality for research, after an audit of the data has shown that at least 95% of prescribing and morbidity events are recorded[221].

The age of a person at the start of the GP record was calculated and people older than 24 years at the start of the CPRD record (n=10,670) were dropped from the cohort (Figure 2-3).

2.4.2.1.1.4 End of CPRD follow-up

CPRD follow-up ended with the earliest of: death of the person; the person leaving the practice; or the practice leaving the CPRD (Figure 2-5).

2.4.2.1.1.5 Diagnosis date

In the case of people with epilepsy, this was the earliest date of any epilepsy prescription or diagnosis code. In the case of people without epilepsy, a random date was assigned for their 'pseudodiagnosis' that fell between three months after the start of CPRD follow-up and the end of CPRD follow-up. A pseudodiagnosis date was chosen for people without epilepsy because this allowed the child or young person to start in the study at similar ages to the epilepsy cohort. People aged above 24 years

at (pseudo)diagnosis were dropped (n=3,985 without epilepsy; n=2 with epilepsy) (Figure 2-3).

2.4.2.1.1.6 Defining incident children and young people

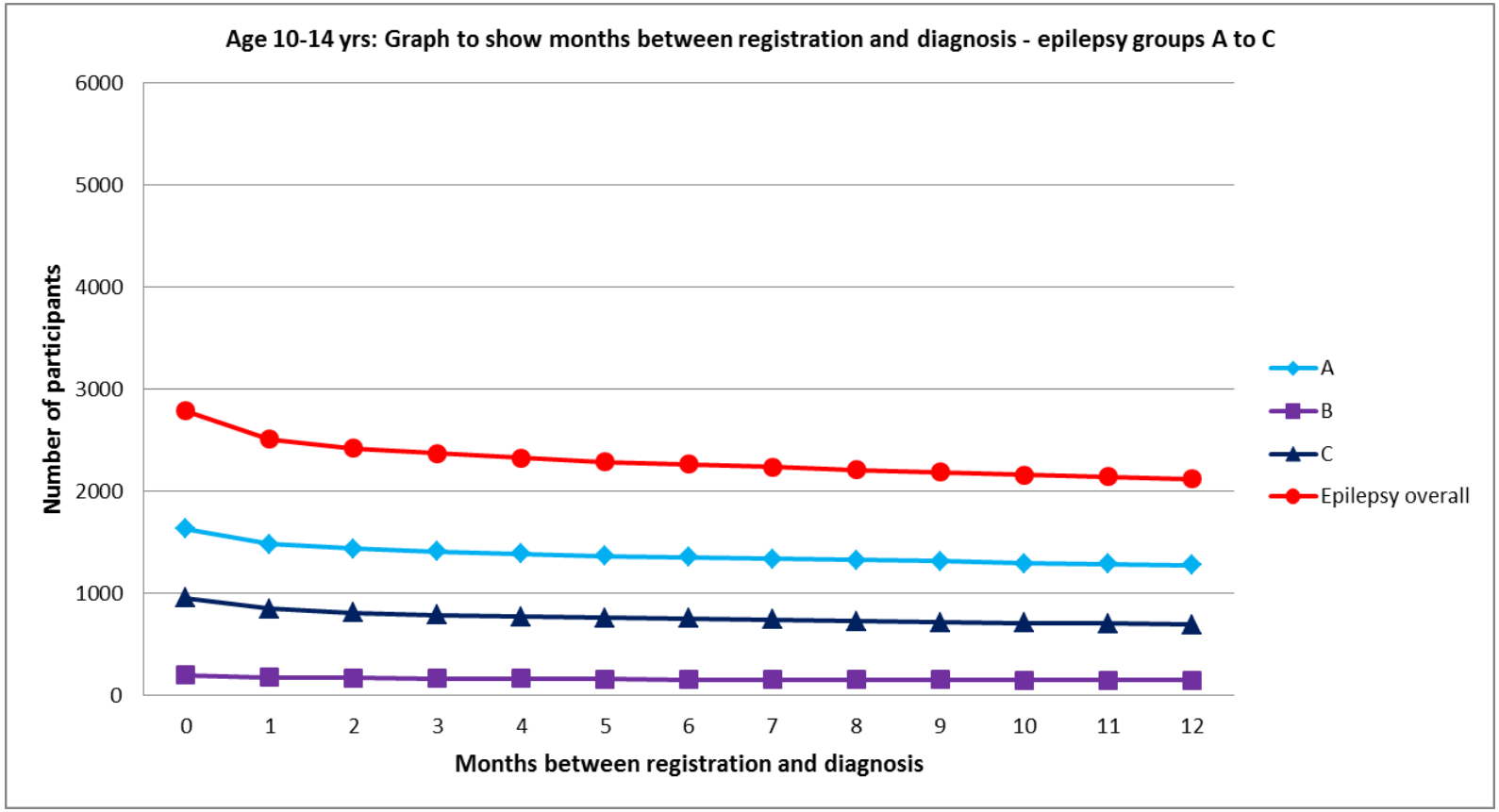
Each time a person registers with a new GP; past medical diagnoses (prevalent diagnoses) are recorded on the GP record by the GP. Consequently, the date for past diagnosis codes can be recorded incorrectly as the date of data input, for example when the individual first sees the GP after registration. This can lead to the impression that the diagnosis was made after registration (incident diagnosis).

A paper by Lewis et al. (2005) explored incidence rates of common acute, chronic and cancerous conditions in terms of the time since registration[235]. Eight chronic conditions, not including epilepsy, were studied in all ages. They showed that, when people register with an UTS practice, the time for incidence rates of chronic conditions to reach a plateau could be as long as 12 months (in the case of asthma) or four-six months in the case of other conditions (such as diabetes)[235]. As these results may not apply to the present population, because Lewis et al. did not study epilepsy and included all ages, a similar analysis was performed in the study cohort.

The time between the start of registration with the GP and diagnosis of epilepsy was explored (appendix 6.2). It was thought that the time at which the number of new epilepsy cases plateaus is likely to be the time at which new cases are genuinely incident. This was done for separate age groups because it was thought that the problem of inaccurate recording of diagnosis dates was less likely in younger children, who are unlikely to have a past diagnosis of epilepsy, and more likely in those over 15 years

of age because they may leave home and register with a new practice. Also attendance rates are known to vary by age and children under five years attend more frequently[236] so this would give more opportunity for epilepsy diagnosis codes to be recorded after registration than in older age groups. Figure 2-6 is shown as an example of a graph to show the number of CYP aged 10 to 14 years according to the number of months between registration with the GP and the diagnosis of epilepsy. It shows that the number of CYP diagnosed with epilepsy is at a peak at the time of registration and that this declines after three months.

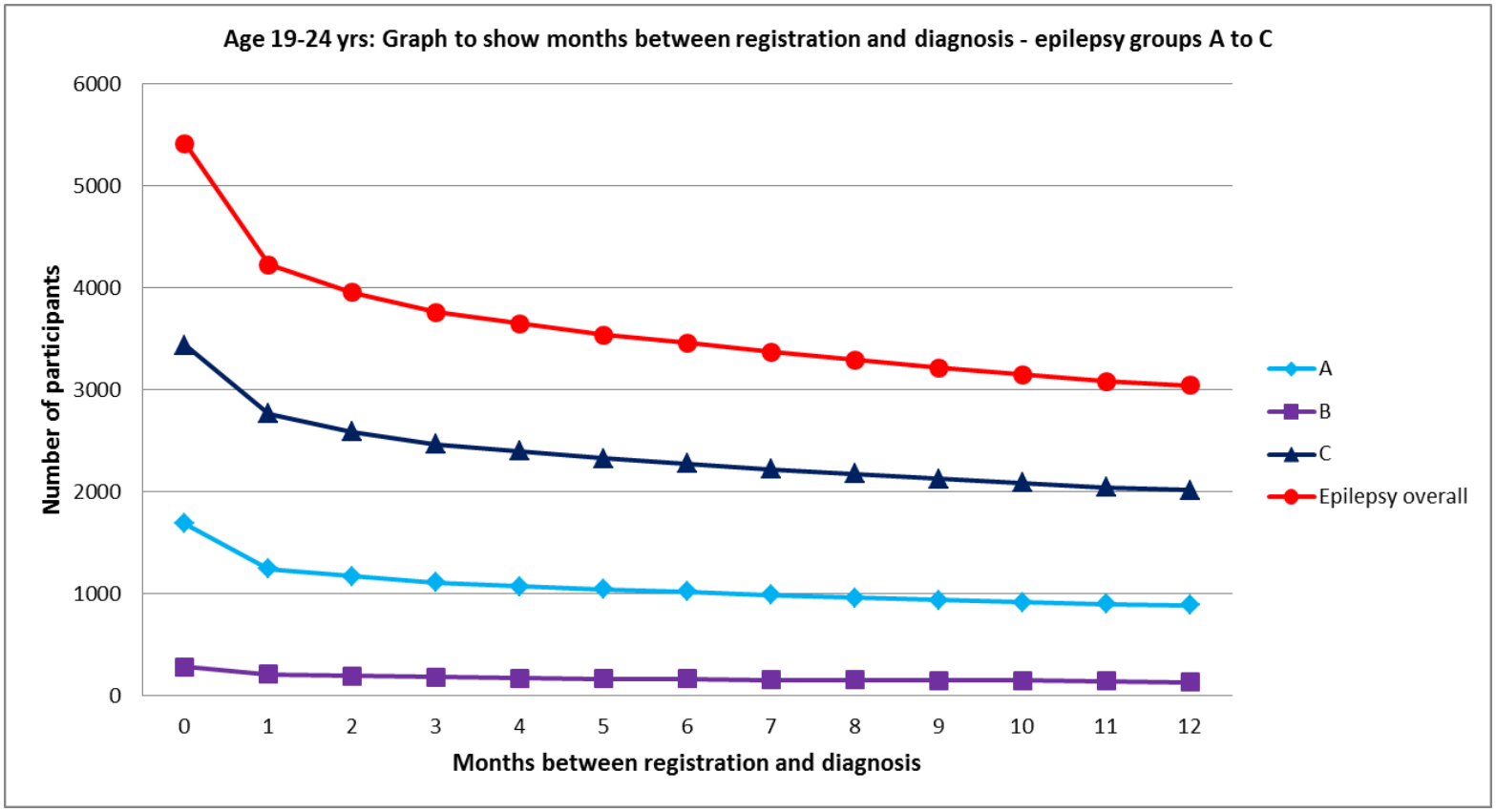
Figure 2-6 The number of people with epilepsy aged 10 to 14 years according to the number of months between registration with the GP and date of diagnosis



A: At least 2 drug codes & at least 2 diagnosis codes; B: At least 2 diagnosis codes & less than 2 drug codes; C: At least 2 drug codes & less than 2 diagnosis codes

In contrast, Figure 2-7 is shown as an example of a graph to show the number of CYP aged 19 to 24 years according to the number of months between registration with the GP and the diagnosis of epilepsy. It shows that the initial gradient is steeper and the graphs take longer to plateau.

Figure 2-7 The number of people aged 19 to 24 years with epilepsy according to the number of months between registration with the GP and date of diagnosis



A: At least 2 drug codes & at least 2 diagnosis codes; B: At least 2 diagnosis codes & less than 2 drug codes; C: At least 2 drug codes & less than 2 diagnosis codes

Therefore, the diagnoses made after three months from registering with the GP were regarded as incident diagnoses for children under 15-years-old because the graphs appeared to plateau within three months for these age groups. However, for children and young people over 15 years of age, diagnoses made after six months from registering with the GP were regarded as incident diagnoses because the graph appeared to plateau later in these groups. This finding probably reflects CYP over 15 years of age being more likely to join new practices when leaving home or university. These assumptions were in agreement with Lewis et al.'s findings in other medical conditions[235]. People with prevalent epilepsy (diagnosed prior to CPRD follow-up) were excluded (n=8,580) because the temporal relationship between diagnosis date and injury could not be estimated with certainty, due to the practice not being UTS for quality of data recording at the time of the diagnosis of epilepsy.

2.4.2.1.1.7 Definition of age

Age was described in terms of the age of individuals at (pseudo)diagnosis. The age bands chosen were: 0; 1; 2; 3; 4; 5-9; 10-14; 15-18; 19-24. One-year age bands were chosen under five years because children's injury risk was expected to change with the rapidly changing developmental stages during this age period[17]. The older age groups were chosen at 15-18 and 19-24 year old because 18 years of age reflects the end of secondary education in the UK. Therefore it was expected that the injury risk in CYP may change when children leave school.

2.4.2.1.1.8 Exploration of diagnosis and drug codes describing people with epilepsy

Once people with and without epilepsy were identified, the first diagnosis (appendix 6.3) and drug codes (appendix 6.4) identifying people with epilepsy were described in order to confirm the diagnosis codes and drugs defining the epilepsy cohort were specific to epilepsy.

Appendix 6.3 details the most frequent Read codes identifying people with epilepsy by age at diagnosis with epilepsy. In all ages and in both sexes the non-specific code, epilepsy, was used in more than 70% of participants. This finding confirmed the findings of Souverein et al, who used the CPRD to estimate the risk of fractures in people with epilepsy of all ages and also found that in the majority of people (89.3%) with epilepsy a non-specific epilepsy diagnosis code was used[68].

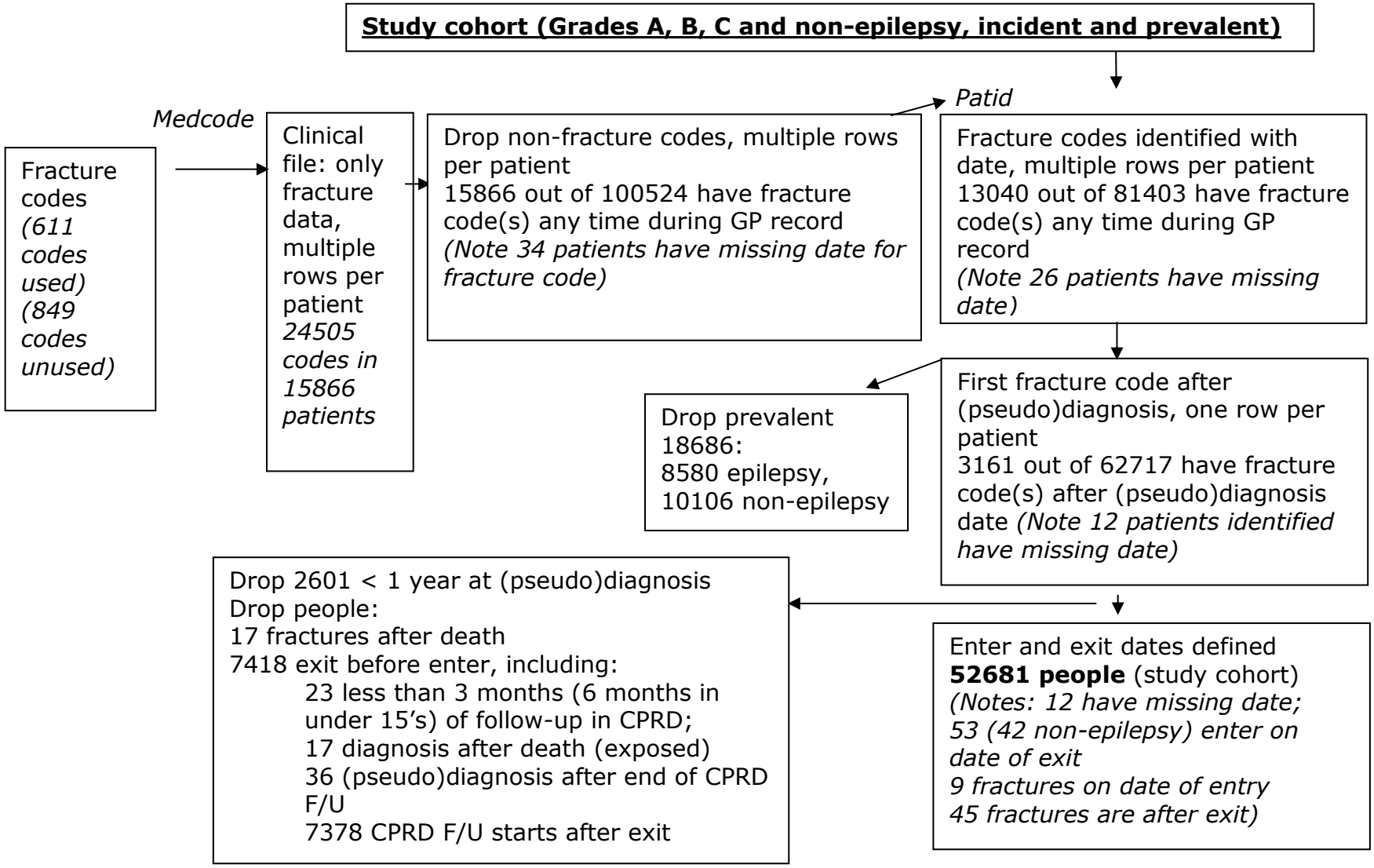
Appendix 6.4 details the most frequent first drug to be prescribed for children and young people with epilepsy by age and sex. It shows that in the under one-year-olds phenobarbital was the most frequently prescribed first drug in children with epilepsy and in 19-24 year olds gabapentin was prescribed in 10.2% of males and 15.4% of females with epilepsy. In one to 15-year-olds with incident epilepsy, sodium valproate (25.5%-66.7% of children within the age band) and carbamazepine (19.1%-33.7% of children within the age band) were the two most frequently prescribed drugs. A recent European survey of paediatric epilepsy specialists concluded that commonly used anti-epilepsy drugs included sodium valproate and carbamazepine[237] which is in keeping with these findings.

Gabapentin and pregabalin are anti-epileptic drugs but are also used in young people and adults for other indications, such as chronic pain. In people with epilepsy over 15 years old, gabapentin and pregabalin appeared in the 10 most frequently first prescribed drugs. As these drugs are not specific to epilepsy in these ages, it was decided to conduct a sensitivity analysis on this group, excluding people prescribed these drugs, to examine the effect on the estimated risks.

2.4.2.1.1.9 Definition of fracture outcome and restriction of cohort to incident diagnosis

Figure 2-8 shows the flow of data in the cohort to identify the first fracture after (pseudo)diagnosis. Individuals without epilepsy with a pseudodiagnosis date between 3 and 6 months from the start of the GP record were also excluded (n=10,106) because the first six months of the GP record for individuals with an age of 15 years or more may have included codes that had been recorded by the GP since registration but which had occurred in the past. As the date of pseudodiagnosis was randomly assigned, some individuals had a date of pseudodiagnosis less than six months since registering with the current GP by chance. The process of identifying the first: long bone fracture; thermal injury; poisoning, was similar to the process of identifying the first fracture of any type.

Figure 2-8 Data flow any fracture



2.4.3 Definition of outcome

The outcome was the first injury to occur after (pseudo)diagnosis of epilepsy. Each injury type (fractures, thermal injuries and poisonings) was chosen *a priori* and identified using a list of Read codes (appendices 6.15 to 6.17). Both mechanisms of injury (e.g. accidents caused by fire and flames) and anatomic sites of injury (e.g. burn of lower limbs) were included to maximise ascertainment of injuries.

2.4.3.1 Start of study follow-up

For people with epilepsy, study follow-up started with the date of diagnosis. In people without epilepsy study follow-up started at pseudodiagnosis.

2.4.3.2 End of study follow-up

Study follow-up ended with the earliest of the date of the first injury code, leaving the CPRD (e.g. transfer to a new practice), or 31st December 2009. People who had a record of the injury before the date of (pseudo)diagnosis were excluded from the analysis of that injury type because people with a previous injury have a higher risk of a subsequent injury[238 239].

2.4.3.3 Subgroup analyses

The relationship between epilepsy and long bone fractures was explored (as indicators of severe injury[30 240]). Also the relationship between epilepsy and medicinal (and non-medicinal) poisonings was explored (as people with epilepsy may have greater access to medicines than people without).

In the analysis of medicinal poisonings, people with a non-medicinal poisoning or a poisoning due to an unknown cause were excluded from the analysis. Similarly, in the analysis of non-medicinal poisonings, people with a medicinal poisoning or a poisoning due to an unknown cause were excluded from the analysis.

2.4.3.4 Study size

There were 100,524 potential individuals in the cohort, including people without epilepsy. After restricting to individuals with incident epilepsy and people without epilepsy, with data after the pseudodiagnosis date, the final cohort consisted of 52,628 people (10,447 with epilepsy; 42,181 without epilepsy).

2.4.4 Definition of confounders

A confounder is a factor that is associated with the exposure of interest (in this case epilepsy) and also independently associated with the outcome of interest (in this case fracture) but is not on the causal pathway between epilepsy and fracture. For example, age is a confounder because as children grow and develop, the risk of fracture changes with developmental stage (as described in section 1.1.1.1). Epilepsy diagnosis is also associated with age such that epilepsy prevalence varies by age group (as described in section 1.2.2). Hence age is independently associated with both epilepsy and fracture. Estimates were adjusted for age, sex, SHA region of the practice, socioeconomic status and calendar year at study entry. The IMD of the GP practice was used as a proxy measure of the person's socioeconomic status. IMD scores were categorised into national (England, Scotland, Wales and Northern Ireland)

quintiles. Using Read codes, several comorbid conditions were identified that may confound the relationship between epilepsy and injury. These included ADHD; behaviour disorder (including oppositional defiant disorder, antisocial behaviour and behaviour disorder), learning disability and cerebral palsy.

2.4.5 Statistical analysis

Categorical variables were described using frequencies and proportions. The age bands chosen were: 1; 2; 3; 4; 5-9; 10-14; 15-18; and 19-24 years for analyses on fractures but in the analyses on thermal injuries and poisonings under 5 year-olds were grouped together due to small numbers of events. Crude rates were estimated for the first type of each injury after diagnosis for people with and without epilepsy, with 95%CIs. HRs were estimated for CYP with epilepsy compared to CYP without, using a Cox regression model. A Cox regression model was chosen because it was assumed that the probability of an injury occurring vary over follow-up time for CYP with and without epilepsy but that the variation in probability would be in proportion for CYP with epilepsy compared to CYP without epilepsy. HRs were adjusted for confounders (age, sex, SHA region, practice level deprivation and calendar year at study entry). Adjustments were then made for each comorbid condition (ADHD, behaviour disorder, learning disability, cerebral palsy) in turn. When adjustment for a comorbid condition led to a change of >10% in the adjusted HR the confounder was retained in the model and the remaining comorbid conditions were assessed for inclusion in the model as described.

Interactions were explored by age and sex by adding interaction terms to the models with a $p<0.05$ taken as statistically significant. Where variables could have been treated as linear or categorical the variable was fitted as a linear term in the test for interaction. Models were checked by inspection of plots of the logarithm of cumulative hazard against time, Schoenfeld residuals against time and a statistical test for non-proportional hazards. The number of CYP out of a thousand who had an injury within five years of diagnosis was estimated for each injury type.

Statistical analysis was performed using Stata version 12MP (Stata Corp. College Station, TX).

2.4.5.1 Sensitivity analyses

Sensitivity analyses were undertaken assessing the robustness of findings in terms of the definition of epilepsy as follows:

1. A stricter definition of epilepsy was used as: CYP with at least two AED prescriptions and two diagnosis codes.
2. CYP were excluded with a first AED of either pregabalin or gabapentin because these drugs can be prescribed for other diagnoses.
3. CYP were excluded with AED prescriptions but no Read code for diagnosis of epilepsy.
4. The risk of injuries was recalculated in CYP aged one to twenty-one years to assess whether the estimates of risk differed when young adults above twenty-one years were excluded from the population. Age twenty-one years was chosen because this is normally the age

at which injury researchers internationally regard adulthood as beginning.

2.4.5.2 Additional analyses

CYP with epilepsy may attend the GP more often than CYP without in order to receive medical care for their epilepsy. Therefore GPs may have more opportunities to record injuries in CYP with epilepsy compared to CYP without. However, long bone fractures are unlikely to go unrecorded in CYP regardless of whether they have epilepsy[30]. Therefore additional analyses were undertaken in order to describe and quantify the recording of injuries in the GP medical records compared to hospital medical records to address the following objectives:

1. To ascertain the recording of serious injuries (indicated by long bone fractures) in GP medical records compared to hospital medical records.
2. To compare the recording of femur fractures in primary care and hospital medical records to quantify any under- or over-ascertainment of femur fractures in GP medical records.

To ascertain the recording of long bone fractures in GP medical records compared to hospital medical records, further work was conducted in around half the sample who had linked hospital records from the Hospital Episodes Statistics (HES) database. Long bone fractures were chosen as virtually all those with long-bone fractures are likely to have attended secondary care[30]. HES data include diagnosis codes, using the ICD version 10[103], and procedure codes, using the Office of Population Censuses and Surveys (OPCS-4) version 4[225] from inpatient admissions to hospital in

England. In total there were three types of codes that could contain a record of a femur fracture: the Read code in the GP records; the diagnosis code in the hospital records; and the procedure code in the hospital records.

In this analysis using GP medical records linked to hospital medical records, all long bone fracture codes recorded during study follow-up in the hospital records were identified. CYP who had a long bone fracture recorded in hospital but not by the GP were then reclassified as having a long bone fracture and the risk of a long bone fracture was re-estimated in CYP with epilepsy compared to CYP without epilepsy. This was done to compare the risk of fractures in CYP with epilepsy compared to CYP without epilepsy to the risk estimated using GP medical records alone.

2.4.5.3 Comparison of primary care and hospital records

In a separate analysis using GP medical records linked to hospital medical records, the similarities and differences in recording of femur fractures were assessed. All CYP with a femur fracture, recorded in either primary care, secondary care or both, were identified using a predefined list of codes (appendix 6.23). Femur fracture codes that were recorded after the later of: 1st April 1997 (the date the CPRD-HES link was established) or the date CYP entered the study cohort; and before the earlier of: 31st October 2009 (the last date CPRD-HES linked data were available for these CYP) or the date CYP left the study cohort, were kept. The date of the first femur fracture to occur in each file was recorded (primary care, hospital diagnosis codes, or hospital procedures files).

Comparison of femur fractures in primary care and hospital records was done in three stages. In the first stage, the number of CYP with a femur fracture in each file was reported, based on the diagnosis codes. In the second stage, diagnosis code descriptions recorded within one month of the earliest femur fracture were identified for each person with a femur fracture. These code descriptions were reviewed by two investigators independently using a data extraction form. The data extraction form was designed to assess whether the: (i) femur fracture had been recorded using a code (e.g. 'hip fracture'), or combinations of codes (e.g. 'shaft of femur' and 'closed reduction of fracture of long bone and rigid internal fixation' recorded on the same date) not in the predefined list of femur fracture codes; (ii) the likely date of the femur fracture enabling calculation of the length of time taken to record the femur fracture in each file; and (iii) whether there is information about the mechanism of injury in the hospital diagnosis code descriptions. Disagreements were resolved by discussion between two investigators (VP and KS). Based on the results of this review, Venn diagrams were used to display the frequency of femur fractures recorded in each of the three sources. In the third stage, all diagnosis codes in the GP and hospital medical records were reviewed for CYP with a femur fracture that appeared to be recorded in either GP or hospital records. This was done to identify events in the past medical history that might be femur fractures but were not in the predefined code list.

2.5 Results

2.5.1 Description of the population

Table 2-1 details the characteristics of the study cohort, which were similar for fractures, long bone fractures, thermal injuries and poisonings. The characteristics for the analysis on fractures will be described here. There were 42,181 CYP without epilepsy and 10,447 with epilepsy. The age at (pseudo)diagnosis was similar for both groups (median age=13.2 (interquartile range (IQR) 7.2 to 19.3) years in CYP without epilepsy and median age=12.9 (IQR 6.7 to 19.0) years in CYP with epilepsy). In CYP without epilepsy, less than half were males (47.3%); in CYP with epilepsy, half were males (50.7%). The region containing the greatest proportion of the study population was the North West (12.8% in CYP without epilepsy vs. 12.8% in CYP with epilepsy) and with the lowest proportion was the North East (2.7% in CYP without epilepsy vs. 2.8% in CYP with epilepsy). The greatest proportion of CYP in the study population was from the most deprived areas (25.1% in CYP with epilepsy vs. 25.8% in CYP with epilepsy) and the smallest proportion was from the least deprived areas (15.8% in CYP with epilepsy vs. 16.2% in CYP without epilepsy). In both groups the number of CYP in each calendar period was similar. There were more CYP with epilepsy with each of the comorbid conditions: behaviour disorder (12.5% in epilepsy vs. 3.7% in CYP without epilepsy); learning disability (9.2% in epilepsy vs. 0.8% in CYP without epilepsy); ADHD (3.5% in epilepsy vs. 0.9% in CYP without epilepsy); and cerebral palsy (0.3% in epilepsy vs. <0.1% in CYP without epilepsy). The median follow-up for the study population overall was 2.4 years.

Table 2-1 Characteristics of CYP with and without epilepsy for analyses of fractures, thermal injuries and poisonings

Study cohort		Fractures		Thermal injuries		Poisonings	
Characteristic		**Non-epilepsy n=42,181 (%)**	**Epilepsy n=10,447 (%)**	**Non-epilepsy n=46,598 (%)**	**Epilepsy n=11,934 (%)**	**Non-epilepsy n=46,576 (%)**	**Epilepsy n=11,720 (%)**
Age group at (pseudo)diagnosis of epilepsy (years)	1	1,751 (4.2)	535 (5.1)	1,751 (3.8)	535 (4.5)	1,754 (3.8)	540 (4.6)
	2	1,623 (3.9)	459 (4.4)	1,623 (3.5)	457 (3.8)	1,643 (3.5)	460 (3.9)
	3	1,589 (3.8)	485 (4.6)	1,605 (3.4)	489 (4.1)	1,610 (3.5)	494 (4.2)
	4	1,764 (4.2)	448 (4.3)	1,759 (3.8)	489 (4.1)	1,787 (3.8)	448 (3.8)
	5-9	8,598 (20.4)	2,115 (20.3)	8,950 (19.2)	2,223 (18.6)	9,021 (19.4)	2,247 (19.2)
	10-14	8,983 (21.3)	2,009 (19.2)	10,059 (21.6)	2,284 (19.1)	10,109 (21.7)	2,311 (19.7)
	15-18	6,826 (16.2)	1,792 (17.2)	7,909 (17.0)	2,183 (18.3)	7,889 (16.9)	2,135 (18.2)
	19-24	11,047 (26.2)	2,604 (24.9)	12,942 (27.8)	3,317 (27.8)	12,763 (27.4)	3,085 (26.3)
Sex	Males	19,953 (47.3)	5,291 (50.7)	22,598 (48.5)	6,185 (51.8)	22,705 (48.8)	6,152 (52.5)
SHA region	East Midlands	2,422 (5.7)	542 (5.2)	2,422 (5.7)	542 (5.2)	5,957 (12.8)	1,523 (13.0)
	East of England	4,457 (10.6)	1,111 (10.6)	4,457 (10.6)	1,111 (10.6)	4,548 (9.8)	1,105 (9.4)
	London	4,288 (10.2)	1,013 (9.7)	4,530 (9.7)	1,119 (9.4)	3,483 (7.5)	976 (8.3)
	North East	1,118 (2.7)	288 (2.8)	1,118 (2.7)	288 (2.8)	3,878 (8.3)	1,005 (8.6)
	North West	5,386 (12.8)	1,341 (12.8)	5,963 (12.8)	1,549 (13.0)	4,190 (9.0)	933 (8.0)
	Northern Ireland	1,219 (2.9)	369 (3.5)	1,219 (2.9)	369 (3.5)	4,569 (9.8)	1,184 (10.1)
	Scotland	3,036 (7.2)	828 (7.9)	3,484 (7.5)	1,003 (8.4)	3,959 (8.5)	994 (8.5)
	South Central	3,586 (8.5)	877 (8.4)	3,586 (8.5)	877 (8.4)	4,893 (10.5)	1,198 (10.2)
	South East Coast	3,542 (8.4)	891 (7.9)	3,875 (8.3)	1,033 (8.7)	3,439 (7.4)	927 (7.9)
	South West	3,792 (9.0)	854 (8.2)	4,196 (9.0)	944 (7.9)	2,371 (5.1)	557 (4.8)
	Wales	3,076 (7.3)	791 (7.6)	3,457 (7.4)	938 (7.9)	2,686 (5.8)	587 (5.0)
	West Midlands	4,138 (9.8)	1,047 (10.0)	4,563 (9.8)	1,198 (10.0)	1,380 (3.0)	417 (3.6)
	Yorkshire & Humber	2,121 (5.0)	495 (4.7)	2,371 (5.1)	556 (4.7)	1,223 (2.6)	314 (2.7)
Deprivation	Least deprived	6,674 (15.8)	1,692 (16.2)	7,437 (16.0)	1,945 (16.3)	7,414 (15.9)	1,911 (16.3)
	2nd least deprived	7,443 (17.7)	1,713 (16.4)	8,273 (17.8)	1,966 (16.5)	8,307 (17.8)	1,938 (16.5)
	Medium deprivation	8,160 (19.4)	2,018 (19.3)	8,993 (19.3)	2,290 (19.2)	9,000 (19.3)	2,257 (19.3)
	2nd most deprived	9,307 (22.1)	2,327 (22.3)	10,266 (22.0)	2,632 (22.1)	10,246 (22.0)	2,587 (22.1)
	Most deprived	10,593 (25.1)	2,695 (25.8)	11,624 (25.0)	3,099 (26.0)	11,604 (24.9)	3,025 (25.8)
Calendar year at study entry	1987-1989	230 (0.6)	44 (0.4)	237 (0.5)	47 (0.4)	237 (0.5)	47 (0.4)
	1990-1994	4,804 (11.4)	1,122 (10.7)	5,048 (10.8)	1,217 (10.2)	5,042 (10.8)	1,211 (10.3)
	1995-1999	7,228 (17.1)	1,925 (18.4)	7,786 (16.7)	2,112 (17.7)	7,806 (16.8)	2,097 (17.9)
	2000-2004	12,271 (29.1)	3,382 (32.4)	13,455 (28.9)	3,850 (32.3)	13,487 (29.0)	3,786 (32.3)
	2005 onwards	17,648 (41.8)	3,974 (38.0)	20,072 (43.1)	4,708 (38.5)	20,004 (43.0)	4,579 (39.1)
Behavior disorder		1,550 (3.7)	1,303 (12.5)	1,817 (3.9)	1,507 (12.6)	1,770 (3.8)	1,443 (12.3)
Learning		318 (0.8)	961 (9.2)	372 (0.8)	1,038 (8.7)	368 (0.8)	1,029 (8.8)
ADHD		374 (0.9)	363 (3.5)	426 (0.9)	426 (3.6)	428 (0.9)	421 (3.6)
Cerebral palsy		13 (<0.1)	29 (0.3)	14 (<0.1)	31 (0.3)	14 (<0.1)	30 (0.3)

Note: Each study population comprises those without a history of the injury of interest

Note: Deprivation is at practice level

2.5.2 Unadjusted and adjusted analyses

Table 2-2 shows the unadjusted and adjusted analyses for the first injury to occur. Overall there were 3,014 fractures (948 in CYP with epilepsy) with a total of 199,646 person years at risk (pyar) (56,310 pyar in CYP with epilepsy). This gives a crude rate of 16.8 (95%CI 15.8 to 17.9) fractures per one thousand pyar and a crude HR of 1.15 (95%CI 1.07 to 1.24) comparing CYP with epilepsy to CYP without epilepsy. The risk of fractures in CYP with epilepsy was 18% greater than in CYP without epilepsy adjusting for age, sex, region, deprivation and calendar year (HR=1.18 (1.09 to 1.27)).

There were 668 thermal injuries (253 in CYP with epilepsy) with similar follow-up to the analysis for fractures (231,478 pyar). This gives a crude rate of 3.8 (95%CI 3.3 to 4.3) injuries per one thousand pyar and a crude HR of 1.51 (95%CI 1.29 to 1.77) comparing CYP with epilepsy to CYP without epilepsy. The risk of thermal injuries in CYP with epilepsy was 49% greater than in CYP without epilepsy adjusting for age, sex, region, deprivation and calendar year (HR=1.49 (95%CI 1.27 to 1.75)).

There were 825 poisonings (408 in CYP with epilepsy) with similar follow-up to the analysis for fractures (231,397 pyar). This gives a crude rate of 6.2 (95%CI 5.6 to 6.8) poisonings per one thousand pyar and a crude HR of 2.57 (95%CI 2.24 to 2.95) comparing CYP with epilepsy to CYP without epilepsy. The risk of poisonings was more than double in CYP with epilepsy compared to CYP without epilepsy adjusting for age, sex, region, deprivation and calendar year (HR=2.47 (95%CI 2.15 to 2.84)).

The risk of long bone fractures was similar to the risk of any fractures (crude HR=1.17 (1.04 to 1.31); HR=1.23 (1.10 to 1.38) adjusting for age, sex, region, deprivation and calendar year).

The risk of medicinal poisonings in CYP with epilepsy compared to CYP without epilepsy adjusted for age, sex, region, deprivation and calendar year was (HR=2.88 (95%CI 2.46 to 3.38)). The risk of medicinal poisonings in CYP with epilepsy compared to CYP without epilepsy was adjusted for behaviour disorder, in addition to age, sex, region, deprivation and calendar year (HR=2.54 (95%CI 2.16 to 2.99)), because the adjustment affected the estimate by more than ten percent compared to the estimate adjusted for age, sex, region, deprivation and calendar year. The risk of non-medicinal poisonings was similar in CYP with epilepsy compared to CYP without epilepsy (HR=0.96 (95%CI 0.61 to 1.52) adjusting for age, sex, region, deprivation and calendar year)). Adjusting the risk of non-medicinal poisonings for behaviour disorder did not affect the estimate.

Table 2-2 The risk of fractures, thermal injuries and poisonings in CYP with and without epilepsy

Injury category	Epilepsy or non-epilepsy	Events (n)	pyar	Rate (per 1000)	(95% CI)	HR	(95% CI)	Adjusted HR[a]	(95% CI)
Any fractures	Non-epilepsy	2066	143,336	14.4	(13.8 -15.0)	1		1	
	Epilepsy	948	56,310	16.8	(15.8 -17.9)	1.15	(1.07 -1.24)	1.18	(1.09 -1.27)
Thermal injuries	Non-epilepsy	415	164,247	2.5	(2.3 -2.8)	1		1	
	Epilepsy	253	67,231	3.8	(3.3 -4.3)	1.51	(1.29 -1.77)	1.49	(1.27 -1.75)
Any poisonings	Non-epilepsy	417	165,376	2.5	(2.3 -2.8)	1		1	
	Epilepsy	408	66,021	6.2	(5.6 -6.8)	2.57	(2.24 -2.95)	2.47	(2.15 -2.84)
Injury sub-groups:									
Long bone fractures	Non-epilepsy	931	155,637	6.0	(5.6 -6.4)	1		1	
	Epilepsy	438	63,454	6.9	(6.3 -7.6)	1.17	(1.04 -1.31)	1.23	(1.10 -1.38)
Medicinal poisonings	Non-epilepsy	293	164,946	1.8	(1.6 -2.0)	1		1	
	Epilepsy	341	65,786	5.2	(4.7 -5.8)	3.06	(2.62 -3.59)	2.54[b]	(2.16 -2.99)
Non-medicinal poisonings	Non-epilepsy	72	164,121	0.4	(1.9 -0.6)	1		1	
	Epilepsy	26	64,760	0.4	(1.9 -0.6)	0.92	(0.59 -1.45)	0.96	(0.61 -1.52)

pyar: Person years at risk (in years)

HR: Hazard ratio

[a]All HRs were adjusted for for age, sex, SHA region, deprivation and calendar year at study entry except[b]

[b]HR additionally adjusted for behaviour disorder

2.5.3 Risk of injury stratified by age and sex

2.5.3.1 Risk of fractures

Table 2-3 shows the crude and adjusted HRs for the risk of fractures, comparing CYP with epilepsy versus CYP without epilepsy stratified by age and sex. The adjusted HR was similar for all age groups (ranging from: HR=0.99 (95%CI 0.69 to 1.41) in 3 year-olds to HR=1.47 (95%CI 1.07 2.03) in 2 year-olds; p=0.56, test for interaction). The adjusted HR was higher in females than males comparing the risk of fractures in CYP with epilepsy versus CYP without epilepsy but this did not reach statistical significance at the 5% level (HR=1.12 (95%CI 1.01 to 1.31) in males; HR=1.31 (95%CI 1.15 to 1.50) in females; p=0.05, test for interaction).

Table 2-3 Risk of fractures in CYP with and without epilepsy by age and sex

		Epilepsy vs. non-epilepsy	Epilepsy vs. non-epilepsy	P-Value[+]
Characteristic		**Unadjusted (95% CI) hazard ratio**	**Adjusted (95% CI) hazard ratio[$]**	
Any fractures				
Age group at diagnosis (years)	1	1.17 (0.85 -1.62)	1.22 (0.89 -1.69)	0.56
	2	1.58 (1.15 -2.19)	1.47 (1.07 -2.03)	
	3	0.99 (0.70 -1.41)	0.99 (0.69 -1.41)	
	4	1.16 (0.83 -1.62)	1.17 (0.84 -1.64)	
	5-9	1.10 (0.95 -1.28)	1.07 (0.92 -1.24)	
	10-14	1.27 (1.08 -1.49)	1.23 (1.05 -1.45)	
	15-18	1.18 (0.94 -1.48)	1.15 (0.93 -1.44)	
	19-24	1.33 (1.07 -1.65)	1.30 (1.06 -1.61)	
Sex	Males	1.08 (0.98 -1.18)	1.12 (1.01 -1.23)	0.05
	Females	1.26 (1.10 -1.44)	1.31 (1.15 -1.50)	

[+]Test for interaction comparing the estimate (adjusted for age, sex, SHA region, deprivation, calendar year of entry) with the adjusted estimate with an interaction term for age or sex

[$]Adjusted for age, sex, SHA region, deprivation and calendar year at study entry

pyar: Person years at risk (in years)

2.5.3.2 Risk of thermal injuries

Table 2-4 shows the stratified crude and adjusted HRs for the risk of thermal injuries, comparing CYP with epilepsy versus CYP without epilepsy by age and sex. The adjusted HR was larger amongst 19 to 24 year-olds but did not differ significantly for other age groups (ranging from 1.24 (95%CI 0.86 to 1.79) in 15 to 18 year-olds to 2.27 (95%CI 1.59 to 3.24) in 19 to 24 year-olds; p=0.12, test for interaction). There was little difference between males and females in the adjusted HRs comparing the risk of thermal injuries in CYP with epilepsy versus CYP without epilepsy (HR=1.47 (95%CI 1.18 to 1.85) in males; HR=1.51 (95%CI 1.21 to 1.89) in females; p=0.87, test for interaction).

Table 2-4 Risk of thermal injuries in CYP with and without epilepsy by age and sex

		Epilepsy vs. non-epilepsy	Epilepsy vs. non-epilepsy	P-Value[+]
Characteristic		**Unadjusted (95% CI) hazard ratio**	**Adjusted (95% CI) hazard ratio[$]**	
Thermal injuries				
Age group at diagnosis (years)	1-4	1.31 (0.92 -1.88)	1.27 (0.89 -1.81)	0.12
	5-9	1.37 (0.98 -1.92)	1.43 (1.02 -2.01)	
	10-14	1.38 (0.95 -2.00)	1.44 (1.00 -2.09)	
	15-18	1.27 (0.87 -1.84)	1.24 (0.86 -1.79)	
	19-24	2.34 (1.62 -3.37)	2.27 (1.59 -3.24)	
Sex	Males	1.50 (1.20 -1.88)	1.47 (1.18 -1.85)	0.87
	Females	1.53 (1.23 -1.91)	1.51 (1.21 -1.89)	

[+]Test for interaction comparing the estimate (adjusted for age, sex, SHA region, deprivation, calendar year of entry) with the adjusted estimate with an interaction term for age or sex

[$]Adjusted for age, sex, SHA region, deprivation and calendar year at study entry

pyar: Person years at risk (in years)

2.5.3.3 Risk of poisonings

Table 2-5 shows the stratified crude and adjusted HRs for the risk of poisonings, comparing CYP with epilepsy versus CYP without epilepsy by age and sex. The adjusted HR was greatest in the 19 to 24 year-olds and least in the 10 to 14 year-olds (ranging from 1.70 (95%CI 1.29 to 2.24) in 10 to 14 year-olds to 4.23 (95%CI 3.16 to 5.66) in 19 to 24 year-olds; $p<0.001$, test for interaction). The adjusted HR was higher in males than females comparing the risk of poisonings in CYP with epilepsy versus CYP without epilepsy but the difference did not reach statistical significance (HR=2.76 (95%CI 2.24 to 3.40) in males; HR=2.27 (95%CI 1.89 to 2.73) in females; $p=0.16$, test for interaction).

Table 2-5 Risk of poisonings in CYP with and without epilepsy by age and sex

		Epilepsy vs. non-epilepsy	Epilepsy vs. non-epilepsy	P-Value[+]
Characteristic		**Unadjusted (95% CI) hazard ratio**	**Adjusted (95% CI) hazard ratio[$]**	
Poisonings				
Age group at diagnosis (years)	1-4	2.52 (1.70 -3.75)	2.40 (1.61 -3.56)	<0.001
	5-9	1.73 (1.18 -2.56)	1.95 (1.32 -2.87)	
	10-14	1.66 (1.26 -2.19)	1.70 (1.29 -2.24)	
	15-18	2.65 (1.98 -3.55)	2.51 (1.88 -3.35)	
	19-24	4.71 (3.51 -6.34)	4.23 (3.16 -5.66)	
Sex	Males	2.89 (2.35 -3.56)	2.76 (2.24 -3.40)	0.16
	Females	2.39 (1.99 -2.87)	2.27 (1.89 -2.73)	

[+]Test for interaction comparing the estimate (adjusted for age, sex, SHA region, deprivation, calendar year of entry) with the adjusted estimate with an interaction term for age or sex

[$]Adjusted for age, sex, SHA region, deprivation, calendar year at study entry and behaviour disorder

pyar: Person years at risk (in years)

2.5.3.4 Risk of medicinal poisonings

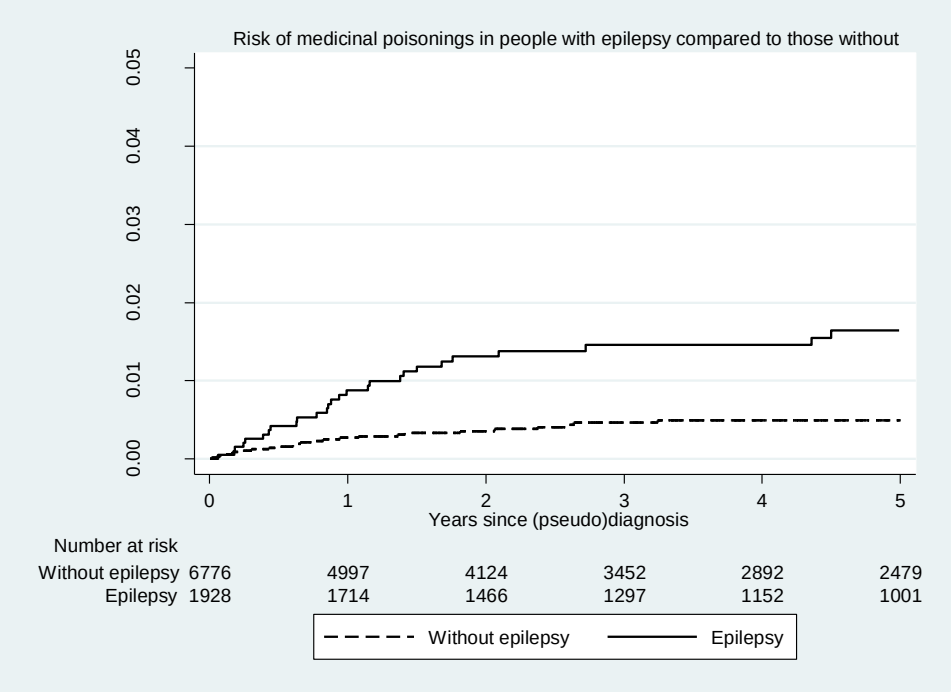
As described in Table 2-2, the risk of poisonings in CYP with epilepsy compared to CYP without epilepsy was similar to the risk of medicinal poisonings but not for non-medicinal poisonings. Subsequently it was shown in Table 2-5 that the risk of poisonings varied by age group. Therefore Figure 2-9 displays the proportion of individuals who sustained a medicinal poisoning by time since diagnosis (cumulative hazard) for CYP with and without epilepsy separately, with all individuals included from the date of diagnosis. The data underneath the plot show the number of individuals being followed each year after diagnosis in annual intervals and CYP who are no longer being follow up at that point in time (e.g. because they have had a medicinal poisoning or left the GP practice before sustaining medicinal poisoning). Figure 2-9 shows that age-specific patterns of increased risk persisted over time (p=0.01, test for interaction comparing the estimate (adjusted for age, sex, region, deprivation, calendar year of entry) with the adjusted estimate with an interaction term for age; adjusted HR for 19-24 year-olds=3.59 (95%CI 2.65 to 4.86); adjusted HR in 10-14 year-olds=1.71 (95%CI 1.23 to 2.37), adjusting for, sex, SHA region, practice level deprivation, calendar year at study entry and behaviour disorder).

There was a higher adjusted HR for males than females comparing the risk of medicinal poisonings in CYP with epilepsy versus CYP without epilepsy (HR=3.11 (95%CI 2.41 to 4.01) in males; HR=2.23 (95%CI 1.81 to 2.74) in females; p=0.04, test for interaction).

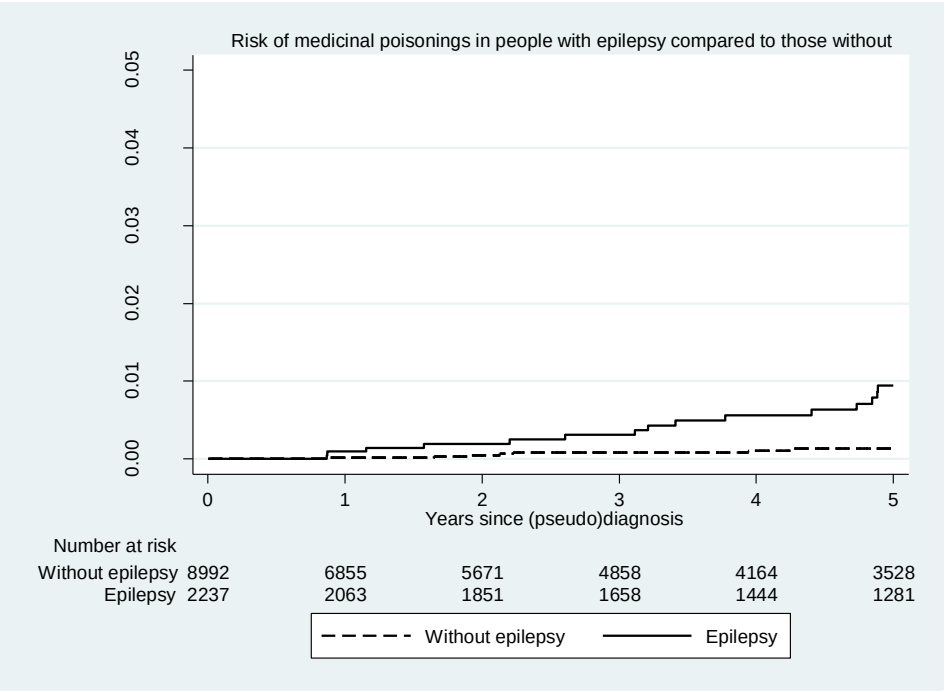
The drug involved in the poisoning incident was recorded in 5% of medicinal poisonings in CYP with epilepsy and 5% of CYP without epilepsy. Two percent of all medicinal poisonings in CYP with epilepsy were due to a named AED. Therefore, in 43% of medicinal poisonings in CYP with epilepsy the poisoning was identified as due to an AED.

Figure 2-9 Risk of medicinal poisonings in CYP with and without epilepsy by age. Numbers of CYP in study by year since diagnosis are shown for CYP with epilepsy and those without.

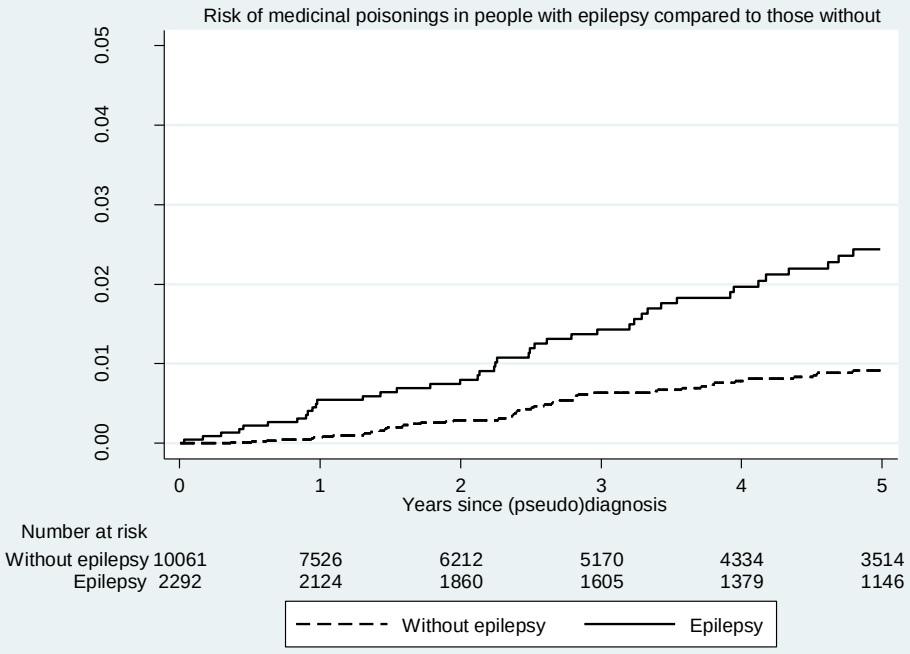
A. Age 1 to 4 years



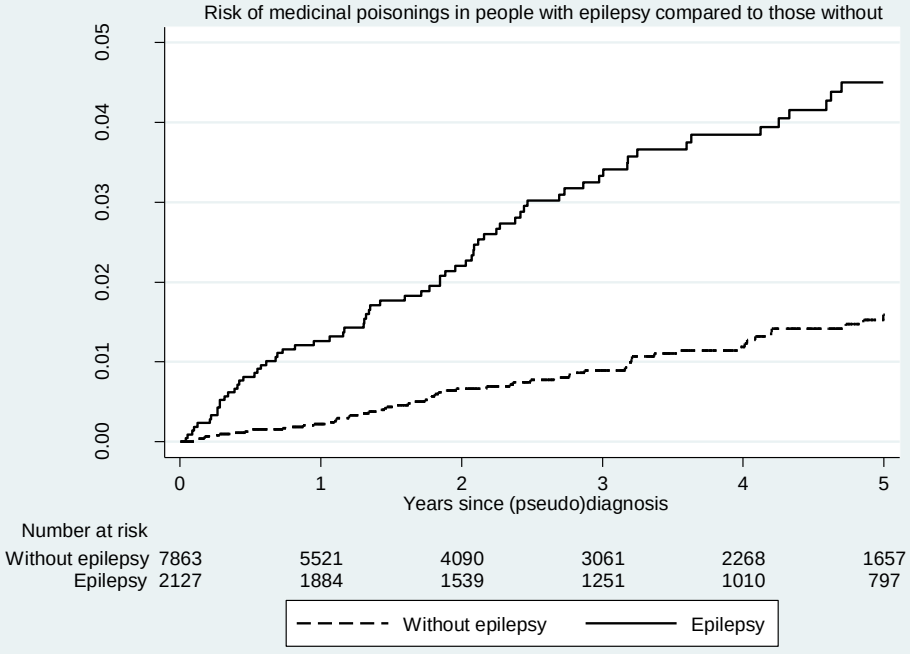
B. Age 5 to 9 years



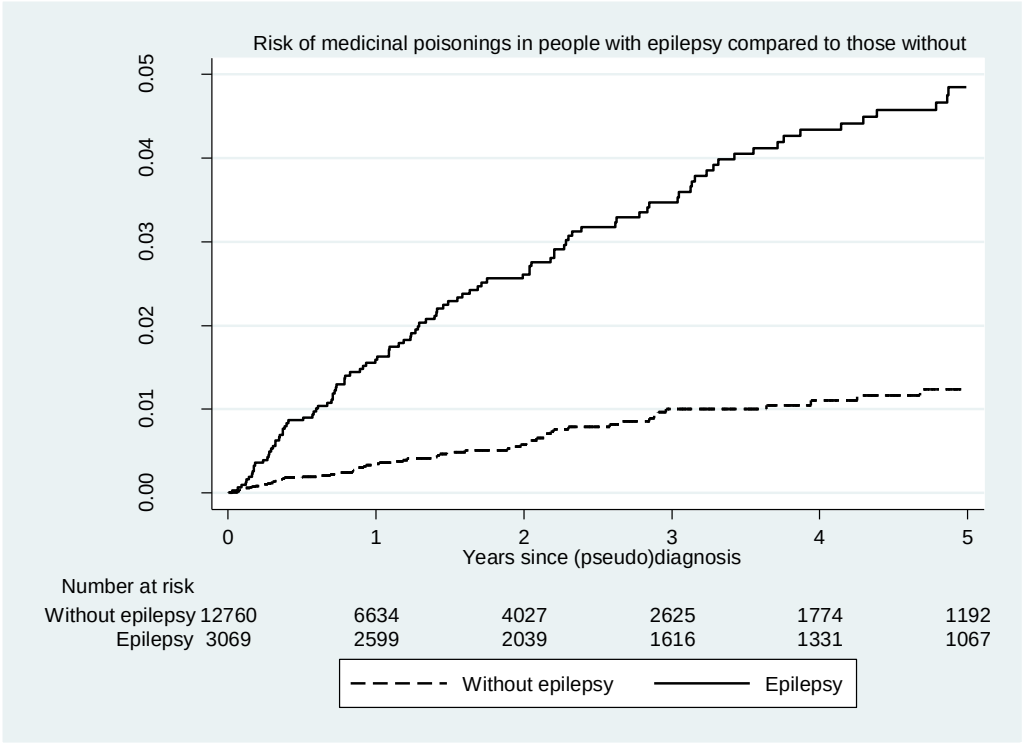
C. Age 10 to 14 years



D. Age 15 to 18 years



E. Age 19 to 24 years



2.5.4 Absolute risk of injury in CYP with and without epilepsy

Table 2-6 shows the absolute risk of injury within the first five years of study follow-up in CYP with and without epilepsy. This shows that the risk of fractures, long bone fractures, thermal injuries, poisonings and medicinal poisonings was greater in CYP with epilepsy compared to CYP without epilepsy. However, the risk of non-medicinal poisonings was similar in CYP with and without epilepsy. Per thousand CYP, CYP with epilepsy experienced an extra 23 poisonings (21 of which were medicinal poisonings), an extra 12 fractures (two of which were long bone fractures) and an extra seven thermal injuries compared to CYP without epilepsy.

Table 2-6 Absolute risk of injury in the first five years of the study in CYP with and without epilepsy

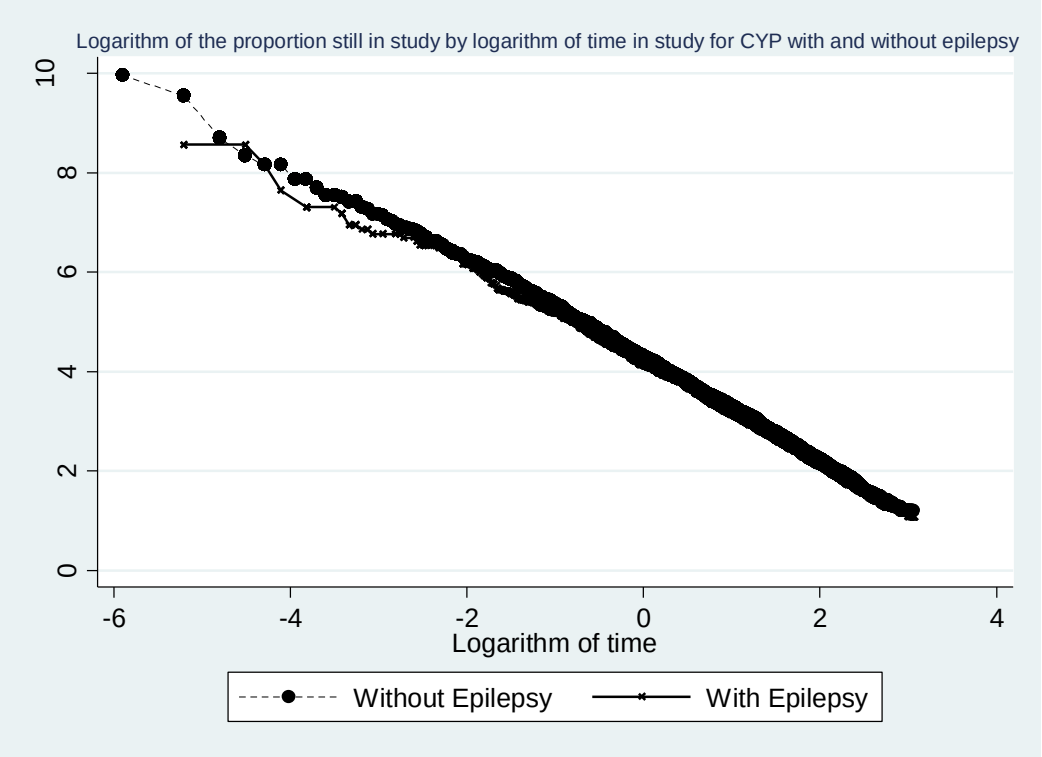
	Non-epilepsy			Epilepsy			
Time since diagnosis	**Total at risk (n)**	**Events (n)**	**Injuries per thousand (95% CI)**	**Total at risk (n)**	**Events (n)**	**Injuries per thousand (95% CI)**	**Excess injuries per thousand (95% CI)**
Any fractures							
Up to 5 years	10,605	976	69.5 (65.7 -73.4)	4,520	427	81.1 (74.6 -88.1)	11.6 (8.9 -14.7)
Thermal injuries							
Up to 5 years	12,303	189	12.3 (10.9 -13.9)	5,416	115	19.2 (16.5 -22.4)	6.9 (5.6 -8.5)
Any poisonings							
Up to 5 years	12,411	194	11.9 (10.6 -13.5)	5,310	186	34.7 (30.9 -38.9)	22.8 (20.3 -25.4)
Injury sub-groups:							
Long bone fracture							
Up to 5 years	11,592	479	31.5 (1.3 -34.1)	5,099	200	33.9 (2.1 -38.3)	2.4 (0.8 -4.2)
Medicinal poisonings							
Up to 5 years	12,377	136	8.2 (7.1 -9.5)	5,293	157	29.3 (25.8 -33.2)	21.1 (18.7 -23.7)
Non-medicinal poisonings							
Up to 5 years	12,312	34	2.1 (1.6 -2.9)	5,220	10	2.0 (1.2 -3.2)	-0.1 (-0.4 -0.3)

2.5.5 Checking assumptions for use of a Cox model

Plots of the logarithm of cumulative hazard against time showed that the risk of injury in CYP with epilepsy was proportional to the risk of injury in CYP without epilepsy for fractures, thermal injuries, poisonings and long bone fractures, respectively. Figure 2-10 shows an example of the plot for the analysis of fractures comparing CYP with and without epilepsy. Figure 2-10 shows that people with epilepsy were more likely compared to CYP without epilepsy throughout the study to have a fracture. The number of CYP with epilepsy to sustain a fracture at any given point in time remained greater than the number of CYP without epilepsy to sustain a fracture at the same time throughout the study and the amount by which this risk was greater did not change during the study.

Plots of Schoenfeld residuals against time were inspected, and a statistical test for non-proportional hazards for CYP with epilepsy compared to CYP without in the final model was performed; (unadjusted results: $p=0.35$, fractures; $p=0.15$, long bone fractures; $p=0.10$, thermal injuries; $p<0.001$, poisonings; $p<0.001$, medicinal poisonings. Adjusted results: $p=<0.001$, fractures; $p=<0.001$, long bone fractures; $p<0.001$, thermal injuries; $p<0.001$, poisonings; $p<0.001$, medicinal poisonings).

Figure 2-10 Plot of the logarithm of cumulative hazard against time for the analysis of fractures for CYP with and without epilepsy



2.5.6 Sensitivity analyses

Table 2-7 shows the effect of varying the definition of epilepsy on the unadjusted and adjusted HRs comparing the risk of injury in CYP with epilepsy compared to CYP without epilepsy. The table shows that the findings were robust to restricting analyses to CYP with at least two drug prescriptions and two diagnosis codes for epilepsy, to excluding CYP prescribed pregabalin or gabapentin as their first anti-epilepsy drug and to excluding 3,554 CYP with AED prescriptions but no Read code for a diagnosis of epilepsy. Results for CYP aged one to twenty-one years old were very similar to those for CYP aged 1-24 years (fractures HR=1.15 (95%CI 1.06 to 1.25); thermal injuries HR=1.39 (95%CI 1.18 to 1.65); poisonings HR=2.39 (95%CI 2.01 to 2.84); long bone fractures HR=1.20 (95%CI 1.06 to 1.35).

Table 2-7 Absolute risk of injury in the first five years of the study in CYP with and without epilepsy

Injury category	Epilepsy subgroups	HR (95% CI)	Adjusted HR[a] (95% CI)
Any fractures:	≥2 drug & ≥2 diagnosis codes	1.22 (1.12 -1.34)	1.22 (1.11 -1.34)
	First AED pregabalin or gabapentin	1.15 (1.07 -1.25)	1.17 (1.08 -1.27)
	≥2 drug & no diagnosis codes	1.20 (1.10 -1.31)	1.19 (1.09 -1.30)
	People aged 1 to 21 years old	1.14 (1.05 -1.23)	1.15 (1.06 -1.25)
Thermal injuries:	≥2 drug & ≥2 diagnosis codes	1.49 (1.23 -1.80)	1.48 (1.22 -1.79)
	First AED pregabalin or gabapentin	1.48 (1.26 -1.74)	1.47 (1.25 -1.73)
	≥2 drug & no diagnosis codes	1.39 (1.16 -1.66)	1.38 (1.15 -1.65)
	People aged 1 to 21 years old	1.41 (1.19 -1.66)	1.39 (1.18 -1.65)
Any poisonings:	≥2 drug & ≥2 diagnosis codes	2.17 (1.83 -2.57)	1.93 [b] (1.62 -2.29)
	First AED pregabalin or gabapentin	2.51 (2.19 -2.89)	2.21 [b] (1.92 -2.56)
	≥2 drug & no diagnosis codes	2.12 (1.81 -2.48)	1.91 [b] (1.62 -2.25)
	People aged 1 to 21 years old	2.34 (2.02 -2.70)	2.39 [b] (2.01 -2.84)
Injury sub-groups:			
Long bone fractures:	≥2 drug & ≥2 diagnosis codes	1.20 (1.05 -1.38)	1.21 (1.06 -1.39)
	First AED pregabalin or gabapentin	1.16 (1.03 -1.30)	1.21 (1.07 -1.35)
	≥2 drug & no diagnosis codes	1.19 (1.05 -1.35)	1.19 (1.05 -1.35)
	People aged 1 to 21 years old	1.16 (1.03 -1.31)	1.20 (1.06 -1.35)

pyar: Person years at risk (in years)

HR: Hazard ratio comparing people with epilepsy to people without epilepsy

[a]HRs were adjusted for for age, sex, SHA region, deprivation and calendar year at study entry except [b]

[b]HR additionally adjusted for behaviour disorder

2.5.7 Additional analyses

25,723 CYP had hospital records linked to their GP record. The risk of long bone fractures, recorded in primary care, secondary care or both, for this sub-group (adjusted HR=1.25 (95%CI 1.07 to 1.46)) was similar to the whole population (adjusted HR=1.23 (95%CI 1.10 to 1.38)).

2.5.7.1 Comparison of primary care and hospital records

Figure 2-11 shows the frequency of femur fractures recorded in each file based on codes for femur fracture. There were twenty-one CYP with a first femur fracture recorded in 27,412 CYP (with and without epilepsy) from the CPRD study cohort with HES-linked records. Of those twenty-one CYP with a record of a femur fracture: eleven (52%) had a femur fracture recorded in the GP record (seven (33%) only in GP record); thirteen (62%) CYP had a femur fracture recorded in the hospital diagnosis record (6 (29%) only in hospital diagnosis record); and four (19%) had a femur fracture recorded in the hospital procedures record (one (5%) only in hospital procedures record). Four CYP had a code recorded in both the GP and the hospital medical records. Of the twenty-one CYP with a femur fracture record, twenty (95%) had any type of hospital diagnosis codes, excluding a code for femur fracture, within thirty days of the first fracture and one (5%) had no type of hospital diagnosis code within thirty days of the earliest fracture.

Figure 2-11 Frequency of femur fracture records in primary care and hospital records

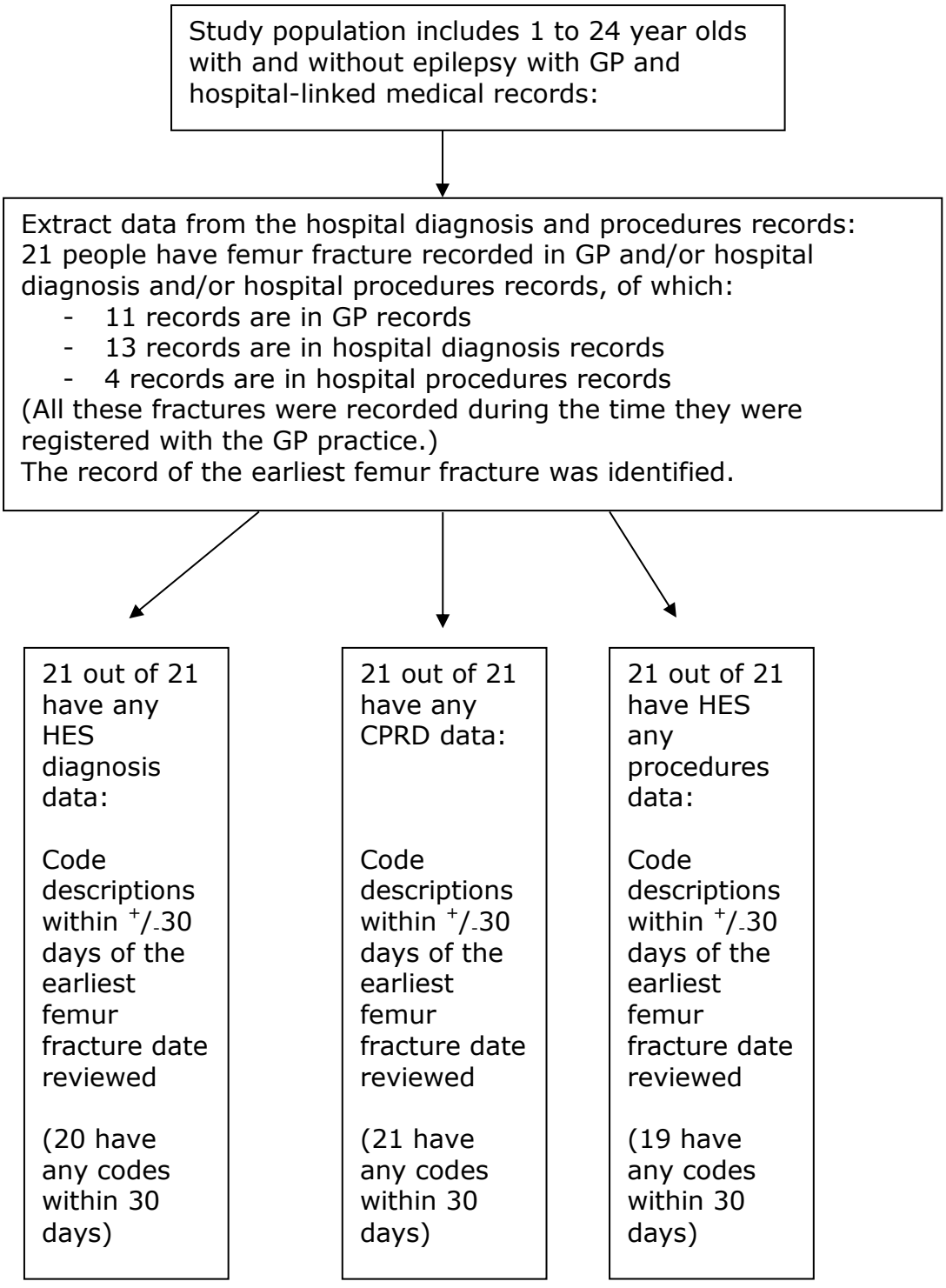
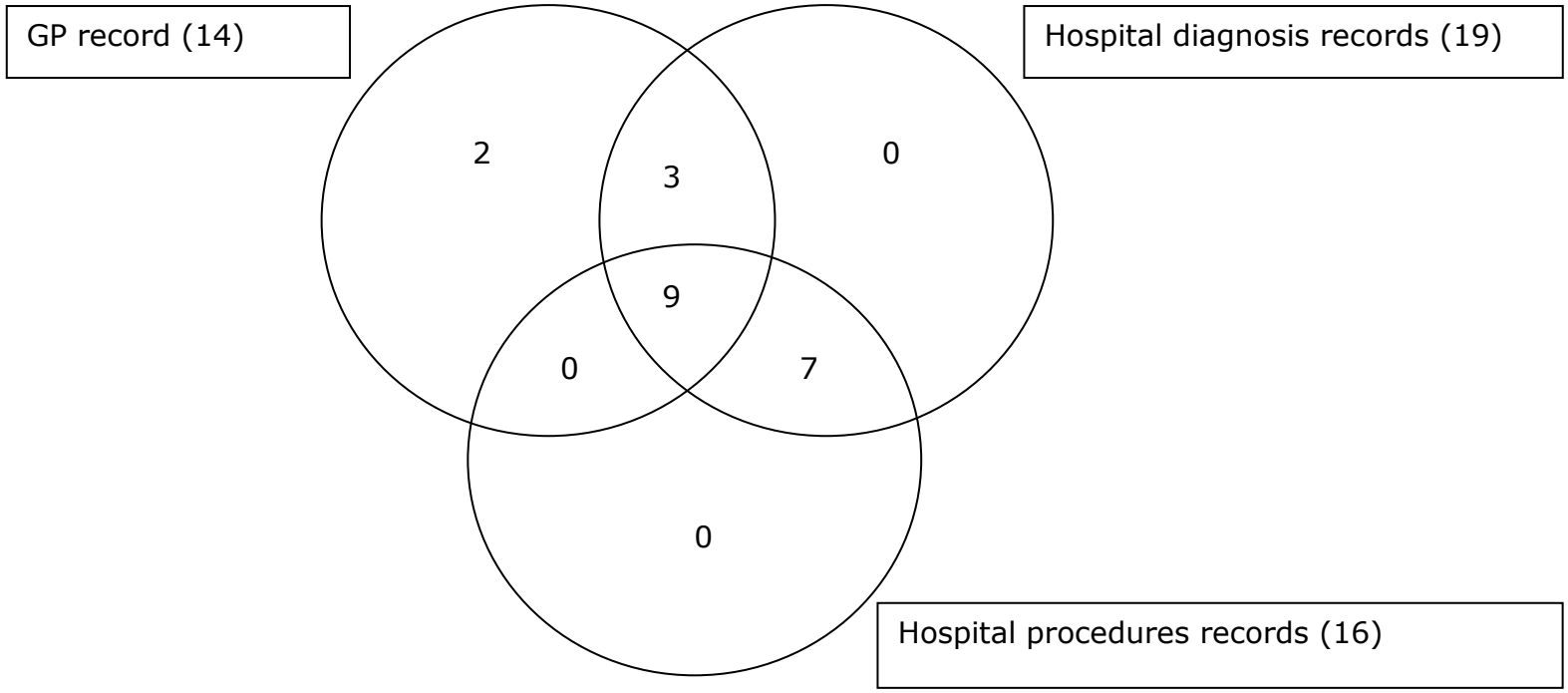


Figure 2-12 shows the frequency of femur fractures recorded in the GP record, hospital diagnosis record and hospital procedures record after further femur fractures were identified by: review of the code descriptions within thirty days of the earliest femur fracture record; and (ii) review of all codes in the GP and hospital records where CYP had no evidence of a femur fracture in the code descriptions within thirty days of the earliest femur fracture record. Manual review of the codes within thirty days of the earliest fracture identified procedure codes which were not specific for femur fracture but the combination of codes and the dates suggested they referred to the same femur fracture coded in the diagnosis codes and/or Read codes (e.g. 'shaft of femur' and 'lower end of femur' on the same date). Codes around the date of the femur fracture in the primary care records that did not identify femur fracture included, for example, 'admitted to paediatric emergency.' A consensus was reached between the two reviewers (VP and KS) that the event described referred to the femur fracture based on the date of the code and the absence of any other diagnosis to which this code might refer. On this basis, twelve (57%) CYP had a femur fracture recorded in GP and hospital medical records. Seven (33%) CYP had insufficient evidence in the GP records to confirm the femur fracture in the code descriptions. In those seven CYP, there were events recorded in the GP records of six CYP within seven days of the femur fracture that suggested: miscoding in three (e.g. knee operation) or coding of other significant events in three (e.g. home visits, admission to emergency department, or death). Of the two CYP with records of a femur fracture only in the GP record, there were codes in the hospital file that suggested the occurrence of the femur fracture (e.g. 'application of plaster

cast’ seventy days after the GP record) for one. There was a delay between the recording in hospital and recording by the GP with a median of 71 (IQR 34 to 109) days, with all records occurring in the hospital record before the GP record. The code descriptions in the hospital diagnosis file showed the likely cause of the femur fracture to be road traffic accidents in ten CYP.

Figure 2-12 Venn diagram to show the number of femur fractures in each source (after manual review of codes)



2.6 Discussion

2.6.1 Main findings

CYP with epilepsy are at greater risk of fractures, thermal injuries and poisonings compared to CYP without epilepsy. In CYP with epilepsy fractures are 18% more likely, thermal injuries 50% more likely and poisonings more than twice as likely compared to CYP without epilepsy, with the increased risk being restricted to medicinal poisonings. Among young adults with epilepsy, aged 19 to 24 years, the risk of medicinal poisoning was four-fold that of the general population of the same age.

2.6.1.1 Fractures

This study shows that of fractures, thermal injuries and poisonings, fractures are the commonest type of injury to occur in CYP with epilepsy, at a rate of seventeen fractures per one thousand person-years at risk. The results suggest that among one thousand CYP with epilepsy, eighty-one CYP would have a fracture within five years of the first record of epilepsy (compared to seventy CYP over five years for CYP without epilepsy). The excess number of fractures associated with epilepsy per thousand CYP over a five year period is twelve.

2.6.1.2 Thermal injuries

This study shows that of fractures, thermal injuries and poisonings, thermal injuries are the least common type of injury to occur in CYP with epilepsy, at a rate of four thermal injuries per one thousand person-years at risk. Among one thousand CYP with epilepsy, nineteen CYP would have

a thermal injury within five years of the first record of epilepsy (compared to twelve CYP at five years for CYP without epilepsy). The excess number of thermal injuries associated with epilepsy per thousand CYP over a five year period is seven.

2.6.1.3 Poisonings

This study shows that of fractures, thermal injuries and poisonings, poisonings are the second commonest type of injury to occur in CYP with epilepsy, at a rate of six poisonings per one thousand person-years at risk. Among one thousand CYP with epilepsy, thirty-five CYP would have a poisoning within five years of the first record of epilepsy (compared to twelve CYP within five years for CYP without epilepsy). The excess number of poisonings associated with epilepsy per thousand CYP over a five year period is twenty-three.

2.6.1.4 Long bone fractures

This study shows that, as expected, the rate of long bone fractures is lower than the rate of any fractures in CYP with epilepsy, at a rate of seven long bone fractures per one thousand person-years at risk. Among one thousand CYP with epilepsy, thirty-four CYP would have a long bone fracture within five years of the first record of epilepsy (compared to thirty-two CYP within five years for CYP without epilepsy). The excess number of long bone fractures associated with epilepsy per thousand CYP over a five year period is two.

2.6.1.5 Medicinal poisonings

This study shows that medicinal poisonings occur at a similar rate to all poisonings in CYP with epilepsy, at a rate of five medicinal poisonings per one thousand person-years at risk. Among one thousand CYP with epilepsy, twenty-nine CYP would have a medicinal poisoning within five years of the first record of epilepsy (compared to eight CYP within five years for CYP without epilepsy). The excess number of medicinal poisonings associated with epilepsy per thousand CYP over a five year period is twenty-one.

2.6.1.6 Non-medicinal poisonings

This study shows that non-medicinal poisonings occur at a lower rate compared to all poisonings in CYP with epilepsy, at a rate of one non-medicinal poisoning per one thousand person-years at risk. Among one thousand CYP with epilepsy, two CYP would have a non-medicinal poisoning within five years of the first record of epilepsy (compared to two CYP within five years for CYP without epilepsy). The excess number of non-medicinal poisonings associated with epilepsy per thousand CYP over a five year period is zero.

2.6.2 Strengths and limitations

This is the first known study to explore associations between epilepsy and fractures, thermal injuries and poisonings in CYP in the primary care population. As the primary care record contains information on diagnoses made in both secondary and primary care this provides a more complete picture of the risk of fractures, thermal injuries and poisonings than

previous studies. Although there were significant results for the tests of the assumption of proportional hazards, the large size of these datasets can give rise to statistical significance when the risk of injuries is, in fact, proportional comparing CYP with epilepsy to CYP without (as was shown by the log-log plots). Misdiagnosis of epilepsy is unlikely as childhood epilepsy is diagnosed by specialists in secondary care with on-going prescriptions provided in primary care[49 53]. Misclassification of epilepsy could have occurred but the subgroup analyses using stricter criteria to define epilepsy made little difference to the estimated risks of injuries, suggesting any misclassification is likely to have minimal impact on the findings. Misclassification of the injuries could have occurred if an injury was not coded by the GP or an injury that had not occurred was incorrectly coded as occurring. However, similar HRs were found for all fractures and for long bone fractures, which were expected to have high levels of recording[241]. For a sub-group including long bone fractures recorded in hospital records a similar estimated risk was found comparing CYP with epilepsy to CYP without epilepsy. Both mechanisms of injury were included (e.g. accidents caused by fire and flames) and anatomic sites of injury (e.g. burn of lower limbs) to maximise ascertainment of injuries. There is a potential risk of ascertainment bias, whereby CYP with epilepsy who may have higher GP consultation rates have more opportunities to report injuries than CYP without epilepsy. Findings of similar HRs for all fractures and for long bone fractures comparing CYP with epilepsy to CYP without would suggest this was not occurring to a large degree. There is no reason to suggest that misclassification for poisonings or thermal injuries would be greater than that for fractures but

any possible misclassification would tend the HR towards unity, meaning the these estimates were conservative estimates of injury risk. Adjustments were made for confounders, such as age, sex, deprivation, region and calendar year. However, it is possible that some residual confounding remains and that the true risk of injuries in CYP with epilepsy is therefore greater or smaller than the estimated risks reported. It was not possible to explore the contribution of anti-epileptic drugs to the increased risk of poisoning because the drug involved was not recorded in most cases of poisoning.

Compared to using hospital and GP medical records together, using information in GP medical records alone would identify 67% of femur fractures. Hence, if hospital records were not included, potentially 33% of CYP with a femur fracture could be missed from calculations of estimates of femur fracture risk and if hospital records alone were used potentially 10% of CYP with a femur fracture could be missed. These findings suggest a more complete assessment of the burden of injuries in CYP under 24 years can be gained by using both GP and hospital records. However, less specific codes are used by GPs that might indicate a femur fracture has occurred (e.g. 'admitted to paediatric emergency'). Therefore using specific femur fracture codes in GP medical records in the absence of other more specific codes in the hospital records may cause an under-ascertainment of femur fractures. In addition, hospital code descriptions may give more information on the mechanism of injuries.

Discrepancies in the recording of fractures in primary care and hospital records may have several possible explanations. Firstly miscoding of femur

fractures in the primary care records may have occurred, as there were other injury codes (e.g. 'knee operation') around the time of the femur fracture. Secondly notifications of femur fractures from secondary care may have been received by the practice but not entered into the primary care record using a Read code indicating an injury (e.g. 'admitted to paediatric emergency'). Thirdly, femur fractures are serious injuries and all patients had several diagnosis codes recorded in the hospital medical records on the date of the femur fracture code but GPs are likely to choose one diagnosis code to summarise the admission (e.g. 'other road vehicle accidents'). Fourthly, when patients register with a practice, previous femur fractures may have been entered onto the primary care record as occurring on the date of data entry (i.e. as an incident fracture) and not the date of hospital admission. Finally, femur fractures treated at hospitals outside England, such as those occurring on holiday, may have been entered onto the primary care record from information provided by the hospital, but this would not appear in HES data and it cannot be known whether these findings for femur fractures can be generalised to the recording all types of fractures in primary care.

This work suggests that rates of femur fracture may have been underestimated but it is unlikely that such underestimates would be different between CYP with and without epilepsy. Furthermore, in this study, the recording of femur fracture was specifically investigated but results suggest that for six of the seven CYP with insufficient evidence of a femur fracture in the primary care record, three had a code that would have been included in this study as a long bone fracture, thereby resulting in an underestimation of femur fractures of four out of twenty-one

fractures. It is possible that GPs are more likely to record a fracture in a person with epilepsy if a fracture was associated with a seizure. However, HRs estimated using GP medical records alone versus using GP and hospital medical records together were similar. If GPs were differentially recording fractures in CYP with epilepsy compared to CYP without epilepsy it would be expected that the estimated HRs would differ between the overall estimates and in the subgroup with GP and hospital medical records but this is not the case.

2.6.3 Comparison with the literature

It is hard to compare the rates of injury in this thesis with previous work because of a lack of population-based studies in comparable groups. However, the rates of fractures in CYP without epilepsy are broadly comparable to those from previous studies[31 242-244]. In contrast, the estimated risk of fractures in CYP of all ages with epilepsy compared to CYP without in a study in the CPRD was higher, with an estimated IRR of 1.89 (95%CI 1.81 to 1.98), adjusting for age and sex[68]. The greater fracture risk in the CPRD study may be, at least partly, explained by the severity of epilepsy as the study population comprised CYP with active epilepsy, with drugs or diagnosis codes recorded for more than one year. There are no previous studies reporting the risk of thermal injuries or poisonings in CYP with epilepsy to CYP without in the general population, therefore comparison of the findings in this thesis chapter with previous studies is not possible.

Potential explanations for increased risk of injuries associated with epilepsy include injuries occurring as a result of seizures (e.g. fractures[245]

[246] and thermal injuries[247-250]). Epilepsy itself may be associated with pathology of the central nervous system that increases injury risk and in the case of poisonings an increased access to medicines (for unintentional poisoning or for self-harm with any medication[251]) or inadvertent over dosage of AED. 19 to 24 year-olds with epilepsy had the highest risk of poisonings, with potential explanations including self-harm or greater risk-taking behaviour. Previous work suggests CYP with epilepsy may have a greater risk of suicide than CYP without epilepsy[252]. It is therefore possible that some of the observed increased risk of poisoning was intentional as opposed to unintentional poisoning. Although it was not possible to explore associations between poisoning with specific drugs and epilepsy, it is possible that easy access to anti-epileptic drugs may be important in this context. Whilst the study in this chapter of the thesis does not allow an exploration of the reasons why injury risks are increased in CYP with epilepsy, it allows quantification of risk and highlights that the excess risk of poisoning is substantially greater than that for fractures or for burns.

A recent review assessing the validity of a range of diagnoses (including fractures in all ages) in the CPRD has shown it to be valid and reliable, with a median of 89% of cases confirmed by primary care record request, algorithm and manual review[222]. Other studies have used codes for femur fractures in large primary care databases in adults aged over thirty years and shown that estimates of the risk of fracture using these data are accurate[253-255] but fractures in older people are likely to have a different aetiology (such as osteoporosis) compared to fractures in children and young people, which are likely to be due to accidental injuries. The National Hip Fracture Database (NHFD) collects data on hip fractures from

England, Wales and Northern Ireland and a previous audit comparing this to HES from England and the Patient Episode Database (PEDW)[256] from Wales has shown that over 95% of all hip fractures were recorded in HES and PEDW were also recorded in the NHFD[257], which suggests that HES is a reliable source of information on hip fractures in adults. Despite this, there has been some debate about the quality of coding in the HES[258-260]. For example, when compared to the Public Health Common Dataset, collected independently on behalf of the Department of Health[261], HES had a completeness of 83% of hip fractures in people over 65 years old[262]. A study from Norway compared recording of femur fractures from local hospital records, compiled at the time of discharge from hospital, and a national database, compiled from separate information from hospitals, and found that the hospital records underestimated fractures by between 17 and 46% (dependent on the hospital) and the national database overestimated fractures by 19%[263].

2.6.4 Clinical implications

All healthcare professionals involved in the care of CYP can use these findings to inform parents, CYP diagnosed with epilepsy of their absolute risk of injuries as part of counselling for unintentional injury prevention[264] and to inform existing guidelines on treatment[265]. For fractures and thermal injuries, the increase in absolute risk associated with epilepsy is small. Given the increased risk of poisoning, in particular among young adults, efforts should be made to prevent this injury. For example, information could be provided on the risk of medicinal poisoning and advice about safe storage of all medicines (not just AEDs), not transferring

medicines to other containers, supervising children taking medicine and about the dangers of overdosing[266-268]. This information could be provided when prescribing medication and during epilepsy reviews and pharmacists can also provide such information when dispensing antiepileptic drugs to CYP.

2.6.5 Conclusions

In conclusion this study shows that, the absolute risk of injury in the five year period following diagnosis was an additional: twelve fractures (two long bone); seven thermal injuries and twenty-three poisonings (twenty-one medicinal poisonings) per one thousand CYP. CYP with epilepsy aged between 19 to 24 years were at the greatest risk of poisonings compared to CYP without epilepsy.

3 What is the prevalence of attention-deficit hyperactivity disorder (ADHD) in children and young people under 18 years old in the Clinical Practice Research Datalink (CPRD)?

This chapter describes a longitudinal study conducted to identify CYP in the CPRD with ADHD and to estimate the administrative prevalence of ADHD in English general practice.

3.1 Background – ADHD in children and young people

As described in section 1.4.1, ADHD is a common mental health problem in CYP. The prevalence of ADHD was described in section 1.4.2.1 of this thesis. The community prevalence of ADHD, defined as the number of people in the community with ADHD, meeting predefined criteria, as a proportion of the whole population, is approximately 5%[108]. However, the administrative prevalence of ADHD, defined as the number of people with diagnosed and/or treated ADHD recorded in their medical records as a proportion of the whole population is thought to be much lower in the UK.

Globally, studies on the community prevalence of ADHD have suggested that there is a higher prevalence of ADHD in more deprived groups[109]. In contrast, the findings for the association of the administrative prevalence of ADHD with deprivation are not consistent[58 152 114].

There is similar evidence from the UK that the community prevalence of ADHD is associated with deprivation[158 159 160]. Also there is evidence from

a referral clinic population of the association between the prevalence of children diagnosed with ADHD and area-level deprivation[161]. However, a community prevalence survey of school children in England and Wales did not find an association between hyperactivity and deprivation but this study used the school's address to define the area-level deprivation so this might not accurately reflect the deprivation of the children concerned[162]. Previous studies using UK primary care datasets, such as the CPRD[142 143 145 146] and THIN[141 144 147] have not reported on how the prevalence of ADHD varies by deprivation and therefore this is an area in which evidence is lacking, from a primary care perspective.

Studies on regional variation in the administrative prevalence of ADHD in the UK are rare. For example, a study on 1,069 children in the Liverpool area, in the North-West of England, with a clinical diagnosis of ADHD investigated the association between the prevalence of ADHD and deprivation[163]. The study found strong evidence for increased rates of clinically diagnosed ADHD in areas of greater deprivation[163].

3.2 Aims

To describe the cumulative administrative prevalence of ADHD in the CPRD.

3.3 Objectives

Using the GP medical records of CYP aged 3 to 17 years old in the CPRD from 1998 to 2012, to:

1. Describe the cumulative administrative prevalence of ADHD overall and by: sex; age; SHA region; deprivation (at LSOA[164] level); and calendar time.
2. Explore the effect on estimates of re-defining CYP with ADHD as CYP who have: at least one drug code or at least one diagnosis code; at least two drug codes and at least two diagnosis codes; at least one drug code; no drug codes.
3. Explore how the administrative prevalence of ADHD varies by deprivation and how the administrative prevalence of ADHD by deprivation varies after adjusting for sex, age, region and calendar time.
4. Conduct sensitivity analyses to investigate the effect on estimates of administrative prevalence of ADHD by deprivation when ADHD is defined using narrower and broader descriptions as described in objective 2 above.

3.4 Methods

3.4.1 Study design

Historical cohort study.

3.4.2 Study population

Medical records of all people with a diagnosis (Read) code (Table 3-1) in the clinical or referral records or drug code in the prescription records for ADHD (Table 3-2) were extracted from the CPRD (GOLD version June 2013[220]) for all patients registered before June 2013. Code lists were

reviewed by a senior academic GP colleague (DK) and an academic consultant child and adolescent psychiatrist (KS).

Table 3-1 Descriptions for diagnosis codes for ADHD

Code descriptions - ADHD
ADD - Attention deficit disorder
Attention deficit disorder
Attention deficit with hyperactivity
Attention deficit without hyperactivity
Child attention deficit disorder
Child attention deficit disorder NOS
Childhood hyperkinetic syndrome
DAMP - Deficits in attention motor control and perception
Deficits in attention motor control and perception
Disorders of attention and motor control
Hyperkinetic syndrome NOS
[X]Attention deficit disorder
[X]Attention deficit disorder
[X]Attention deficit hyperactivity disorder
[X]Deficits in attention, motor control and perception
[X]Disturbance of activity and attention
[X]Hyperkinetic disorder, unspecified
[X]Hyperkinetic disorders
[X]Hyperkinetic reaction of childhood or adolescence NOS
[X]Hyperkinetic syndrome NOS
[X]Other hyperkinetic disorders

Table 3-2 Descriptions for drug codes for ADHD

Drugs identifying ADHD
amfetamine/dexamfetamine sulphate
atomoxetine hydrochloride
dexamfetamine sulphate
methylphenidate hydrochloride
modafinil
pemoline

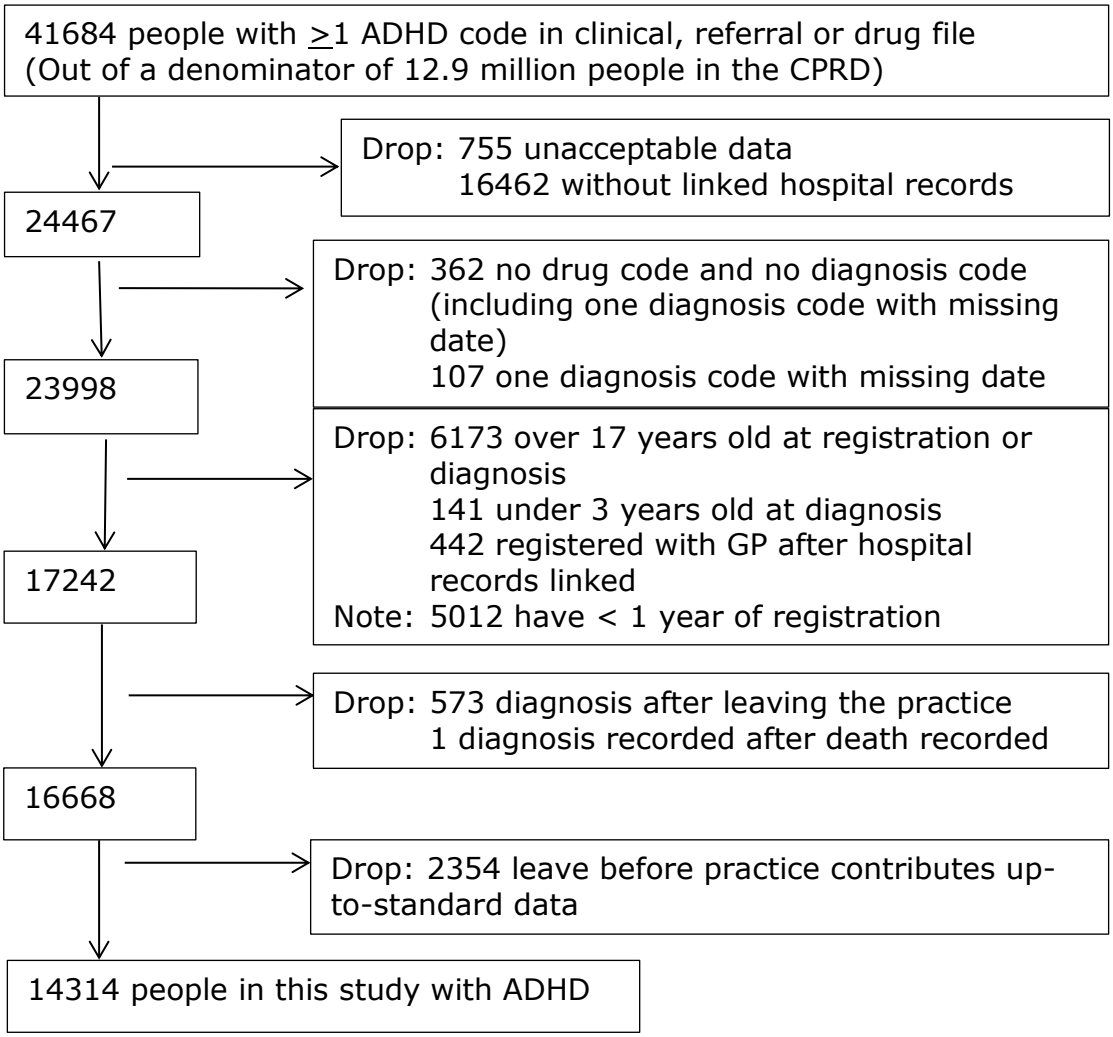
3.4.3 Definition of ADHD

Figure 3-1 shows how people with ADHD were defined as people with at least one diagnosis code or at least one drug code for ADHD. People aged less than 3 years and over 17 years at diagnosis were dropped from the population of people with ADHD. In children under 3 years the diagnosis of ADHD was uncertain because national guidelines suggest that ADHD should not be diagnosed below this age[98] and in people over 17 years old there may be limited services to diagnose and treat ADHD resulting in people with ADHD not having a diagnosis or prescription in their GP medical records[144 145 269]. Therefore, in contrast to the population of CYP with epilepsy, CYP with ADHD were not included over the age of 17 years. In CYP with epilepsy a sensitivity analysis had been conducted on CYP aged 1 to 21 years (as described in section 2.4.5.1), rather than 1 to 17 years because there was no evidence for the same lack of services for young adults with epilepsy from the age of 18 years onwards. People who had inconsistent dates, e.g. diagnosis after leaving the practice, were dropped. To identify the population with ADHD, the frequency of the first and second drug prescribed was described (appendix 6.5), confirming that

methylphenidate is prescribed as the first and second drug in 92% of people. The frequency of the first and second Read code recorded was also described (appendix 6.6), confirming that approximately 60% of people have 'attention deficit hyperactivity disorder' as their first and second diagnosis code.

As ADHD is a developmental condition with long term symptoms, it could not be known from these data when the person first displayed symptoms of the condition or when they ceased having symptoms. However, the latest of the date of: diagnosis; registration with the practice (in those people who had been diagnosed before registration); or 1st January 1998 (the first full year that the link between CPRD and HES was established) was taken as the date when ADHD was first known to the GP. The earliest of the date when the: person left the practice; practice stopped contributing data to the CPRD; person died; person turned 25 years old; or 31st December 2012 (the last complete year that CPRD-HES linked data were available), was taken as the last date of follow-up in the study. Although the data were downloaded from the CPRD in June 2013, data are regularly added to each new version of the database and hence people who joined the database after 31st December 2012 would not have been included in this study.

Figure 3-1 Flow of people with ADHD code(s)



3.4.4 Alternative definitions of ADHD

In order to explore how altering the definition of ADHD affects estimates of administrative prevalence, subgroups of people with ADHD were defined as people with: at least one drug code or at least one diagnosis code; at least two drug codes and at least two diagnosis codes; at least one drug code; no drug codes.

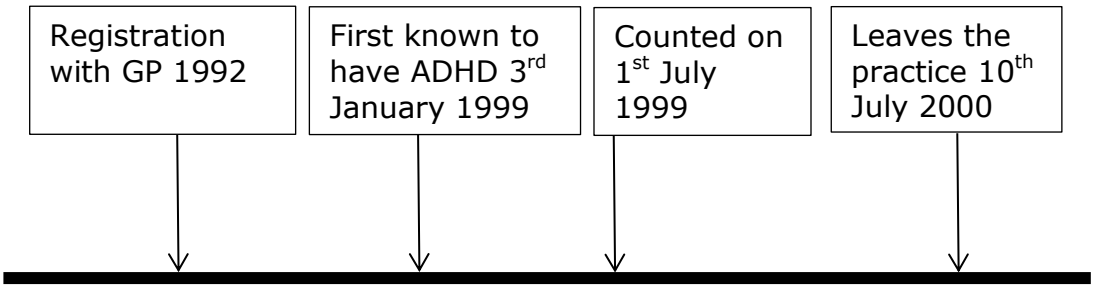
3.4.5 Age

Age was defined as the number of years between birth and the current year of analysis.

3.4.6 Numerators

In order to calculate the frequency of people with known ADHD in each calendar year, the person was required to have received the diagnosis on or prior to 1st July that year and to have GP registration on the 1st July (mid-point of the year) in that year. For example, for 1999 the person would be counted as having ADHD if she or he had registered with the GP on or before 1st July 1999, left the database on or after 1st July 1999 and they had ADHD known to the GP before 1st July 1999. An example is illustrated below (Figure 3-2).

Figure 3-2 Example of how a person was counted in the numerator for 1999



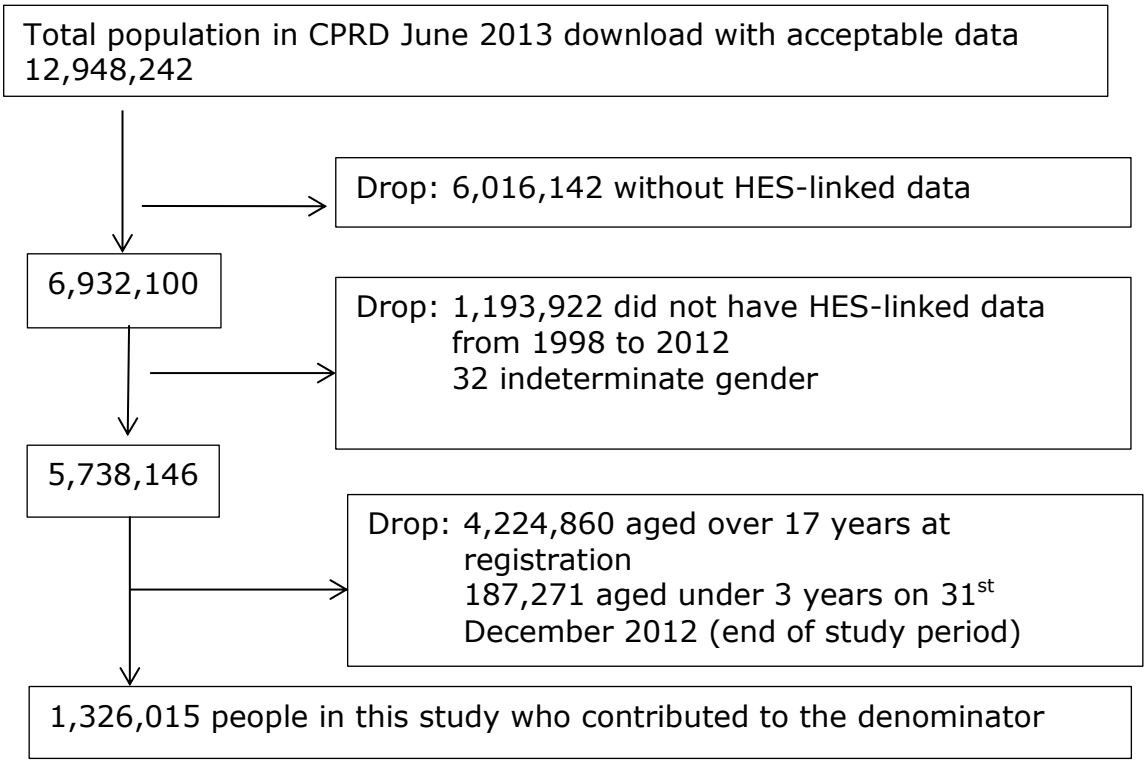
People who had been diagnosed with ADHD prior to 1st January 1998 with GP records beyond that date contributed data. The number of people known to have ADHD by 1st July each year was counted overall and by: age, sex, SHA region and the social deprivation quintile of the person (at the level of the LSOA of their home postcode measured by the English IMD score 2010[270]).

3.4.7 Denominators

Figure 3-4 shows the flow of people for whom medical records were extracted from the CPRD for all patients registered before 31st December 2012. There were a total of 12,948,242 people with data in the CPRD which were up-to-standard for research according to CPRD criteria. Of those, 6,932,100 had HES-linked data and of those 5,738,146 people had HES-linked data between 1998 and 2012. People with unacceptable data (e.g. indeterminate gender), people over 17 years at the time of registration and people under 3 years at the end of the study were dropped from the population. CYP were counted in the denominator after the latest of: registration with the practice; 1st January 1998; or the date of the third birthday. The earliest of the date of when the: person left the

practice; practice stopped contributing data to the CPRD; person died; person turned 25 years old; or 31st December 2012, was when CYP were no longer counted in the denominator. The number of CYP registered in the CPRD on 1st July each year was counted overall and by age, sex, SHA region and the social LSOA-level deprivation quintile of the person). In order to be counted in the denominator population, the person was required to have been registered with the GP on or prior to 1st July that year and to remain registered on 1st July that year. For example, for 1999 the person would be counted in the denominator if she or he had registered with the GP on or before 1st July 1999 and left the database on or after 1st July 1999.

Figure 3-3 Flow of people who contributed to the denominators



3.4.8 Calculation of administrative prevalence

In each year of the study the frequency of people in the numerator population (who had a diagnosis of ADHD before 1st July in the given year and were still registered in the CPRD) was calculated overall and by sex, age, deprivation quintile and region). Similarly in each year of the study the frequency of people in the denominator population (who were registered in the CPRD and had HES-linked data before 1st July and beyond 1st July in the given year) was calculated overall and by sex, age, deprivation quintile and region. Administrative prevalence was calculated as the sum of the annual numerators divided by the sum of the annual denominators multiplied by one hundred, to give a percentage. The 95%CI was also estimated using an assumption of Poisson distribution to

give a measure of sampling error. An assumption of Poisson distribution was appropriate because the diagnosis of ADHD is a rare event with most CYP being diagnosed early on in their lives; less CYP are diagnosed as a proportion of the whole population the older they become; the diagnosis of ADHD in one CYP is not dependent on the diagnosis in other CYP (they are unrelated); and CYP contributed different lengths of time to the study[271] [272]. Administrative prevalence was described overall, by sex, age, SHA region, deprivation and calendar year.

In estimating the cumulative prevalence in this way it was possible that the assumption of independence of annual observations would be violated because the observations in each year were on the same people. Therefore a further estimate was made restricting the analysis to CYP with data in 2012.

In order to explore how altering the definition of ADHD affects estimates of administrative prevalence, administrative prevalence was re-estimated for CYP with: at least one drug code or at least one diagnosis code; at least two drug codes and at least two diagnosis codes; at least one drug code; no drug codes.

3.4.9 Exploration of administrative prevalence of ADHD by calendar year

In order to assess how the administrative prevalence of ADHD has changed from 1998 to 2012, estimates of the administrative prevalence of ADHD were explored for each calendar year from 1998 to 2012. In order to assess whether changes in the administrative prevalence of ADHD over time were consistent for CYP in each deprivation quintile, the

administrative prevalence of ADHD over time was explored by deprivation quintile. In order to test for evidence against the null hypothesis that the administrative prevalence of ADHD is similar in CYP from each deprivation quintile across time, a likelihood ratio test (LRT) was conducted, comparing the estimated administrative prevalence by deprivation quintile (adjusted for sex, age, region and calendar year) with the adjusted estimate with an interaction term for deprivation with calendar year (excluding CYP with no deprivation data). In order to assess whether the length of time for which CYP with ADHD were registered with the GP practice varied by their area-level deprivation quintile, the length of their registration was described and ratios were estimated compared to the CYP in the least deprived areas.

3.4.10 Estimation of administrative prevalence rate ratios of ADHD by sex, age, deprivation and region

The unadjusted administrative prevalence rate ratio (PRR) was estimated overall and by each variable (sex, age, deprivation and SHA region) using an assumption of Poisson distribution, comparing each level of the variable to the baseline group. The estimated PRR's were then adjusted for the other variables and for calendar year.

Interactions between: age and sex; sex and calendar time; deprivation and region; deprivation and calendar time, were assessed using a LRT, comparing Poisson models, with and without the interaction terms with a P value of <0.05 taken as significant. All models included sex, age, deprivation, region and calendar time. Where variables could have been

treated as linear or categorical the variable was fitted as a linear term in the test for interaction.

3.4.11 Sensitivity analyses: estimation of administrative prevalence rate ratios of ADHD with varying definitions of ADHD

In order to explore how altering the definition of ADHD affects estimates of the PRR comparing CYP in each quintile of deprivation with CYP in the least deprived quintile, PRR's were re-estimated for CYP with: at least two drug codes and at least two diagnosis codes; at least one drug code; no drug codes.

3.5 Results

3.5.1 The prevalence of ADHD

There were a total of 14,314 CYP with ADHD and 1.3 million CYP in the study population overall. The median (interquartile range) follow-up time was 3 (IQR 1 to 7) years. Table 3-3 shows the prevalence of ADHD in the study population overall. The overall prevalence was 0.88% (95%CI 0.87 to 0.89). Males had a higher prevalence than females (1.45% in males (95%CI 1.44 to 1.46) vs. 0.27% in females (95%CI 0.26 to 0.27)). The prevalence of ADHD was highest in 15 to 17 year-olds (1.38% (95%CI 1.36 to 1.40)) and lowest in 3 to 4 year-olds (0.02% (95%CI 0.02 to 0.03)). The CYP from the quintile of greatest deprivation had the highest prevalence of ADHD with a prevalence of 1.14% (95%CI 1.12 to 1.16) and CYP in the quintile of least deprivation had the lowest prevalence of 0.64% (95%CI 0.63 to 0.65). The region with the highest prevalence of ADHD was the South East Coast with a prevalence of 1.27% (95%CI 1.24 to 1.29) and the region with the lowest prevalence was the Yorkshire and Humber region of 0.59% (95%CI 0.56 to 0.62). In Appendix 6.7 Table 6-11 shows that in 2012 the overall prevalence of ADHD was 1.06% (95%CI 1.03 to 1.09) and the prevalence by sex, age, deprivation and region were similar to Table 3-3.

Table 3-3 The prevalence of ADHD in CYP with medical records between 1998 and 2012 for the study population overall

Characteristic		≥1 drug OR ≥1 diagnosis code			
		Sum of annual numerators	Sum of annual denominators	Prevalence %	(95% CI)
Overall		59,559	6,779,300	0.88	(0.87 -0.89)
Sex	Male	50,743	3,504,771	1.45	(1.44 -1.46)
	Female	8,816	3,274,529	0.27	(0.26 -0.27)
Age group	3-4	220	901,518	0.02	(0.02 -0.03)
	5-9	11,602	2,262,361	0.51	(0.50 -0.52)
	10-14	29,376	2,288,178	1.28	(1.27 -1.30)
	15-17	18,361	1,327,243	1.38	(1.36 -1.40)
Deprivation	Least deprived	10,444	1,636,282	0.64	(0.63 -0.65)
	2nd least deprived	10,679	1,440,406	0.74	(0.73 -0.76)
	Medium deprivation	11,089	1,237,430	0.90	(0.88 -0.91)
	2nd most deprived	13,537	1,250,135	1.08	(1.06 -1.10)
	Most deprived	13,213	1,161,605	1.14	(1.12 -1.16)
	Deprivation missing	597	53,442	1.12	(1.03 -1.21)
SHA Region	East Midlands	1,811	261,731	0.69	(0.66 -0.72)
	East of England	8,996	842,775	1.07	(1.05 -1.09)
	London	5,654	902,851	0.63	(0.61 -0.64)
	North East	1,612	179,848	0.90	(0.85 -0.94)
	North West	8,465	1,154,538	0.73	(0.72 -0.75)
	South Central	8,534	854,347	1.00	(0.98 -1.02)
	South East Coast	10,394	819,611	1.27	(1.24 -1.29)
	South West	6,762	697,721	0.97	(0.95 -0.99)
	West Midlands	5,534	761,666	0.73	(0.71 -0.75)
	Yorkshire & Humber	1,797	304,212	0.59	(0.56 -0.62)

Age is described as the age in the current calendar year

Table 3-4 shows the prevalence of ADHD in CYP with at least two drug codes and at least two diagnosis codes. The prevalence was 0.25% (95%CI 0.25 to 0.26) compared to 0.88% (95%CI 0.87 to 0.89) in the study population overall (Table 3-3 above). In contrast to the study population overall, the prevalence of ADHD using the criteria was highest in 10 to 14 year-olds (0.39% (95%CI 0.38 to 0.40)) but the prevalence was lowest in 3 to 4 year-olds (0.004% (95%CI 0.003 to 0.01)), which was similar to when CYP with ADHD in the numerator were described as CYP with at least one drug code or at least one diagnosis code.

Table 3-4 The prevalence of ADHD in CYP with medical records between 1998 and 2012 in CYP with at least two drug codes and at least two diagnosis codes

Characteristic		≥2 drug & ≥2 diagnosis codes			
		Sum of annual numerators	Sum of annual denominators	Prevalence %	(95% CI)
Overall		17,278	6,779,300	0.25	(0.25 -0.26)
Sex	Male	15,141	3,504,771	0.43	(0.43 -0.44)
	Female	2,137	3,274,529	0.07	(0.06 -0.07)
Age group	3-4	35	901,518	0.004	(0.003 -0.01)
	5-9	3,336	2,262,361	0.15	(0.14 -0.15)
	10-14	8,963	2,288,178	0.39	(0.38 -0.40)
	15-17	4,944	1,327,243	0.37	(0.36 -0.38)
Deprivation	Least deprived	3,016	1,636,282	0.18	(0.18 -0.19)
	2nd least deprived	2,892	1,440,406	0.20	(0.19 -0.21)
	Medium deprivation	3,285	1,237,430	0.27	(0.26 -0.27)
	2nd most deprived	3,967	1,250,135	0.32	(0.31 -0.33)
	Most deprived	3,953	1,161,605	0.34	(0.33 -0.35)
	Deprivation missing	165	53,442	0.31	(0.26 -0.36)
SHA Region	East Midlands	520	261,731	0.20	(0.18 -0.22)
	East of England	2,635	842,775	0.31	(0.30 -0.32)
	London	1,581	902,851	0.18	(0.17 -0.18)
	North East	488	179,848	0.27	(0.25 -0.30)
	North West	2,404	1,154,538	0.21	(0.20 -0.22)
	South Central	2,690	854,347	0.31	(0.30 -0.33)
	South East Coast	2,991	819,611	0.36	(0.35 -0.38)
	South West	1,915	697,721	0.27	(0.26 -0.29)
	West Midlands	1,549	761,666	0.20	(0.19 -0.21)
	Yorkshire & Humber	505	304,212	0.17	(0.15 -0.18)

Age is described as the age in the current calendar year

Table 3-5 shows the prevalence of ADHD in CYP with at least one drug code. The prevalence was 0.55% (95%CI 0.55 to 0.56) compared to 0.88% (95%CI 0.87 to 0.89) when the numerators consisted of CYP with at least one drug code or at least one diagnosis code (Table 3-3 above).

Table 3-5 The prevalence of ADHD in CYP with medical records between 1998 and 2012 in CYP with at least one drug code

Characteristic		≥1 drug code			
		Sum of annual numerators	Sum of annual denominators	Prevalence %	(95% CI)
Overall		37,503	6,779,300	0.55	(0.55 -0.56)
Sex	Male	32,541	3,504,771	0.93	(0.92 -0.94)
	Female	4,962	3,274,529	0.15	(0.15 -0.16)
Age group	3-4	61	901,518	0.01	(0.01 -0.01)
	5-9	6,974	2,262,361	0.31	(0.30 -0.32)
	10-14	19,195	2,288,178	0.84	(0.83 -0.85)
	15-17	11,273	1,327,243	0.85	(0.83 -0.87)
Deprivation	Least deprived	6,764	1,636,282	0.41	(0.40 -0.42)
	2nd least deprived	6,630	1,440,406	0.46	(0.45 -0.47)
	Medium deprivation	6,936	1,237,430	0.56	(0.55 -0.57)
	2nd most deprived	8,461	1,250,135	0.68	(0.66 -0.69)
	Most deprived	8,320	1,161,605	0.72	(0.70 -0.73)
	Deprivation missing	392	53,442	0.73	(0.66 -0.81)
SHA Region	East Midlands	1,064	261,731	0.41	(0.38 -0.43)
	East of England	5,931	842,775	0.70	(0.69 -0.72)
	London	3,534	902,851	0.39	(0.38 -0.40)
	North East	1,008	179,848	0.56	(0.53 -0.60)
	North West	5,335	1,154,538	0.46	(0.45 -0.47)
	South Central	5,936	854,347	0.69	(0.68 -0.71)
	South East Coast	6,682	819,611	0.82	(0.80 -0.84)
	South West	4,126	697,721	0.59	(0.57 -0.61)
	West Midlands	3,029	761,666	0.40	(0.38 -0.41)
	Yorkshire & Humber	858	304,212	0.28	(0.26 -0.30)

Age is described as the age in the current calendar year

Table 3-6 shows the prevalence of ADHD in CYP with no drug code. The prevalence was 0.33% (95%CI 0.32 to 0.33) compared to 0.88% (95%CI 0.87 to 0.89) in the study population overall (Table 3-3 above). The region with the highest prevalence of ADHD was the South East Coast with a prevalence of 0.45% (95%CI 0.44 to 0.47), similar to the study population overall, but the region with the lowest prevalence was London at 0.23% (95%CI 0.22 to 0.25).

Table 3-6 The prevalence of ADHD in CYP with medical records between 1998 and 2012 in CYP with no drug code

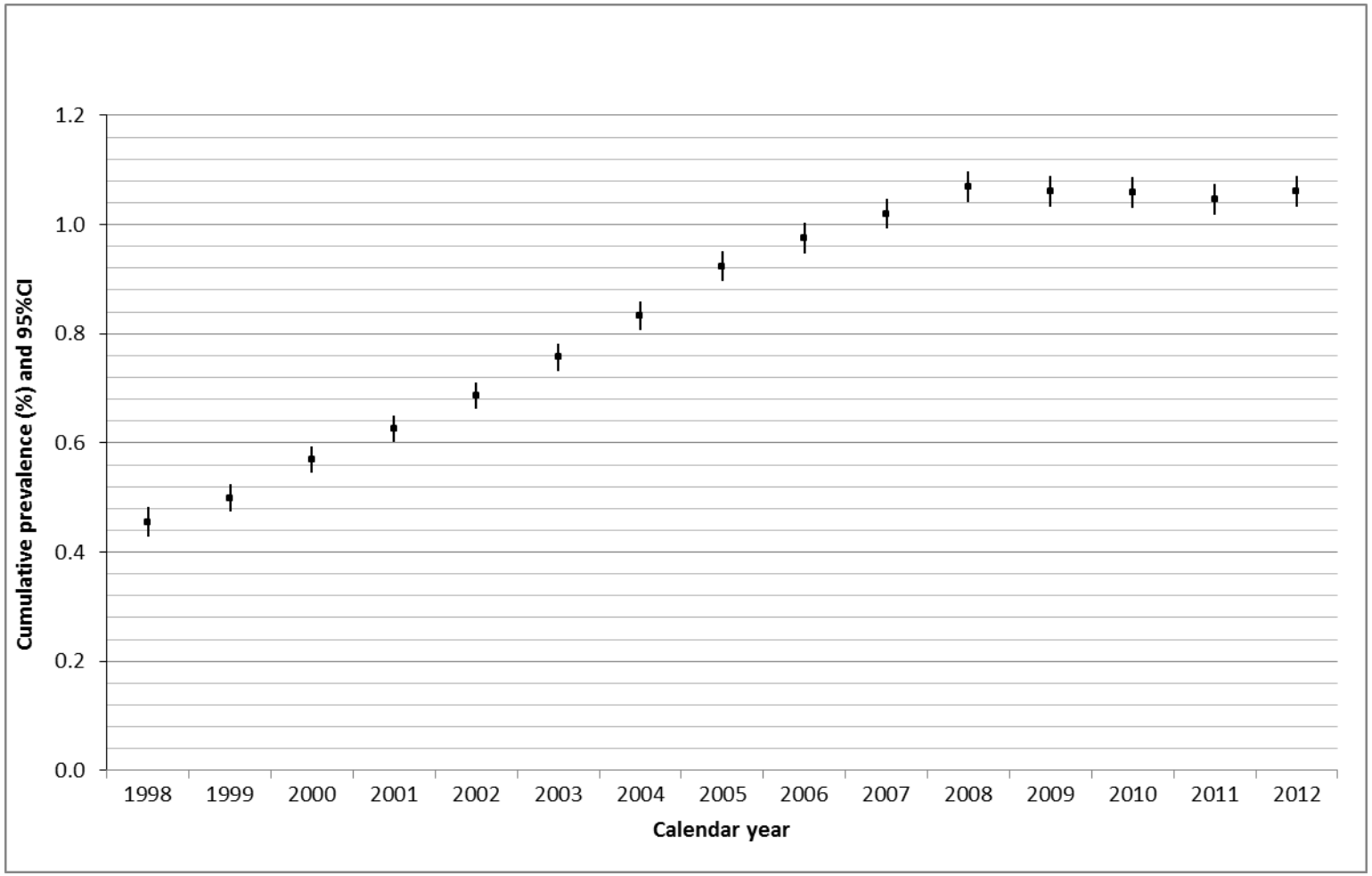
Characteristic		≥ 1 diagnosis code (no drug code)		
		Sum of annual numerators	Sum of annual denominators	Prevalence % (95% CI)
Overall		22,056	6,779,300	0.33 (0.32 -0.33)
Sex	Male	18,202	3,504,771	0.52 (0.51 -0.53)
	Female	3,854	3,274,529	0.12 (0.11 -0.12)
Age group	3-4	159	901,518	0.02 (0.02 -0.02)
	5-9	4,628	2,262,361	0.20 (0.20 -0.21)
	10-14	10,181	2,288,178	0.44 (0.44 -0.45)
	15-17	7,088	1,327,243	0.53 (0.52 -0.55)
Deprivation	Least deprived	3,680	1,636,282	0.22 (0.22 -0.23)
	2nd least deprived	4,049	1,440,406	0.28 (0.27 -0.29)
	Medium deprivation	4,153	1,237,430	0.34 (0.33 -0.35)
	2nd most deprived	5,076	1,250,135	0.41 (0.39 -0.42)
	Most deprived	4,893	1,161,605	0.42 (0.41 -0.43)
	Deprivation missing	205	53,442	0.38 (0.33 -0.44)
SHA Region	East Midlands	747	261,731	0.29 (0.27 -0.31)
	East of England	3,065	842,775	0.36 (0.35 -0.38)
	London	2,120	902,851	0.23 (0.22 -0.25)
	North East	604	179,848	0.34 (0.31 -0.36)
	North West	3,130	1,154,538	0.27 (0.26 -0.28)
	South Central	2,598	854,347	0.30 (0.29 -0.32)
	South East Coast	3,712	819,611	0.45 (0.44 -0.47)
	South West	2,636	697,721	0.38 (0.36 -0.39)
	West Midlands	2,505	761,666	0.33 (0.32 -0.34)
	Yorkshire & Humber	939	304,212	0.31 (0.29 -0.33)

Age is described as the age in the current calendar year

3.5.2 Prevalence of ADHD by calendar year

Figure 3-4 shows the prevalence of ADHD by calendar year for the study population overall (with at least one drug or at least one diagnosis code). This shows that the prevalence of ADHD increased consistently from 1998 (0.46% (95%CI 0.43 to 0.48)) to 2008 (1.07 (95%CI 1.04 to 1.10)) with a plateau until the end of the study in 2012.

Figure 3-4 The prevalence of ADHD by calendar year for the study population overall



3.5.3 The prevalence rate ratios by sex, age, SHA region and deprivation

Table 3-7 shows the crude and adjusted PRR of ADHD by sex, age, deprivation, and region in the overall population. It shows that ADHD was 5.4 times greater in males compared to females (PRR 5.37 (95%CI 5.25 to 5.50), adjusting for age, deprivation, region and calendar year). The prevalence of ADHD was 55 times greater in the 15 to 17 year-old children compared to the 3 to 4 year-old children (PRR 55.31 (95%CI 48.42 to 63.17), adjusting for sex, deprivation, region and calendar year). The prevalence of ADHD was twice as high in the CYP living in the most deprived areas compared to CYP in the least deprived areas (PRR 2.29 (95%CI 2.23 to 2.35), adjusting for sex, age, region, and calendar year) and there was strong evidence for a linear trend from the least deprived to the most deprived areas, excluding CYP for whom their area-level deprivation was not known ($p<0.001$, test for linear trend). The prevalence of ADHD was more than double in the South East Coast region compared to the Yorkshire and Humber region (PRR 2.30 (95%CI 2.19 to 2.42), adjusting for sex, age, deprivation and calendar year).

Table 3-7 The crude and adjusted prevalence rate ratio of ADHD in CYP with medical records between 1998 and 2012

Characteristic		≥1 drug OR ≥1 diagnosis code				P-value
		PRR	95% CI	Adjusted PRR	95% CI	
Sex	Female	1.00		1.00		**p<0.001[&]**
	Male	5.38	(5.26 -5.50)	5.37	(5.25 -5.50)	
Age group	3-4	1.00		1.00		**p<0.001[#]**
	5-9	21.01	(18.39 -24.01)	21.31	(18.65 -24.36)	
	10-14	52.61	(46.07 -60.07)	52.58	(46.05 -60.04)	
	15-17	56.69	(49.63 -64.75)	55.31	(48.42 -63.17)	
Deprivation	Least deprived	1.00		1.00		**p<0.001[#]**
	2nd least deprived	1.16	(1.13 -1.19)	1.23	(1.20 -1.27)	
	Medium deprivation	1.40	(1.37 -1.44)	1.52	(1.48 -1.56)	
	2nd most deprived	1.70	(1.65 -1.74)	1.95	(1.90 -2.00)	
	Most deprived	1.78	(1.74 -1.83)	2.29	(2.23 -2.35)	
	Deprivation missing	1.75	(1.61 -1.90)	1.97	(1.82 -2.14)	
SHA Region	East Midlands	1.17	(1.10 -1.25)	1.19	(1.12 -1.27)	**p<0.001[&]**
	East of England	1.81	(1.72 -1.90)	2.07	(1.97 -2.18)	
	London	1.06	(1.01 -1.12)	1.03	(0.97 -1.08)	
	North East	1.52	(1.42 -1.62)	1.33	(1.24 -1.42)	
	North West	1.24	(1.18 -1.31)	1.15	(1.09 -1.21)	
	South Central	1.69	(1.61 -1.78)	1.94	(1.84 -2.04)	
	South East Coast	2.15	(2.04 -2.26)	2.30	(2.19 -2.42)	
	South West	1.64	(1.56 -1.73)	1.63	(1.55 -1.72)	
	West Midlands	1.23	(1.17 -1.30)	1.24	(1.17 -1.30)	
	Yorkshire & Humber	1.00		1.00		

[$]Adjusted for the other variables in the table and calendar year

[&]P value for likelihood ratio test comparing the adjusted model with the variable to a model without

Age is described as the age in the current calendar year

[#]P value for test for linear trend adjusting for other variables in the table and calendar year

3.5.4 Prevalence of ADHD by age and sex

Table 3-8 shows the prevalence rates and PRR's for males and females separately by age group. Although the prevalence of ADHD was greater in males compared to females, the PRR's were similar by age (p=0.54, test for interaction).

Table 3-8 The prevalence and prevalence rate ratio of ADHD in CYP with medical records between 1998 and 2012 by age and sex

Characteristic	≥1 drug OR ≥1 diagnosis code					
	Prevalence				$Adjusted	
	%	95% CI	PRR	95% CI	PRR	95% CI
Male						
Age group 3-4	0.04	(0.03 -0.05)	1.00		1.00	
5-9	0.85	(0.83 -0.86)	21.12	(18.26 -24.42)	21.45	(18.54 -24.81)
10-14	2.11	(2.09 -2.14)	52.73	(45.63 -60.94)	53.20	(46.04 -61.48)
15-17	2.25	(2.22 -2.29)	56.19	(48.61 -64.96)	55.75	(48.23 -64.44)
Female						
Age group 3-4	0.01	(0.01 -0.01)	1.00		1.00	
5-9	0.16	(0.15 -0.17)	20.26	(14.50 -28.31)	20.63	(14.77 -28.83)
10-14	0.39	(0.38 -0.40)	49.02	(35.15 -68.37)	49.31	(35.36 -68.77)
15-17	0.43	(0.41 -0.45)	53.87	(38.60 -75.19)	53.01	(37.98 -73.98)

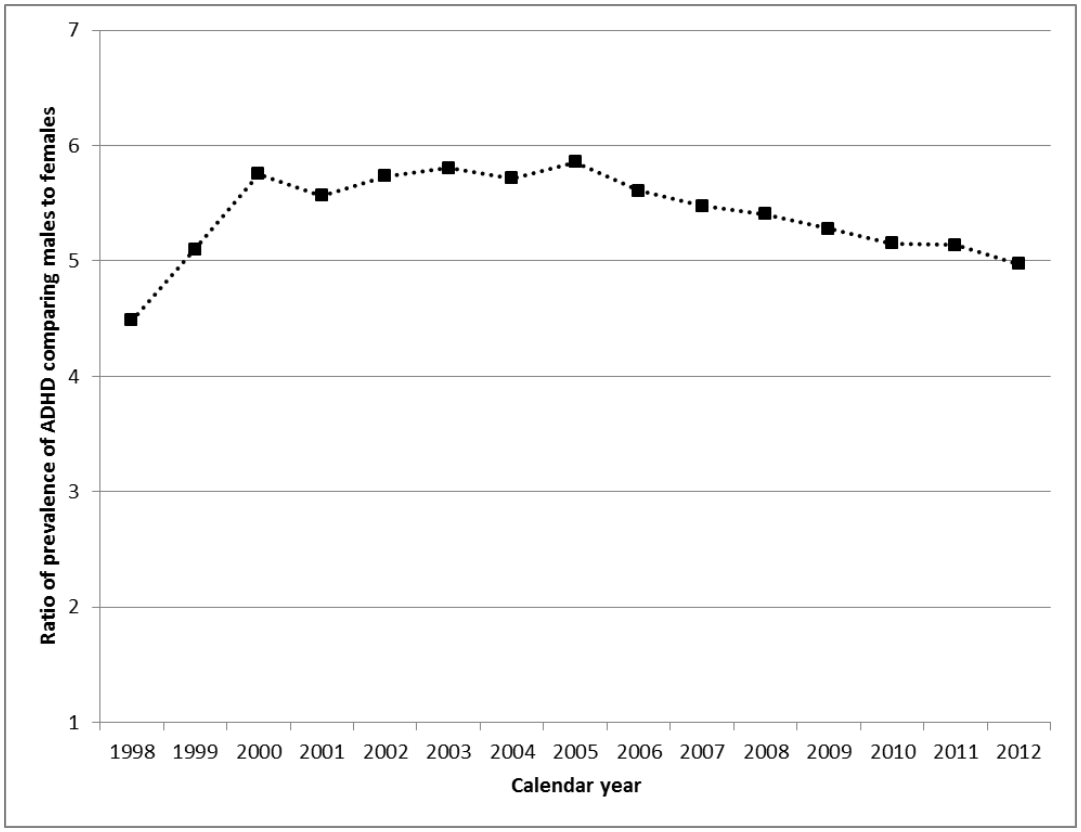
PRR=Prevalence rate ratio

Age is described as the age in the current calendar year

$Adjusted for deprivation, region and calendar year

The prevalence ratio of ADHD in males compared to females was estimated annually between 1998 and 2012. Figure 3-5 shows that the prevalence of ADHD in males compared to females remained similar by calendar year between 1998 to 2012 (p=0.07, test for interaction).

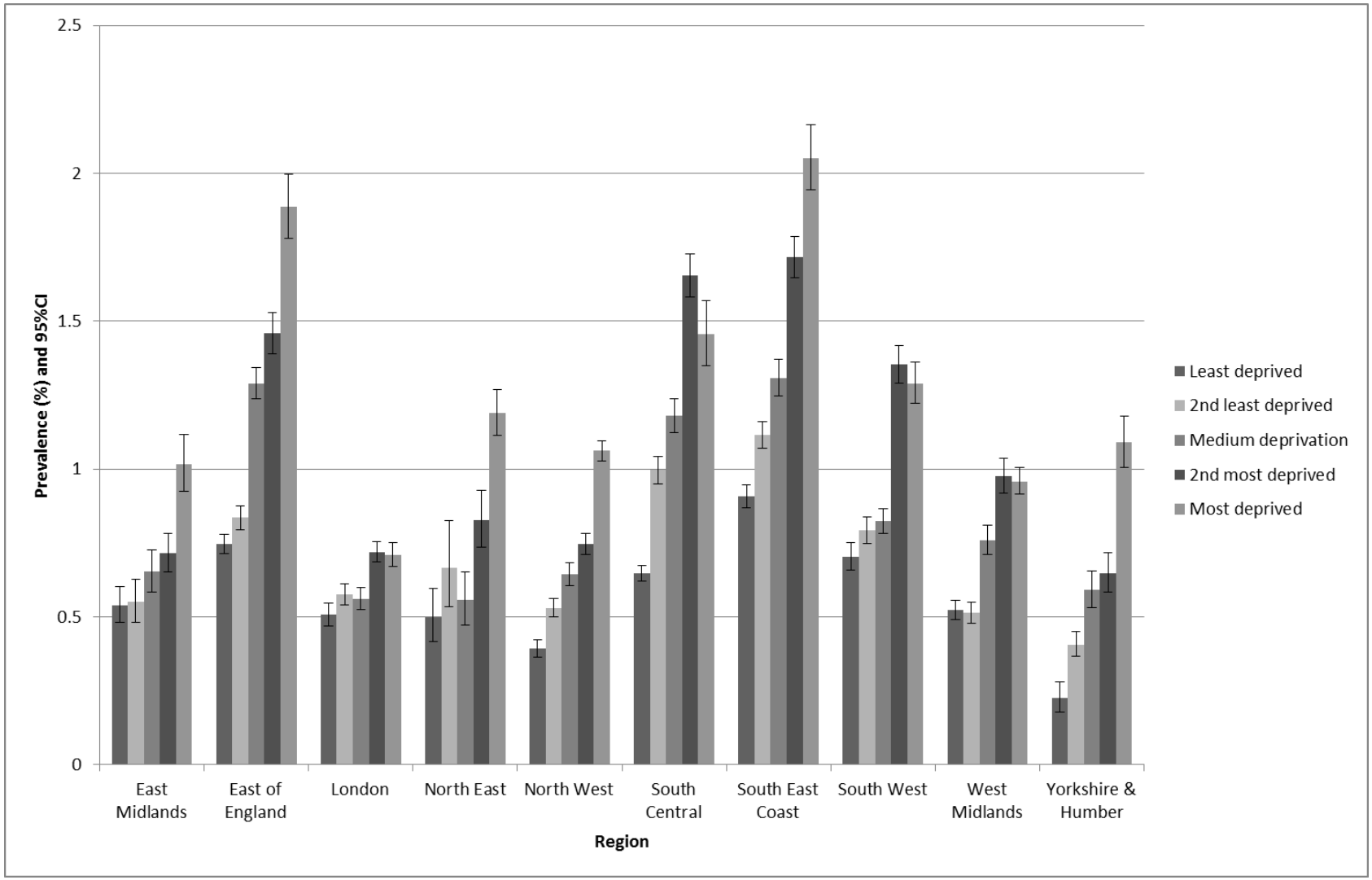
Figure 3-5 The ratio of the prevalence of ADHD comparing males to females by calendar year



3.5.5 Prevalence of ADHD by deprivation for each region

Figure 3-6 shows the prevalence of ADHD for CYP in each region by the area-level deprivation quintile, excluding CYP where their area-level deprivation quintile was not known. It shows that in all regions the CYP in the most deprived areas had a higher prevalence of ADHD than in the least deprived areas. However, the dose-response relationship for an increasing prevalence of ADHD in areas of greater deprivation was not equal in every region, with strong evidence for an interaction between deprivation and region ($p<0.001$, test for interaction). The greatest difference in prevalence comparing CYP's area-level deprivation to CYP in the least deprived areas was in CYP from the most deprived areas in the Yorkshire and Humber region (PRR 4.87 (95%CI 3.86 to 6.16), adjusting for sex, age and calendar year). The smallest difference in prevalence comparing CYP's area-level deprivation to CYP in the least deprived areas was in CYP from the most deprived areas in the London region (PRR 1.37 (95%CI 1.25 to 1.51), adjusting for sex, age and calendar year).

Figure 3-6 The prevalence of ADHD by deprivation for each region

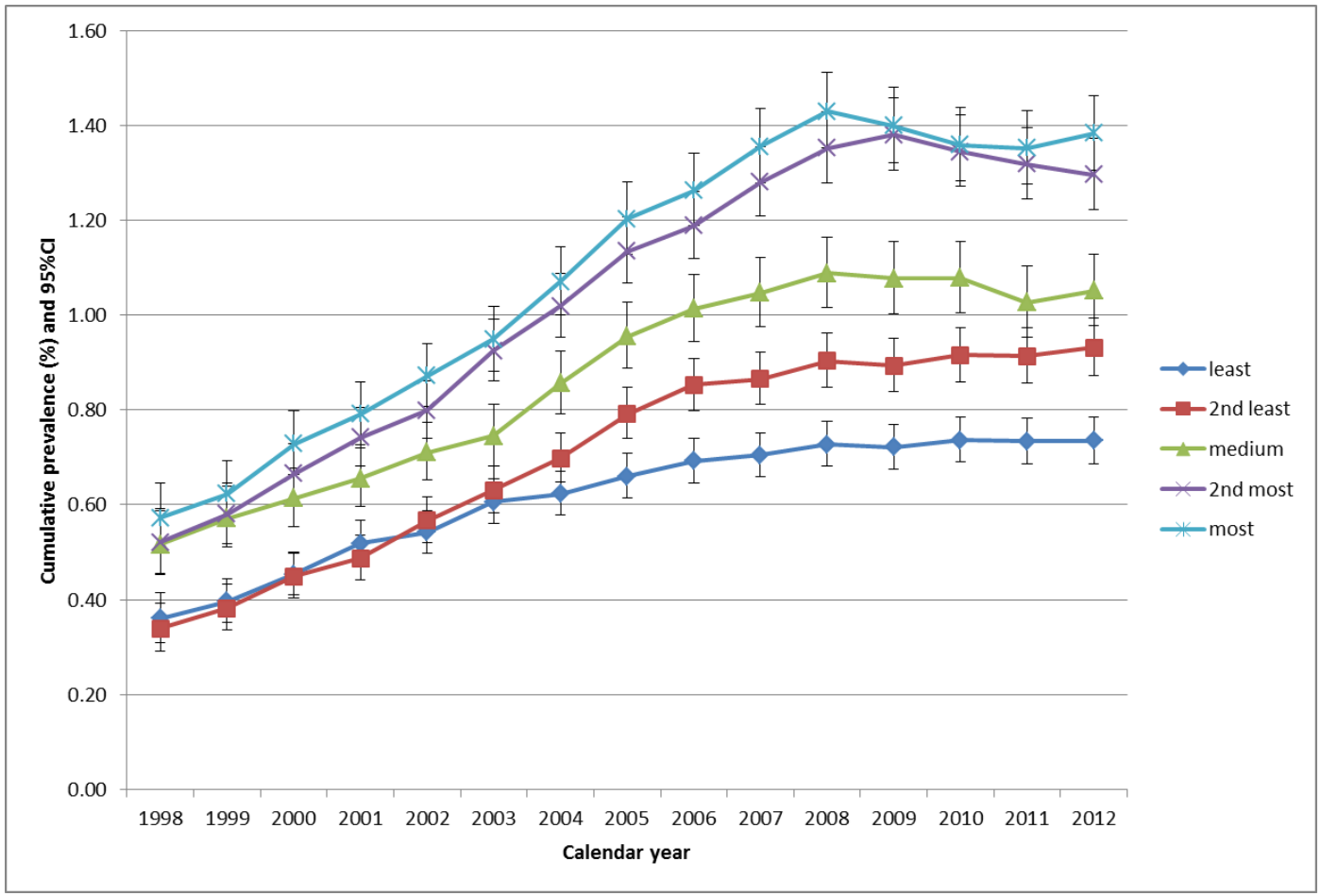


3.5.6 Prevalence of ADHD by calendar year for each deprivation quintile

Figure 3-7 shows the prevalence of ADHD by calendar year for each area-level deprivation quintile, excluding CYP with missing deprivation data. This shows that the prevalence of ADHD increased for all CYP from 1998 with some evidence that the prevalence of ADHD increased more in the CYP living in the most deprived areas than CYP from the less deprived areas ($p<0.001$, test for interaction). The trend for a greater number of CYP from more deprived areas to have ADHD than CYP from less deprived areas remained consistent over time.

In order to assess whether the length of time CYP were registered with the practice differed by their area-level deprivation quintile, the ratio of the length of follow-up in each deprivation quintile was compared to the length of follow-up in the least deprived quintile (appendix 6.8). There was no consistent pattern for length of follow-up by the area-level deprivation quintile.

Figure 3-7 The prevalence of ADHD by calendar year for each area-level deprivation quintile, excluding CYP with missing data on deprivation



3.5.7 Prevalence of ADHD by deprivation in CYP with varying definitions of ADHD

Table 3-9 shows the unadjusted and adjusted PRR for ADHD in each area-level deprivation quintile, compared to the prevalence of ADHD for CYP in the least deprived areas. This shows that the ratios for prevalence of ADHD in each area-level deprivation quintile were similar, regardless of how ADHD is defined.

Table 3-9 The crude and adjusted prevalence rate ratio of ADHD in CYP with medical records between 1998 and 2012 by deprivation in CYP with varying definitions of ADHD

Deprivation	≥2 drug & ≥2 diagnosis codes		≥1 drug code		≥ 1 diagnosis code (no drug code)	
	PRR (95% CI)	$Adj. PRR (95% CI)	PRR (95% CI)	$Adj. PRR (95% CI)	PRR (95% CI)	$Adj. PRR (95% CI)
Least deprived	1.00	1.00	1.00	1.00	1.00	1.00
2nd least deprived	1.09 (1.04 -1.15)	1.17 (1.11 -1.23)	1.11 (1.08 -1.15)	1.21 (1.17 -1.25)	1.25 (1.20 -1.31)	1.27 (1.22 -1.33)
Medium deprivation	1.44 (1.37 -1.51)	1.59 (1.51 -1.67)	1.36 (1.31 -1.40)	1.50 (1.45 -1.55)	1.49 (1.43 -1.56)	1.55 (1.48 -1.62)
2nd most deprived	1.72 (1.64 -1.81)	2.02 (1.93 -2.12)	1.64 (1.59 -1.69)	1.93 (1.87 -2.00)	1.81 (1.73 -1.88)	1.98 (1.89 -2.07)
Most deprived	1.85 (1.76 -1.94)	2.46 (2.34 -2.58)	1.73 (1.68 -1.79)	2.33 (2.26 -2.41)	1.87 (1.79 -1.95)	2.22 (2.12 -2.32)
Deprivation missing	1.68 (1.43 -1.96)	1.95 (1.67 -2.28)	1.77 (1.60 -1.96)	2.00 (1.80 -2.21)	1.71 (1.48 -1.96)	1.92 (1.67 -2.21)

$Adjusted for sex, age, region and and calendar year

3.6 Discussion

3.6.1 Main findings

This study showed that the administrative prevalence of ADHD in children aged 3 to 17 years old was 0.88% (95%CI 0.87 to 0.89). The prevalence of ADHD was around five times greater in males than in females. The prevalence of ADHD appeared to increase with age, with the lowest prevalence in 3 to 4 year-olds (0.02 (95%CI 0.02 to 0.03)) and the highest prevalence in 15 to 17 year olds (1.38 (95%CI 1.36 to 1.40)). There was strong evidence that the prevalence of ADHD was twice as high in CYP from the most deprived areas compared to CYP from the least deprived areas (1.14% (95%CI 1.12 to 1.16) in the most deprived areas to 0.64% (95%CI 0.63 to 0.65) in the least deprived areas)). There was some suggestion of a regional difference in the prevalence of ADHD, with the South East Coast region having the highest prevalence (1.27% (95%CI 1.24 to 1.29) and the Yorkshire and Humber region having the lowest prevalence (0.59% (95%CI 0.56 to 0.62)). However, since regions are defined by administrative boundaries, this finding must be interpreted with caution because CYP within a region will not all share the same characteristics in terms of recording of ADHD.

3.6.2 Strengths and limitations

The CPRD provided a large primary care dataset. Research has shown that the CPRD is broadly representative of the UK population compared to the UK census[227 234] and a systematic review showed that the CPRD has valid coding for a range of medical diagnoses compared to manual record

reviews and hospital medical records systems[222]. The analyses using varying definitions of ADHD showed that the pattern of greater recorded ADHD in CYP from more deprived areas compared to less deprived areas remained with the stricter and less strict definitions of ADHD. This study explored how the prevalence of ADHD within each deprivation quintile varies by region and calendar time, which has not been done before using these data.

3.6.2.1 Bias

Misclassification could have occurred in two ways: firstly, if CYP classified as having ADHD did not have ADHD and secondly, if CYP not classified as having ADHD actually had undiagnosed ADHD. The work done to describe the first and second drug code and/or diagnosis code recorded confirmed that CYP with ADHD had been treated and/or diagnosed as having ADHD by their GP. It is unlikely that GPs would record a diagnosis or prescription for ADHD in the absence of a diagnosis made in secondary care by specialists, especially in view of national guidance[98]. However, in light of other studies on the community prevalence of ADHD[108], it is highly likely that there are CYP in the denominator population who have undiagnosed ADHD. Furthermore, previous studies have shown that the administrative prevalence of ADHD has been increasing with time, which may in part be due to increasing awareness and ability to diagnose and treat ADHD[142-146]. Such misclassification of ADHD, where CYP with ADHD are undiagnosed, would imply that this study will have underestimated prevalence compared to the community prevalence of ADHD. Misdiagnosis by specialists of ADHD, although unlikely, cannot be ruled out by this study and would

result in an overestimate of the prevalence of ADHD. Ascertainment bias whereby CYP from more deprived areas are more likely to be diagnosed by the GP with ADHD than CYP from less deprived areas is possible. This might mean that the estimated prevalence in CYP from less deprived areas are underestimates or that the prevalence in CYP from more deprived areas are overestimates of the community prevalence of ADHD.

Selection bias could occur if specific groups of CYP with ADHD were systematically more or less likely to be included in estimates of prevalence, for example this could have happened if CYP from more deprived areas were more likely to be included in the study than CYP from less deprived areas. Selection bias is unlikely to have occurred because this study sampled all CYP in the CPRD with a recorded diagnosis of ADHD or a recorded prescription for ADHD and the CPRD has been found to be generally representative of the UK population[227 234]. In terms of the length of time CYP were followed up in this study, once CYP had been diagnosed with ADHD they continued to be counted in the estimates of prevalence until they left the practice. If CYP from more deprived areas were systematically more likely to remain registered with the same GP, rather than leaving to register with a new practice this may have resulted in an over-estimate of the prevalence of ADHD in those CYP. However, the follow-up time did not vary according to area-level deprivation so it is unlikely that bias due to different lengths of time in the study for CYP from different areas of deprivation occurred. The definition of 'lifelong' ADHD, in which CYP continued to be counted in the numerator after the point of diagnosis and until they left the practice, may have resulted in an overestimate of the true prevalence of ADHD because some CYP with

ADHD may no longer meet diagnostic criteria (e.g. symptoms or impairment improve) or no longer require treatment for their condition. Therefore, particularly the results for the oldest CYP aged 15 to 17 years could be overestimates and reflect a cumulative prevalence. However, many young adults may stop receiving prescriptions for ADHD because of a lack of services to treat them and monitor them but this does not mean that they are no longer symptomatic[269 145]. Previous studies have implied that there is an under-treatment of young adults with ADHD, who stop their medication on becoming adults, and thus studies which stop counting CYP without prescriptions after a length of time may underestimate prevalence rates[138 168].

The age at which ADHD was most prevalent was in the 15 to 17 year-olds. This is due to the fact that the definition of cases of ADHD used cumulative lifetime prevalence and children, once diagnosed with ADHD, would be counted in the data until they left the practice, died or the practice stopped contributing data.

Misclassification of the individuals' deprivation is possible because the measure of deprivation is not a true reflection of the deprivation of the individual CYP with and without ADHD. Deprivation was measured as an area-level variable, which may be why the gradient of a higher prevalence of ADHD in areas of higher deprivation was less in London. In London, many neighbourhoods have a mixed socio-economic make up[273]. In fact, in a study of upper gastrointestinal bleeding Crooks also found a gradient by deprivation which was less in London and drew similar conclusions about the mixed nature of areas in London by deprivation[227]. Outside of

London, it is likely that the measure of deprivation was appropriate because there is less heterogeneity between individuals within any given LSOA than in London.

3.6.2.2 Confounding

The estimated PRR's were adjusted for sex, age, region and calendar year. Adjusting for these confounders made minimal difference to the estimated PRR's. There may still be residual confounding, due to factors that were not measured. For example, ethnicity is not well recorded in the CPRD but there is some evidence from the USA that children from African American groups and other ethnic minorities have a higher number of symptoms of ADHD than White children [109]. Similarly, parental mental health problems may be associated with ADHD in children and deprivation may be linked to parental mental health[274]. The effect of residual confounding cannot be quantified.

3.6.2.3 Chance

The estimated prevalence of ADHD was 0.88% with a 95%CI of 0.87% to 0.89%, which means that there is a 95 per cent certainty that the true estimate of the prevalence of ADHD in the English primary care population lies between 0.87% to 0.89%. The CPRD represents a large dataset and narrow 95%CIs could have resulted due to a large sample size. Repeated comparisons across different groups could have yielded significant differences in prevalence estimates by chance alone, which is a type I statistical error. In a type I statistical error the null hypothesis (a statement that there is no difference between two groups) is incorrectly rejected when it is in fact true, i.e. there is actually no difference between

two groups but the test suggests there is a difference[275]. However, the tests for interaction were defined before the study was conducted and a limited number of comparisons were performed to test plausible hypotheses. Therefore, it is likely that the differences in prevalence between CYP from different areas of deprivation are true differences and that they are consistent within the regions. A type II statistical error could have occurred where a comparison between two groups was non-significant and the null hypothesis was wrongly taken to be true. A type II error could have occurred where the sample size for the comparison was small and no difference between two groups was found. For example, within the London region (where CPRD practices are under-represented[227]) it is possible that the lack of a difference in CYP from the lowest three quintiles of deprivation was due to a lack of statistical power as well as the added issue of heterogeneity in the area-level measure of deprivation mentioned above.

3.6.2.4 Specificity of association

The sensitivity analyses showed that, even with a more strict definition of ADHD (at least two drug codes and at least two diagnosis codes) the prevalence differences by deprivation remained similar. When CYP with ADHD were defined as CYP who have received a drug and, separately, as CYP who have never received a drug for ADHD the PRR's by deprivation again remained similar.

3.6.3 Comparison with the literature

3.6.3.1 Community prevalence

The study in this thesis was intended to estimate the prevalence of ADHD known to the GP. Therefore these estimates must be interpreted as estimates of administrative prevalence rather than community prevalence. Community prevalence studies would be expected to give rise to higher prevalence estimates than this study. Global estimates of community prevalence are around 5%, which is more than five times greater than the present study[108]. Compared to the community prevalence in the UK, in 1999 a cross-sectional survey was undertaken by the Office for National Statistics (ONS) in England, Wales and Scotland, in 5 to 15 year-old children using child benefit records to identify participants[276]. The ONS survey identified CYP with ADHD through: questionnaires completed by parents and teachers; interviews with parents; interviews with children if they were aged above 10 years[276]. The prevalence of ADHD estimated by the ONS study was 2.2%[277], which is nearly double the estimated prevalence in the same age groups in this thesis.

3.6.3.2 Administrative prevalence

Internationally, studies on the prevalence of ADHD using health care databases have estimated prevalence rates that may reflect cultural differences in the diagnosis and treatment of ADHD. However, there is some evidence that Northern European health systems are more likely to recognise and record ADHD than the UK. For example, a health database study using Norwegian hospital in-patient and out-patient medical records

estimated that 3.4% of all 12 year-olds in 2011 had ADHD[62]. A study on the health insurance data of 2,150,362 German CYP aged 3 to 17 years estimated a prevalence for methylphenidate-treated ADHD of 1.5% in 2005 and 1.7% in 2006[140], which is slightly greater than our estimates for the whole study population. A large study in Taiwan, which has a different health system compared to the UK, including one million people used the National Health Insurance database to describe the prevalence of ADHD in CYP under 18 years old[130]. The Taiwanese study described a prevalence of 0.06% and 1.64% in 1996 and 2005 respectively[130].

Compared to previous studies estimating the administrative prevalence of ADHD in large UK primary care databases, the prevalence estimates are broadly similar in this thesis. For example, in a recent study by O'Leary et al. the prevalence of ADHD in five to 15 year-old children using diagnosis and prescription records in THIN was 0.75% (in 2010-11) and 0.76% (in 2011-12)[141]. However, the findings of O'Leary et al. have only been published as an abstract and they did not report prevalence rate ratios adjusted for confounders, such as sex, deprivation and calendar time. Furthermore, in the study in this thesis, the study period was over a longer period of time with a rising prevalence of ADHD in recent years, which may explain the slight difference in estimated prevalence compared to this thesis.

3.6.3.3 Age

The findings of the study in this thesis were similar to O'Leary's study using THIN in an equivalent age group (0.95% (95%CI 0.94 to 0.96 in 5 to 15 year-olds))[141]. Another study using THIN (by McCarthy et al.)

identifying CYP above age 6 years who had received a diagnosis code and a prescription for ADHD had similar estimates to this thesis for the prevalence of ADHD between 2003 to 2008: 0.73% in 6 to 12 year-olds and 0.57% in 13 to 17 year-olds[143]. The findings of McCarthy et al. compare to 0.87% in 6 to 12 year-olds and 1.39% in 13 to 17 year-olds from 1998 to 2012 in this thesis. However, McCarthy et al. calculated prevalence as the number of CYP with a prescription or diagnosis code for ADHD in a given year as a proportion of the whole population and regarded CYP as no longer having ADHD if there was no prescription or diagnosis code in a given calendar year[143]. This difference in the calculation of prevalence explains why 13 to 17 year-olds had a lower prevalence than 6 to 12 year-olds. Also, it is likely that the estimates in this thesis are higher than McCarthy et al. because CYP were counted as having ADHD from diagnosis until they left the study and were able to contribute to estimates from an earlier date than in McCarthy et al.'s study.

McCarthy et al. also used the CPRD to describe the discontinuation of treatment for ADHD in CYP aged 15 to 21 years old[144]. The prevalence reported for 2006 for 15 year-old males was 1.3%[144]. McCarthy et al.'s estimate is lower than in this thesis but this is because the definition used by McCarthy et al. required CYP to have received at least one prescription during the study period and between the ages of 15 to 21 years[144].

3.6.3.4 Sex

Jick et al. conducted a study in boys aged 5 to 14 years using the CPRD and found a prevalence of 0.53% in 1999[147], which compares to 1.48%

(95%CI 1.47 to 1.50) in boys aged 5 to 14 years in this thesis who received at least one prescription over the whole study period from 1998 to 2012. The estimate in this thesis is likely to be greater than Jick et al. because the study in this thesis covered a period of time after 1999 when the prevalence of ADHD was rising. Researchers from CPRD published an abstract of a study describing the prescribing trends for methylphenidate using data from children under 18 years and described a constant male to female ratio of 5.7:1, which is very similar to the estimate of 5.5:1 in this thesis[278].

3.6.3.5 Deprivation

Internationally, there are large population-based studies which report similar associations between the community prevalence of ADHD and deprivation. For example, a Danish study based on prescriptions for ADHD in under twenty-year-olds found the prevalence of ADHD to be 2.2% in CYP from the most deprived quintile compared to 1.8% in the three least deprived quintiles[127]. In Germany, although the prevalence of ADHD in a community-based survey was higher than in our study, 4.8% based on 17,461 3 to 17 year-olds, there was a similar association with deprivation, or socioeconomic status (SES) [279]. The proportion of CYP in the survey diagnosed with ADHD by SES was: 6.4% 'low' SES; 5.0% medium SES; and 3.2% high SES[279].

In the UK a study of one thousand and sixty-nine children aged up to 16 years in Liverpool published in 2011 found that the community prevalence of ADHD was 0.99%[163]. The study found that the prevalence of ADHD was higher in CYP from areas with greater deprivation, measured at the level

of the LSOA[163]. However, the authors did not detail how the population with ADHD were selected.

The findings in this thesis of a relationship between the administrative prevalence of ADHD and deprivation are the first in a large primary care-based study in the UK. As this was an observational study on routinely collected data, it is not possible to know why CYP with ADHD from more deprived areas have a higher prevalence than less deprived areas. As this study included CYP, if ADHD in the CYP influenced their area-level deprivation the mechanism would need to involve the adults in the household. For example, it is possible that parents of CYP with ADHD might have ADHD or traits of ADHD themselves or that ADHD in the CYP influences the parents' area-level deprivation. For example, a Danish study has suggested that parents of children with ADHD are 7 to 13% less likely to have a job and 75% more likely to experience a relationship breakdown[274]. A cohort study in Brazil investigated the association between family income over time from birth to 15 years of age and found no consistent association with attention/hyperactivity problems[280]. However, for families that experienced a reduction in their income, there was strong evidence for an association with higher conduct problems[280]. However, it was not possible in this thesis to measure socioeconomic position at multiple points in time and it is possible that the cultural differences between Brazil and the UK would mean that the findings are not directly applicable to the UK population. In the Dunedin Multidisciplinary Health and Development Study (n=1037) from New Zealand, there was evidence that CYP with ADHD are more likely to come from families with a low socioeconomic position which implies the ADHD

could be a consequence of deprivation[281]. However, people with ADHD also had lower performance in High school examinations and this determined their lower socioeconomic position in adult life[281]. The willingness of parents to seek medical help for symptoms of ADHD and the services available to diagnose the condition are also likely to be contributory factors in the UK[104]. It is possible that professional recognition is greater for CYP in more deprived areas. Also, it is possible that parents present to other services, such as education, rather than presenting to their GP with symptoms of ADHD in their children and therefore GP medical records under-record the true extent of ADHD[104].

3.6.3.6 Calendar year

The study in this thesis estimated the cumulative administrative prevalence of ADHD. Therefore, the cumulative prevalence rose between 1998 and 2012 as new CYP joined the study upon registering with a GP practice that contributed data to the CPRD. CYP only left the study when they died, left the practice or turned 18 years old. Therefore the rate at which CYP joined the study population was lower than the rate at which CYP would be expected to leave the study population. Also the youngest children would have continued in the study from the age of 3 years old and could have contributed data until the end of the study period (when they would have been 17 years old). Hence, the number of CYP in the study population with ADHD reached a plateau. The exploration of how the administrative prevalence of ADHD varied over calendar time showed some evidence that the prevalence of ADHD increased more in CYP from more deprived areas compared to less deprived areas. This could be

explained by the fact that people from more deprived areas were more likely over time to have a recording of ADHD than CYP from less deprived areas. Or it could reflect the fact that CYP from less deprived areas were increasingly less likely to have a recording of ADHD. The hypothesis that CYP from less deprived areas contributed more follow-up time to the study was unlikely to be true because there was no consistent pattern to the follow-up time by deprivation (appendix 6.8).

3.6.4 Clinical implications

The administrative prevalence of ADHD is nearly twice as high in children from deprived areas. Yet it seems that there is an under-recording of ADHD in the English primary care population overall[104]. The results of the study described in this thesis could inform education approaches for health and educational professionals, CYP with ADHD and parents of CYP with ADHD about the symptoms of ADHD in children in order to improve diagnosis of ADHD. The increased prevalence of ADHD in the most deprived areas could present an opportunity for GPs, Clinical Commissioning Groups (CCGs) and public health services to address the inequality in recording of ADHD. The inequalities may arise from an under-recording of ADHD in CYP from areas with less deprivation or an increased prevalence in CYP from areas with greater deprivation. Public health services should use these findings to target appropriate services for CYP according to area-level deprivation.

3.6.5 Conclusions

The estimated prevalence of ADHD in English primary care is lower than would be expected if all cases of ADHD had been diagnosed and known to

the GP. The lower estimated prevalence of ADHD has been confirmed in GP medical records studies using the CPRD and THIN databases in the past[143 147]. The administrative prevalence of ADHD increases as area-level deprivation increases.

4 What is the risk of fractures, thermal injuries and poisonings in children and young people with attention-deficit hyperactivity disorder (ADHD) compared to children and young people without aged between 3 and 17 years old in the Clinical Practice Research Datalink (CPRD)?

This chapter describes a cohort study conducted to describe the relationship between childhood ADHD and injuries, namely: fractures; thermal injuries; poisonings, using the CPRD in English primary care.

4.1 Background

As described in section 1.4.2.1, ADHD is common in CYP, with a community prevalence of between 2-5%[108 110] and representing around one fifth of all psychiatric diagnoses in children in the community[108 277]. The annual total UK healthcare costs for children aged 6 to 17 years with ADHD are estimated to be £1,290 per person per year[142]. As described in section 1.1.2 of this thesis, worldwide[7] and in the UK, unintentional injuries are a leading cause of morbidity and mortality in children[8]. Since both ADHD and injuries are common in CYP, it is important to have accurate estimates of the risk of injuries in order to inform CYP, their parents and health professionals.

As described in section 1.5.1 of this thesis, previous studies indicate that the risk of injury in CYP with ADHD may be one and a half to two times greater compared to children without[174 176 177 180 185 186]. However, direct

comparisons between studies are difficult due to differences in methodology. Studies which use hospital-based recording of injuries would be expected to estimate the risk of more severe injuries in contrast to community-based studies that would estimate the risk of all injuries, regardless of severity. However there are also studies which have found a lack of association between ADHD and injuries[183 197 199]. The reasons why studies have found a lack of association between ADHD and injuries could relate to the definition of ADHD, e.g. studies which select previously undiagnosed CYP on the basis of ADHD symptoms may include those with less severe symptoms[183 197], or the young age of children, e.g. pre-schoolers who may be better supervised than older children[199] Previous studies conducted in the UK primary care population, such as a study using the self-controlled case series analysis method[172], have important limitations. Firstly, a failure to include a comparison population without ADHD does not allow clinicians to give parents an estimate of the risk of injuries in children with ADHD compared to children without ADHD. Secondly, by using only children treated with medication for ADHD it is possible that the population of children studied may have a more severe form of ADHD or that the risk of injuries in the treated subgroup differs from the risk in the whole population with ADHD. Thirdly, previous studies have failed to adjust for social deprivation, which may alter the relationship between ADHD and injuries[172]. The previous chapter of this thesis (see section 3.5.3) has shown that the prevalence of ADHD varies by deprivation and therefore it is an important confounder. Children with ADHD are known to have a higher prevalence of behaviour disorder (such

as conduct disorder)[140 165], learning disabilities (such as reading/writing disorder)[165], epilepsy[61 282 283] and cerebral palsy[60].

As reported in section 3.5.1 of this thesis, the proportion of children recorded to have ADHD in English primary care is 0.88% (95%CI 0.87 to 0.89%) and the CPRD provides an ideal sample of children to estimate injury risk comparing children with ADHD to children without. Therefore, this chapter investigates whether CYP with ADHD are at an increased risk of fracture (including long bone fracture), thermal injury, or poisoning compared to CYP without ADHD and estimates the risk of injury within the first five years of study follow-up.

4.2 Aims

To explore associations between ADHD and fractures, thermal injuries and poisonings in CYP.

4.3 Objectives

To estimate the risk of injury (for fractures, thermal injuries and poisonings), using the General Practice (GP) medical records of CYP aged 3 to 17 years old with Hospital Episodes Statistics (HES)-linked data from the Clinical Practice Research Datalink (CPRD) from 1st January 1998 to 30th March 2012, comparing children with ADHD to children without. The risk of the first injury to occur will be estimated separately for:-

1. Fractures (including long bone fractures).
2. Fractures (including long bone fractures) occurring within the first five years of study follow-up.

3. thermal injuries.
4. thermal injuries occurring within the first five years of study follow-up.
5. poisonings.
6. poisonings occurring within the first five years of study follow-up.

4.4 Methods

4.4.1 Study design

Historical cohort study.

4.4.2 Study population

The study population consisted of CYP with ADHD (exposed) and CYP without ADHD (unexposed). The cohort of CYP with ADHD used in this study was the cohort identified in chapter 3 of this thesis.

4.4.3 Data management

4.4.3.1 Selection of unexposed population

People in the CPRD without evidence of ADHD in the clinical file, drug file or referral file (as described in chapter 3, Figure 3-1) were eligible for inclusion in the unexposed population. By this definition 5,716,383 people of all ages did not have evidence of ADHD and were therefore eligible to contribute to the unexposed population.

4.4.3.2 Allocation of dates

For this chapter, information was included from the medical records from the latest of: 1st January 1998, GP registration, or the date that the practice was up-to-standard for data collection. The 1st January 1998 was chosen because this was the first full calendar year after the GP-hospital-linked medical records were available. Information was no longer included from the earliest of: 30th March 2012, death of the person, the date the person left the practice, or when they were 25 years old. The 30th of March 2012 was chosen because this was the last date that GP-hospital-linked medical records were available to download. CYP were followed up to the age of 25 years because this thesis focuses on injuries in CYP. Furthermore, in the study on epilepsy and injuries (as described in section 2.5.1 of this thesis) the median follow-up time in CPRD for the study population overall was 2.4 years. Therefore it was hypothesised that injuries would be recorded within this period of follow-up time without including injuries occurring in adulthood. 3,586,191 people were excluded from the unexposed population because they were aged 25 years or above at the time of registration. 187,256 children were excluded because they left the practice before they were 3 years old. As a result of these criteria, 1,754,152 people had medical records and were eligible to be included in the exposed population.

Unexposed people were allocated a 'pseudodiagnosis' date, which was a random date, assigned using a computer algorithm, between three months after the start of the medical record and the end of the medical record. The pseudodiagnosis date enabled the unexposed people to be

separated into age bands by pseudodiagnosis and therefore allowed the sampling of an unexposed population with a similar age distribution to the exposed population. People aged less than 3 years or above 25 years at pseudodiagnosis were dropped from the unexposed population. The first three months of the medical record were excluded for the unexposed population because previous work has shown that a higher number of diagnosis codes are recorded in the first months of registration[235], indicating that medical events may be inaccurately coded as new events when, in fact, they occurred in the past and this could result in an overestimation of injury risk in the first months of registration. People registered with their GP for less than three months were also dropped from the exposed population.

The medical records for CYP without ADHD were added to the medical records of CYP with ADHD (as defined in chapter 3). Five hundred and seven children were dropped from the study cohort because they were aged less than 3 years at diagnosis, based on their date of birth (estimated using their month of birth and year of birth). Previously these 547 children had been included in the estimates of prevalence because their age had been estimated at over 3 years old using their year of their birth but not the month of birth.

4.4.3.2.1 Definition of age

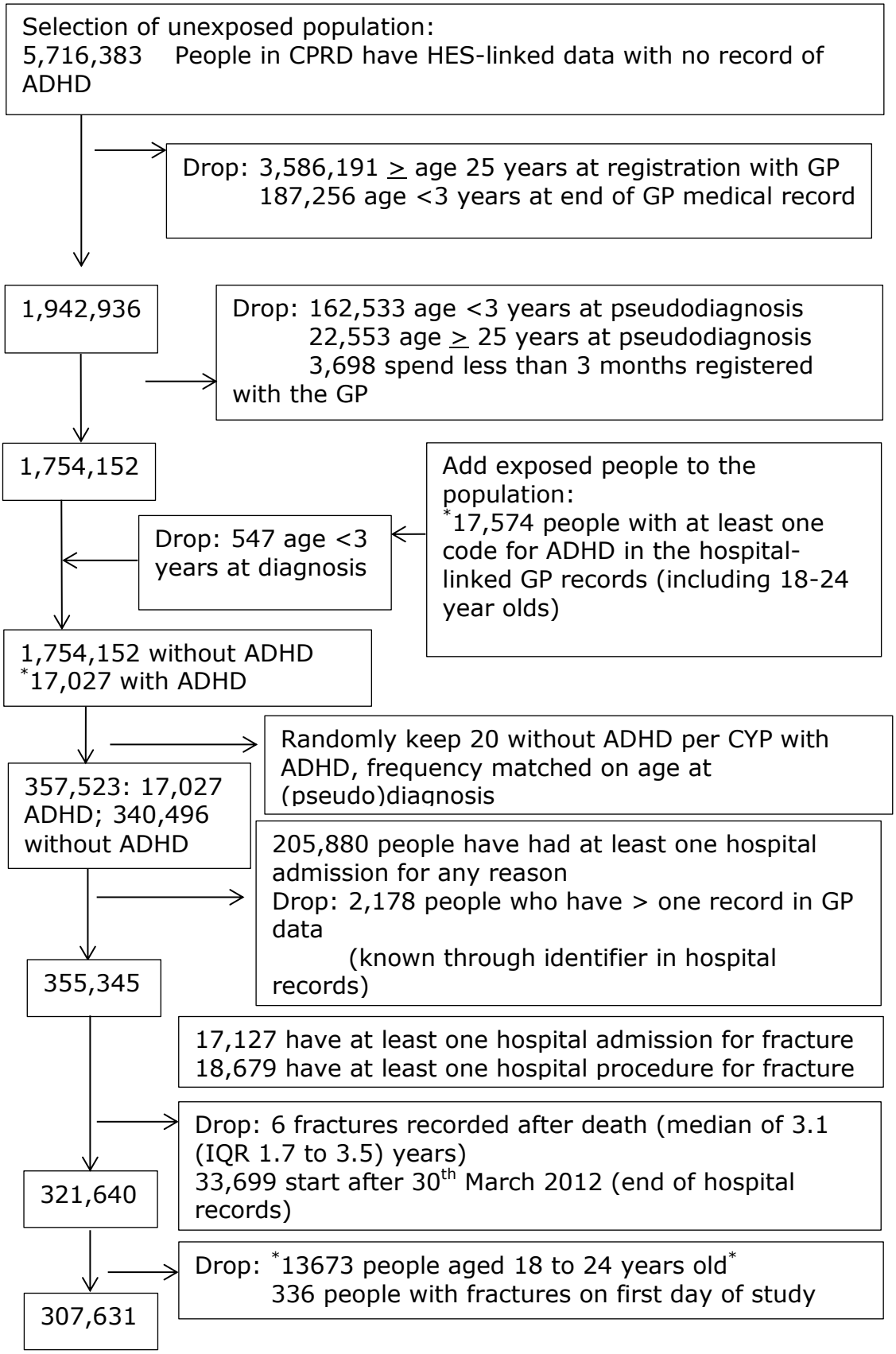
For CYP with ADHD, the age when the first ADHD diagnosis or drug code was recorded was taken to be the age of 'diagnosis'. Age was described in terms of the age at (pseudo)diagnosis. The age bands chosen were 3-4;

5-9; 10-14; and 15-17. These age bands were chosen based on the age distribution of the cohort and the epidemiology of injury occurrence.

4.4.4 Frequency matching of CYP with ADHD to CYP without

Up to twenty CYP without ADHD were selected at random, frequency matched by age band to CYP with ADHD. Figure 4-1 summarises the flow of people from the CPRD through to selection of the sample for analysis.

Figure 4-1 Flow of people with ADHD code(s)



*Note: 18 to 24 year-olds were excluded

4.4.5 Data management for linked GP-hospital medical records

Figure 4-1 summarises the data management used to format the dataset for the analysis on fractures. For the analysis on long bone fractures, thermal injuries and poisonings, the dataset was formatted in a similar way starting with the same study population described above and resulting in a dataset with information on long bone fractures, thermal injuries and poisonings respectively. The hospital medical records contained diagnosis codes, coded using the version 10[103], and procedure codes, coded using the Office of Population Censuses and Surveys version 4 (OPCS4)[225] from inpatient admissions to hospitals in England. The hospital medical records also contained information on people who had been registered at more than one GP practice within the CPRD and therefore it was possible to identify 2,178 people who had more than one GP medical record in the CPRD. The first GP medical records were kept for these people and subsequent medical records in the CPRD were ignored because it could not be known what medical events took place after a person left the GP practice the first time and before they joined the database again.

4.4.6 Definition of injury outcome

In view of the work undertaken in chapter 2 (see section 2.5.7.1) previously, in which it was concluded that a more complete picture of injury recording would be obtained by using hospital and GP medical records, lists of codes identifying injuries were prepared using ICD10 and OPCS4 codes in addition to the lists of previously prepared Read codes.

The Read code list for fractures, including long bone fractures and for thermal injuries, remained unchanged compared to chapter 2. Amendments were made to the Read codes identifying poisonings to ensure they included similar poisonings to those that might be identified in the hospital records, e.g. poisonings due to specific agents, such as 'accidental poisoning by ophthalmological drugs'. The ICD10 and OPCS4 code lists were reviewed by an academic public health doctor who was an injury researcher (RB) and an academic GP (VP) with any disagreements resolved by discussion. People with an injury recorded after death and people who started after 30th March 2012 (when the hospital-linked data were no longer available for people in this study) were excluded from the study cohort. The outcome of interest was the first injury to be recorded after (pseudo)diagnosis. CYP were identified where the injury had occurred: (i) before (pseudo)diagnosis or registration with the GP, or (ii) after they had left the practice; in case the risk of injury was different for these CYP compared to the rest of the study population.

4.4.7 Start of study follow-up

When people join a new GP practice the GP may record diagnosis codes with a date prior to the date that the patient joined the practice, a 'prevalent' code. A prevalent diagnosis code reflects a past medical event that is reported to the current GP by the patient or through communication received from the previous GP practice. CYP started in the study from the date of (pseudo)diagnosis or, in the case of CYP who had a prevalent diagnosis of ADHD, from the date of registering with the practice. The decision was made to include CYP with a prevalent diagnosis

of ADHD and follow them from the date of registration (rather than exclude the first three months of their medical records, as was done in chapter 2) because ADHD is a developmental condition that does not have a sudden onset of symptoms[98].

4.4.8 End of study follow-up

CYP were no longer followed in the study at the earliest of: leaving the practice; death; or the first injury to occur during follow-up.

4.4.9 Identification of denominators

CYP contributed time in the study from the start of study follow-up to the end of study follow-up.

4.4.10 Final study cohort

In total there were 307,631 CYP in the study cohort, consisting of 291,894 CYP without ADHD and 15,737 CYP with ADHD in the study population formatted for fractures. The study populations formatted for other injuries had a similar number of CYP (long bone fractures, n=307,645; thermal injuries, n=307,650; and poisonings, n=307,651). There was a small difference between the 14,314 CYP who contributed to the study on prevalence in Figure 3-2 in chapter 3 and the 15,737 in the current chapter because, for example, the year (not the month or day) of birth was used in calculations of prevalence and CYP with a prior injury (e.g. fracture) were excluded from the analysis of that injury (e.g. a CYP with a prior record of a fracture would be excluded from the study population prepared for analysis of fractures).

4.4.11 Comorbid medical conditions

As described in Table 2-1, section 1.4.8 and section 1.5.1: epilepsy; behaviour disorder; cerebral palsy; and learning disability, may be associated with ADHD and with injuries. Therefore, evidence for epilepsy, behaviour disorder, cerebral palsy and learning disability was sought in the GP medical records for all CYP in the study using a pre-defined Read code list (and drug code list, in the case of epilepsy). At least one diagnosis code (in the case of epilepsy, at least one drug code or one diagnosis code) on the record was taken as evidence that the person had the condition. The three most frequent Read codes used to describe behaviour disorder were 'behavioural problems', 'behaviour disorder', and 'behavioural problem'; and to describe learning disability were 'learning difficulties', 'on learning disability register', and 'Learning disability not otherwise specified'. A table showing the five most frequent Read or drug codes to describe the comorbid medical conditions is shown in appendix 6.9. The code lists are appended in (appendices 6.13, epilepsy codes; 6.14, epilepsy drugs; 6.20, behaviour disorder; 6.21, learning disabilities; 6.22, cerebral palsy).

4.4.12 Statistical analysis

Statistical analysis was performed using STATA version 12MP (Stata Corp. College Station, TX). The outcome of interest in all analyses was the first injury to occur during follow-up.

4.4.12.1 Description of the study population

Baseline characteristics of CYP with and without ADHD were described. The distribution of continuous variables was examined and dependent on normality of the distribution, either the mean and standard deviation (normally distributed variables) or the median and interquartile range (IQR) (non-normally distributed variables) was used to describe these variables. Categorical variables were described using frequencies and percentages.

4.4.12.2 Unadjusted analysis

The crude rates and HR's for CYP with and without ADHD, with 95%CI, were estimated for the first injury to occur during study follow-up using a Cox regression model. The HR compared the rate of injury in CYP with ADHD to the rate in CYP without. It was thought that the rate of injury would be greater in CYP with ADHD compared to CYP without and that the difference in the rate in CYP with ADHD compared to CYP without would stay constant throughout time in the study.

4.4.12.3 Adjusted analysis

Cox regression was used to estimate the HR for the first injury to occur during the study adjusted for the *a priori* defined confounders of age, sex, SHA region, the person's area-level deprivation quintile (measured using the IMD score, 2010[270]) and the calendar year when the person entered the study. As described in section 1.1.2 and 1.4.2, *a priori* confounders were chosen for the following reasons: age because the epidemiology of injury varies by age group as CYP mature and develop[8 15-17] and because

the prevalence of ADHD varies by age [87 90 97 100]; sex because males are more likely than females to sustain injuries[17-19] and have a higher prevalence of ADHD than girls[109-111]; region because the rate of injuries may vary by region[31] and the analyses in section 3.5.3 showed some variation in the prevalence of ADHD by region; deprivation because it is known that the rate of injuries is higher in CYP from more deprived areas[11 21] and ADHD is more prevalent in CYP from more deprived areas (as described in section 3.5.3); and calendar year because the rate of injuries has been decreasing over time[23 24] and the prevalence of ADHD in the CPRD has been increasing with time (as described in section 3.5.2). The HR was then adjusted for each of the following comorbid medical conditions: learning disability, epilepsy, cerebral palsy; in turn (in order of the comorbid conditions with the greatest prevalence in CYP with ADHD first). When adjustment for a comorbid medical condition led to a change of more than ten percent in the adjusted HR, this was retained in the adjusted model and the remaining comorbid medical conditions were assessed for inclusion in the model using the same criterion[284].

Behaviour disorder was thought to be on the causal pathway between ADHD and injuries and was therefore not included in the models described above. It was also thought that GPs may use a Read code for behaviour disorder to record symptoms that subsequently are diagnosed by a specialist to be ADHD and also that CYP with ADHD may see the GP after a diagnosis of ADHD but that the GP may code the diagnosis as a 'behaviour disorder' because the codes describe similar symptoms to ADHD. Therefore graphs were inspected of the number of CYP with a behaviour disorder code by the number of years from the initial diagnosis of ADHD

for CYP with and without ADHD (appendix 6.10). Behaviour disorder and ADHD appeared to be used synonymously by GPs with a peak in use of these codes around the time of diagnosis. Therefore, no adjustments were made for behaviour disorder.

4.4.12.4 Test for interaction with age

It was hypothesised that the risk of injury in CYP with ADHD compared to CYP without would be greater amongst teenagers than other age groups. This was considered plausible because of increased risk taking behaviour[285 286] and the potential for less parental supervision during teenage years. The final adjusted estimated HR of the risk of injury in CYP with ADHD compared to CYP without ADHD was described for different age groups. A LRT was used to compare the model without the interaction term to a model with the interaction term. The null hypothesis was that the two models would be similar. The null hypothesis was rejected if the p value was less than 0.05.

4.4.12.5 Test for interaction with sex

In a similar way to the test for interaction with age, a test for interaction with sex was also performed. This was undertaken because injury incidence varies with sex (as described in section 1.1.2) and the prevalence of ADHD varies with sex (as described in section 1.4.2 and section 3.5.3).

4.4.12.6 Test for linear trend in relationship between deprivation and injury risk

A test for linear trend between deprivation and injury risk was performed. A LRT was used, excluding CYP with missing data for deprivation, comparing their HR for injury by deprivation quintile entered as a categorical variable (adjusted for age, sex, region, deprivation, calendar year) with the adjusted HR with deprivation entered as a continuous variable. The null hypothesis was that the two models would be similar. The null hypothesis was rejected if the p value was less than 0.05. This was done to assess whether the risk of injury in CYP with ADHD compared to CYP without would increase as the deprivation score for the area of residence increased in a linear manner.

4.4.12.7 Absolute risk of injury in CYP with and without ADHD

To aid with the communication of risk the absolute risk of injury in CYP with ADHD compared to CYP without ADHD was estimated. The risk of injury occurring within the first five years of study follow-up was estimated per thousand CYP with and without ADHD.

In order to provide a graphical representation of the risk of injury occurring within the first five years of study follow-up, the cumulative hazard of injury in CYP with and without ADHD was plotted on Nelson-Aalen plots to show the proportion of CYP who had an injury by the number of years they had been in the study for CYP with and without ADHD separately.

4.4.12.8 Checking assumptions for using a Cox model

A Cox model assumes that the rate of injuries in CYP with ADHD compared to the rate in CYP without ADHD would be proportional throughout follow-up time[287]. In order to check this assumption, plots of the logarithm of cumulative hazard against time and Schoenfeld residuals against time were inspected, and a statistical test for non-proportional hazards was performed.

4.4.12.9 Sensitivity analyses

As reported in section 3.4.11, four subgroups of ADHD had been defined. In order to test how a broader or narrower definition of ADHD affected estimates, the analysis was repeated for ADHD defined as: (i) at least two drug codes and at least two diagnosis codes; (ii) at least two diagnosis codes and less than two drug codes; (iii) at least two drug codes and less than two diagnosis codes; (iv) one drug code or one diagnosis code/one drug code and one diagnosis code.

In order to test the robustness of the findings in terms of the definition of injury, the following two analyses were performed. Firstly, after inspection of graphs describing the frequency of injuries recorded according to the time CYP had spent in the study, there appeared to be a sharp decline in the recording of injuries after 3 months of time in the study (appendix 6.11). In CYP with and without ADHD this may reflect the fact that, at any chosen date, the incidence of injury reduces with time and the graph reflects this. However, in CYP with prevalent ADHD (diagnosed before joining the practice) there is a peak in injury incidence the first months of the study and this may reflect that the recording of injuries that occurred

in the past are incorrectly recorded as new injuries after people register with the GP and their past medical history is recorded. This was possible in this study because CYP with prevalent ADHD were followed from the date of registration and no time was excluded to account for the recording of prevalent diagnoses as incident diagnoses. Secondly, in CYP with ADHD overall (i.e. prevalent and incident), CYP with ADHD may receive a clinical diagnosis of ADHD because of their injury. This increase in recognition of ADHD due to injuries might result in an over-estimation of the risk of injury in CYP with ADHD compared to CYP without ADHD (reverse causality). For these two reasons data from the first three months of registration were excluded in a separate analysis.

4.5 Results

4.5.1 Description of the population

Table 4-1 details the characteristics of the study cohort, which were similar for fractures, long bone fractures, thermal injuries and poisonings. The characteristics of the study population for the analysis on fractures will be described here. There were 291,894 CYP without ADHD and 15,737 CYP with ADHD. The age at (pseudo) diagnosis was similar for CYP with and without ADHD, with the peak age being 5 to 9 years old (51.0% without ADHD and 51.5% with ADHD). Of CYP without ADHD, half were males (50.7%), compared to CYP with ADHD, in whom 84.6% were males. Among CYP without ADHD the region containing the greatest proportion of the study population was the North West (15.5%) and with the lowest proportion was the North East (2.3%). Among CYP with ADHD the region with the greatest proportion of the study population was the South East coast (18.2%) and with the lowest proportion was the North East (2.3%). Among CYP without ADHD most CYP were from the least deprived areas (23.2%) and the smallest proportion were from the most deprived areas (18.2%). Data on deprivation was missing for 0.9% of CYP without ADHD and 1.2% of CYP with ADHD. In contrast, among CYP with ADHD most CYP were from the most deprived areas (23.3%) and the smallest proportion were from the least deprived areas (17.0%). In CYP with and without ADHD the number of CYP in each calendar period was similar. There were more CYP with than without ADHD with the comorbid conditions of: behaviour disorder (48.2% in ADHD vs. 4.5% in CYP without ADHD); learning disability (11.4% in ADHD vs. 0.8% in CYP without ADHD);

epilepsy (5.4% in ADHD vs. 1.2% in CYP without ADHD); but similar proportions with cerebral palsy (0.04% in ADHD vs. 0.03% in CYP without ADHD).

Table 4-1 Characteristics of CYP with and without ADHD for analyses of fractures, thermal injuries and poisonings

Study cohort		Fractures		Thermal injuries		Poisonings	
Characteristic		**Non-ADHD n=291,894 (%)**	**ADHD n=15,737 (%)**	**Non-ADHD n=291,909 (%)**	**ADHD n=15,741 (%)**	**Non-ADHD n=291,909 (%)**	**ADHD n=15,742 (%)**
Age group at (pseudo)diagnosis of ADHD (years)	3-4	21,394 (7.3)	1,189 (7.6)	21,395 (7.3)	1,189 (7.6)	21,395 (7.3)	1,189 (7.6)
	5-9	150,442 (51.5)	8,020 (51.0)	150,450 (51.5)	8,019 (50.9)	150,450 (51.5)	8,020 (51.0)
	10-14	107,758 (36.9)	5,601 (35.6)	107,764 (36.9)	5,605 (35.6)	107,763 (36.9)	5,604 (35.6)
	15-17	12,300 (4.2)	927 (5.9)	12,300 (4.2)	928 (5.9)	12,301 (4.2)	929 (5.9)
Sex	Males	148,072 (50.7)	13,308 (84.6)	148,085 (50.7)	13,311 (84.6)	148,089 (50.7)	13,313 (84.6)
SHA region	East Midlands	11,964 (4.1)	512 (3.3)	11,964 (4.1)	512 (3.3)	11,964 (4.1)	512 (3.3)
	ast of England	35,587 (12.2)	2,247 (14.3)	35,591 (12.2)	2,246 (14.3)	35,590 (12.2)	2,247 (14.3)
	London	44,450 (15.2)	1,630 (10.4)	44,449 (15.2)	1,630 (10.4)	44,450 (15.2)	1,630 (10.4)
	North East	6,641 (2.3)	370 (2.4)	6,641 (2.3)	370 (2.4)	6,641 (2.3)	370 (2.4)
	North West	45,136 (15.5)	2,035 (12.9)	45,138 (15.5)	2,035 (12.9)	45,137 (15.5)	2,035 (12.9)
	South Central	36,907 (12.6)	2,247 (14.3)	36,907 (12.6)	2,248 (14.3)	36,907 (12.6)	2,248 (14.3)
	South East Coast	36,192 (12.4)	2,867 (18.2)	36,193 (12.4)	2,868 (18.2)	36,194 (12.4)	2,869 (18.2)
	South West	31,653 (10.8)	2,045 (13.0)	31,656 (10.8)	2,046 (13.0)	31,657 (10.8)	2,045 (13.0)
	West Midlands	30,352 (10.4)	1,343 (8.5)	30,356 (10.4)	1,345 (8.5)	30,356 (10.4)	1,345 (8.5)
	Yorkshire & Humber	13,012 (4.5)	441 (2.8)	13,014 (4.5)	441 (2.8)	13,013 (4.5)	441 (2.8)
Deprivation	Least deprived	67,896 (23.3)	2,667 (17.0)	67,900 (23.3)	2,668 (17.0)	67,900 (23.3)	2,668 (17.0)
	2nd least deprived	60,461 (20.7)	2,817 (17.9)	60,464 (20.7)	2,818 (17.9)	60,467 (20.7)	2,817 (17.9)
	Medium deprivation	52,945 (18.1)	2,860 (18.2)	52,949 (18.1)	2,861 (18.2)	52,946 (18.1)	2,861 (18.2)
	2nd most deprived	55,033 (18.9)	3,534 (22.5)	55,035 (18.9)	3,534 (22.5)	55,035 (18.9)	3,535 (22.5)
	Most deprived	53,092 (18.2)	3,666 (23.3)	53,094 (18.2)	3,667 (23.3)	53,094 (18.2)	3,668 (23.3)
	Missing data	2,467 (0.9)	193 (1.2)	2,467 (0.9)	193 (1.2)	2,467 (0.9)	193 (1.2)
Calendar year at study entry	1998-2001	61,324 (21.0)	3,215 (20.4)	61,327 (21.0)	3,216 (20.4)	61,326 (21.0)	3,217 (20.4)
	2002-2005	75,908 (26.0)	3,881 (24.7)	75,913 (26.0)	3,881 (24.7)	75,914 (26.0)	3,881 (24.7)
	2006-2009	88,411 (30.3)	5,277 (33.5)	88,415 (30.3)	5,279 (33.5)	88,415 (30.3)	5,279 (33.5)
	2010-2012	66,251 (22.7)	3,364 (21.4)	66,254 (22.7)	3,365 (21.4)	66,254 (22.7)	3,365 (21.4)
Behavior disorder		12,979 (4.5)	7,585 (48.2)	12,981 (4.5)	7,588 (48.2)	12,981 (4.5)	7,589 (48.2)
Learning		2,390 (0.8)	1,793 (11.4)	2,390 (0.8)	1,792 (11.4)	2,390 (0.82)	1,793 (11.4)
Epilepsy		3,426 (1.2)	843 (5.4)	3,426 (1.2)	843 (5.4)	3,426 (1.2)	843 (5.4)
Cerebral palsy		82 (0.03)	7 (0.04)	82 (0.03)	7 (0.04)	82 (0.03)	7 (0.04)

4.5.2 Unadjusted and adjusted analyses

Table 4-2 shows the unadjusted and adjusted analyses for the first injury to occur. Overall there were 20,476 fractures (1,878 in CYP with ADHD) with a total of 1,052,057 pyar (63,465 pyar in CYP with ADHD) giving a crude rate of 29.6 (28.3 to 31.0) fractures per one thousand person years and a crude HR of 1.58 (1.51 to 1.66) comparing CYP with ADHD to CYP without ADHD. The risk of fractures in CYP with ADHD was 28% greater than in CYP without ADHD adjusting for age, sex, region, deprivation and calendar year (HR=1.28 (1.22 to 1.35)).

There were 2,270 thermal injuries (313 in CYP with ADHD) with similar follow-up to the analysis for fractures (1,117,278 pyar) giving a crude rate of 4.5 (4.0 to 5.0) injuries per one thousand person years and a crude HR of 2.09 (1.86 to 2.35) comparing CYP with ADHD to CYP without ADHD. The risk of thermal injuries in CYP with ADHD was more than double the risk in CYP without ADHD adjusting for age, sex, region, deprivation and calendar year (HR=2.04 (1.80 to 2.31)).

There were 2,496 poisonings (463 in CYP with ADHD) with similar follow-up to the analysis for fractures (1,119,141 pyar) giving a crude rate of 6.7 (6.1 to 7.3) poisonings per one thousand person years and a crude HR of 3.41 (3.08 to 3.77) comparing CYP with ADHD to CYP without ADHD. The risk of poisonings was nearly 4 times greater in CYP with ADHD compared to CYP without ADHD adjusting for age, sex, region, deprivation and calendar year (HR=3.99 (3.58 to 4.44)).

The risk of long bone fractures was similar to the risk of any fractures (crude HR=1.53 (1.44 to 1.63); HR=1.23 (1.16 to 1.31) adjusting for age, sex, region, deprivation and calendar year).

Table 4-2 The risk of fractures, thermal injuries and poisonings in CYP with and without ADHD

Injury category	ADHD or non-ADHD	Events (n)	pyar	Rate (per 1000) (95% CI)	HR (95% CI)	Adjusted HR[a] (95% CI)
Any fractures	Non-ADHD	18,598	988,592	18.8 (18.5 -19.1)	1	1
	ADHD	1,878	63,465	29.6 (28.3 -31.0)	1.58 (1.51 -1.66)	1.28 (1.22 -1.35)
Thermal injuries	Non-ADHD	2,270	1,047,829	2.2 (2.1 -2.3)	1	1
	ADHD	313	69,449	4.5 (4.0 -5.0)	2.09 (1.86 -2.35)	2.04 (1.80 -2.31)
Any poisonings	Non-ADHD	2,033	1,049,731	1.9 (1.9 -2.0)	1	1
	ADHD	463	69,410	6.7 (6.1 -7.3)	3.41 (3.08 -3.77)	3.99 (3.58 -4.44)
Injury sub-groups:						
Long bone fractures	Non-ADHD	11,958	1,011,787	11.8 (11.6 -12.0)	1	1
	ADHD	1,189	66,121	18.0 (17.0 -19.0)	1.53 (1.44 -1.63)	1.23 (1.16 -1.31)

pyar: Person years at risk (in years)

HR: Hazard ratio

[a]HRs were adjusted for for age, sex, SHA region, deprivation and calendar year at study entry

4.5.3 Risk of injury stratified by age, sex and deprivation

4.5.3.1 Risk of fractures

Table 4-3 shows the crude and adjusted HRs for the risk of fractures, comparing CYP with ADHD versus CYP without ADHD stratified by age, sex and deprivation. The adjusted HR was similar for all age groups. Although there was statistical evidence of a difference in HR across the four age groups ($p<0.001$, test for interaction) there was little difference in the estimated HRs when taking the 95%CIs into consideration (ranging from 1.13 (95%CI 1.06 to 1.21) in 5 to 9 year-olds to 1.39 (95%CI 1.08 to 1.79) in 15 to 17 year-olds). The adjusted HR was higher in females than males comparing the risk of fracture in CYP with ADHD versus CYP without ADHD but this did not reach statistical significance at the 5% level (HR=1.28 (95%CI 1.22 to 1.35) in males; HR=1.32 (95%CI 1.12 to 1.55) in females, $p=0.76$, test for interaction). Although there was some statistical evidence of a linear trend in the relationship between deprivation and injuries ($p=0.01$, test for linear trend) there was little difference in the estimated HRs when taking the 95%CIs into consideration (ranging from 1.22 (95%CI 1.09 to 1.37) in CYP from areas with medium deprivation to 1.41 (95%CI 1.28 to 1.55) in CYP from the second most deprived areas).

Table 4-3 Risk of fractures in CYP with and without ADHD by age, sex and deprivation

Characteristic		ADHD vs. non-ADHD Unadjusted hazard ratio (95% CI)	ADHD vs. non-ADHD Adjusted hazard ratio[$] (95% CI)	P-Value[+]
Any fractures				
Age group at diagnosis (years)	3-4	1.51 (1.27 -1.79)	1.39 (1.17 -1.65)	<0.001
	5-9	1.41 (1.32 -1.51)	1.13 (1.06 -1.21)	
	10-14	1.86 (1.72 -2.00)	1.49 (1.39 -1.61)	
	15-17	1.63 (1.26 -2.10)	1.39 (1.08 -1.79)	
Sex	Males	1.28 (1.21 -1.34)	1.28 (1.22 -1.35)	0.76
	Females	1.30 (1.10 -1.53)	1.32 (1.12 -1.55)	
Deprivation	Least deprived	1.57 (1.40 -1.75)	1.29 (1.15 -1.44)	0.01[£]
	2nd least deprived	1.53 (1.37 -1.72)	1.25 (1.12 -1.40)	
	Medium deprivation	1.51 (1.34 -1.69)	1.22 (1.09 -1.37)	
	2nd most deprived	1.75 (1.59 -1.92)	1.41 (1.28 -1.55)	
	Most deprived	1.53 (1.37 -1.69)	1.23 (1.11 -1.37)	
	Missing data	1.66 (1.01 -2.72)	1.32 (0.81 -2.17)	

[+]Test for interaction comparing the estimate (adjusted for age, sex, SHA region, deprivation, calendar year of entry) with the adjusted estimate with an interaction term for age or sex unless otherwise stated

[$]Adjusted for age, sex, SHA region, deprivation and calendar year at study entry unless otherwise stated

[£]Likelihood ratio test, excluding people with missing data for deprivation, comparing the estimate (adjusted for age, sex, SHA region, deprivation, calendar year of entry) with the adjusted estimate with deprivation fitted as a continous variable

pyar: Person years at risk (in years)

4.5.3.2 Risk of thermal injuries

Table 4-4 shows the crude and adjusted HRs for the risk of thermal injuries, comparing CYP with ADHD versus CYP without ADHD stratified by age, sex and deprivation. The adjusted HR was statistically similar for all age groups (ranging from 1.95 (95%CI 1.15 to 3.29) in 15 to 17 year-olds to 2.45 (95%CI 1.67 to 3.58) in 3 to 4 year-olds; p=0.79, test for interaction). There was little difference between males and females in the adjusted HR comparing the risk of thermal injuries in CYP with ADHD versus CYP without ADHD (HR=2.00 (1.75 to 2.29) in males; HR=2.25 (1.69 to 2.99) in females, p=0.47, test for interaction). There was no evidence of a linear trend in the relationship between deprivation and injuries (ranging from 1.76 (1.29 to 2.40) in the second least deprived areas to 2.32 (1.72 to 3.14) in the least deprived areas, p=0.29, test for linear trend).

Table 4-4 Risk of thermal injuries in CYP with and without ADHD by age, sex and deprivation

Characteristic		ADHD vs. non-ADHD Unadjusted hazard ratio (95% CI)	ADHD vs. non-ADHD Adjusted hazard ratio[$] (95% CI)	P-Value[+]
Thermal injuries				
Age group at diagnosis (years)	3-4	2.90 (1.98 -4.26)	2.45 (1.67 -3.58)	0.79
	5-9	2.13 (1.79 -2.52)	2.04 (1.71 -2.43)	
	10-14	2.00 (1.65 -2.43)	1.96 (1.61 -2.39)	
	15-17	1.84 (1.09 -3.10)	1.95 (1.15 -3.29)	
Sex	Males	2.10 (1.83 -2.40)	2.00 (1.75 -2.29)	0.47
	Females	2.36 (1.77 -3.14)	2.25 (1.69 -2.99)	
Deprivation	Least deprived	2.29 (1.70 -3.09)	2.32 (1.72 -3.14)	0.29[£]
	2nd least deprived	1.74 (1.27 -2.37)	1.76 (1.29 -2.40)	
	Medium deprivation	1.90 (1.44 -2.51)	1.90 (1.43 -2.52)	
	2nd most deprived	2.28 (1.80 -2.88)	2.32 (1.83 -2.94)	
	Most deprived	1.84 (1.45 -2.34)	1.86 (1.46 -2.37)	
	Missing data	4.37 (1.57 -12.13)	4.28 (1.54 -11.89)	

[+]Test for interaction comparing the estimate (adjusted for age, sex, SHA region, deprivation, calendar year of

[$]Adjusted for age, sex, SHA region, deprivation and calendar year at study entry unless otherwise stated

[£]Likelihood ratio test, excluding people with missing data for deprivation, comparing the estimate (adjusted

pyar: Person years at risk (in years)

4.5.3.3 Risk of poisonings

Table 4-5 shows the crude and adjusted HRs for the risk of poisonings, comparing CYP with ADHD versus CYP without ADHD stratified by age, sex and deprivation. The adjusted HR was larger amongst 3 to 4 year-olds but differences by age did not reach statistical significance at the 5% level (ranging from 3.62 (95%CI 3.10 to 4.23) in 10 to 14 year-olds to 4.79 (95%CI 3.31 to 6.93) in 3 to 4 year-olds, p=0.31, test for interaction). There was little difference between males and females in the adjusted HRs comparing the risk of fractures in CYP with ADHD versus CYP without ADHD (HR=3.81 (95%CI 3.35 to 4.33) in males; HR=4.46 (95%CI 3.68 to 5.41) in females, p=0.18, test for interaction). Although there was statistical evidence of a linear trend in the relationship between deprivation and injuries (p<0.001, test for linear trend) there was little difference in the estimated HRs when taking the 95%confidence intervals into consideration (ranging from 3.37 (95%CI 2.77 to 4.10) in the second most deprived areas to 4.60 (95%CI 3.75 to 5.64) in the most deprived areas).

Table 4-5 Risk of poisonings in CYP with and without ADHD by age, sex and deprivation

Characteristic		ADHD vs. non-ADHD Unadjusted hazard ratio (95% CI)	ADHD vs. non-ADHD Adjusted hazard ratio[$] (95% CI)	P-Value[+]
Any poisonings				
Age group at diagnosis (years)	3-4	4.86 (3.33 -7.11)	4.79 (3.31 -6.93)	0.31
	5-9	3.74 (3.18 -4.40)	4.33 (3.66 -5.12)	
	10-14	3.22 (2.77 -3.74)	3.62 (3.10 -4.23)	
	15-17	3.53 (2.45 -5.09)	4.02 (2.78 -5.80)	
Sex	Males	4.14 (3.65 -4.71)	3.81 (3.35 -4.33)	0.18
	Females	4.88 (4.03 -5.91)	4.46 (3.68 -5.41)	
Deprivation	Least deprived	3.26 (2.42 -4.40)	4.18 (3.09 -5.64)	<0.001[£]
	2nd least deprived	3.21 (2.43 -4.26)	4.04 (3.05 -5.36)	
	Medium deprivation	3.25 (2.60 -4.06)	4.01 (3.20 -5.02)	
	2nd most deprived	2.78 (2.30 -3.38)	3.37 (2.77 -4.10)	
	Most deprived	3.64 (2.97 -4.44)	4.60 (3.75 -5.64)	
	Missing data	4.58 (1.78 -11.81)	6.78 (2.63 -17.48)	

[+]Test for interaction comparing the estimate (adjusted for age, sex, SHA region, deprivation, calendar year of entry) with the adjusted estimate with an interaction term for age or sex unless otherwise stated

[$]Adjusted for age, sex, SHA region, deprivation and calendar year at study entry unless otherwise stated

[£]Likelihood ratio test, excluding people with missing data for deprivation, comparing the estimate (adjusted for age, sex, SHA region, deprivation, calendar year of entry) with the adjusted estimated with deprivation fitted as a continous variable

pyar: Person years at risk (in years)

4.5.4 Absolute risk of injury in CYP with and without ADHD

Table 4-6 shows the absolute risk of injury within the first five years of study follow-up in CYP with and without ADHD. This shows that the risk of fractures, long bone fractures, thermal injuries and poisonings was greater in CYP with ADHD compared to CYP without ADHD. Per thousand CYP, CYP with ADHD experienced an extra fifty-three fractures (thirty-one of which were long bone fractures), an extra twenty-three poisonings and an extra thirteen thermal injuries compared to CYP without ADHD.

Table 4-6 Absolute risk of injury within the first five years of study follow-up in CYP with and without ADHD

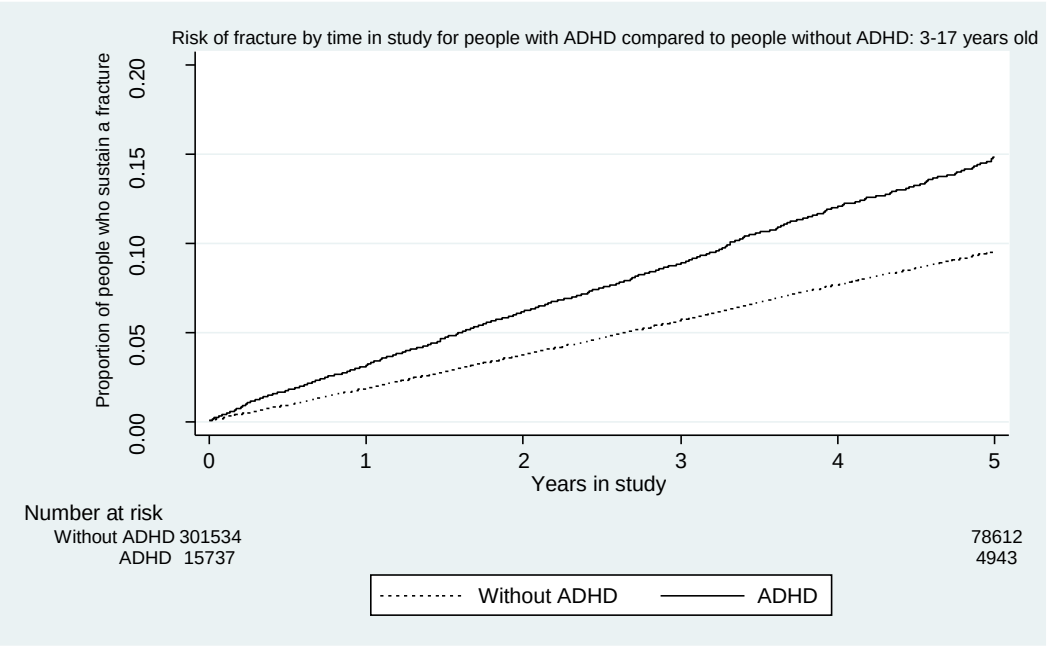
	Non-ADHD			ADHD			
Time since diagnosis	**Total at risk (n)**	**Events (n)**	**Injuries per thousand (95% CI)**	**Total at risk (n)**	**Events (n)**	**Injuries per thousand (95% CI)**	**Excess injuries per thousand (95% CI)**
Any fractures							
Up to 5 years	76,708	14,373	95.7 (94.1 -97.4)	4,945	1,409	148.2 (140.2 -156.6)	52.5 (46.10 -59.20)
Thermal injuries							
Up to 5 years	83,903	1,666	10.5 (10.0 -11.1)	5,595	232	23.3 (20.3 -26.6)	12.8 (10.30 -15.50)
Any poisonings							
Up to 5 years	84,089	1,351	8.8 (8.4 -9.4)	5,617	341	31.7 (28.4 -35.5)	22.9 (20.00 -26.10)
Injury sub-groups:							
Long bone fracture							
Up to 5 years	79,487	9,297	60.7 (59.4 -62.1)	5,234	884	91.6 (85.4 -98.2)	30.9 (26.00 -36.10)

4.5.5 The risk of injury within the first five years of the study

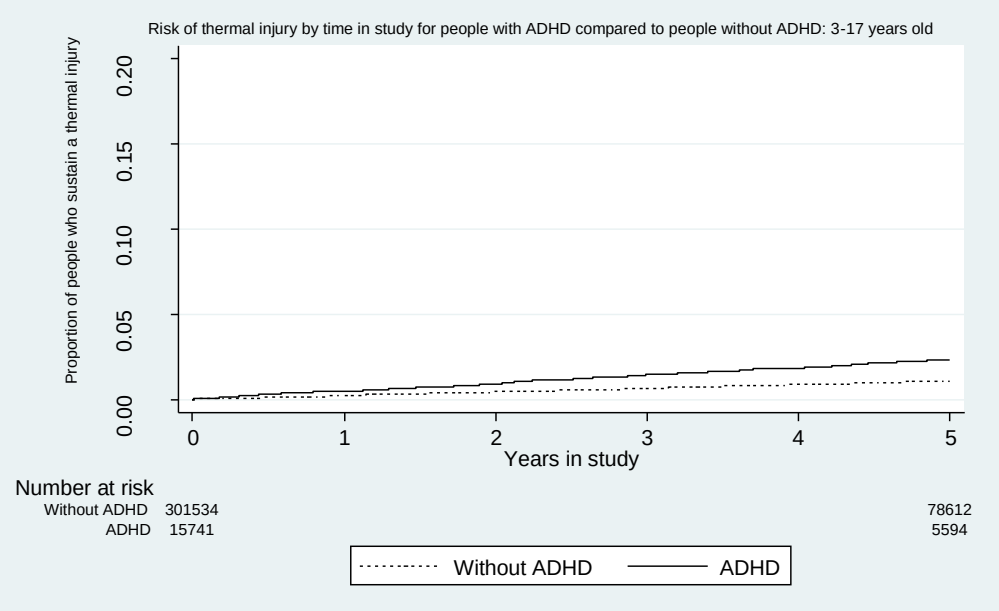
Figure 4-2 shows the cumulative hazard of injury by time in the study for fractures, thermal injuries and poisonings on Nelson-Aalen plots for the first five years of the study. The data underneath the plot show the number of individuals being followed each year after study follow-up at 0 and 5 years and CYP who are no longer being follow up at that point in time (e.g. because they have had an injury or left the GP practice before sustaining an injury).The graphs show that the risk of injury in CYP with ADHD was greater than in CYP without ADHD and there is some evidence that the risk increased more in CYP with ADHD than CYP without over time but also that the number of events reduced over time. The graphs also show that the greatest risk in CYP with and without ADHD was from fractures, followed by poisonings and that the least risk was from thermal injuries.

Figure 4-2 Nelson-Aalen cumulative hazard estimates to show the risk of fractures, thermal injuries and poisonings by time in the study for all age groups, comparing people with ADHD vs. people without ADHD.

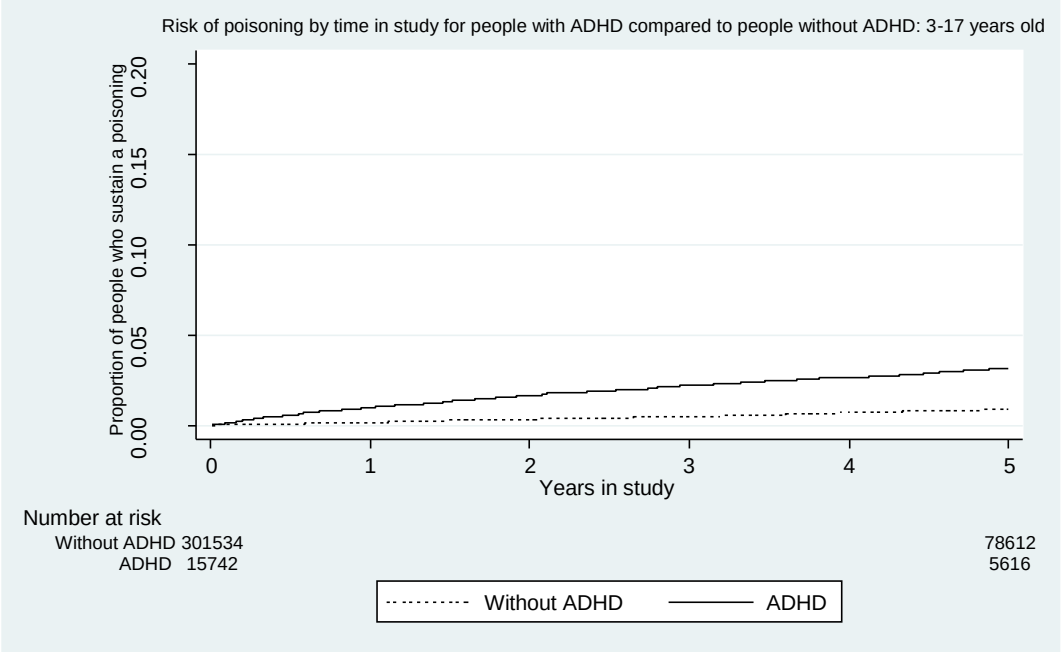
A. Fractures



B. Thermal injuries



C. Poisonings



4.5.6 Checking assumptions for using a Cox model

Plots of the logarithm of cumulative hazard against time showed that the risk of injury in CYP with ADHD was proportional to the risk of injury in CYP without ADHD for fractures, thermal injuries, poisonings and long bone fractures, respectively (appendix 6.12). Plots of Schoenfeld residuals against time were inspected, and a statistical test for non-proportional hazards for CYP with ADHD compared to CYP without in the final model was performed; (unadjusted results: p=0.42, fractures; p=0.26, long bone fractures; p=0.49, thermal injuries; p<0.001, poisonings and adjusted results: p=<0.001, fractures; p=<0.001, long bone fractures; p<0.001, thermal injuries; p=0.26, poisonings). However, large datasets can give rise to significant statistical tests and the plots implied proportional hazards.

4.5.7 Sensitivity analyses

Table 4-7 shows the effect of varying the definition of ADHD on the unadjusted and adjusted HRs comparing the risk of injury in CYP with ADHD compared to CYP without ADHD. The table shows that, for (long bone) fractures and poisonings, there was no substantial variation in the point estimates for the HR by how ADHD was defined, (e.g. for fractures: adjusted HR ranging from 1.21 (95%CI 1.11 to 1.32) in CYP with at least two drug codes and less than two diagnosis codes to 1.50 (95%CI 1.30 to 1.74) in CYP with at least two diagnosis codes and less than two drug codes). However, for thermal injuries, the HR for CYP with ADHD defined by at least two drug codes and less than two diagnosis codes was nearly twice that of CYP defined by one drug or one diagnosis, or one drug and

one diagnosis code (ranging from 1.58 (95%CI 1.27 to 1.98) in one drug or one diagnosis, or one drug and one diagnosis code to 2.92 (95%CI 2.12 to 4.04) in at least two drug codes and less than two diagnosis codes).

Table 4-7 The risk of fractures, thermal injuries and poisonings in CYP with and without ADHD by sub groups

Injury category	ADHD subgroup	HR (95% CI)	Adjusted HR[a] (95% CI)
Any fractures:			
	≥2 drug & ≥2 diagnosis codes	1.64 (1.50 -1.78)	1.30 (1.19 -1.42)
	≥2 diagnosis & <2 drug codes	1.81 (1.57 -2.10)	1.50 (1.30 -1.74)
	≥2 drug & <2diagnosis codes	1.53 (1.41 -1.67)	1.21 (1.11 -1.32)
	1 drug or 1 diagnosis, or 1 drug & 1 diagnosis code	1.52 (1.41 -1.65)	1.28 (1.18 -1.38)
Thermal injuries:			
	≥2 drug & ≥2 diagnosis codes	2.51 (2.06 -3.05)	2.49 (2.04 -3.05)
	≥2 diagnosis & <2 drug codes	2.99 (2.17 -4.13)	2.92 (2.12 -4.04)
	≥2 drug & <2diagnosis codes	1.97 (1.59 -2.44)	1.90 (1.53 -2.36)
	1 drug or 1 diagnosis, or 1 drug & 1 diagnosis code	1.64 (1.31 -2.04)	1.58 (1.27 -1.98)
Any poisonings:			
	≥2 drug & ≥2 diagnosis codes	3.20 (2.67 -3.84)	3.95 (3.28 -4.77)
	≥2 diagnosis & <2 drug codes	4.03 (3.02 -5.39)	4.87 (3.63 -6.53)
	≥2 drug & <2diagnosis codes	3.27 (2.75 -3.90)	3.43 (2.86 -4.11)
	1 drug or 1 diagnosis, or 1 drug & 1 diagnosis code	3.49 (2.97 -4.09)	4.24 (3.59 -5.00)
Injury sub-groups:			
Long bone fractures:			
	≥2 drug & ≥2 diagnosis codes	1.58 (1.42 -1.76)	1.24 (1.11 -1.38)
	≥2 diagnosis & <2 drug codes	1.94 (1.62 -2.31)	1.57 (1.31 -1.87)
	≥2 drug & <2diagnosis codes	1.45 (1.30 -1.61)	1.15 (1.03 -1.28)
	1 drug or 1 diagnosis, or 1 drug & 1 diagnosis code	1.47 (1.33 -1.63)	1.21 (1.09 -1.34)

pyar: Person years at risk (in years)

HR: Hazard ratio comparing people with ADHD to people without ADHD

[a]HRs were adjusted for for age, sex, SHA region, deprivation and calendar year at study entry

Table 4-8 shows the risk of injuries in CYP with and without ADHD after the first three months of the medical record were excluded. The risk of fracture, excluding the first three months of the medical record, in CYP with ADHD compared to CYP without, adjusting for age, sex, region, deprivation and calendar year, was 25% greater in CYP with ADHD (HR=1.25 (95%CI 1.19 to 1.31)). The adjusted risk of fracture was similar in the analysis including the first three months of the medical record (HR=1.28 (95%CI 1.22 to 1.35)). The risk of thermal injuries, excluding the first three months of the medical record, in CYP with ADHD compared to CYP without, adjusting for age, sex, region, deprivation and calendar year, was double in CYP with ADHD (HR=2.00 (95%CI 1.76 to 2.27)). The adjusted risk of thermal injuries was similar in the analysis including the first three months of the medical record (HR=2.04 (95%CI 1.80 to 2.31)). The risk of poisonings, excluding the first three months of the medical record, in CYP with ADHD compared to CYP without, adjusting for age, sex, region, deprivation and calendar year, was more than three times greater in CYP with ADHD (HR=3.72 (95%CI 3.32 to 4.17)). The adjusted risk of poisonings was similar in the analysis including the first three months of the medical record (HR=3.99 (95%CI 3.58 to 4. 44)). The risk of long bone fractures, excluding the first three months of the medical record, in CYP with ADHD compared to CYP without, adjusting for age, sex, region, deprivation and calendar year, was 21% greater in CYP with ADHD (HR=1.21 (95%CI 1.13 to 1.18)). The adjusted risk of long bone fractures was similar in the analysis including the first three months of the medical record (HR=1.23 (95%CI 1.16 to 1. 31)).

Table 4-8 The risk of fractures, thermal injuries and poisonings in CYP with and without ADHD after excluding the first three months of the medical record

Injury category	HR (95% CI)	Adjusted HR[a] (95% CI)
Any fractures:	1.55 (1.47 -1.63)	1.25 (1.19 -1.31)
Thermal injuries:	2.04 (1.80 -2.30)	2.00 (1.76 -2.27)
Any poisonings:	3.18 (2.86 -3.54)	3.72 (3.32 -4.17)
Injury sub-groups:		
Long bone fractures:	1.51 (1.42 -1.61)	1.21 (1.13 -1.28)

pyar: Person years at risk (in years)

HR: Hazard ratio comparing people with ADHD to people without ADHD

[a]HRs were adjusted for for age, sex, SHA region, deprivation and calendar year at study entry

4.6 Discussion

4.6.1 Main findings

CYP aged 3 to 17 years with ADHD are at a greater risk of fractures, thermal injuries and poisonings than CYP without ADHD. The risk of fracture is twenty-eight percent greater in CYP with ADHD compared to CYP without ADHD. Thermal injuries are twice as common in CYP with ADHD compared to CYP without ADHD. CYP with ADHD are at greatest risk from poisonings compared to CYP without ADHD, with a risk that is four times greater. When the analysis is restricted to long bone fractures the results are similar to the analysis for any fractures.

4.6.1.1 Fractures

This study shows that fractures are the commonest type of injury of those studied to occur in CYP with ADHD, at a rate of thirty fractures per one thousand person-years at risk. The results suggest that among one thousand CYP with ADHD, one hundred and forty-eight CYP would have a fracture over the subsequent five years (compared to ninety-six CYP at five years for CYP without ADHD). The excess number of fractures associated with ADHD per thousand CYP over five years is fifty-three.

4.6.1.2 Thermal injuries

This study shows that thermal injuries are the least common type of injury of those studied to occur in CYP with ADHD, at a rate of five thermal injuries per one thousand person-years at risk. Among one thousand CYP with ADHD, twenty-three CYP would have a thermal injury within five

years (compared to eleven CYP at five years for CYP without ADHD). The excess number of thermal injuries associated with ADHD per thousand CYP over five years is thirteen.

4.6.1.3 Poisonings

This study shows that poisonings are the second least common type of injury of those studied to occur in CYP with ADHD, at a rate of seven poisonings per one thousand person-years at risk. Among one thousand CYP with ADHD, thirty-two CYP would have a poisoning within five years (compared to nine CYP at five years for CYP without ADHD). The excess number of poisonings associated with ADHD per thousand CYP over five years is twenty-three.

4.6.1.4 Long bone fractures

This study shows that, as expected, long bone fractures are less common than any fractures in CYP with ADHD, at a rate of eighteen per one thousand person-years at risk. Among one thousand CYP with ADHD, ninety-two CYP would have a long bone fracture within five years (compared to sixty-one CYP at five years for CYP without ADHD). The excess number of long bone fractures associated with ADHD per thousand CYP over five years is thirty-one.

4.6.2 Strengths and limitations

This is the first known study to describe the risk of fractures, thermal injuries and poisonings in children with ADHD compared to children without ADHD using English primary care data. The strengths and limitations already described in section 3.6.2, which apply to the definition

of ADHD also apply to the present chapter and will not be repeated here. The primary care medical record contains information on diagnoses made in both secondary and primary care with on-going prescriptions provided in primary care[30 197]. In addition, as described in section **Error! Reference source not found.**, in case there were injury events that had been recorded exclusively in the hospital medical records and which may have been missed by the GP, the full GP and hospital medical records were used. The present study included injuries recorded in hospital and GP medical records and therefore provides a more complete picture of injuries than previous studies which focused exclusively on injury recording in one data source, such as emergency department attendances[196] or hospital admissions[189].

4.6.2.1 Bias

Misclassification of ADHD could have occurred but the sensitivity analyses using stricter criteria to define ADHD did not show substantial or statistically significant variation for most HRs by definition of ADHD suggesting misclassification of ADHD may only have minimal impact on the findings. Misclassification of the injuries could have occurred if an injury was not coded in the GP nor in the hospital medical records or if an injury that had not occurred was incorrectly coded as occurring. However, similar HRs were found for all fractures and for long bone fractures, which were expected to have high levels of recording[241]. Both mechanisms of injury were included (e.g. accidents caused by fire and flames) and anatomic sites of injury (e.g. burn of lower limbs) to maximise ascertainment of injuries. There is a potential risk of ascertainment bias,

whereby CYP with ADHD who may have higher GP consultation rates have more opportunities to report injuries than CYP without ADHD. However, findings of similar HRs for all fractures and for long bone fractures comparing CYP with ADHD to CYP without would suggest this was not occurring to a large degree. There is no reason to suggest that misclassification for poisonings or thermal injuries would be greater than that for fractures. If the misclassification for poisonings or thermal injuries did not differ systematically between CYP with and without ADHD (non-differential) the HR would tend towards unity, meaning the these estimates were conservative estimates of injury risk. However, if the misclassification for poisonings or thermal injuries differed systematically between CYP with and without ADHD (differential) the HR could be affected in either direction, meaning the these estimates could be either under or over estimates of injury risk.

The present study specifically set out to estimate the risk of unintentional injuries. However, it is possible that there was misclassification whereby some of the injuries were intentional injuries. For example, intentional injuries could have been misclassified as unintentional injuries to a greater extent in CYP with ADHD compared to CYP without, for example because CYP with ADHD are more likely to have experienced significant life events than CYP without ADHD[288]. Misclassification of the intent of the injuries in this way could have resulted in an over-estimate of the risk of injuries in CYP with ADHD compared to children without.

4.6.2.2 Confounding

Results were adjusted for age, sex, deprivation, region, calendar year and comorbid conditions, which were all plausible confounders of the association between ADHD and injuries in children. However, it is possible there was residual confounding, for example, due to parent-related factors (e.g. parents' educational achievement[289]), which would not have been possible to measure using the CRPD. Any residual confounding could affect the relationship between ADHD and injuries in either direction.

After an exploration of the coding of behaviour disorder and ADHD it was hypothesised that GPs were using the codes interchangeably and there was a risk of adjusting estimated risks between ADHD and injuries for 'behaviour disorder' when, in fact, behaviour disorder referred to ADHD. Therefore, to avoid the risk of reverse causality (whereby the estimated risks are adjusted for the exposure), estimates were not adjusted for behaviour disorder. Hence, it is likely there is residual confounding for estimates for CYP who had comorbid behaviour disorders (such as conduct disorder or oppositional defiant disorder). The residual confounding due to behaviour disorder is a limitation of these data.

4.6.2.3 Chance

Taking fracture as an example, the HR estimating the risk of fractures in CYP with ADHD compared to CYP without ADHD was 1.28 with a 95%CI of 1.22 to 1.35, which means that there is a 95 per cent certainty that the true estimate of the risk of fractures in CYP with ADHD compared to CYP without ADHD in the English primary care population lies between 1.22 to 1.35. The 95%CIs for thermal injuries and poisonings were also narrow.

As with previous studies in this thesis, the CPRD represents a large dataset and narrow 95%CIs could have resulted due to a large sample size. Repeated comparisons across different groups could have yielded significant differences in HRs by chance alone (a type I statistical error). However, the decisions to estimate the associations described in this study were described *a priori* to test plausible hypotheses. Therefore, it is likely that the associated risks of injuries described in this thesis are true. A type II statistical error could have occurred where a comparison between groups was non-significant and the null hypothesis was wrongly taken to be true. Such a type II error could occur if there was a lack of power but this is unlikely in such a large dataset.

4.6.2.4 Specificity of association

The sensitivity analyses showed that, even with a more strict definition of ADHD (at least two drug codes and at least two diagnosis codes) the estimates of risk of injuries remained similar. When CYP with ADHD were defined by CYP who have received a drug and, separately, by CYP who have never received a drug for ADHD the HRs again remained similar. The sensitivity analyses showed that after the first three months of the medical record were excluded, the risk of injuries remained similar to the main analyses, in which the first three months of the medical record had been included. This means that if prevalent injuries were being recorded by GPs in the first three months in CYP with prevalent ADHD (diagnosed before registering with the practice) this made little difference to the overall estimates of risk.

4.6.2.5 Medication use

Although, sensitivity analyses were conducted in the definition of ADHD was varied, the thesis did not examine the effect of medication use in CYP with ADHD. A study that examined the use of medication using the self-controlled case series method[290] in THIN data concluded that during periods of medication for ADHD the risk of injuries was lower but Raman et al. did not define separate injuries, such as fractures, thermal injuries and poisonings and did not adjust estimates for deprivation[172]. The effect of treatment on the association between ADHD and the risk of fractures, thermal injuries and poisonings therefore remains an important unknown.

4.6.2.6 Severity of disease

The study in this thesis did not examine the issue of severity of ADHD and, although varying definitions of ADHD were examined in the sensitivity analyses, the varying definitions may not indicate severity of ADHD.

4.6.3 Comparison with the literature

Previous studies indicate that the risk of injury in CYP with ADHD is approximately one and a half to two times greater than in children without ADHD[174 176 177 180 185 186]. However, most previous studies do not categorise the risk of injuries by specific injury types. No previous studies are known to have explored poisonings in children with ADHD to poisonings in children without ADHD. Compared to previous studies that estimate the risk of fractures and thermal injuries in children with ADHD to children without, the overall estimates of risk estimated in this thesis are similar to

published estimates. For example, a study from Holland reported that the IRR for injuries was twice as high in children with ADHD compared to children without (IRR= 2.2 (95%CI 1.6 to 2.9))[173]. This Dutch study was based on hospital admissions data but the estimated risk is similar to the estimates in this thesis. A Taiwanese hospital medical records database study estimated that the risk of injuries in 4 to 12 year-olds with ADHD was around 60% greater compared to children without (HR=1.64 (95%CI 1.50 to 1.79)), which is again consistent with the findings of the present study[174].

As this was an observational study on routinely collected data, it was not possible to know what might have caused the increased risk of injuries in CYP with ADHD compared to CYP without. A matched case-control study which used a simulated environment to measure the behaviour of CYP with ADHD, recruited from out-patient behavioural assessment clinics in the USA, found that CYP with ADHD chose more risky environments when choosing where to cross the road than community control children who had been recruited through advertising in newspapers and flyers in the community[291]. However, although the controls did not have ADHD it is possible that there was referral bias with more severe cases of ADHD than in this thesis. It is also possible that community controls in the USA study had less risky behaviour because the recruitment method would have selected a biased sample of CYP and parents who were willing to engage in the research study. Therefore, it is plausible that CYP with ADHD are more likely to engage in risky behaviours and that this puts them at risk of a range of injuries. A previous study in 16 to 25 year-olds found that CYP with ADHD may be more likely to engage in motorsports[292] and it is

possible that a proportion of the fractures in the oldest CYP were due to road injuries, especially in CYP with ADHD compared to CYP without ADHD. Other possible explanations for the higher risk of injuries may include the use of alcohol or drugs[293], risky behaviour and comorbid conduct disorder[140].

4.6.4 Clinical implications

All services involved in the care and education of CYP with ADHD should be aware of the findings of the study in this thesis. The estimated risks of injury should be communicated to CYP and their parents at the time of diagnosis, medication reviews and follow-up visits. Existing NICE guidelines on the prevention of injuries should be used to reduce the risk of unintentional injuries[1 294]. Age-appropriate guidance should be given during visits to the GP, practice nurse, health visitor and contacts with the pharmacist[264]. For example, precautions should be taken for injury prevention, such as safe storage of hazardous substances, not transferring medicines to other containers, and supervising children[266-268].

The findings of this study do not allow conclusions to be drawn on the effect of treatment on ADHD. According to national guidance only the CYP with more severe ADHD would be expected to receive medication for their ADHD and the results suggest that regardless of whether the CYP received medication the risk of fractures, thermal injuries and poisonings in CYP with ADHD compared to CYP without remained similar. Therefore, the findings of this study do not imply there has been a failure to treat ADHD symptoms adequately.

4.6.5 Conclusions

In conclusion this study shows that, of one thousand children diagnosed with ADHD: one hundred and forty-eight CYP would have a fracture over the subsequent five years (compared to ninety-six CYP at five years for CYP without ADHD); twenty-three CYP would have a thermal injury over the subsequent five years (compared to eleven CYP at five years for CYP without ADHD); and thirty-two CYP would have a poisoning over the subsequent five years (compared to nine CYP at five years for CYP without ADHD).

5 Discussion

Subsequent sections of this chapter summarise the key findings of this thesis (Section 5.1); discuss the key findings (Section 5.2); discuss the strengths and limitations of the work in this thesis (Section 5.3); draw conclusions based on the work in this thesis (Section 5.4); discuss implications for future research (Section 5.5); and discuss implications for policy and practice (Section 5.6).

5.1 Summary of key findings

This thesis has described three linked studies to describe the risk of fractures, thermal injuries and poisonings in cohorts of CYP in the primary care population with two specific conditions, namely epilepsy and attention deficit-hyperactivity disorder (ADHD). Using the clinical practice research datalink (CPRD) a cohort of CYP with epilepsy was defined. In the cohort of CYP with epilepsy the risk of fractures, thermal injuries and poisonings was found to be significantly greater than in CYP without epilepsy. Furthermore, work undertaken in a subgroup of CYP with linked hospital medical records from the hospital episodes statistics (HES) database indicated that a more complete picture of injury recording may be obtained using HES-linked GP medical records. Therefore, when a cohort of CYP with ADHD was identified for this study, HES-linked GP medical records were used to explore injury risk in CYP with and without ADHD. In CYP with ADHD the risk of fractures, thermal injuries and poisonings was found to be significantly greater than in CYP without ADHD.

In summary, the risk of fracture is 18% higher; thermal injury is 50% higher and poisoning is more than twice as high in CYP with epilepsy compared to CYP without epilepsy. The risk of fracture is 28% higher; thermal injury is twice as high and poisoning is four times as high in CYP with ADHD compared to CYP without ADHD. In both epilepsy and ADHD the risk of poisoning is particularly increased compared to CYP in the general population. The estimated administrative prevalence of ADHD in CYP aged 3 to 17 years old is 0.88% compared to published estimates of community prevalence of ADHD of 2 to 5%. The administrative prevalence of ADHD is twice as high in CYP from the most deprived areas compared to CYP from the least deprived areas with a dose-response relationship between prevalence and deprivation.

5.2 Discussion of key findings

5.2.1 What is the risk of fractures, thermal injuries and poisonings in CYP with epilepsy compared to CYP without?

In the introduction to this thesis previous studies that reported detailed and reliable estimates of the risk of fractures, thermal injuries and poisonings for CYP with epilepsy compared to CYP without were shown to be lacking. Studies that were identified, mainly in adults, suggested epilepsy is associated with an increase in the risk of injuries. However, because previous studies used populations with more severe epilepsy, such as institutionalized adults, or CYP in epilepsy clinics, it is possible that the risk of injuries may have been overestimated.

Chapter 2 reported the first study to exclusively study CYP in UK primary care using GP medical records and to estimate the risk of fractures, thermal injuries and poisonings by age, sex, region and deprivation. In CYP with epilepsy the risk of a fracture was 18% higher, of a thermal injury was 50% higher and of a poisoning was more than twice as high as in CYP without epilepsy. Among young CYP with epilepsy, aged 19 to 24 years, the risk of medicinal poisoning was four-fold that of young CYP without epilepsy of the same age. The findings were robust to varying the definition of epilepsy using different Read codes for diagnoses and medications. Further work reported in the chapter indicated that a more complete picture of injury recording may be obtained by using HES-linked medical records.

5.2.2 What is the prevalence of ADHD in CYP under 18 years old in the CPRD?

In the introduction to this thesis studies describing the prevalence of ADHD were grouped into those describing community prevalence (the number of CYP in a representative sample of the whole population with ADHD) and clinically recognised (administrative) prevalence (the number of CYP with diagnosed and/or recognised ADHD in their medical records as a proportion of the whole population). As reported in (section 1.4.2.1) of this thesis, the community prevalence of ADHD is estimated to be 2 to 5%. The published literature reported that the administrative prevalence in the UK ranged from 0.003% in under nineteen-year-olds in 1992[146] to 0.92% in six to twelve-year-olds in 2008[143]. However, there was a lack of

studies describing how the administrative prevalence of ADHD varied by age, sex, deprivation, region and calendar time in UK primary care.

Chapter 3 described a study conducted to identify CYP in the CPRD with ADHD and to estimate the administrative prevalence of ADHD in English primary care. Only CYP from England were eligible for the cohort because HES-linked GP medical records are only available for practices in England. However, apart from the restriction to CYP from England, the work undertaken to describe a cohort of children with ADHD used similar methods to that for the epilepsy cohort. A sensitivity analysis was also undertaken varying the definition of ADHD to explore the effect on estimates of prevalence. The estimated administrative prevalence of ADHD in children aged 3 to 17 years old was 0.88% (95%CI 0.87 to 0.89), which was lower than expected based on published estimates of community prevalence[108]. In addition this thesis showed for the first time, using a large population-level dataset, that the prevalence of ADHD was twice as high in CYP from the most deprived areas compared to CYP from the least deprived areas (1.14% (95%CI 1.12 to 1.16) in the most deprived areas to 0.64% (95%CI 0.63 to 0.65) in the least deprived areas)) with an increased prevalence with greater measured deprivation.

5.2.3 What is the risk of fractures, thermal injuries and poisonings in CYP with ADHD compared to CYP without?

The introduction to this thesis described the lack of studies reporting detailed and reliable estimates of the risk of fractures, thermal injuries and poisonings in children with ADHD and without ADHD in primary care in the UK. Published studies indicated that the risk of injuries in children with

ADHD may be one and a half to two times greater compared to children without[174 176 177 180 185 186].

Chapter 4 described the first study to exclusively study children in English primary care using GP medical records to estimate the risk of fractures, thermal injuries and poisonings by age, sex, region and deprivation. In contrast to the study on CYP with epilepsy, the hospital-linked medical records were used in addition to the GP medical records to provide a more complete picture of injuries. In CYP with ADHD the risk of fracture was 28% higher, of a thermal injury was twice as high and of a poisoning was four times as high as in CYP without ADHD.

5.3 Strengths and limitations

5.3.1 Strengths

The CPRD is a large primary care dataset that is representative of the general population of CYP in the UK[227]. 98% of CYP aged 1 to 24 are registered with a GP[14 295] and previous studies have shown that CPRD practices are broadly representative of UK general practice[222 227]. The CPRD is a large database that covers 8% of the UK population[220]. The linkage between GP and hospital medical records allowed a more complete ascertainment of injuries in the study on CYP with and without ADHD and more detailed information on the types of injuries described than would have been possible using GP medical records alone. In the study on CYP with and without epilepsy a sensitivity analysis was employed which compared the risk of long bone fracture in CYP with epilepsy to the risk in CYP without epilepsy. It is likely that long bone fracture would have a high

level of ascertainment in GP medical records because almost all long bone fractures will result in medical attendance in secondary care[30]. Therefore, since the higher risk of fractures in CYP with epilepsy compared to CYP without epilepsy was similar for both long bone fracture and any fracture, this suggests any ascertainment bias (due to CYP with epilepsy being more likely to have a fracture recorded in their GP medical records than CYP without epilepsy) is unlikely to have a large effect on the findings. Both the epilepsy and the ADHD study findings were robust to varying the definitions of epilepsy or ADHD by use of different Read codes for diagnosis and medication codes.

5.3.2 Limitations

The studies presented in this thesis relied on routinely collected primary and secondary care data on epilepsy, ADHD and injuries. To date the CPRD and other large primary care databases have been rarely used to study the epidemiology of injuries in CYP. The coding of data on injuries in CPRD may be incomplete and lack specificity in terms of information on injury type and mechanisms of injury[37 296]. This has limited the research questions that can be addressed using these data. For example, exploring substances involved in the poisonings in the epilepsy and ADHD studies would have been useful, particularly in relation to medication prescribed for epilepsy and ADHD; or explaining whether injuries occurred as a result of seizures or not. However, using HES-CPRD linked data considerably improves data quality in terms of providing codes for injury type and mechanism of injury, but as only around half of CPRD practices have HES-

linked data[220] this also limits the size of the database and reduces study power.

Both CPRD and HES data frequently lack information on where the injury occurred (e.g. road, school, home, etc.), which would be useful for planning prevention programmes.

Ascertainment bias in terms of injury recording may have occurred. CYP with conditions such as epilepsy and ADHD will have more frequent contacts with health care services. This provides opportunities for injuries to be entered into the medical records that might otherwise have not been recorded. In addition, CYP with conditions such as epilepsy and ADHD may be more likely to present with injuries than CYP without these conditions, for example, due to parental concern or CYP concern, propensity to seek medical advice, or familiarity with health care services. It is therefore possible that injuries could be more completely ascertained in CYP with epilepsy and ADHD than in CYP without. The sensitivity analysis for long bone fracture in the epilepsy study suggested this was unlikely to have occurred to a large extent for fractures. It was not possible to do similar sensitivity analyses for thermal injuries or poisonings due to the difficulty of identifying sufficiently severe injuries in these data that would almost certainly receive medical attention. It is therefore possible that some of the increase in injury risk in CYP with epilepsy and ADHD would be explained by ascertainment bias.

The studies in this thesis were only able to adjust injury risk estimates for a small set of confounders (age, sex, SHA region, deprivation and calendar year at study entry, comorbid medical conditions). It is therefore possible

that some residual confounding remains which may partly explain differences in injury risk between CYP with and without the conditions studied. For example, due to parent-related factors (e.g. parents' educational achievement, lone parenthood, age at birth of child[289] or parental mental health).

Although CPRD practices are considered to be broadly representative of general practices in the UK, there are some differences between CPRD practices and other practices in the UK. For example, practices from the North East, Yorkshire and Humber and East Midlands are slightly under-represented[227]. Injury rates may vary by region and it is known that for fractures, for example, that fracture rates in Wales are higher than in England[31 32]. Some of the regional difference in injury rates may be explained by a difference in deprivation. As the North East, Yorkshire and Humber and East Midlands may be more deprived than regions in the South of England, it is possible that the rate of injuries in the CPRD overall is an underestimate compared to the general population because injuries are strongly associated with deprivation[11]. Also if ADHD is associated with region, the regions that are under-represented in the CPRD are also the regions that have a lower administrative prevalence of ADHD. Therefore, it is possible that the administrative prevalence of ADHD in the CPRD is an under-estimate compared to general practices in the UK.

It is possible that some findings are type I statistical errors resulting from multiple significance testing. In addition, due to the large database used, there will have been sufficient power to detect small increases in injury risk. It is therefore important to bear in mind the absolute injury risk when

considering the clinical importance of the relative increases in risk found in these studies.

The administrative prevalence of ADHD found in this thesis is considerably lower than the prevalence found in community studies[107-110] not using routinely collected primary care data. This may reflect under-diagnosis of ADHD, under-recording of ADHD in primary care or a combination of both of these. It was not possible to explore the reasons for this low prevalence in this thesis.

5.4 Conclusion

CYP with epilepsy and ADHD have an increased risk of fracture, thermal injury and poisoning compared to CYP without these conditions. For both conditions the risk of poisoning is higher than the risk of fracture or thermal injuries. Whilst bias, confounding and chance may partly account for some of the increased risks found they are unlikely to completely explain the increased risk of injury associated with these conditions.

The administrative prevalence of ADHD is lower than estimates of community prevalence ascertained from studies not using routinely collected primary care data. The reasons for this were not able to be explained within this thesis. The prevalence of ADHD varied with deprivation, being almost twice as high in CYP from the most deprived areas compared to CYP from the least deprived areas

5.5 Implications for future research

Future research is required to explore the circumstances surrounding injuries in CYP with and without epilepsy and ADHD. In particular more detailed information on injury type, injury mechanisms and intent of injury would be useful for planning prevention programmes. In terms of poisoning, exploring the extent of poisoning by medication prescribed for epilepsy and ADHD would be helpful; as would exploring the risk of poisoning of varying intent. Further research is required to obtain descriptions from CYP and their parents about the antecedents to injuries, the predisposing risk factors for injuries specific to epilepsy and to ADHD, which may arise from qualitative research or recording of the narrative stories of CYP and their carers/parents. It is possible that CYP's lived experience is different due to their illness (be it epilepsy or ADHD) so parents, carers and teachers may expect them to participate in activities differently or they may respond differently to injuries that occur. For example, CYP with epilepsy may be advised not to participate in activities that are perceived to be a danger thus reducing their actual risk of injuries. Similarly CYP with ADHD may have injuries that parents or carers do not report to health care professionals because they have had previous experience of injuries and are confident in dealing with them independently or health care professionals do not record the injury as the main reason for attendance. However, it is unlikely this was happening to a large degree because the analysis on severe injuries (e.g. long bone fractures) showed similar risk of injuries compared to CYP overall. Nevertheless future research should compare the ways in which parental supervision differs in CYP with a chronic condition (such as epilepsy and

ADHD) Research should also be extended to other chronic conditions in CYP, such as diabetes, inflammatory bowel disease and asthma to test the hypothesis that CYP with chronic conditions are at an increased risk of injuries as a result of having an illness or to explore the effect on injury risk of having a chronic condition.

Qualitative or mixed methods research would be required to obtain more information from CYP with epilepsy and ADHD who have sustained fractures, thermal injuries and poisonings. Such work would need to be focussed on CYP as a whole but also specifically for different ages, the two sexes, by deprivation and region because work in this thesis and prior work has shown that injury risk in CYP with epilepsy and ADHD differs by these factors. Such research could lead into an exploration of parental behaviour for parents of CYP with epilepsy, ADHD and other chronic medical diagnoses. Further work on the physical and mental health of parents or carers of CYP with epilepsy and ADHD and the effect of their health on injury risk would also be useful to explain or interpret the findings in this thesis.

Little is currently known about the specific exposure to the hazard of injuries in CYP with epilepsy and ADHD. For example, if CYP with epilepsy are less likely to engage in sports then the true risk of fractures due to the epilepsy may be higher. Cross sectional surveys conducted with CYP, their parents and teachers in the early teenage years could explore the pattern of engagement in activities such as sports and explore the circumstances in which CYP spend their leisure time (e.g. in the home or outside in play).

Future research is also required to explore the effect of treating epilepsy and ADHD with medication on injury risk. Self-controlled case series analysis comparing injury risk in time periods when medication was and was not prescribed would be useful[290]. Research is required to explore the effect of the severity of illness (for epilepsy and for ADHD) on estimated risks of injuries. Other research methodology, such as randomised controlled trials of existing injury prevention interventions is required to ascertain the effectiveness of such interventions in CYP with epilepsy and ADHD compared to the overall population of CYP. Interventions should be trialled in GP practices, clinical commissioning groups using GP practices as clusters and also in terms of public health interventions on a community or regional basis.

The work in this thesis has demonstrated an increased risk of injury amongst CYP with epilepsy and ADHD. The effect of prevention programmes on reducing the risk requires evaluation. More specifically, injury prevention programmes targeted towards CYP with epilepsy and ADHD should be designed and evaluated. As a starting point, an analysis is required of how appropriate standard injury prevention advice would be for CYP with epilepsy and ADHD and whether CYP with epilepsy or ADHD differ in terms of the injury risk when current injury prevention measures are targeted at them compared to CYP without epilepsy or ADHD respectively.

Future research exploring potential under-diagnosis or under-recording of diagnosis of ADHD in CYP in primary care is needed. This needs to also

explore whether under-diagnosis and under-recording varies by CYP's age, sex, geographical region and deprivation.

Further research is required to explore the added value of using free text data from CPRD for ascertaining epilepsy, ADHD and injuries, and if ascertainment is improved, whether this impacts on the estimates of risk and prevalence found in this thesis.

5.6 Implications for policy and practice

CYP with epilepsy and ADHD and their parents should be provided with evidence-based injury prevention interventions because the work in this thesis has demonstrated they are at higher risk of injury than the general population of CYP. This includes those interventions included in NICE public health guidance PH30 for the prevention of home injuries[294] and PH31[297] for the prevention of road injuries. For example, as part of the annual epilepsy review that GPs conduct as part of their contractual work, specific questions could be added to the computer software that prompt the health care professional to give current injury prevention advice. For CYP with ADHD they should already have a regular review of their mental health plan in primary care because this is part of the GP contract and this should also include a similar prompt for the health professional to give injury prevention advice. Specific age groups should receive further advice, such as young people with epilepsy and ADHD and young adults with epilepsy in terms of their risk of poisonings. This poisoning prevention advice should be repeated at times of prescribing.

Health care professionals (e.g. health visitors, GPs, practice nurses, emergency department staff and community paediatric staff), child and adolescent mental health services (CAMHS) and child education or care practitioners (e.g. child care centres, nurseries, schools, child minders, family support workers) and other agencies and organisations with an injury prevention role (e.g. community services) should be made aware of the increased risk of injury in CYP with epilepsy and ADHD through undergraduate and postgraduate training and in service training.

Health care professionals with prescribing roles (e.g. GPs, nurses, emergency department staff, community paediatricians, CAMHS, secondary care paediatricians) should be made aware of the increased risk of poisonings in CYP with epilepsy and ADHD and provide poisoning prevention advice to CYP and their parents when prescribing in these conditions.

The recommendations for injury prevention are at multiple levels: individual or family; community; clinical commissioning groups (CCGs); the National Health Service (NHS); government or legislation and international. At the individual or family level the results of this work can be used to inform CYP about the risk of fractures, thermal injuries and poisonings at the time of diagnosis, medication reviews and annual medical reviews by the GPs, nurses, pharmacists and specialists in secondary care. The information could be disseminated to these individuals through publicity in the lay media (some of this has already occurred in the case of the risk of injuries in CYP with epilepsy).

GPs should receive training on the findings of this thesis so that they may have a greater awareness of the inequality in injury risk between CYP with epilepsy or ADHD and the rest of the population. GPs should also receive education about the inequality in the administrative prevalence of ADHD compared to the community prevalence of ADHD. GPs should also receive education about how the administrative prevalence of ADHD varies by deprivation. At the level of CCGs this thesis can help the commissioning of services to prevent injuries in CYP with epilepsy and ADHD. Some of the findings from the thesis can be used by CCGs to implement injury prevention policies targeted at different stages of child development. For example in the National Institute for Health and Care Excellence (NICE) have issued guidance on preventing unintentional injuries in children under fifteen years in the home[294] and have recommended prioritising households at greatest risk. This thesis recommends that CYP with ADHD from areas with the greatest deprivation are at a high risk of injuries and injury prevention efforts should be targeted at such deprived areas. All staff in the NHS should be aware of the increased risk of injuries in CYP with both epilepsy and ADHD and efforts to prevent injuries should be targeted according to primary prevention (such as in primary care or at diagnosis of epilepsy or ADHD) or secondary prevention (e.g. in emergency departments if a child is seen with an injury).

As well as the implementation of evidence-based action, it is crucial to strengthen health systems, build capacity (especially community mental health services (CAMHS) and other services for CYP with ADHD), and enhance the quality and quantity of all kinds of data (including potentially free text data, linkage to other forms of data, e.g. police and crime

statistics data and education data). According to the United Nations (UN) Rights of the Child children should have the right to be free from injury and this thesis presents evidence to suggest that children with epilepsy and ADHD are at a greater risk than all CYP of injury[298].

6 Appendices

6.1 Search strategies for literature searches

Table 6-1 Using Medline (1948 to August week 1 2014)

	Search terms used
Aim: To ascertain the estimated risk of injuries in people with epilepsy	
1	exp Epilepsy/
2	epilepsy.mp.
3	or/1-2
4	*"Wounds and Injuries"/
5	3 and 4

Note: Restricting to systematic reviews gave no results

Table 6-2 Using Medline (1948 to August week 1 2014)

	Search terms used
Aim: To ascertain the published community prevalence of ADHD	
1	Meta-analysis as Topic/
2	meta analy$.tw.
3	metaanaly$.tw.
4	Meta-Analysis/
5	(systematic adj (review$1 or overview$1)).tw.
6	exp Review Literature as Topic/
7	or/1-6
8	cochrane.ab.
9	embase.ab.
10	(psychlit or psyclit).ab.
11	(cinahl or cinhal).ab.
12	science citation index.ab.
13	bids.ab.
14	(psychinfo or psycinfo).ab.
15	or/8-14
16	reference list$.ab.
17	bibliograph$.ab.
18	hand-search$.ab.
19	relevant journals.ab.
20	manual search$.ab.
21	or/16-20
22	selection criteria.ab.
23	data extraction.ab.
24	22 or 23
25	Review/
26	24 or 25
27	Comment/
28	Letter/
29	Editorial/
30	animal/
31	human/
32	30 not (30 and 31)
33	or/27-29,32
34	7 or 15 or 21 or 26
35	34 not 33
36	*Attention Deficit Disorder with Hyperactivity/
37	ADHD.mp.
38	attention-deficit.mp.
39	(hyperkinetic adj disorder$1).tw.
40	or/36-39
41	*Prevalence/
42	prevalence.mp.
43	*Epidemiology/
44	occurrence.mp.
45	rate.mp.
46	or/41-45
47	46 and 40
48	47 and 35

Table 6-3 Using Embase (1974 to August 15 2014)

	Search terms used
Aim: To ascertain the published community prevalence of ADHD	
1	exp Meta Analysis/
2	((meta adj analy$) or metaanalys$).tw.
3	(systematic adj (review$1 or overview$1)).tw.
4	or/1-3
5	cochrane.ab.
6	embase.ab.
7	(psychlit or psyclit).ab.
8	(psychinfo or psycinfo).ab.
9	(cinahl or cinhal).ab.
10	science citation index.ab.
11	bids.ab.
12	or/5-11
13	reference lists.ab.
14	bibliograph$.ab.
15	hand-search$.ab.
16	manual search$.ab.
17	relevant journals.ab.
18	or/13-17
19	data extraction.ab.
20	selection criteria.ab.
21	19 or 20
22	review.pt.
23	21 and 22
24	letter.pt.
25	editorial.pt.
26	animal/
27	human/
28	26 not (26 and 27)
29	or/24-25,28
30	4 or 12 or 18 or 23
31	30 not 29
32	*attention deficit disorder/
33	ADHD.mp.
34	attention-deficit.mp.
35	(hyperkinetic adj disorder$1).tw.
36	or/32-35
37	*prevalence/
38	prevalence.mp.
39	*epidemiology/
40	occurrence.mp.
41	rate.mp.
42	or/37-41
43	42 and 36
44	43 and 31

Table 6-4 Using PsycINFO (1806 to August week 2 2014)

	Search terms used
Aim: To ascertain the published community prevalence of ADHD	
1	exp Meta Analysis/
2	((meta adj analy$) or metaanalys$).tw.
3	(systematic adj (review$1 or overview$1)).tw.
4	or/1-3
5	exp Attention Deficit Disorder with Hyperactivity/
6	ADHD.mp.
7	or/5-6
8	exp Epidemiology/
9	prevalence.mp.
10	occurrence.mp.
11	rate.mp.
12	or/8-11
13	12 and 7
14	13 and 4

Table 6-5 Using CINAHL (1982 to August 16 2014)

	Search terms used
Aim: To ascertain the published community prevalence of ADHD	
1	(MH "Meta Analysis") OR Meta analys$.tw. OR Metaanaly$.tw. OR exp Literature review/ OR ((systematic adj (review or overview)).tw.)
2	(MH "Animals+")
3	Commentary.pt. OR Letter.pt. OR Editorial.pt.
4	2 or 3
5	1 not 4
6	(MH "Attention Deficit Hyperactivity Disorder")
7	"ADHD"
8	6 or 7
9	(MH "Epidemiology+")
10	(MH "Prevalence")
11	prevalence
12	occurrence
13	rate
14	9 or 10 or 11 or 12 or 13
15	14 and 8
16	15 and 5

Table 6-6 Using ASSIA (1987 to August 15 2014)

	Search terms used
Aim: To ascertain the published community prevalence of ADHD	
1	("Meta analysis" OR "literature review" OR "systematic review" OR "systematic overview") AND ((ADHD OR "Attention-deficit hyperactivity disorder") AND (prevalence OR epidemiology OR occurrence OR rate))

Table 6-7 Using Medline (1946 to August week 1 2014)

	Search terms used
Aim: To ascertain the published administrative prevalence of ADHD	
1	*Drug Utilization/
2	Office Visits/td [Trends]
3	prescribing.mp.
4	*Diagnosis/ec, sn, td [Economics, Statistics & Numerical Data, Trends]
5	exp Primary Health Care/
6	or/1-5
7	Meta-Analysis as Topic/
8	meta analy$.tw.
9	metaanaly$.tw.
10	Meta-Analysis/
11	(systematic adj (review$1 or overview$1)).tw.
12	exp Review Literature as Topic/
13	or/7-12
14	reference list$.ab.
15	bibliograph$.ab.
16	hand-search$.ab.
17	relevant journals.ab.
18	manual search$.ab.
19	or/14-18
20	selection criteria.ab.
21	data extraction.ab.
22	20 or 21
23	Review/
24	22 and 23
25	Comment/
26	Letter/
27	Editorial/
28	animal/
29	human/
30	28 not (28 and 29)
31	or/25-27,30
32	*Attention Deficit Disorder with Hyperactivity/
33	ADHD.mp.
34	attention-deficit.mp.
35	(hyperkinetic adj disorder$1).tw.
36	or/32-35
37	*Prevalence/
38	prevalence.mp.
39	*Epidemiology/
40	occurrence.mp.
41	rate.mp.
42	or/37-41
43	42 and 36
44	43 and 6
45	44 not 31
46	or/13,19,24
47	45 not 46

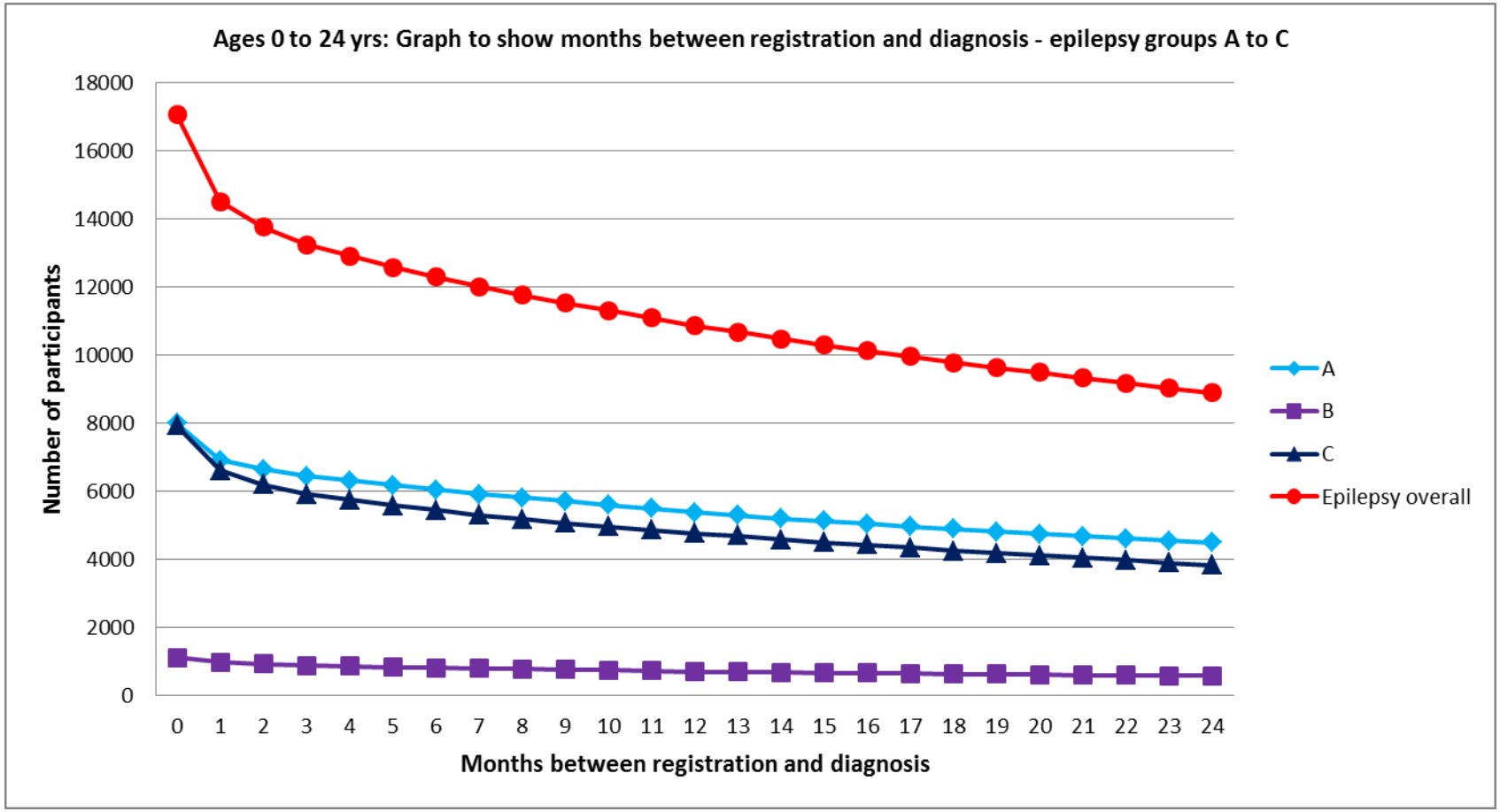
Table 6-8 Using Medline (1946 to August week 1 2014)

	Search terms used
Aim: To ascertain the estimated risk of injuries in people with ADHD	
1	*Attention Deficit Disorder with Hyperactivity/
2	ADHD.mp.
3	attention-deficit.mp.
4	(hyperkinetic adj disorder$1).tw.
5	or/1-4
6	"Wounds and Injuries"/
7	5 and 6

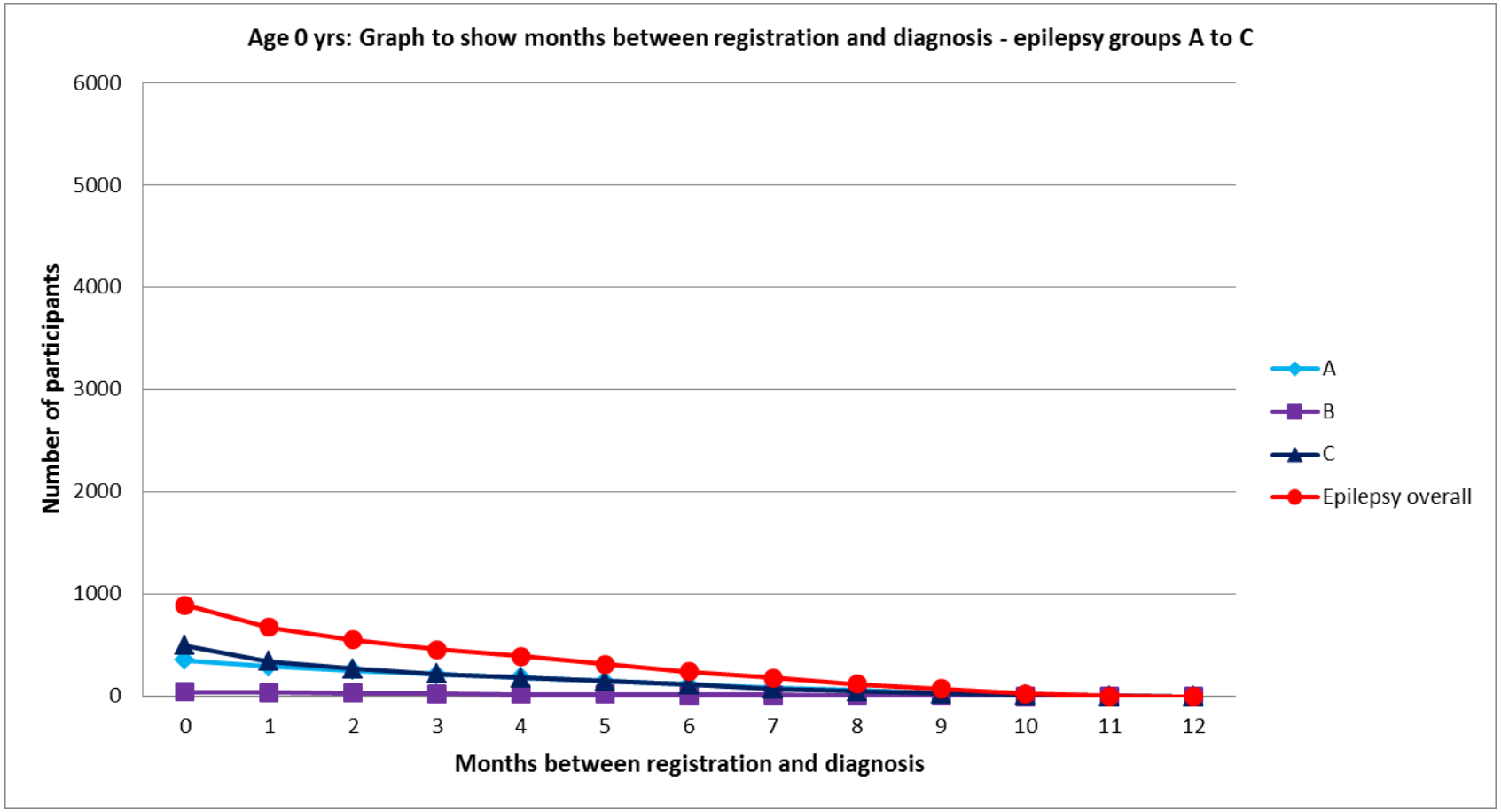
Note: Restricting to systematic reviews gave no results

6.2 Months between registration and diagnosis, overall and by age

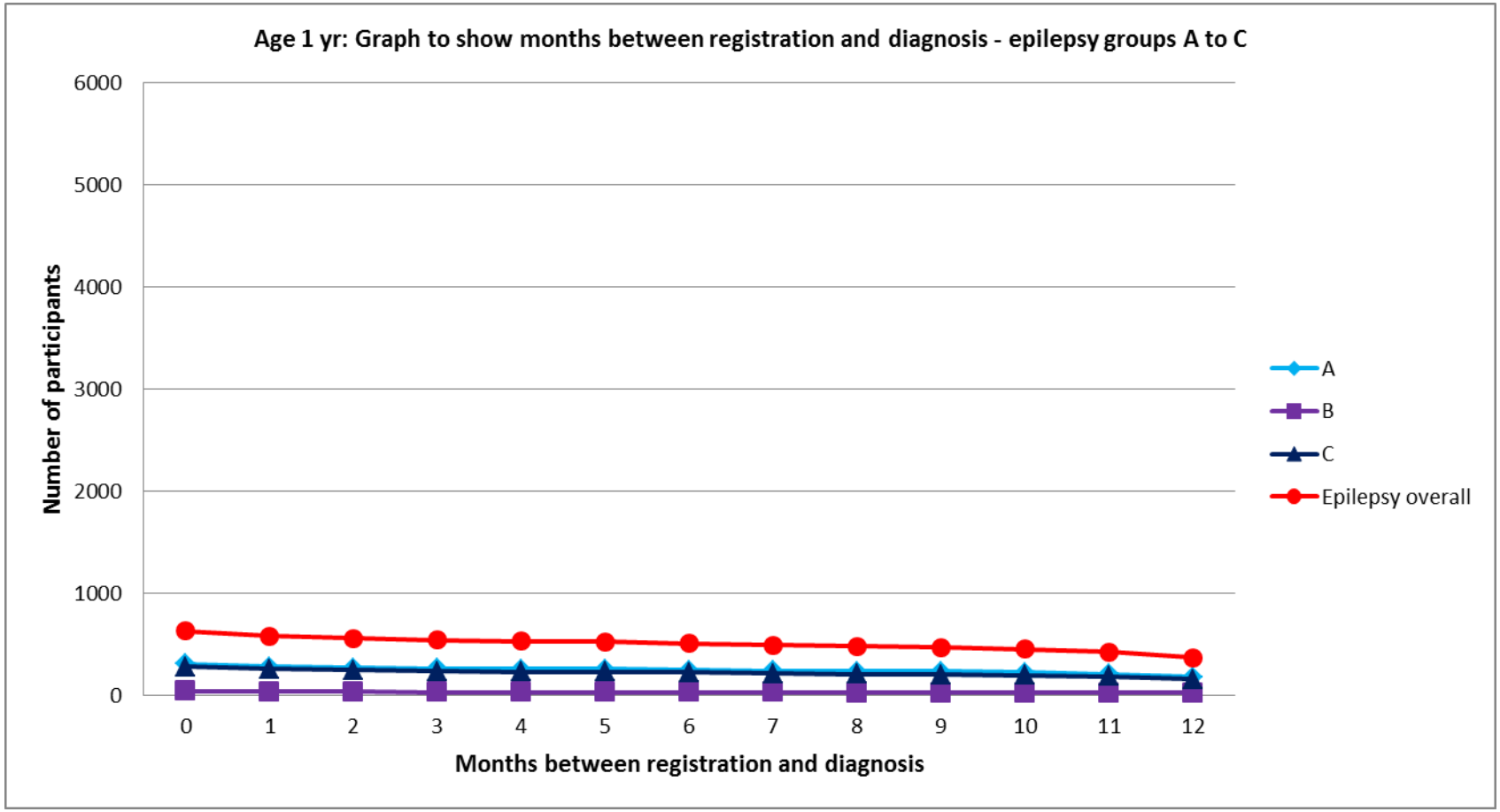
The following graphs show the number of CYP with epilepsy according to the number of months between registration with the GP and date of diagnosis. The numbers are displayed for all age groups combined and then by different age bands, by age at diagnosis. These graphs confirm that the number of CYP diagnosed with epilepsy is at a peak at the time of registration. This is thought to be due to past epilepsy diagnosis codes being inaccurately entered as new epilepsy diagnosis codes, with the date of data entry as the date of diagnosis. This effect is seen to decline as past epilepsy diagnosis codes are no longer being recorded and graphs plateau. An exception is in the youngest children, under one-year-old, where it is unlikely that the peak is due to past epilepsy from a previous GP but due to the time taken to diagnose epilepsy after birth and for communication to reach the GP from hospital. In ages below 15 years the graphs appear to plateau after three months. In ages above 15 years the initial gradient is steeper and the graphs take longer to plateau. The effect may be greater in CYP over 15 years because at this age children are more likely to leave home for work or higher education and therefore a larger proportion of these age groups will register with a new GP compared to younger age groups.



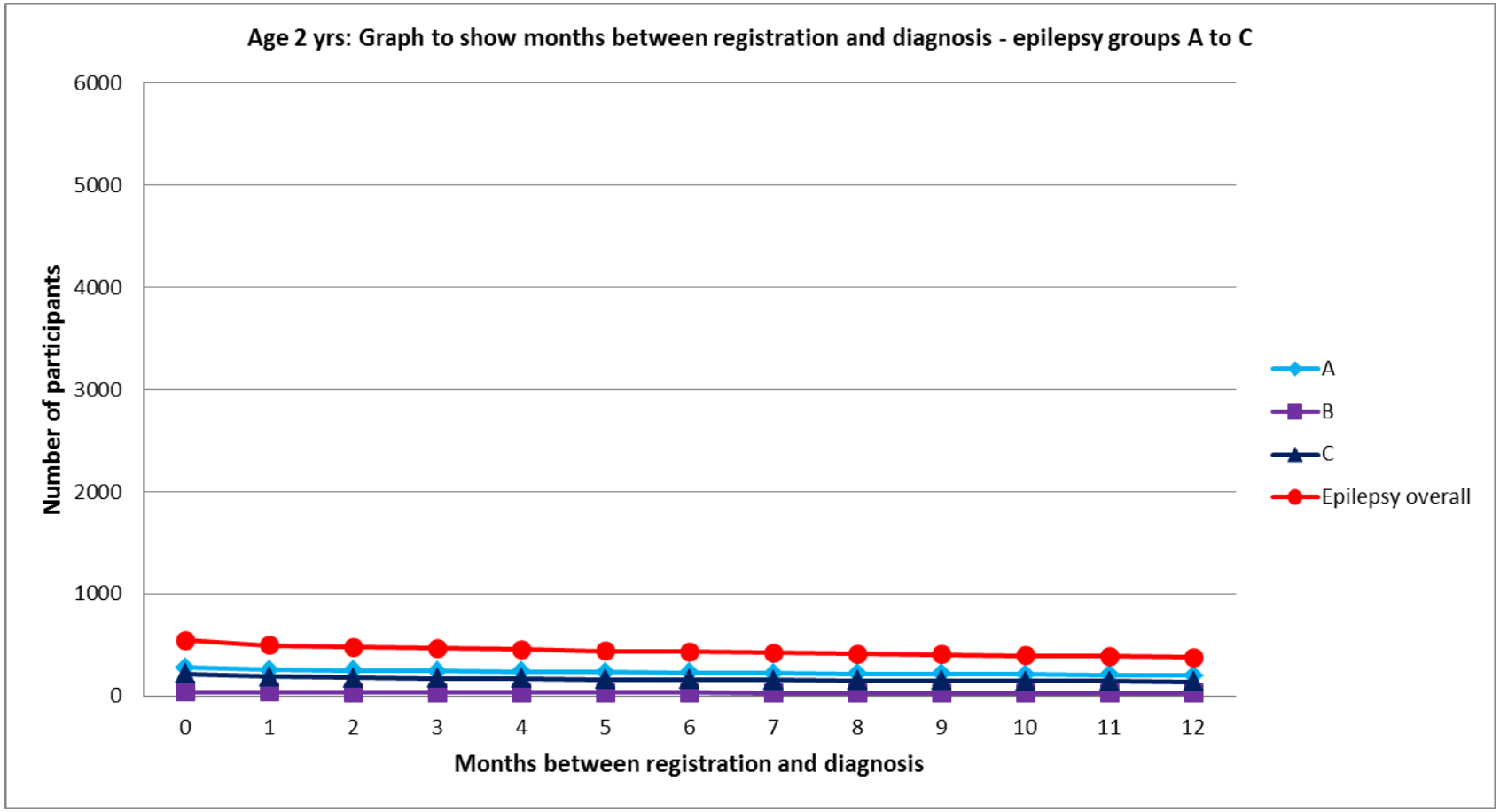
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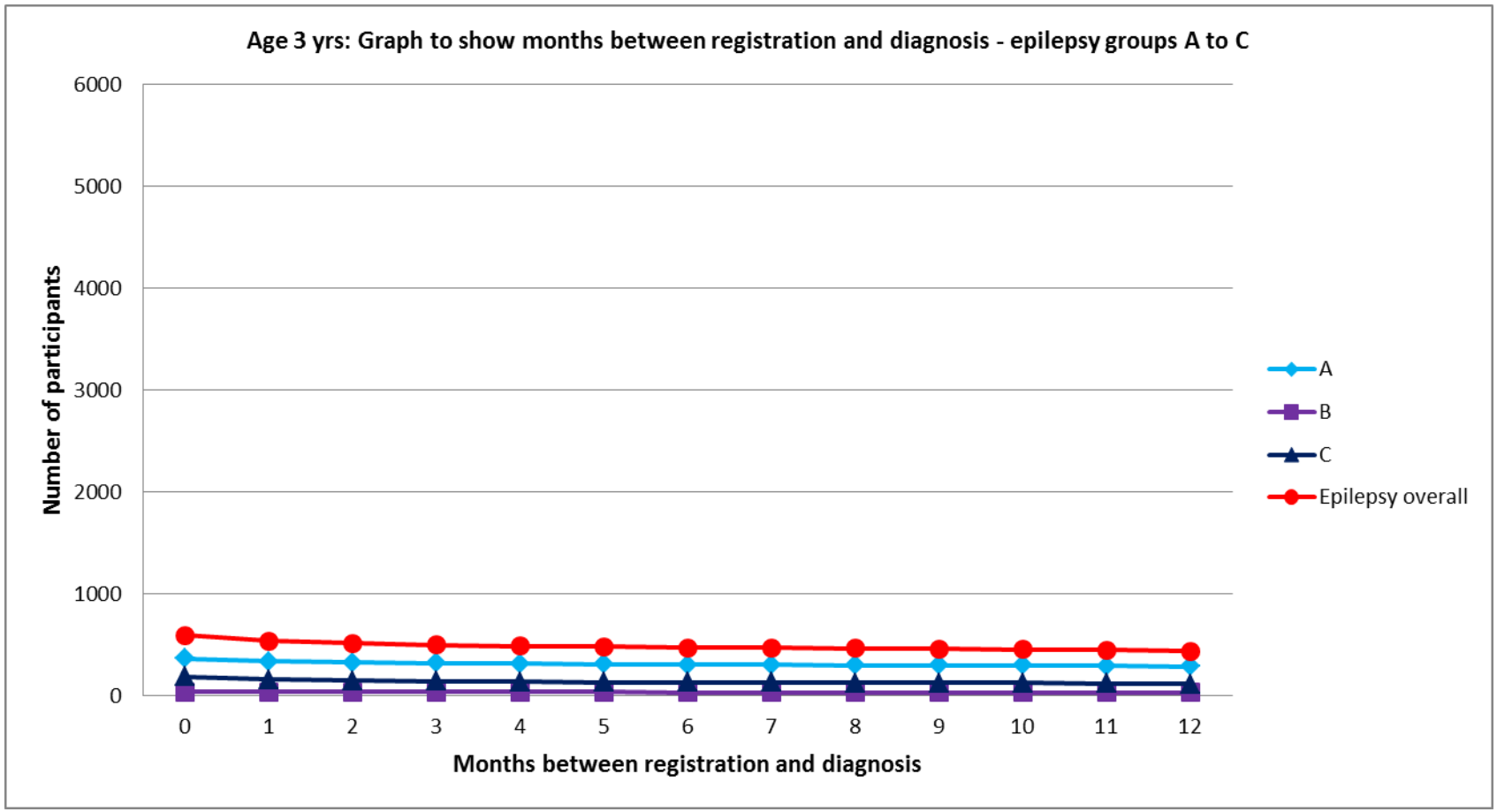
A: At least 2 drug codes & at least 2 diagnosis codes; B: At least 2 diagnosis codes & less than 2 drug codes; C: At least 2 drug codes & less than 2 diagnosis codes



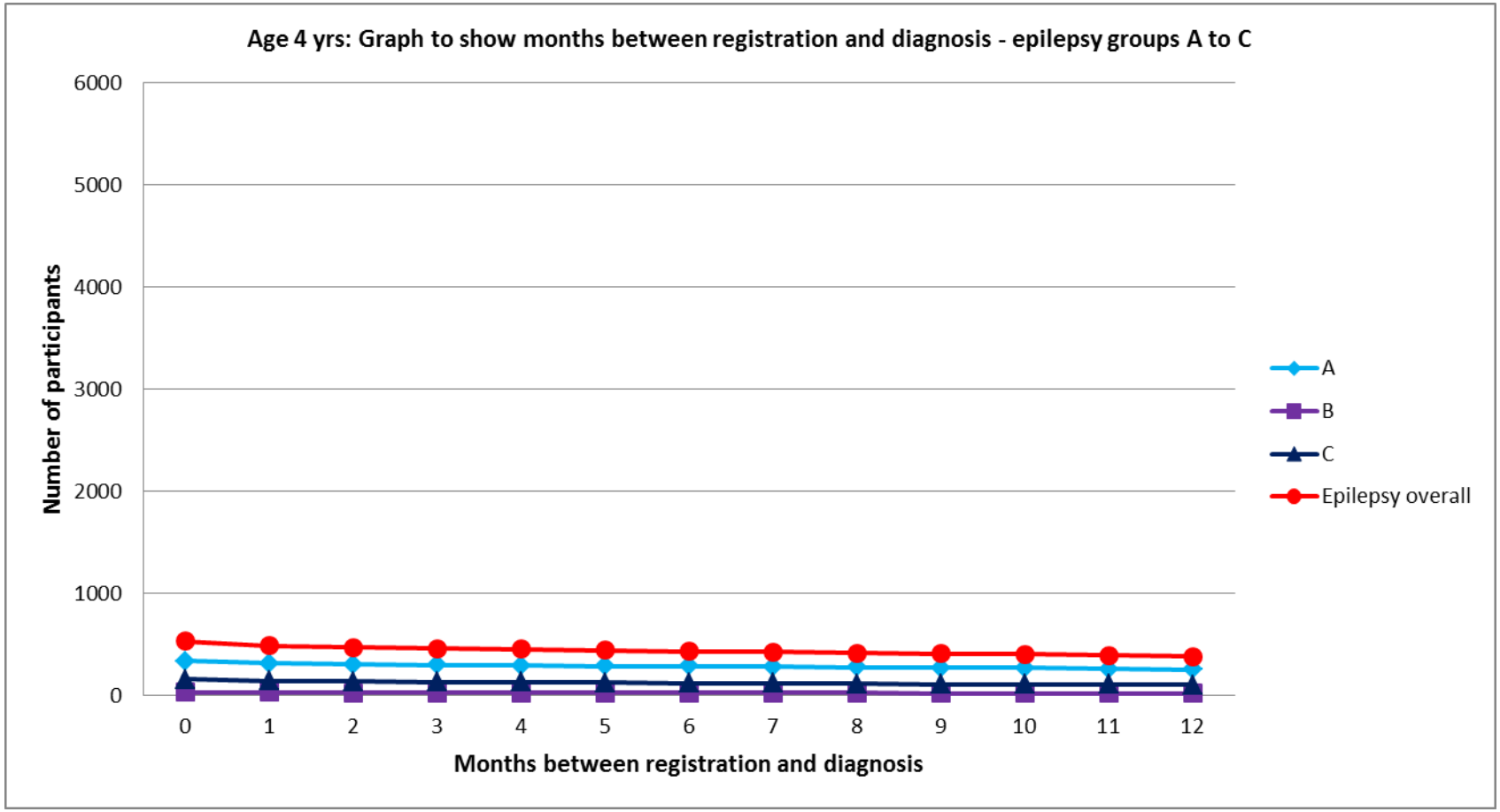
A: At least 2 drug codes & at least 2 diagnosis codes; B: At least 2 diagnosis codes & less than 2 drug codes; C: At least 2 drug codes & less than 2 diagnosis codes



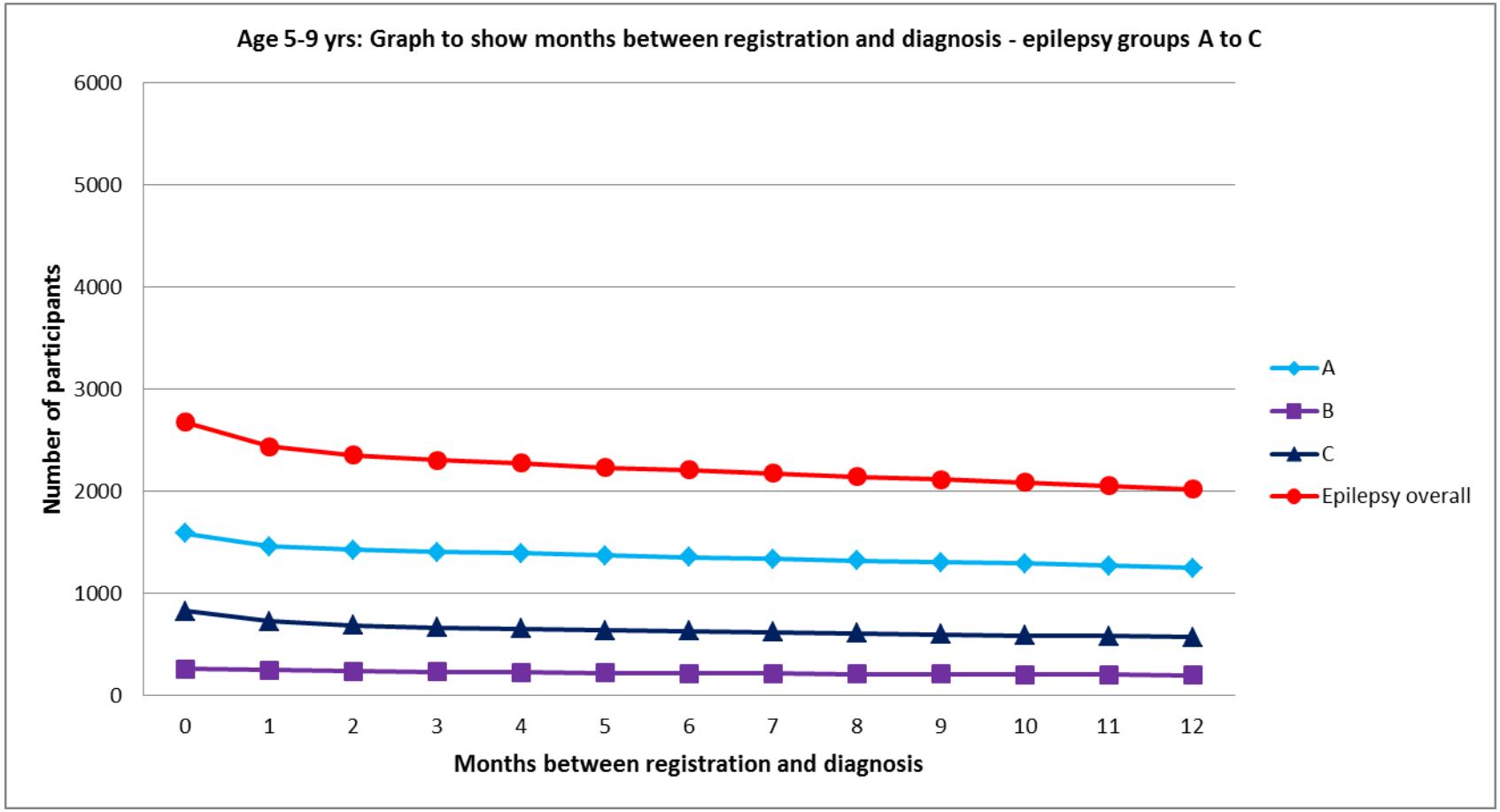
A: At least 2 drug codes & at least 2 diagnosis codes; B: At least 2 diagnosis codes & less than 2 drug codes; C: At least 2 drug codes & less than 2 diagnosis codes



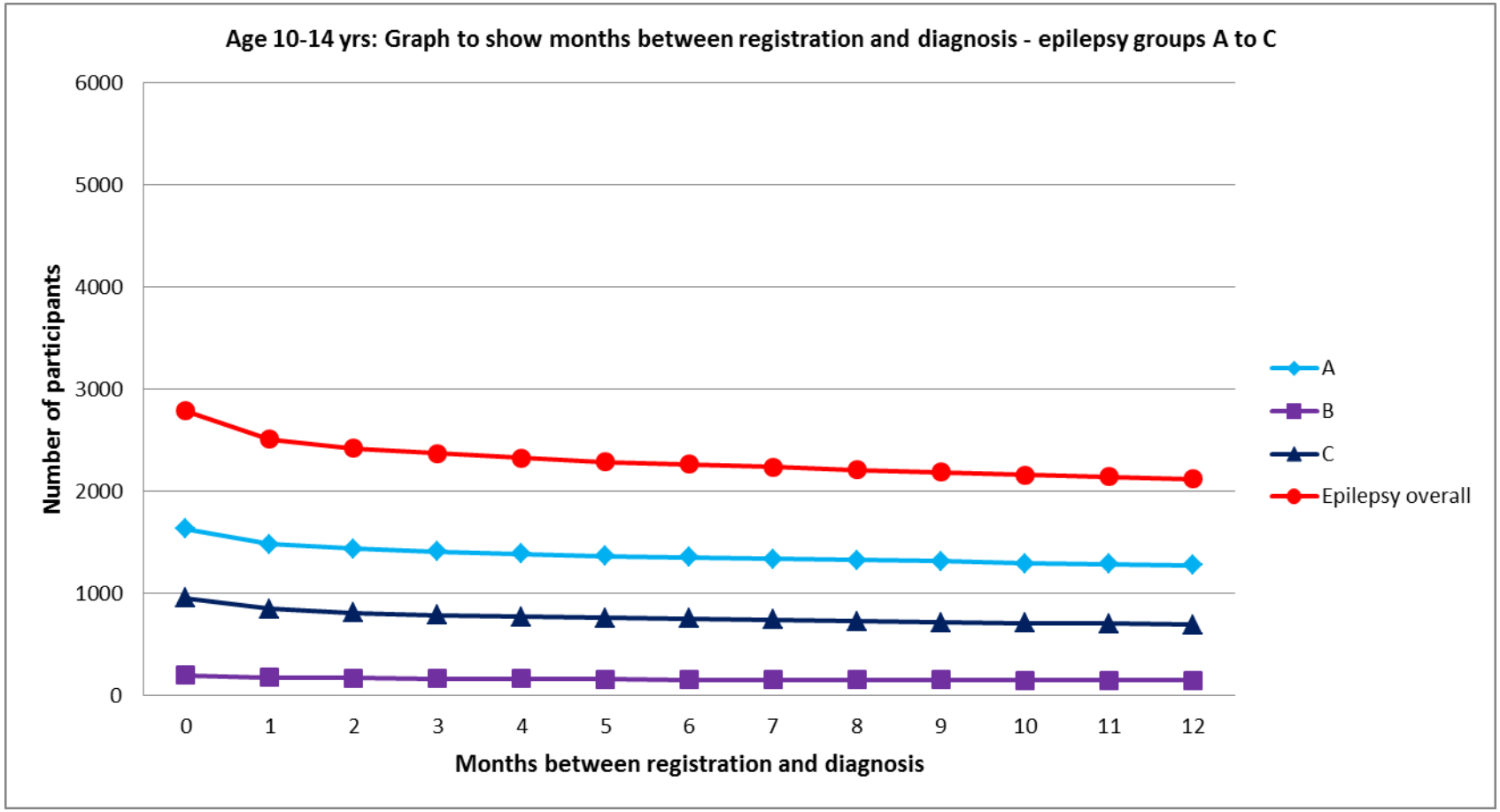
A: At least 2 drug codes & at least 2 diagnosis codes; B: At least 2 diagnosis codes & less than 2 drug codes; C: At least 2 drug codes & less than 2 diagnosis codes



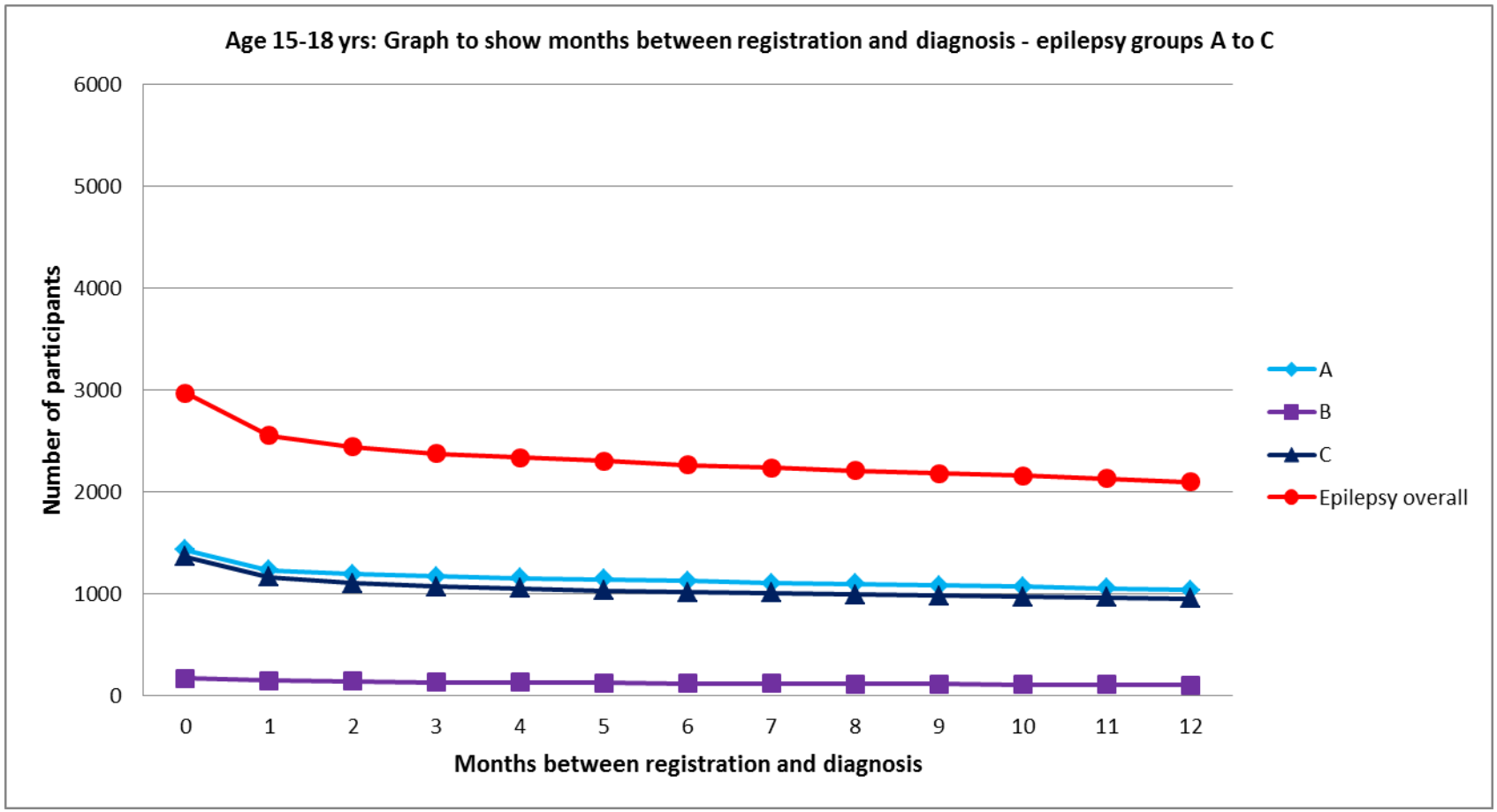
A: At least 2 drug codes & at least 2 diagnosis codes; B: At least 2 diagnosis codes & less than 2 drug codes; C: At least 2 drug codes & less than 2 diagnosis codes



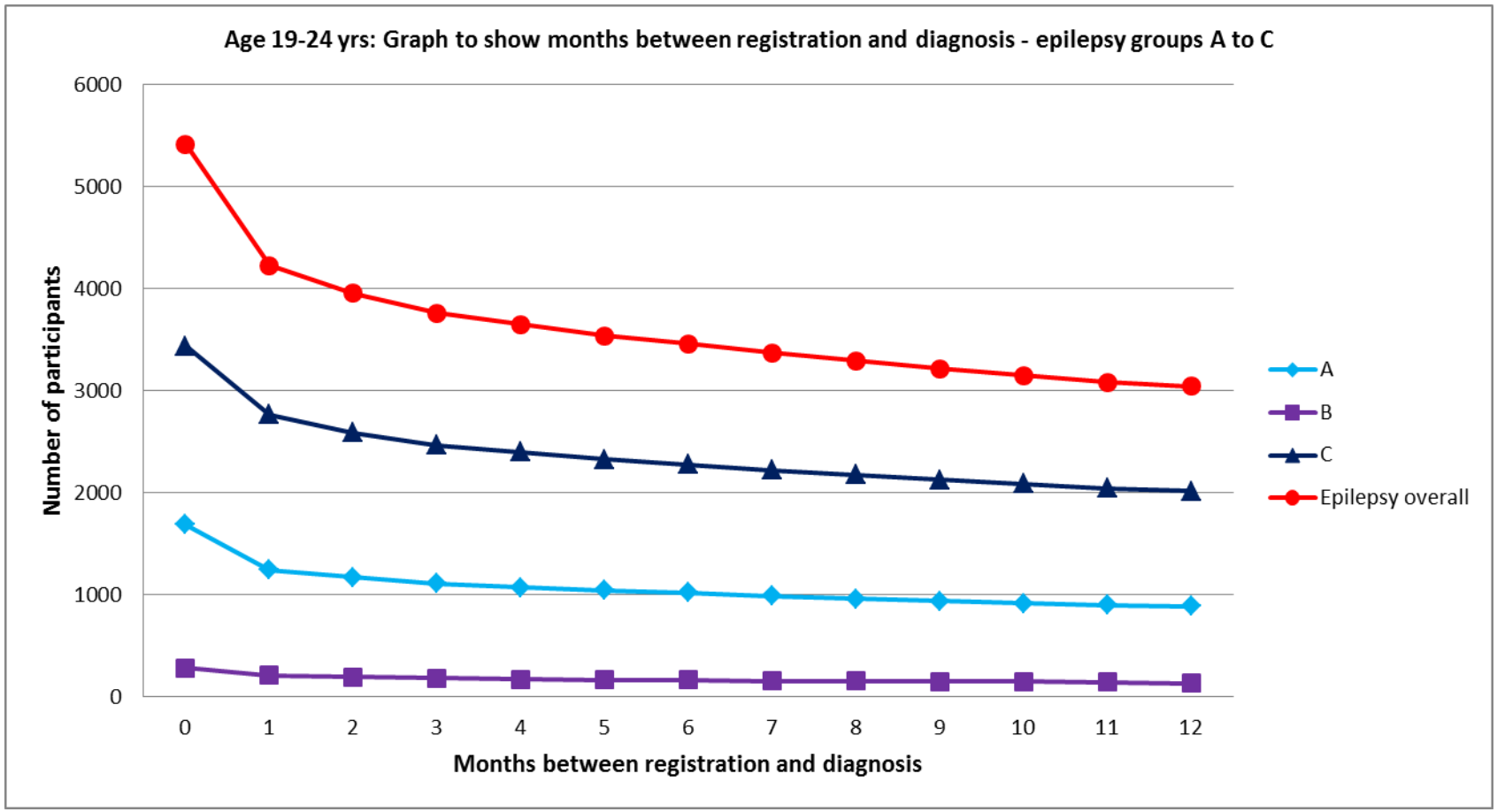
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A: At least 2 drug codes & at least 2 diagnosis codes; B: At least 2 diagnosis codes & less than 2 drug codes; C: At least 2 drug codes & less than 2 diagnosis codes



A: At least 2 drug codes & at least 2 diagnosis codes; B: At least 2 diagnosis codes & less than 2 drug codes; C: At least 2 drug codes & less than 2 diagnosis codes



A: At least 2 drug codes & at least 2 diagnosis codes; B: At least 2 diagnosis codes & less than 2 drug codes; C: At least 2 drug codes & less than 2 diagnosis codes

6.3 Ten most frequent diagnosis codes identifying cohort

By age and sex – incident participants only (first code ever recorded)

Epilepsy cohort - incident participants					
Age Group (years)	Read Description MALES	n(%)		Read Description FEMALES	n(%)
0	EpilepsyF25..00	215	(77.3)	EpilepsyF25..00	174 (73.4)
	Epileptic absencesF250011	8	(2.9)	Epileptic seizures - tonicF251400	7 (3.0)
	Epilepsy monitoring667..00	5	(1.8)	Focal epilepsyF255011	7 (3.0)
	Epileptic seizures - clonicF251200	5	(1.8)	Epilepsy monitoring667..00	5 (2.1)
	Epileptic seizures - tonicF251400	5	(1.8)	Epileptic seizures - myoclonicF251300	5 (2.1)
	Epileptic seizures - myoclonicF251300	4	(1.4)	Fit (in known epileptic) NOSF25z.11	5 (2.1)
	Fit (in known epileptic) NOSF25z.11	4	(1.4)	H/O: epilepsy1473.00	5 (2.1)
	H/O: epilepsy1473.00	4	(1.4)	Epileptic seizures - clonicF251200	4 (1.7)
	Tonic-clonic epilepsyF251500	4	(1.4)	Epilepsy NOSF25z.00	3 (1.3)
	Excepted from epilepsy quality indicato	3	(1.1)	Epilepsy medication review8BIF.00	3 (1.3)
1	EpilepsyF25..00	154	(76.2)	EpilepsyF25..00	140 (79.6)
	Petit mal (minor) epilepsyF250000	7	(3.5)	Epilepsy monitoring667..00	6 (3.4)
	Epileptic absencesF250011	6	(3.0)	Grand mal (major) epilepsyF251000	5 (2.8)
	H/O: epilepsy1473.00	4	(2.0)	Petit mal (minor) epilepsyF250000	5 (2.8)
	Epileptic seizures - myoclonicF251300	3	(1.5)	Epileptic seizures - myoclonicF251300	3 (1.7)
	Juvenile absence epilepsyF250400	3	(1.5)	Generalised convulsive epilepsyF251.00	3 (1.7)
	Tonic-clonic epilepsyF251500	3	(1.5)	Epileptic absencesF250011	2 (1.1)
	Epilepsy NOSF25z.00	2	(1.0)	Fit (in known epileptic) NOSF25z.11	2 (1.1)
	Epilepsy medication review8BIF.00	2	(1.0)	Complex partial epileptic seizureF25450	1 (0.6)
	Epilepsy monitoring667..00	2	(1.0)	Complex partial status epilepticusF25y3	1 (0.6)
2	EpilepsyF25..00	158	(76.0)	EpilepsyF25..00	98 (69.5)
	Epileptic absencesF250011	8	(3.9)	Petit mal (minor) epilepsyF250000	7 (5.0)
	Petit mal (minor) epilepsyF250000	7	(3.4)	Epileptic absencesF250011	5 (3.6)
	Epilepsy monitoring667..00	5	(2.4)	Focal epilepsyF255011	5 (3.6)
	Juvenile myoclonic epilepsyF25A.00	4	(1.9)	Epilepsy monitoring667..00	4 (2.8)
	Epilepsy confirmed1O30.00	2	(1.0)	Complex partial epileptic seizureF25450	3 (2.1)
	Epileptic seizures - clonicF251200	2	(1.0)	Epilepsy NOSF25z.00	3 (2.1)
	Epileptic seizures - myoclonicF251300	2	(1.0)	Epileptic seizures - myoclonicF251300	2 (1.4)
	Epileptic seizures - tonicF251400	2	(1.0)	Epileptic seizures - tonicF251400	2 (1.4)
	Fit (in known epileptic) NOSF25z.11	2	(1.0)	Fit (in known epileptic) NOSF25z.11	2 (1.4)

Epilepsy cohort - incident participants						
Age Group (years)	**Read Description**	**n(%)**		**Read Description**	**n(%)**	
	MALES			**FEMALES**		
3	EpilepsyF25..00	165	(70.5)	EpilepsyF25..00	122	(68.5)
	Epileptic absencesF250011	13	(5.6)	Petit mal (minor) epilepsyF250000	11	(6.2)
	Petit mal (minor) epilepsyF250000	11	(4.7)	Epileptic absencesF250011	6	(3.4)
	Epilepsy monitoring667..00	8	(3.4)	Epilepsy monitoring667..00	4	(2.3)
	Epileptic seizures - myoclonicF251300	4	(1.7)	Fit (in known epileptic) NOSF25z.11	4	(2.3)
	Epileptic seizures - tonicF251400	4	(1.7)	Grand mal (major) epilepsyF251000	4	(2.3)
	Grand mal (major) epilepsyF251000	4	(1.7)	H/O: epilepsy1473.00	4	(2.3)
	Generalised convulsive epilepsyF251.00	3	(1.3)	Benign Rolandic epilepsyF25y400	2	(1.1)
	H/O: epilepsy1473.00	3	(1.3)	Complex partial epileptic seizureF25450	2	(1.1)
	Epilepsy NOSF25z.00	2	(0.9)	Epileptic seizures - atonicF250200	2	(1.1)
4	EpilepsyF25..00	147	(75.4)	EpilepsyF25..00	123	(68.3)
	Epilepsy monitoring667..00	7	(3.6)	Epileptic absencesF250011	16	(8.9)
	Petit mal (minor) epilepsyF250000	6	(3.1)	Petit mal (minor) epilepsyF250000	10	(5.6)
	Epileptic absencesF250011	5	(2.6)	Epilepsy monitoring667..00	5	(2.8)
	Grand mal (major) epilepsyF251000	4	(2.1)	Juvenile absence epilepsyF250400	4	(2.2)
	H/O: epilepsy1473.00	4	(2.1)	Epilepsy medication review8BIF.00	2	(1.1)
	Benign Rolandic epilepsyF25y400	3	(1.5)	Epileptic seizures - clonicF251200	2	(1.1)
	Epilepsy medication review8BIF.00	3	(1.5)	H/O: epilepsy1473.00	2	(1.1)
	Juvenile absence epilepsyF250400	3	(1.5)	Epilepsy NOSF25z.00	1	(0.6)
	Complex partial epileptic seizureF25450	2	(1.0)	Epilepsy severity667N.00	1	(0.6)
5-9	EpilepsyF25..00	652	(62.5)	EpilepsyF25..00	508	(61.5)
	Petit mal (minor) epilepsyF250000	75	(7.2)	Petit mal (minor) epilepsyF250000	81	(9.8)
	Epileptic absencesF250011	57	(5.5)	Epileptic absencesF250011	63	(7.6)
	Benign Rolandic epilepsyF25y400	27	(2.6)	Benign Rolandic epilepsyF25y400	16	(1.9)
	Epilepsy monitoring667..00	24	(2.3)	Epilepsy monitoring667..00	16	(1.9)
	Complex partial epileptic seizureF25450	20	(1.9)	Juvenile absence epilepsyF250400	16	(1.9)
	Fit (in known epileptic) NOSF25z.11	19	(1.8)	Epilepsy NOSF25z.00	12	(1.5)
	Temporal lobe epilepsyF254000	19	(1.8)	Epilepsy medication review8BIF.00	11	(1.3)
	Focal epilepsyF255011	17	(1.6)	Fit (in known epileptic) NOSF25z.11	11	(1.3)
	Tonic-clonic epilepsyF251500	16	(1.5)	Grand mal (major) epilepsyF251000	10	(1.2)

Epilepsy cohort - incident participants					
Age Group (years)	**Read Description**	**n(%)**		**Read Description**	**n(%)**	
	MALES			**FEMALES**		
10-14	EpilepsyF25..00	681	(70.1)	EpilepsyF25..00	539	(66.8)
	Petit mal (minor) epilepsyF250000	33	(3.4)	Petit mal (minor) epilepsyF250000	31	(3.8)
	Grand mal (major) epilepsyF251000	25	(2.6)	Epileptic absencesF250011	29	(3.6)
	Epileptic absencesF250011	24	(2.5)	Grand mal (major) epilepsyF251000	21	(2.6)
	Benign Rolandic epilepsyF25y400	22	(2.3)	Temporal lobe epilepsyF254000	21	(2.6)
	Epilepsy monitoring667..00	20	(2.1)	Epilepsy monitoring667..00	16	(2.0)
	Fit (in known epileptic) NOSF25z.11	14	(1.4)	Tonic-clonic epilepsyF251500	13	(1.6)
	Tonic-clonic epilepsyF251500	14	(1.4)	Benign Rolandic epilepsyF25y400	12	(1.5)
	Focal epilepsyF255011	12	(1.2)	Juvenile myoclonic epilepsyF25A.00	11	(1.4)
	Juvenile absence epilepsyF250400	11	(1.1)	Juvenile absence epilepsyF250400	10	(1.2)
15-18	EpilepsyF25..00	560	(74.9)	EpilepsyF25..00	501	(70.9)
	Grand mal (major) epilepsyF251000	23	(3.1)	Epilepsy monitoring667..00	21	(3.0)
	Epilepsy monitoring667..00	18	(2.4)	Grand mal (major) epilepsyF251000	20	(2.8)
	H/O: epilepsy1473.00	16	(2.1)	Fit (in known epileptic) NOSF25z.11	19	(2.7)
	Fit (in known epileptic) NOSF25z.11	13	(1.7)	Petit mal (minor) epilepsyF250000	15	(2.1)
	Temporal lobe epilepsyF254000	12	(1.6)	Epilepsy NOSF25z.00	13	(1.8)
	Tonic-clonic epilepsyF251500	12	(1.6)	Epileptic absencesF250011	12	(1.7)
	Petit mal (minor) epilepsyF250000	11	(1.5)	Temporal lobe epilepsyF254000	12	(1.7)
	Epileptic seizures - tonicF251400	8	(1.1)	Complex partial epileptic seizureF25450	8	(1.1)
	Juvenile myoclonic epilepsyF25A.00	8	(1.1)	Epileptic seizures - myoclonicF251300	8	(1.1)
19-24	EpilepsyF25..00	583	(74.7)	EpilepsyF25..00	526	(74.1)
	Grand mal (major) epilepsyF251000	26	(3.3)	Temporal lobe epilepsyF254000	30	(4.2)
	Epilepsy monitoring667..00	25	(3.2)	Epilepsy monitoring667..00	20	(2.8)
	Temporal lobe epilepsyF254000	20	(2.6)	Grand mal (major) epilepsyF251000	15	(2.1)
	Fit (in known epileptic) NOSF25z.11	14	(1.8)	Excepted from epilepsy quality indicato	13	(1.8)
	Epilepsy medication review8BIF.00	12	(1.5)	H/O: epilepsy1473.00	12	(1.7)
	Tonic-clonic epilepsyF251500	12	(1.5)	Epilepsy medication review8BIF.00	10	(1.4)
	Excepted from epilepsy quality indicato	11	(1.4)	Fit (in known epileptic) NOSF25z.11	10	(1.4)
	Epilepsy NOSF25z.00	8	(1.0)	Petit mal (minor) epilepsyF250000	10	(1.4)
	Complex partial epileptic seizureF25450	6	(0.8)	Epilepsy NOSF25z.00	8	(1.1)

6.4 Ten most frequent drug codes identifying cohort

By age and sex – incident participants only (first drug ever issued)

Epilepsy cohort - incident participants					
Age Group (years)	**Drug** **MALES**	**n**	**(%)**	**Drug** **FEMALES**	**n** **(%)**
0	phenobarbital	174	(36.9)	phenobarbital	137 (35.2)
	sodium valproate	115	(24.4)	sodium valproate	103 (26.5)
	vigabatrin	66	(14.0)	carbamazepine	59 (15.2)
	carbamazepine	58	(12.3)	vigabatrin	39 (10.0)
	phenytoin	37	(7.8)	phenytoin	34 (8.7)
	topiramate	6	(1.3)	clonazepam	6 (1.5)
	clonazepam	5	(1.1)	topiramate	6 (1.5)
	clobazam	4	(0.9)	lamotrigine	2 (0.5)
	lamotrigine	4	(0.9)	clobazam	1 (0.3)
	levetiracetam	3	(0.6)	gabapentin	1 (0.3)
1	sodium valproate	176	(66.7)	sodium valproate	146 (59.1)
	carbamazepine	54	(20.5)	carbamazepine	51 (20.7)
	phenytoin	12	(4.6)	phenytoin	18 (7.3)
	vigabatrin	10	(3.8)	vigabatrin	11 (4.5)
	phenobarbital	6	(2.3)	phenobarbital	9 (3.6)
	lamotrigine	2	(0.8)	clobazam	4 (1.6)
	clobazam	1	(0.4)	clonazepam	2 (0.8)
	clonazepam	1	(0.4)	gabapentin	2 (0.8)
	levetiracetam	1	(0.4)	levetiracetam	2 (0.8)
	topiramate	1	(0.4)	lamotrigine	1 (0.4)
2	sodium valproate	172	(65.7)	sodium valproate	116 (66.7)
	carbamazepine	50	(19.1)	carbamazepine	38 (21.8)
	clobazam	8	(3.1)	phenytoin	8 (4.6)
	phenobarbital	8	(3.1)	clonazepam	3 (1.7)
	phenytoin	6	(2.3)	lamotrigine	3 (1.7)
	lamotrigine	5	(1.9)	phenobarbital	2 (1.2)
	vigabatrin	5	(1.9)	ethosuximide	1 (0.6)
	clonazepam	3	(1.2)	gabapentin	1 (0.6)
	gabapentin	2	(0.8)	topiramate	1 (0.6)
	ethosuximide	1	(0.4)	vigabatrin	1 (0.6)

Epilepsy cohort - incident participants					
Age Group (years)	**Drug** **MALES**	**n**	**(%)**	**Drug** **FEMALES**	**n**	**(%)**
3	sodium valproate	179	(65.6)	sodium valproate	121	(60.5)
	carbamazepine	65	(23.8)	carbamazepine	66	(33.0)
	ethosuximide	5	(1.8)	ethosuximide	5	(2.5)
	phenobarbital	5	(1.8)	levetiracetam	2	(1.0)
	phenytoin	5	(1.8)	clonazepam	1	(0.5)
	vigabatrin	4	(1.5)	lamotrigine	1	(0.5)
	clonazepam	3	(1.1)	phenobarbital	1	(0.5)
	lamotrigine	3	(1.1)	phenytoin	1	(0.5)
	phenytoin sodium	2	(0.7)	phenytoin sodium	1	(0.5)
	clobazam	1	(0.4)	vigabatrin	1	(0.5)
4	sodium valproate	142	(63.1)	sodium valproate	130	(61.6)
	carbamazepine	64	(28.4)	carbamazepine	59	(28.0)
	phenytoin	9	(4.0)	ethosuximide	5	(2.4)
	lamotrigine	3	(1.3)	lamotrigine	5	(2.4)
	topiramate	3	(1.3)	levetiracetam	3	(1.4)
	clobazam	1	(0.4)	phenytoin	3	(1.4)
	clonazepam	1	(0.4)	clobazam	2	(1.0)
	ethosuximide	1	(0.4)	gabapentin	1	(0.5)
	levetiracetam	1	(0.4)	phenobarbital	1	(0.5)
				primidone	1	(0.5)
5-9	sodium valproate	659	(56.0)	sodium valproate	526	(56.9)
	carbamazepine	396	(33.7)	carbamazepine	265	(28.7)
	lamotrigine	33	(2.8)	lamotrigine	44	(4.8)
	ethosuximide	18	(1.5)	ethosuximide	33	(3.6)
	gabapentin	14	(1.2)	gabapentin	12	(1.3)
	clonazepam	10	(0.9)	phenytoin	11	(1.2)
	phenytoin	10	(0.9)	topiramate	8	(0.9)
	phenytoin sodium	10	(0.9)	clonazepam	6	(0.7)
	clobazam	8	(0.7)	phenobarbital	6	(0.7)
	vigabatrin	6	(0.5)	phenytoin sodium	5	(0.5)

Epilepsy cohort - incident participants					
Age Group (years)	**Drug** **MALES**	**n**	**(%)**	**Drug** **FEMALES**	**n**	**(%)**
10-14	sodium valproate	606	(50.5)	sodium valproate	375	(36.9)
	carbamazepine	398	(33.2)	carbamazepine	317	(31.2)
	lamotrigine	63	(5.3)	lamotrigine	168	(16.5)
	topiramate	31	(2.6)	gabapentin	62	(6.1)
	gabapentin	29	(2.4)	topiramate	33	(3.2)
	phenytoin sodium	24	(2.0)	ethosuximide	23	(2.3)
	clonazepam	12	(1.0)	levetiracetam	9	(0.9)
	phenytoin	9	(0.8)	phenytoin sodium	8	(0.8)
	clobazam	6	(0.5)	clonazepam	5	(0.5)
	ethosuximide	6	(0.5)	phenytoin	5	(0.5)
15-18	sodium valproate	465	(41.0)	carbamazepine	293	(25.5)
	carbamazepine	331	(29.2)	sodium valproate	293	(25.5)
	lamotrigine	92	(8.1)	lamotrigine	273	(23.8)
	phenytoin sodium	78	(6.9)	gabapentin	90	(7.8)
	gabapentin	52	(4.6)	topiramate	61	(5.3)
	valproate semisodium	27	(2.4)	phenytoin sodium	30	(2.6)
	topiramate	22	(1.9)	pregabalin	27	(2.4)
	levetiracetam	20	(1.8)	levetiracetam	26	(2.3)
	clonazepam	17	(1.5)	clonazepam	23	(2.0)
	pregabalin	15	(1.3)	valproate semisodium	18	(1.6)
19-24	carbamazepine	529	(31.1)	carbamazepine	523	(27.0)
	sodium valproate	476	(28.0)	sodium valproate	325	(16.8)
	gabapentin	174	(10.2)	gabapentin	298	(15.4)
	phenytoin sodium	135	(7.9)	lamotrigine	296	(15.3)
	lamotrigine	102	(6.0)	topiramate	128	(6.6)
	valproate semisodium	81	(4.8)	pregabalin	110	(5.7)
	clonazepam	71	(4.2)	valproate semisodium	97	(5.0)
	pregabalin	55	(3.2)	clonazepam	74	(3.8)
	topiramate	34	(2.0)	phenytoin sodium	44	(2.3)
	levetiracetam	14	(0.8)	levetiracetam	17	(0.9)

6.5 The frequency of the first and second drug prescribed in people with ADHD

Table 6-9 The frequency of the first and second drug prescribed in people with ADHD

Table The frequency of the first and second drug prescribed in people with ADHD

Drug Name	Prescribed as 1st drug, n	(%)	Prescribed as 2nd drug, n	(%)
Methylphenidate	8,220	(92.0)	7,694	(91.9)
Atomoxetine	568	(6.4)	545	(6.5)
Dexamphetamine	147	(1.6)	136	(1.6)

Note: People in study population with at least two drug codes or at least two diagnosis codes included

Note: People with no drug prescription are excluded from this table

6.6 The frequency of the first and second Read code recorded in people with ADHD

Table 6-10 The frequency of the first and second Read code recorded in people with ADHD

Read code description	Used as 1st Read code, n	(%)	Used as 2nd Read code, n	(%)
[X]Attention deficit hyperactivity disorder	7,346	(58.3)	2,796	(60.4)
Child attention deficit disorder	2,901	(23.0)	1,133	(24.5)
Childhood hyperkinetic syndrome	1,406	(11.2)	332	(7.2)
Attention deficit with hyperactivity	235	(1.9)	96	(2.1)
[X]Attention deficit disorder	221	(1.8)	86	(1.9)
Attention deficit disorder	124	(1.0)	39	(0.8)
ADD - Attention deficit disorder	101	(0.8)	44	(1.0)
[X]Hyperkinetic disorders	85	(0.7)	35	(0.8)
Child attention deficit disorder NOS	58	(0.5)	20	(0.4)
DAMP - Deficits in attention motor control	32	(0.3)	10	(0.2)
Hyperkinetic conduct disorder	26	(0.2)	12	(0.3)
Disorders of attention and motor control	18	(0.1)	2	(0.04)
Attention deficit without hyperactivity	14	(0.1)	1	(0.02)
[X]Deficits in attention, motor control	10	(0.1)	8	(0.2)
[X]Hyperkinetic disorder, unspecified	10	(0.1)	5	(0.1)
Deficits in attention motor control and perception	8	(0.1)	0	
[X]Hyperkinetic conduct disorder	8	(0.1)	6	(0.1)
Hyperkinetic syndrome NOS	4	(0.03)	1	(0.02)
[X]Other hyperkinetic disorders	2	(0.02)	1	(0.02)
[X]Hyperkinetic disorder associated with conduct disorder	1	(0.01)	0	

Note: People with at least two drug codes or at least two diagnosis codes are included.

Note: People with no diagnosis code are excluded from this table

6.7 The estimated prevalence of ADHD in 2012

Table 6-11 The prevalence of ADHD in CYP with medical records between in 2012 in CYP with at least one drug code or at least on diagnosis code

Characteristic		≥1 drug OR ≥1 diagnosis code				
		Numerator	Denominator	Prevalence %	(95% CI)	
Overall		5,196	490,016	1.06	(1.03	-1.09)
Sex	Male	4,355	249,982	1.74	(1.69	-1.79)
	Female	841	240,034	0.35	(0.33	-0.37)
Age group	3-4	5	69,713	0.01	(0.002	-0.02)
	5-9	830	163,834	0.51	(0.47	-0.54)
	10-14	2,467	157,090	1.57	(1.51	-1.63)
	15-17	1,894	99,379	1.91	(1.82	-1.99)
Deprivation	Least deprived	870	118,422	0.73	(0.69	-1.79)
	2nd least deprived	926	99,463	0.93	(0.87	-0.99)
	Medium deprivation	908	86,374	1.05	(0.98	-1.12)
	2nd most deprived	1,169	90,230	1.30	(1.22	-1.37)
	Most deprived	1,211	87,564	1.38	(1.31	-1.46)
	Deprivation missing	112	7,963	1.41	(1.16	-1.69)
SHA Region	East Midlands	79	7,480	1.06	(0.84	-1.32)
	East of England	698	51,995	1.34	(1.24	-1.45)
	London	630	83,266	0.76	(0.70	-0.82)
	North East	111	11,165	0.99	(0.82	-1.20)
	North West	717	80,541	0.89	(0.83	-0.96)
	South Central	860	67,269	1.28	(1.19	-1.37)
	South East Coast	1,046	67,691	1.55	(1.45	-1.64)
	South West	534	54,875	0.97	(0.89	-1.06)
	West Midlands	450	52,969	0.85	(0.77	-0.93)
	Yorkshire & Humber	71	12,765	0.56	(0.43	-0.70)

Age is described as the age in the current calendar year

6.8 The length of time people with ADHD were registered with the practice by area-level deprivation quintile

Table 6-12 Follow-up time in years, median (interquartile range) and ratio compared to people in the least deprived areas by deprivation

Characteristic:	≥1 drug OR ≥1 diagnosis code	
Deprivation	Median years (IQR)	Ratio 95% CI
Least deprived	4 (1 -7)	1.00
2nd least deprived	3 (1 -7)	0.90 (0.88 -0.93)
Medium deprivation	3 (1 -7)	0.94 (0.92 -0.97)
2nd most deprived	3 (1 -7)	0.94 (0.92 -0.97)
Most deprived	3 (1 -7)	0.91 (0.88 -0.93)

6.9 Read or drug codes describing comorbid conditions

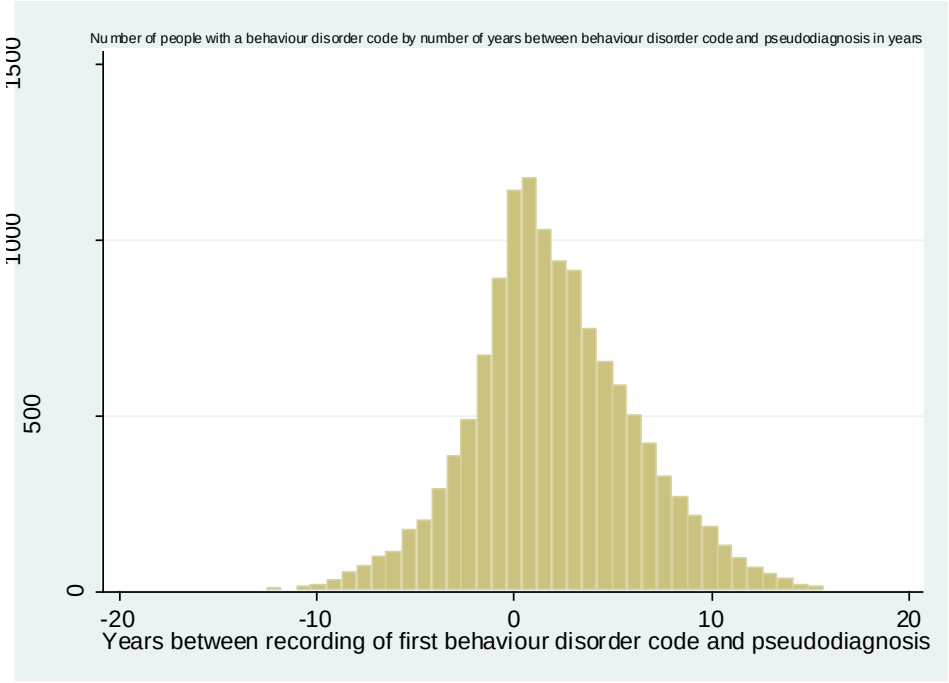
	Non-ADHD			ADHD		
Comorbid condition	**Code description**	**n**	**(%)**	**Code description**	**n**	**(%)**
Behaviour disorder						
	[V]Behavioural problems	4753	(36.6)	[V]Behavioural problems	2665	(34.1)
	Behaviour disorder	3407	(26.3)	Behaviour disorder	2075	(27.4)
	Behavioural problem	1975	(15.2)	Behavioural problem	1106	(14.6)
	H/O: behaviour problem	1452	(11.2)	H/O: behaviour problem	716	(9.4)
	Behavioural problems at school	480	(3.7)	Behavioural problems at school	303	(4.0)
Learning disability						
	Learning difficulties	1552	(64.9)	Learning difficulties	1163	(64.9)
	On learning disability register	297	(12.4)	On learning disability register	191	(10.7)
	[X]Learning disability NOS	215	(9.0)	[X]Learning disability NOS	157	(8.8)
	Other specific learning difficulty	149	(6.2)	Other specific learning difficulty	125	(7.0)
	Learning disability	65	(2.7)	Learning disability	57	(3.2)
Epilepsy diagnosis codes						
	Epilepsy	1737	(71.1)	Epilepsy	392	(73.1)
	Petit mal (minor) epilepsy	106	(4.3)	Petit mal (minor) epilepsy	26	(4.9)
	Epileptic absences	104	(4.3)	Epilepstic absences	21	(3.9)
	Epilepsy monitoring	57	(2.3)	H/O: epilepsy	19	(3.5)
	H/O: epilepsy	52	(2.1)	Benign Rolandic epilepsy	11	(2.0)
Epilepsy drug codes						
	sodium valproate	1,175	(42.0)	sodium valproate	270	(37.8)
	carbamazepine	622	(22.2)	carbamazepine	257	(35.9)
	lamotrigine	254	(9.1)	lamotrigine	59	(8.3)
	gabapentin	196	(7.0)	clonazepam	22	(3.1)
	topiramate	141	(5.0)	gabapentin	25	(3.5)
Cerebral palsy						
	Cerebral palsy with spastic diplegia	56	(68.3)	Cerebral palsy with spastic diplegia	6	(85.7)
	Cerebral palsy, not congenital or infan	21	(25.6)	Other Read codes	1	(14.3)
	Spastic cerebral palsy	5	(6.1)			

[$] Read codes used less than 5 times have been grouped as 'Other Read codes' to maintain anonymity

6.10 Graphs to show the number of CYP with a behaviour disorder code by number of years from (pseudo)diagnosis

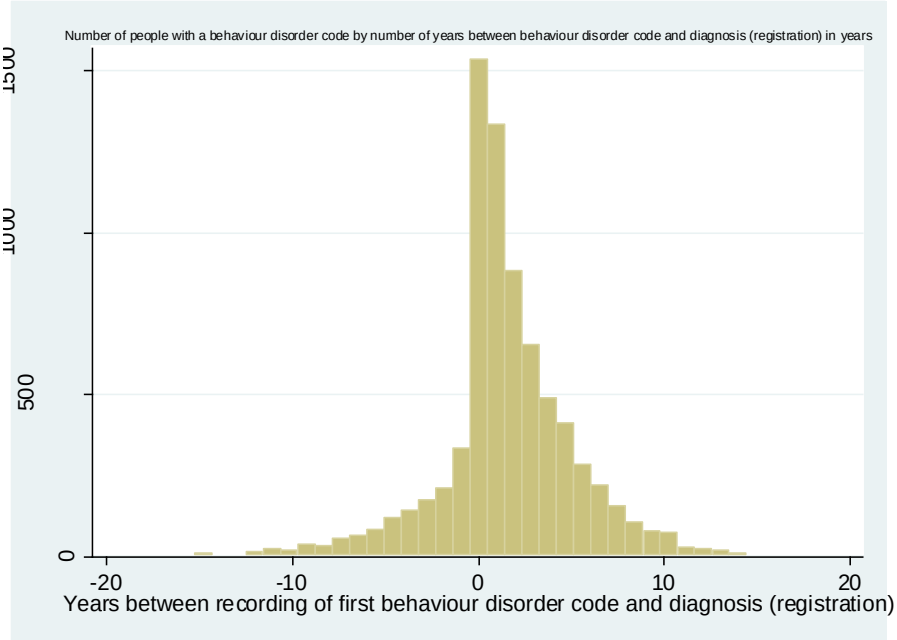
The following graphs show the results in the study population formatted for the analysis of first fractures but the results were similar for the study population formatted for the analyses of thermal injuries, poisonings and long bone fractures.

6.10.1 The number of CYP with a behaviour disorder code by number of years between behaviour disorder code and date of pseudodiagnosis in years: CYP without ADHD



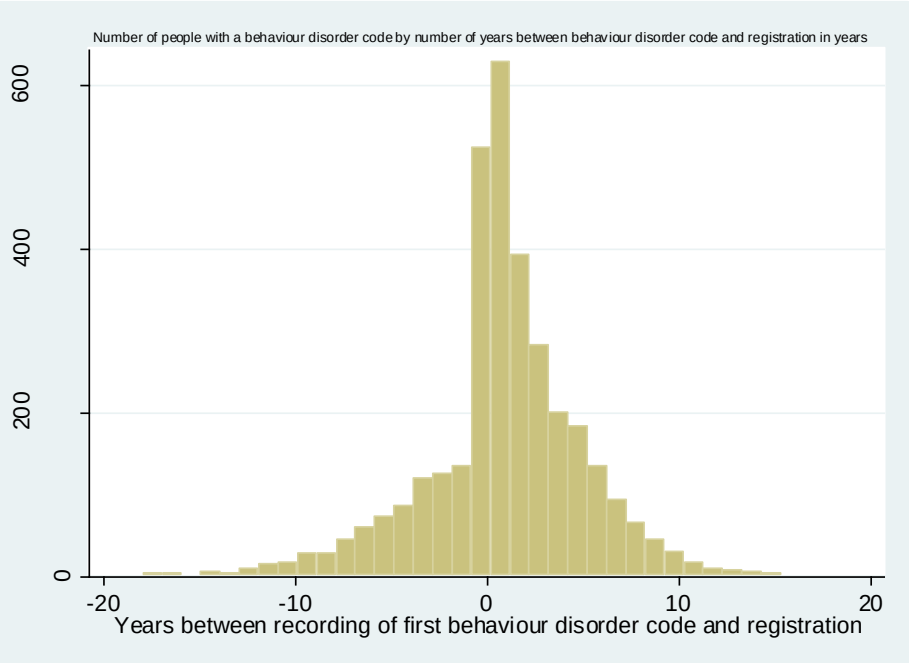
The number of CYP with behaviour disorder codes is distributed around the date of registration with a normal distribution. This implies that the recording of behaviour disorder is not related to 'pseudodiagnosis' in CYP without ADHD. This finding was to be expected because the 'pseudodiagnosis' date was a randomly assigned date between three months after registration with the GP and leaving the practice.

6.10.2 The number of CYP with a behaviour disorder code by number of years between behaviour disorder code and date of diagnosis (registration) in years: CYP with ADHD



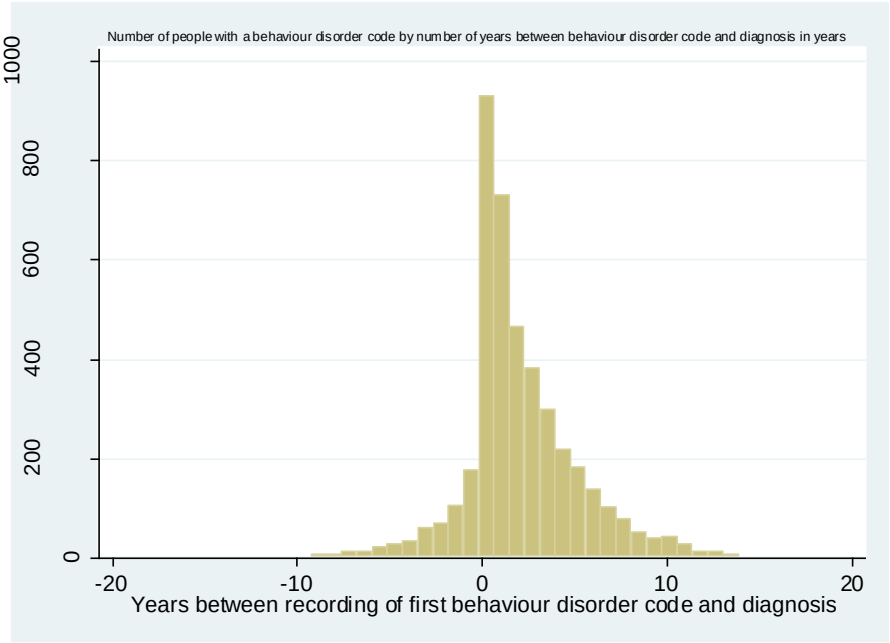
The number of CYP with behaviour disorder codes is distributed around the date of diagnosis (registration in CYP with prevalence ADHD, diagnosed before registration) with a peak around the date of diagnosis and more cases recorded after diagnosis. This implies that the recording of behaviour disorder is more likely after the diagnosis of ADHD but that the term is also used prior to the code for ADHD in some cases.

6.10.3 The number of CYP with a behaviour disorder code by number of years between behaviour disorder code and date of registration in years: CYP with prevalent ADHD



This graph shows that, leading up to the date of diagnosis, the distribution of CYP with a code for behaviour disorder was steadily rising, as with the distribution for CYP without ADHD. However, around the date of registration, there is a peak in the number of CYP with a behaviour disorder code, which then falls steadily according to the time since diagnosis. This may show that GPs use the diagnosis of behaviour disorder synonymously with ADHD or that this reflects the recording of prevalent behaviour disorder incorrectly as a new diagnosis, which is highest in the time immediately after registration.

6.10.4 The number of CYP with a behaviour disorder code by number of years between behaviour disorder code and date of diagnosis in years: CYP with incident ADHD

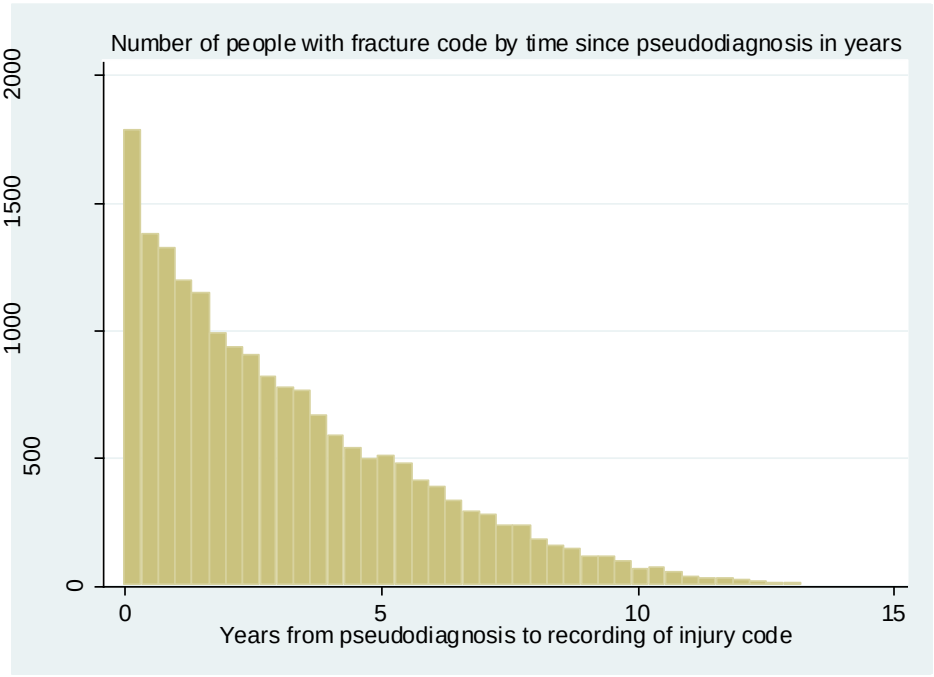


This graph shows that, leading up to the date of diagnosis, the distribution of CYP with a code for behaviour disorder was steadily rising, as with the distribution for CYP without ADHD and in the CYP with prevalent ADHD. However, around the date of diagnosis, there is a peak in the number of CYP with a behaviour disorder code, which then falls steadily according to the time since diagnosis. This may show that GPs use the diagnosis of behaviour disorder synonymously with ADHD, which is highest in the time immediately after diagnosis.

6.11 Graphs to show the number of people with a fracture code by number of years since (pseudo)diagnosis

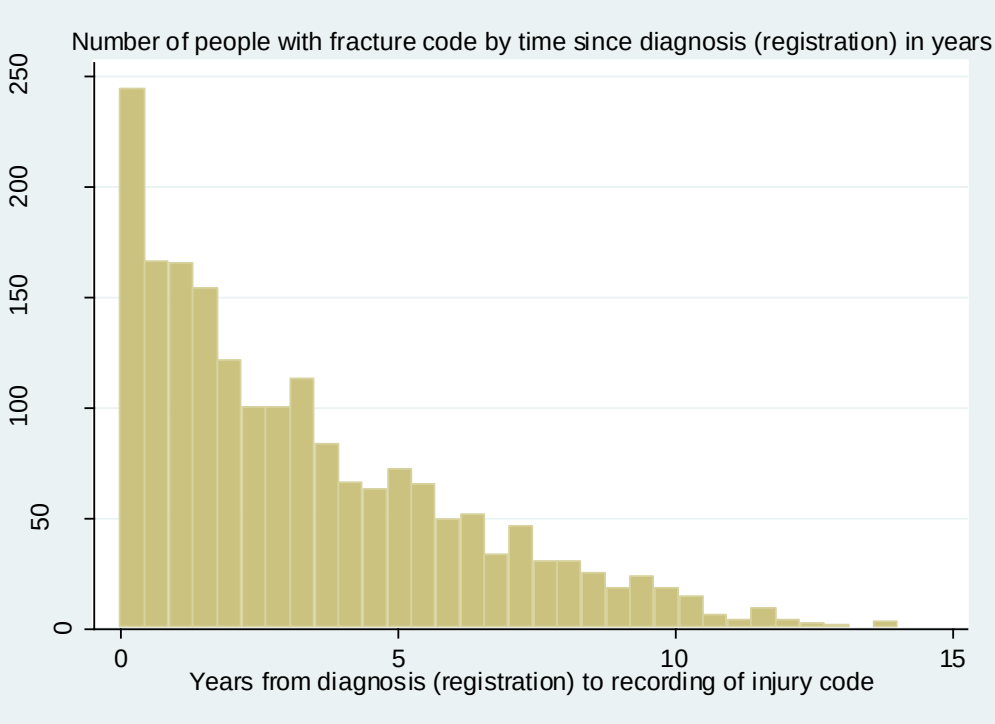
The following graphs show the results in the study population formatted for the analysis of first fractures but the results were similar for the study population formatted for the analyses of thermal injuries, poisonings and long bone fractures.

6.11.1 The number of people with a fracture code by time since pseudodiagnosis in years: people without ADHD



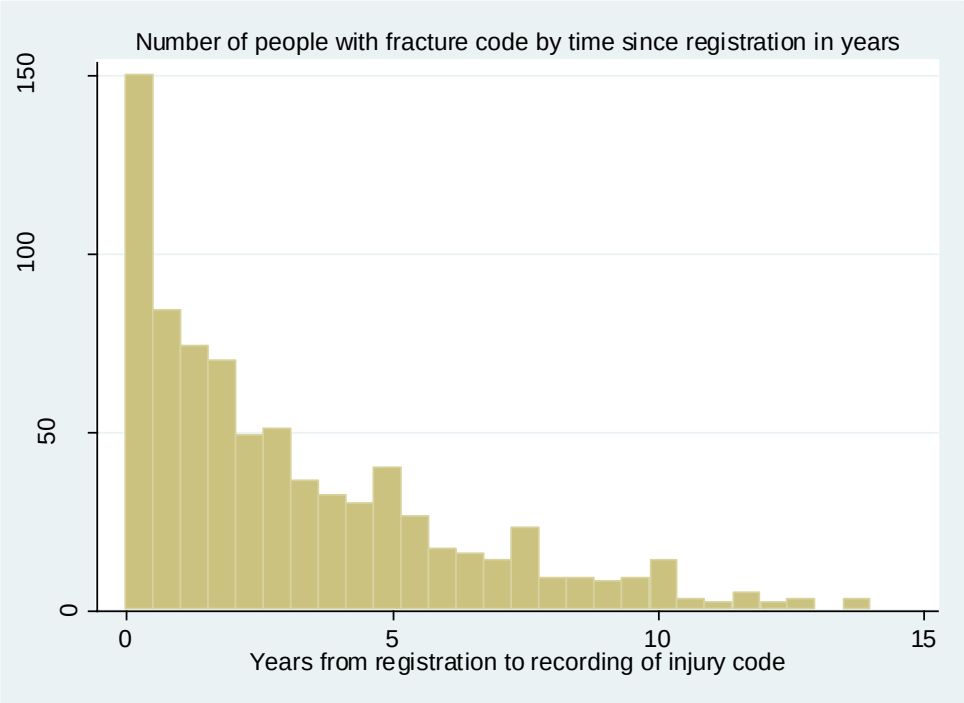
This graph shows that the number of people with a code for fracture gradually reduces from the time of pseudodiagnosis. This implies that the recording of fracture is unrelated to the date of 'pseudodiagnosis' in people without ADHD. This finding was to be expected because the pseudodiagnosis date was randomly assigned between three months after registration with the GP and leaving the practice.

6.11.2 The number of people with a fracture code by time since diagnosis in years: people with ADHD



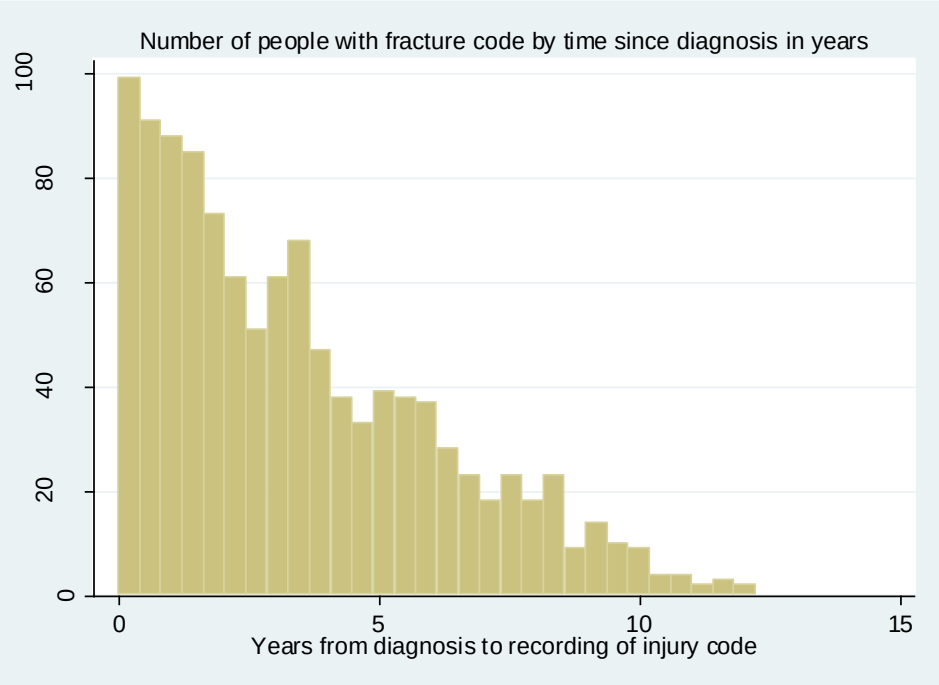
This graph shows that the number of people with a code for fracture gradually reduces from an initial peak in the first four months after diagnosis. The above results include people with both incident and prevalent ADHD.

6.11.3 The number of people with a fracture code by time since diagnosis in years: people with prevalent ADHD



This graph shows that, restricting the people with ADHD to people with a prevalent diagnosis, there is a peak in the recording of fractures in the period immediately after registration and then a sharp decline. This is likely to reflect the recording of past fractures incorrectly as new fractures at the time when people register with a new GP and past diagnoses are recorded.

6.11.4 The number of people with a fracture code by time since diagnosis in years: people with incident ADHD

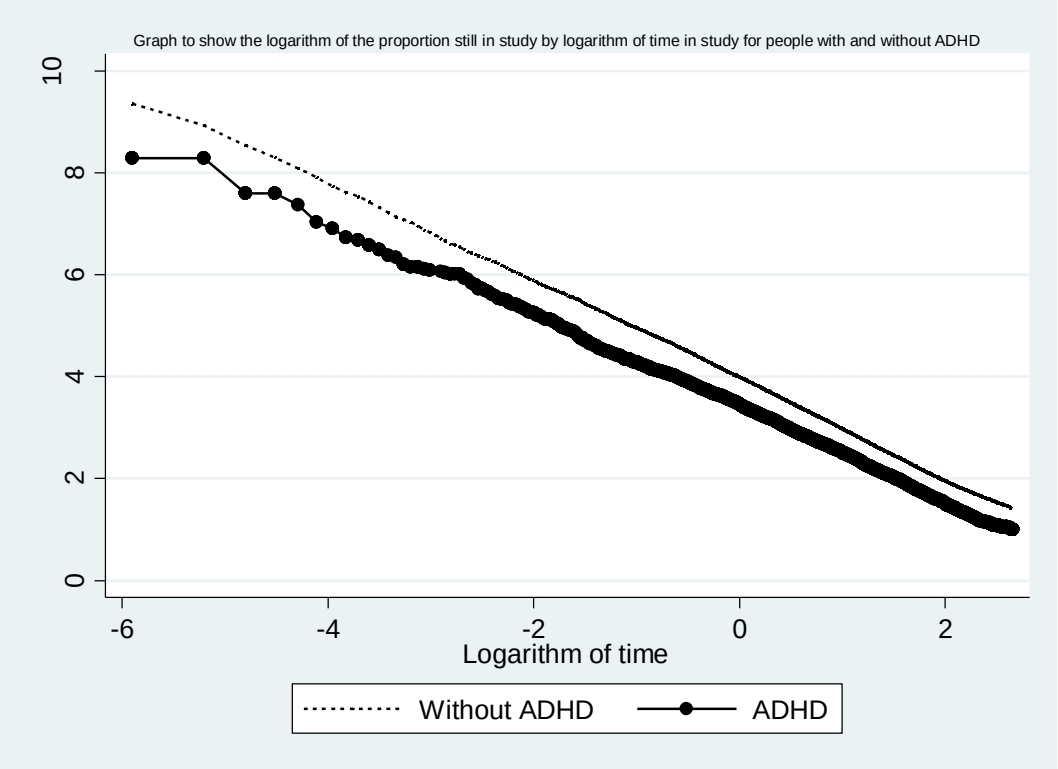


This graph shows that, restricting the people with ADHD to people with an incident diagnosis, there is a gradual decline in the recording of fractures in the after registration, similar to the decline in people without ADHD.

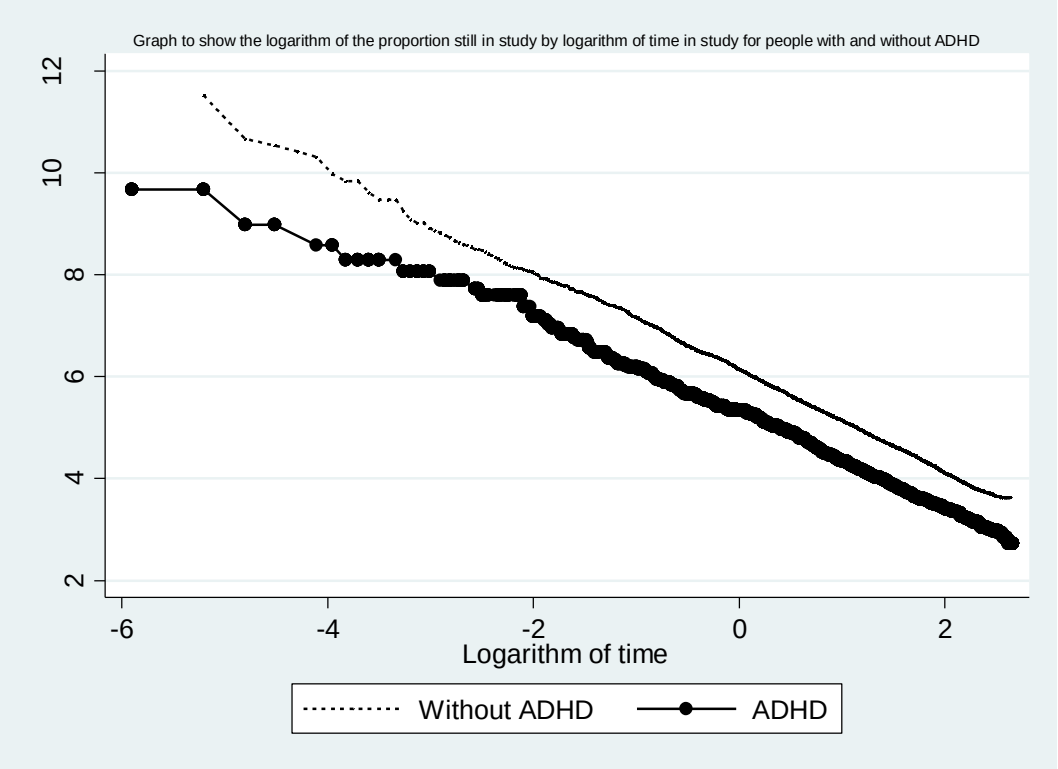
6.12 Graphs to show the logarithm of the proportion of people still in the study by the logarithm of time in the study for people with and without ADHD for fractures, thermal injuries, poisonings and long bone fractures

The following graphs show that .people with ADHD were more likely compared to people without ADHD throughout the study to have an injury. The number of people with ADHD to sustain an injury at any given point in time remained greater than the number of people without ADHD to sustain an injury at the same time throughout the study and the amount by which this risk was greater did not change during the study.

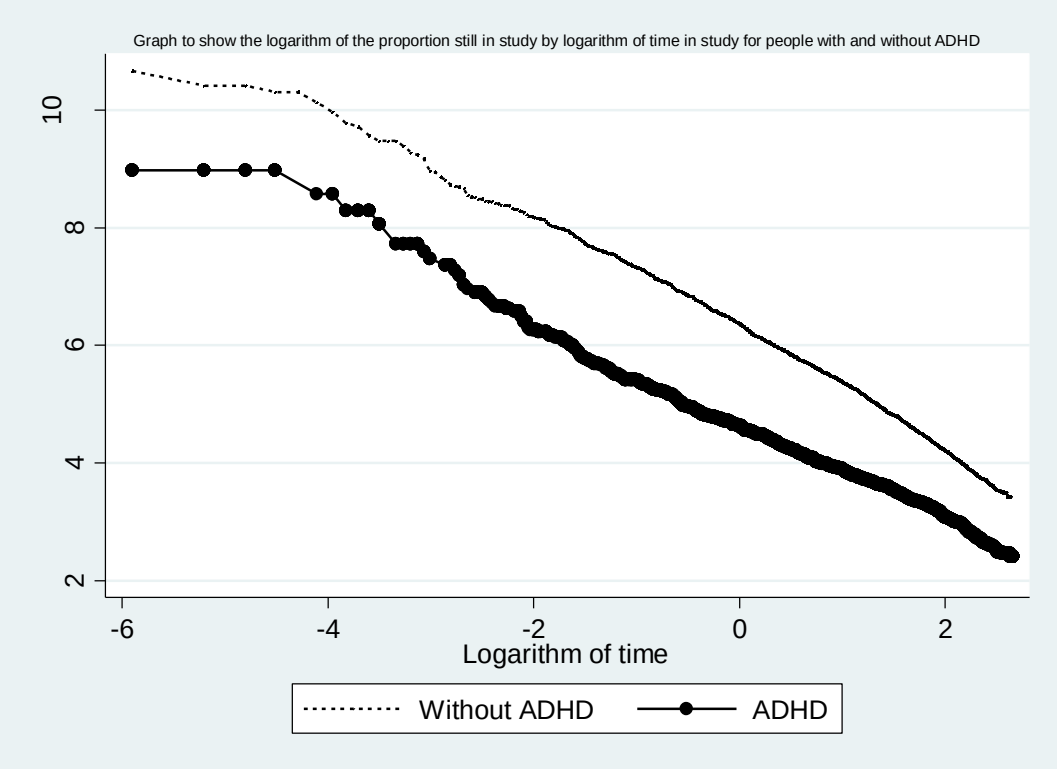
6.12.1 The logarithm of the proportion of people still in the study by the logarithm of time in the study for people with and without ADHD in the analysis on fractures



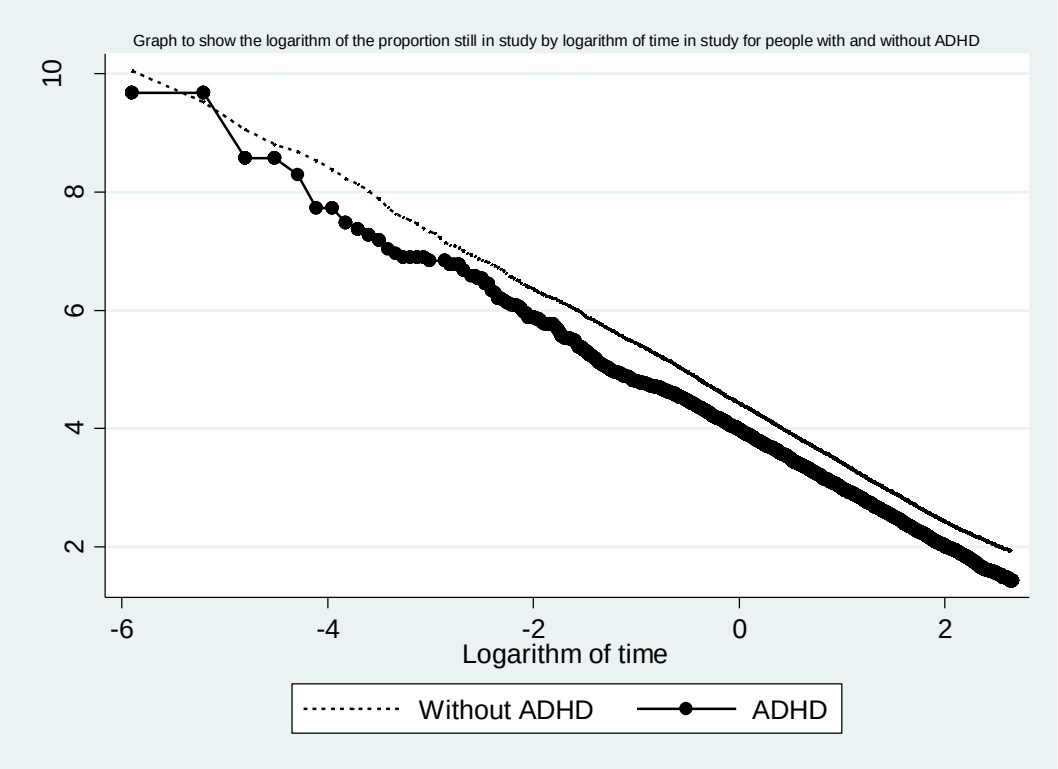
6.12.2 The logarithm of the proportion of people still in the study by the logarithm of time in the study for people with and without ADHD in the analysis on thermal injuries



6.12.3 The logarithm of the proportion of people still in the study by the logarithm of time in the study for people with and without ADHD in the analysis on poisonings



6.12.4 The logarithm of the proportion of people still in the study by the logarithm of time in the study for people with and without ADHD in the analysis on long bone fractures



This graph shows that there is some instability in the estimated risk in people with and without ADHD towards the beginning of the study because of smaller numbers of long bone fractures.

6.13 Code descriptions identifying epilepsy

Code descriptions - epilepsy
Acquired epileptic aphasia
Alcohol-induced epilepsy
Benign Rolandic epilepsy
Complex partial epileptic seizure
Complex partial status epilepticus
Cursive (running) epilepsy
Early infant epileptic encephalopathy wth suppression bursts
Epilepsy
Epilepsy NOS
Epilepsy associated problems
Epilepsy care arrangement
Epilepsy confirmed
Epilepsy control good
Epilepsy control poor
Epilepsy does not limit activities
Epilepsy drug side effects
Epilepsy impairs education
Epilepsy limits activities
Epilepsy management plan given
Epilepsy medication review
Epilepsy monitoring
Epilepsy monitoring NOS
Epilepsy monitoring telephone invite
Epilepsy monitoring verbal invite
Epilepsy prevents employment
Epilepsy restricts employment
Epilepsy severity
Epilepsy treatment changed
Epilepsy treatment started
Epileptic absences
Epileptic automatism
Epileptic seizures - akinetic
Epileptic seizures - atonic
Epileptic seizures - clonic
Epileptic seizures - myoclonic
Epileptic seizures - tonic
Excepted from epilepsy quality indicators: Informed dissent
Excepted from epilepsy quality indicators: Patient unsuitabl
Exception reporting: epilepsy quality indicators
Fit (in known epileptic) NOS
Focal epilepsy
Follow-up epilepsy assessment
Gelastic epilepsy
Generalised convulsive epilepsy
Generalised convulsive epilepsy NOS

Code descriptions - epilepsy
Generalised nonconvulsive epilepsy
Generalised nonconvulsive epilepsy NOS
Grand mal (major) epilepsy
H/O: epilepsy
Initial epilepsy assessment
Jacksonian, focal or motor epilepsy
Juvenile absence epilepsy
Juvenile myoclonic epilepsy
Kojevnikov's epilepsy
Lennox-Gastaut syndrome
Limbic system epilepsy
Locl-rlt(foc)(part)idiop epilep&epilptic syn seiz locl onset
Menstrual epilepsy
Motor epilepsy
Neonatal myoclonic epilepsy
No epilepsy drug side effects
Nocturnal epilepsy
Ohtahara syndrome
Other forms of epilepsy
Other forms of epilepsy NOS
Other specified generalised convulsive epilepsy
Other specified generalised nonconvulsive epilepsy
Otohara syndrome
Panayiotopoulos syndrome
Partial epilepsy with autonomic symptoms
Partial epilepsy with impairment of consciousness
Partial epilepsy with impairment of consciousness NOS
Partial epilepsy without impairment of consciousness
Partial epilepsy without impairment of consciousness NOS
Partial epilepsy without impairment of consciousness OS
Petit mal (minor) epilepsy
Photosensitive epilepsy
Progressive myoclonic epilepsy
Psychomotor epilepsy
Psychosensory epilepsy
Pykno-epilepsy
Sensory induced epilepsy
Simple partial epileptic seizure
Somatosensory epilepsy
Stress-induced epilepsy
Temporal lobe epilepsy
Tonic-clonic epilepsy
Tonic-clonic epilepsy
Transient epileptic amnesia
Traumatic epilepsy

Code descriptions - epilepsy
Unilateral epilepsy
Visceral reflex epilepsy
Visual reflex epilepsy
West syndrome
[X]Acquired aphasia with epilepsy [Landau - Kleffner]
[X]Antiepilept + antiparksn drug caus advers eff therap use
[X]Epileptic psychosis NOS
[X]Oth unspec antiepileptics caus adverse eff in therap use
[X]Other epilepsy
[X]Other generalized epilepsy and epileptic syndromes
[X]Other status epilepticus
[X]Schizophrenia-like psychosis in epilepsy
[X]Status epilepticus, unspecified

6.14 Drugs identifying epilepsy

Drugs identifying epilepsy
beclamide
carbamazepine
clobazam
clonazepam
eslicarbazepine acetate
ethosuximide
fosphenytoin sodium
gabapentin
lacosamide
lamotrigine
levetiracetam
mesuximide
methylphenobarbital
oxcarbazepine
phenobarbital
phenobarbital sodium
phenytoin
phenytoin sodium
potassium bromide
pregabalin
primidone
rufinamide
sodium valproate
stiripentol
sultiame
tiagabine hydrochloride monohydrate
topiramate
valproate semisodium
valproic acid
vigabatrin
zonisamide

6.15 Code descriptions identifying fractures

Code descriptions - long bone fractures
Arm fracture
Cl fractures involving multiple regions of both upper limbs
Cl red intracaps frac neck femur fix-Garden cannulated screw
Cl red intracaps fract neck femur fix - Smith-Petersen nail
Closd dorsal Barton's fracture
Closed Barton's fracture
Closed Colles' fracture
Closed Galeazzi fracture
Closed Monteggia's fracture
Closed Smith's fracture
Closed dorsal Barton's fracture-dislocation
Closed fracture ankle, bimalleolar
Closed fracture ankle, bimalleolar, high fibular fracture
Closed fracture ankle, bimalleolar, low fibular fracture
Closed fracture ankle, lateral malleolus
Closed fracture ankle, lateral malleolus, high
Closed fracture ankle, lateral malleolus, low
Closed fracture ankle, medial malleolus
Closed fracture ankle, trimalleolar
Closed fracture ankle, trimalleolar, high fibular fracture
Closed fracture ankle, trimalleolar, low fibular fracture
Closed fracture ankle, unspecified
Closed fracture distal femur
Closed fracture distal femur, bicondylar (T-Y fracture)
Closed fracture distal femur, comminuted/intra-articular
Closed fracture distal femur, lateral condyle
Closed fracture distal femur, medial condyle
Closed fracture distal femur, supracondylar
Closed fracture distal humerus, bicondylar (T-Y fracture)
Closed fracture distal humerus, capitellum
Closed fracture distal humerus, lateral condyle
Closed fracture distal humerus, lateral epicondyle
Closed fracture distal humerus, medial condyle
Closed fracture distal humerus, medial epicondyle
Closed fracture distal humerus, supracondylar
Closed fracture distal radius, extra-articular, other type
Closed fracture distal radius, intra-articular, die-punch
Closed fracture distal radius, intra-articular, other type
Closed fracture distal tibia
Closed fracture distal tibia, extra-articular
Closed fracture distal tibia, intra-articular
Closed fracture distal ulna, unspecified
Closed fracture fibula, head
Closed fracture fibula, neck
Closed fracture head of femur

Code descriptions - long bone fractures
Closed fracture of distal femur not otherwise specified
Closed fracture of distal femur, unspecified
Closed fracture of distal fibula
Closed fracture of distal humerus, condyle(s) unspecified
Closed fracture of distal humerus, multiple
Closed fracture of distal humerus, not otherwise specified
Closed fracture of distal humerus, trochlea
Closed fracture of elbow, unspecified part
Closed fracture of femoral condyle, unspecified
Closed fracture of femur, distal end
Closed fracture of femur, greater trochanter
Closed fracture of femur, intertrochanteric
Closed fracture of femur, lesser trochanter
Closed fracture of femur, lower epiphysis
Closed fracture of femur, shaft or unspecified part
Closed fracture of femur, subcapital
Closed fracture of femur, unspecified part
Closed fracture of femur, upper epiphysis
Closed fracture of fibula, unspecified part, NOS
Closed fracture of forearm, lower end, NOS
Closed fracture of forearm, lower end, unspecified
Closed fracture of forearm, unspecified
Closed fracture of humerus NOS
Closed fracture of humerus, shaft
Closed fracture of humerus, shaft or unspecified part
Closed fracture of humerus, shaft or unspecified part NOS
Closed fracture of humerus, upper epiphysis
Closed fracture of lower limb, level unspecified
Closed fracture of neck of femur NOS
Closed fracture of proximal femur, pertrochanteric
Closed fracture of proximal forearm not otherwise specified
Closed fracture of proximal forearm, unspecified part
Closed fracture of proximal humerus not otherwise specified
Closed fracture of proximal humerus, anatomical neck
Closed fracture of proximal humerus, unspecified part
Closed fracture of proximal radius and ulna
Closed fracture of proximal ulna, comminuted
Closed fracture of radius (alone), unspecified
Closed fracture of radius and ulna, NOS
Closed fracture of radius and ulna, lower end
Closed fracture of radius and ulna, shaft
Closed fracture of radius and ulna, shaft, NOS
Closed fracture of radius and ulna, unspecified part
Closed fracture of radius, shaft, unspecified
Closed fracture of shaft or unspecified part, NOS

Code descriptions - long bone fractures
Closed fracture of the distal humerus
Closed fracture of the distal radius, unspecified
Closed fracture of the proximal humerus
Closed fracture of the proximal radius
Closed fracture of the proximal tibia
Closed fracture of the proximal ulna
Closed fracture of the radial shaft
Closed fracture of the radius and ulna
Closed fracture of the ulnar shaft
Closed fracture of tibia and fibula, proximal
Closed fracture of tibia and fibula, proximal
Closed fracture of tibia and fibula, proximal NOS
Closed fracture of tibia and fibula, shaft
Closed fracture of tibia and fibula, shaft, NOS
Closed fracture of tibia and fibula, unspecified part
Closed fracture of tibia and fibula, unspecified part, NOS
Closed fracture of tibia and fibula, unspecified part, NOS
Closed fracture of tibia, unspecified part, NOS
Closed fracture of tibia/fibula, shaft
Closed fracture of tibial condyles
Closed fracture of tibial tuberosity
Closed fracture of ulna (alone), unspecified
Closed fracture of ulna, coronoid
Closed fracture of ulna, lower epiphysis
Closed fracture of ulna, styloid process
Closed fracture of unspecified proximal femur
Closed fracture olecranon, extra-articular
Closed fracture olecranon, intra-articular
Closed fracture proximal femur, basicervical
Closed fracture proximal femur, intertrochanteric, two part
Closed fracture proximal femur, midcervical section
Closed fracture proximal femur, other transcervical
Closed fracture proximal femur, subcapital, Garden grade I
Closed fracture proximal femur, subcapital, Garden grade II
Closed fracture proximal femur, subcapital, Garden grade III
Closed fracture proximal femur, subcapital, Garden grade IV
Closed fracture proximal femur, subtrochanteric
Closed fracture proximal femur, transcervical
Closed fracture proximal femur, transcervical, NOS
Closed fracture proximal femur, transepiphyseal
Closed fracture proximal fibula
Closed fracture proximal humerus, four part
Closed fracture proximal humerus, greater tuberosity
Closed fracture proximal humerus, head
Closed fracture proximal humerus, neck

Code descriptions - long bone fractures
Closed fracture proximal humerus, three part
Closed fracture proximal radius, comminuted
Closed fracture proximal tibia, bicondylar
Closed fracture proximal tibia, lateral condyle (plateau)
Closed fracture proximal tibia, medial condyle (plateau)
Closed fracture radial styloid
Closed fracture radius and ulna, distal
Closed fracture radius and ulna, middle
Closed fracture radius and ulna, proximal
Closed fracture radius, head
Closed fracture radius, neck
Closed fracture shaft of femur
Closed fracture shaft of fibula
Closed fracture shaft of tibia
Closed fracture spine, tibia
Closed fracture tubercle, tibia
Closed fracture, base of neck of femur
Closed fracture-dislocation distal radio-ulnar joint
Closed fracture-dislocation elbow
Closed fracture-dislocation elbow joint
Closed fracture-dislocation superior radio-ulnar joint
Closed fracture-dislocation, ankle joint
Closed fracture-dislocation, hip joint
Closed fracture-subluxation elbow
Closed fracture-subluxation elbow joint
Closed fracture-subluxation, ankle joint
Closed fracture-subluxation, distal radio-ulnar jt
Closed fracture-subluxation, hip joint
Closed fractures involving multiple regions of one upp limb
Closed ill-defined fractures of upper limb
Closed multiple fractures of clavicle, scapula and humerus
Closed reduction # arm
Closed reduction # leg
Closed reduction fract long bone & flexible intern fixat HFQ
Closed reduction fract long bone & rigid internal fixatn NEC
Closed reduction of fracture of ankle
Closed reduction of fracture of elbow
Closed reduction of fracture of femur
Closed reduction of fracture of hip
Closed reduction of fracture of humerus
Closed reduction of fracture of lower limb
Closed reduction of fracture of radius and or ulna
Closed reduction of fracture of tibia and or fibula
Closed reduction of fracture of upper limb
Closed reduction of intracapsular # NOF internal fixat DHS

Code descriptions - long bone fractures
Closed volar Barton fracture-subluxation
Closed volar Barton's fracture
Closed volar Barton's fracture-dislocation
Delivery of rehabilitation for hip fracture
Dupuytren's fracture, fibula
Dupuytren's fracture, radius - closed
Elbow fracture - closed
Elbow fracture - open
Forearm fracture
Fracture of ankle
Fracture of ankle, NOS
Fracture of femur, NOS
Fracture of fibula alone
Fracture of humerus
Fracture of humerus NOS
Fracture of lateral malleolus
Fracture of lower end of both ulna and radius
Fracture of lower end of femur
Fracture of lower end of humerus
Fracture of lower end of radius
Fracture of lower end of tibia
Fracture of lower leg, part unspecified
Fracture of lower limb
Fracture of lower limb, level unspecified
Fracture of medial malleolus
Fracture of neck of femur
Fracture of radius NOS
Fracture of radius and ulna
Fracture of radius and ulna, NOS
Fracture of shaft of femur
Fracture of shaft of humerus
Fracture of shaft of radius
Fracture of shaft of tibia
Fracture of shaft of ulna
Fracture of shafts of both ulna and radius
Fracture of tibia
Fracture of tibia and fibula
Fracture of tibia and fibula, NOS
Fracture of ulna NOS
Fracture of upper end of humerus
Fracture of upper end of radius
Fracture of upper end of tibia
Fracture of upper end of ulna
Fracture of upper limb
Fracture of upper limb NOS

Code descriptions - long bone fractures
Fracture of upper limb, level unspecified
Fracture-dislocation or subluxation ankle
Fracture-dislocation or subluxation elbow
Fracture-dislocation or subluxation hip
Fractures involving multiple regions of both lower limbs
Fractures involving multiple regions of both upper limbs
Fractures involving multiple regions of one lower limb
Fractures involving multiple regions of one upper limb
Greenstick fracture
H/O: hip fracture
Hip fracture
Hip fracture NOS
Ill-defined fracture of arm
Ill-defined fractures of upper limb
Ill-defined fractures of upper limb NOS
Late effect of fracture neck of femur
Late effect of fracture of arm
Late effect of other fracture of leg
Leg fracture
Lower leg fracture NOS
Multiple fractures of arm
Multiple fractures of clavicle, scapula and humerus
Multiple fractures of femur
Multiple fractures of forearm
Multiple fractures of lower leg
Open Barton's fracture
Open Colles' fracture
Open Galeazzi fracture
Open Monteggia's fracture
Open Smith's fracture
Open fracture ankle, bimalleolar
Open fracture ankle, bimalleolar, low fibular fracture
Open fracture ankle, lateral malleolus
Open fracture ankle, lateral malleolus, high
Open fracture ankle, lateral malleolus, low
Open fracture ankle, medial malleolus
Open fracture ankle, trimalleolar
Open fracture ankle, trimalleolar, low fibular fracture
Open fracture ankle, unspecified
Open fracture base of neck of femur
Open fracture distal femur
Open fracture distal femur, comminuted/intra-articular
Open fracture distal femur, lateral condyle
Open fracture distal femur, medial condyle
Open fracture distal femur, supracondylar

Code descriptions - long bone fractures
Open fracture distal femur, unspecified
Open fracture distal humerus, bicondylar (T-Y fracture)
Open fracture distal humerus, capitellum
Open fracture distal humerus, lateral condyle
Open fracture distal humerus, lateral epicondyle
Open fracture distal humerus, medial condyle
Open fracture distal humerus, medial epicondyle
Open fracture distal humerus, supracondylar
Open fracture distal radius, extra-articular other type
Open fracture distal radius, intra-articular other type
Open fracture distal tibia
Open fracture distal tibia, extra-articular
Open fracture distal tibia, intra-articular
Open fracture distal ulna - other
Open fracture fibula, head
Open fracture fibula, neck
Open fracture head, femur
Open fracture of distal femur not otherwise specified
Open fracture of distal fibula
Open fracture of distal humerus, condyle(s) unspecified
Open fracture of distal humerus, multiple
Open fracture of distal humerus, not otherwise specified
Open fracture of distal humerus, trochlea
Open fracture of elbow, unspecified part
Open fracture of femoral condyle, unspecified
Open fracture of femur, distal end
Open fracture of femur, greater trochanter
Open fracture of femur, intertrochanteric
Open fracture of femur, lower epiphysis
Open fracture of femur, shaft or unspecified part
Open fracture of femur, shaft or unspecified part, NOS
Open fracture of femur, subcapital
Open fracture of femur, unspecified part
Open fracture of fibula, unspecified part, NOS
Open fracture of forearm, lower end, NOS
Open fracture of forearm, lower end, unspecified
Open fracture of forearm, unspecified
Open fracture of forearm, upper end, NOS
Open fracture of humerus NOS
Open fracture of humerus, shaft
Open fracture of humerus, shaft or unspecified part
Open fracture of humerus, shaft or unspecified part NOS
Open fracture of humerus, upper epiphysis
Open fracture of lower limb, level unspecified
Open fracture of neck of femur NOS

Code descriptions - long bone fractures
Open fracture of proximal femur, pertrochanteric
Open fracture of proximal femur, pertrochanteric, NOS
Open fracture of proximal forearm, unspecified
Open fracture of proximal humerus not otherwise specified
Open fracture of proximal humerus, anatomical neck
Open fracture of proximal humerus, unspecified part
Open fracture of proximal radius and ulna
Open fracture of radius (alone), unspecified
Open fracture of radius and ulna, NOS
Open fracture of radius and ulna, lower end
Open fracture of radius and ulna, shaft
Open fracture of radius and ulna, shaft, NOS
Open fracture of radius and ulna, unspecified part
Open fracture of radius, shaft, unspecified
Open fracture of the distal humerus
Open fracture of the distal radius, unspecified
Open fracture of the proximal humerus
Open fracture of the proximal radius
Open fracture of the proximal tibia
Open fracture of the proximal ulna
Open fracture of the radial shaft
Open fracture of the radius and ulna
Open fracture of the ulnar shaft
Open fracture of tibia and fibula, proximal
Open fracture of tibia and fibula, proximal
Open fracture of tibia and fibula, proximal NOS
Open fracture of tibia and fibula, shaft
Open fracture of tibia and fibula, shaft, NOS
Open fracture of tibia and fibula, unspecified part
Open fracture of tibia and fibula, unspecified part, NOS
Open fracture of tibia and fibula, unspecified part, NOS
Open fracture of tibia, unspecified part, NOS
Open fracture of tibia/fibula, shaft
Open fracture of tibial condyles
Open fracture of tibial tuberosity
Open fracture of ulna (alone), unspecified
Open fracture of ulna, coronoid
Open fracture of ulna, lower epiphysis
Open fracture of ulna, styloid process
Open fracture of unspecified proximal femur
Open fracture olecranon, extra-articular
Open fracture olecranon, intra-articular
Open fracture proximal femur, intertrochanteric, comminuted
Open fracture proximal femur, other transcervical
Open fracture proximal femur, subtrochanteric

Code descriptions - long bone fractures
Open fracture proximal femur, transcervical
Open fracture proximal femur, transepiphyseal
Open fracture proximal femur,subcapital, Garden grade I
Open fracture proximal femur,subcapital, Garden grade II
Open fracture proximal femur,subcapital, Garden grade III
Open fracture proximal femur,subcapital, Garden grade IV
Open fracture proximal femur,subcapital, Garden grade unspec
Open fracture proximal fibula
Open fracture proximal humerus, four part
Open fracture proximal humerus, greater tuberosity
Open fracture proximal humerus, head
Open fracture proximal humerus, neck
Open fracture proximal humerus, three part
Open fracture proximal radius, comminuted
Open fracture proximal tibia, lateral condyle (plateau)
Open fracture proximal tibia, medial condyle (plateau)
Open fracture radial head
Open fracture radial neck
Open fracture radial styloid
Open fracture radius and ulna, distal
Open fracture radius and ulna, middle
Open fracture radius and ulna, proximal
Open fracture shaft of femur
Open fracture shaft of fibula
Open fracture shaft of tibia
Open fracture spine, tibia
Open fracture tubercle, tibia
Open fracture-dislocation elbow
Open fracture-dislocation elbow joint
Open fracture-dislocation, ankle joint
Open fracture-dislocation, distal radio-ulnar joint
Open fracture-dislocation, hip joint
Open fracture-subluxation elbow
Open fracture-subluxation, ankle joint
Open fracture-subluxation, distal radio-ulnar joint
Open ill-defined fractures of upper limb
Open multiple fractures of clavicle, scapula and humerus
Open volar Barton's fracture
Other fracture of femur
Other, multiple and ill-defined closed fractures lower limb
Other, multiple and ill-defined fractures of lower limb
Other, multiple and ill-defined fractures of lower limb NOS
Other, multiple and ill-defined open fractures of lower limb
Pertrochanteric fracture
Pott's fracture - ankle

Code descriptions - long bone fractures
Prim op red # nck femur & op fix - Deyerle multiple hip pin
Prim op red # nck femur & op fix- Charnley compression screw
Prim op red # nck femur & op fix- Zickel intramed nail plate
Prim open red # long bone & fix - Ender flexi intramed nail
Prim open red # long bone & fix - Rush flexi intramedul nail
Prim open red # neck femur & op fix - McLaughlin nail plate
Prim open reduc fract long bone & cmplx extramedul fixat NEC
Prim open reduct # long bone & fix - Parham circlage band
Prim open reduct # neck femur & op fix - Blount nail plate
Prim open reduct # neck femur & op fix - Holt nail
Prim open reduct # neck femur & op fix - Neufield nail plate
Prim open reduct # neck femur & op fix - Pugh nail plate
Prim open reduct # neck femur & op fix - Richards screw
Prim open reduct # neck femur & op fix - Ross Brown nail
Prim open reduct fract ankle & complex extramedull fixat NEC
Prim open reduct fract ankle & complex extramedull fixat NEC
Prim open reduct fract ankle & extramedull fixat NEC
Prim open reduct fract long bone & extramedull fixatn suture
Prim open reduct fract long bone & fix using Eggers plate
Prim open reduct fract long bone & fix using Ellis plate
Prim open reduct fract long bone & fix using Hicks plate
Prim open reduct fract long bone & fixation flexible nail
Prim open reduct fract long bone & fixation rigid nail NEC
Primary closed reduction #+intramed nail fixation
Primary cls reduction #+locked reamed intramed nail fxn
Primary cls reduction #+locked unreamed intramed nail fxn
Primary cls reduction #+unlocked reamed intramed nail fxn
Primary cls reduction #+unlocked unreamed intramed nail fxn
Primary external fixation(without reduction) prox femoral #
Primary open reduction+external fixation of femoral fracture
Prmy open red #+locked unreamed intramedullary nail fixation
Prmy open red #+unlocked reamed intramedullary nail fixation
Prmy open reduction # elbow+fixation with Hook fixtn plate
Prmy open reduction #+locked reamed intramedullary nail fxtn
Prmy open reduction #+unlocked unreamed intramedullary nail
Prmy open reduction of #+intramedullary nail fixation
Revision cls reduction #+unlocked unreamed intramed nail fxn
Revision to closed reduction #+intramed nail fixation
Smith's fracture - closed
Smith's fracture - open
Subtrochanteric fracture
Thigh fracture NOS
Upper leg fracture NOS
[X]Fracture of forearm, unspecified
[X]Fractures of other parts of femur

Code descriptions - long bone fractures
[X]Fractures of other parts of lower leg
[X]Multiple fractures of clavicle, scapula and humerus

Code descriptions - non-long bone fractures
bone follow insertn/orthopaed implnt,jnt pros,bne plate
Angular mal-union of fracture
Anterior decompression of fracture of spine
Anterior fossa fracture
Balloon kyphoplasty of fracture of spine
Barr skull traction for fracture of spine
C1 vertebra closed fracture - no spinal cord lesion
C1 vertebra open fracture without spinal cord lesion
C2 vertebra closed fracture without spinal cord lesion
C2 vertebra open fracture without spinal cord lesion
C3 vertebra closed fracture without spinal cord lesion
C3 vertebra open fracture without spinal cord lesion
C4 vertebra closed fracture without spinal cord lesion
C5 vertebra closed fracture without spinal cord lesion
C5 vertebra open fracture without spinal cord lesion
C6 vertebra closed fracture without spinal cord lesion
C6 vertebra open fracture without spinal cord lesion
C7 vertebra closed fracture without spinal cord lesion
C7 vertebra open fracture without spinal cord lesion
Closed (or no) reduction of fracture and external fixation
Closed (or no) reduction of fracture and internal fixation
Closed compression fracture sacrum
Closed fracture acetabulum
Closed fracture acetabulum NOS
Closed fracture acetabulum, anterior column
Closed fracture acetabulum, anterior lip alone
Closed fracture acetabulum, double column unspecified
Closed fracture acetabulum, floor
Closed fracture acetabulum, posterior column
Closed fracture acetabulum, posterior lip alone
Closed fracture atlas
Closed fracture atlas, comminuted
Closed fracture atlas, isolated arch or articular process
Closed fracture axis
Closed fracture axis, odontoid process
Closed fracture axis, posterior arch
Closed fracture axis, spinous process
Closed fracture axis, transverse process
Closed fracture base of skull with intracranial injury
Closed fracture base of skull without intracranial injury
Closed fracture calcaneus, extra-articular
Closed fracture calcaneus, intra-articular
Closed fracture capitate

Code descriptions - non-long bone fractures
Closed fracture capitate
Closed fracture carpal bones, multiple
Closed fracture cervical vertebra, burst
Closed fracture cervical vertebra, posterior arch
Closed fracture cervical vertebra, spinous process
Closed fracture cervical vertebra, spondylolysis
Closed fracture cervical vertebra, transverse process
Closed fracture cervical vertebra, wedge
Closed fracture clavicle, lateral end
Closed fracture clavicle, medial end
Closed fracture clavicle, shaft
Closed fracture cuboid
Closed fracture dislocation of sacro-iliac joint
Closed fracture dislocation of wrist
Closed fracture distal phalanx, toe
Closed fracture finger distal phalanx
Closed fracture finger distal phalanx, base
Closed fracture finger distal phalanx, mallet
Closed fracture finger distal phalanx, multiple
Closed fracture finger distal phalanx, shaft
Closed fracture finger distal phalanx, tuft
Closed fracture finger metacarpal
Closed fracture finger metacarpal base
Closed fracture finger metacarpal head
Closed fracture finger metacarpal neck
Closed fracture finger metacarpal shaft
Closed fracture finger metacarpal, multiple
Closed fracture finger middle phalanx
Closed fracture finger middle phalanx, base
Closed fracture finger middle phalanx, head
Closed fracture finger middle phalanx, multiple
Closed fracture finger middle phalanx, neck
Closed fracture finger middle phalanx, shaft
Closed fracture finger proximal phalanx
Closed fracture finger proximal phalanx, base
Closed fracture finger proximal phalanx, head
Closed fracture finger proximal phalanx, multiple
Closed fracture finger proximal phalanx, neck
Closed fracture finger proximal phalanx, shaft
Closed fracture hamate
Closed fracture hamate, hook
Closed fracture intermediate cuneiform
Closed fracture inv thorax wth low back and pelvis and limbs
Closed fracture larynx
Closed fracture larynx and trachea

Code descriptions - non-long bone fractures
Closed fracture lateral cuneiform
Closed fracture lumbar vertebra
Closed fracture lumbar vertebra, burst
Closed fracture lumbar vertebra, posterior arch
Closed fracture lumbar vertebra, spinous process
Closed fracture lumbar vertebra, spondylolysis
Closed fracture lumbar vertebra, transverse process
Closed fracture lumbar vertebra, tricolumnar
Closed fracture lumbar vertebra, wedge
Closed fracture lunate
Closed fracture mandible (site unspecified)
Closed fracture maxilla
Closed fracture medial cuneiform
Closed fracture metatarsal
Closed fracture metatarsal base
Closed fracture metatarsal head
Closed fracture metatarsal neck
Closed fracture metatarsal shaft
Closed fracture metatarsal, multiple
Closed fracture middle phalanx, toe
Closed fracture multiple phalanges, toe
Closed fracture multiple ribs
Closed fracture nasal bone
Closed fracture navicular
Closed fracture nose
Closed fracture of astragalus
Closed fracture of base of fifth metatarsal
Closed fracture of bones, unspecified
Closed fracture of bony thorax part unspecified
Closed fracture of calcaneus
Closed fracture of carpal bone
Closed fracture of carpal bone NOS
Closed fracture of carpal bone, unspecified
Closed fracture of cervical spine
Closed fracture of cervical spine not otherwise specified
Closed fracture of cervical spine with cord lesion
Closed fracture of cervical spine with cord lesion NOS
Closed fracture of clavicle
Closed fracture of clavicle NOS
Closed fracture of clavicle, unspecified part
Closed fracture of coccyx with spinal cord lesion
Closed fracture of cuneiforms
Closed fracture of eight or more ribs
Closed fracture of fifth cervical vertebra
Closed fracture of five ribs

Code descriptions - non-long bone fractures
Closed fracture of four ribs
Closed fracture of fourth cervical vertebra
Closed fracture of great toe
Closed fracture of hyoid bone
Closed fracture of ilium, unspecified
Closed fracture of ill-defined bone of trunk
Closed fracture of lumbar spine with spinal cord lesion
Closed fracture of mandible, alveolar border of body
Closed fracture of mandible, angle of jaw
Closed fracture of mandible, body, other and unspecified
Closed fracture of mandible, condylar process
Closed fracture of mandible, coronoid process
Closed fracture of mandible, multiple sites
Closed fracture of mandible, ramus, unspecified
Closed fracture of mandible, subcondylar
Closed fracture of mandible, symphysis of body
Closed fracture of metacarpal bone (s), site unspecified
Closed fracture of metacarpal bone(s)
Closed fracture of metacarpal bone(s) NOS
Closed fracture of one or more phalanges of foot
Closed fracture of one or more phalanges of hand
Closed fracture of one or more phalanges of hand NOS
Closed fracture of one or more tarsal + metatarsal bones NOS
Closed fracture of one rib
Closed fracture of other carpal bone
Closed fracture of other parts of bony thorax
Closed fracture of other tarsal and metatarsal bones
Closed fracture of pelvis NOS
Closed fracture of phalanx or phalanges, unspecified
Closed fracture of rib(s) NOS
Closed fracture of rib, unspecified
Closed fracture of sacrum with spinal cord lesion
Closed fracture of sacrum with spinal cord lesion NOS
Closed fracture of scapula
Closed fracture of scapula NOS
Closed fracture of scapula, unspecified part
Closed fracture of seven ribs
Closed fracture of seventh cervical vertebra
Closed fracture of six ribs
Closed fracture of sixth cervical vertebra
Closed fracture of skull NOS with intracranial injury
Closed fracture of skull NOS without intracranial injury
Closed fracture of spine with spinal cord lesion unspecified
Closed fracture of spine, unspecified,
Closed fracture of talus

Code descriptions - non-long bone fractures
Closed fracture of tarsal bone, unspecified
Closed fracture of the patella
Closed fracture of the scaphoid
Closed fracture of third cervical vertebra
Closed fracture of thoracic spine with cord lesion NOS
Closed fracture of thoracic spine with spinal cord lesion
Closed fracture of three ribs
Closed fracture of thumb metacarpal
Closed fracture of thyroid cartilage
Closed fracture of trachea
Closed fracture of two ribs
Closed fracture of unspecified cervical vertebra
Closed fracture other facial bone
Closed fracture patella, comminuted (stellate)
Closed fracture patella, distal pole
Closed fracture patella, proximal pole
Closed fracture patella, transverse
Closed fracture patella, vertical
Closed fracture pelvis, anterior inferior iliac spine
Closed fracture pelvis, anterior superior iliac spine
Closed fracture pelvis, coccyx
Closed fracture pelvis, iliac wing
Closed fracture pelvis, ischial tuberosity
Closed fracture pelvis, ischium
Closed fracture pelvis, multiple pubic rami - stable
Closed fracture pelvis, multiple pubic rami - unstable
Closed fracture pelvis, single pubic ramus
Closed fracture pisiform
Closed fracture proximal phalanx, toe
Closed fracture pubis
Closed fracture pubis NOS
Closed fracture rib
Closed fracture sacrum
Closed fracture scaphoid, proximal pole
Closed fracture scaphoid, tuberosity
Closed fracture scaphoid, waist, comminuted
Closed fracture scaphoid, waist, oblique
Closed fracture scaphoid, waist, transverse
Closed fracture scapula, acromion
Closed fracture scapula, blade
Closed fracture scapula, coracoid
Closed fracture scapula, glenoid
Closed fracture scapula, neck
Closed fracture scapula, spine
Closed fracture sesamoid bone of hand

Code descriptions - non-long bone fractures
Closed fracture sternum
Closed fracture talus, body
Closed fracture talus, head
Closed fracture talus, neck
Closed fracture thoracic vertebra
Closed fracture thoracic vertebra not otherwise specified
Closed fracture thoracic vertebra, burst
Closed fracture thoracic vertebra, posterior arch
Closed fracture thoracic vertebra, spinous process
Closed fracture thoracic vertebra, spondylolysis
Closed fracture thoracic vertebra, transverse process
Closed fracture thoracic vertebra, wedge
Closed fracture thumb distal phalanx
Closed fracture thumb distal phalanx, base
Closed fracture thumb distal phalanx, mallet
Closed fracture thumb distal phalanx, shaft
Closed fracture thumb distal phalanx, tuft
Closed fracture thumb metacarpal head
Closed fracture thumb metacarpal neck
Closed fracture thumb metacarpal shaft
Closed fracture thumb proximal phalanx
Closed fracture thumb proximal phalanx, base
Closed fracture thumb proximal phalanx, head
Closed fracture thumb proximal phalanx, neck
Closed fracture thumb proximal phalanx, shaft
Closed fracture trapezium
Closed fracture trapezoid
Closed fracture triquetral
Closed fracture vault of skull with intracranial injury
Closed fracture vault of skull without intracranial injury
Closed fracture zygoma
Closed fracture-dislocation IPJ, unspecified
Closed fracture-dislocation acromio-clavicular joint
Closed fracture-dislocation digit
Closed fracture-dislocation digit, unspecified
Closed fracture-dislocation foot
Closed fracture-dislocation lunate (volar)
Closed fracture-dislocation mid carpal
Closed fracture-dislocation multiple digits
Closed fracture-dislocation of pelvis
Closed fracture-dislocation of sternum
Closed fracture-dislocation peri-lunate (dorsal)
Closed fracture-dislocation peri-lunate trans-scaphoid
Closed fracture-dislocation radiocarpal joint
Closed fracture-dislocation shoulder

Code descriptions - non-long bone fractures
Closed fracture-dislocation shoulder joint
Closed fracture-dislocation, IPJ, multiple toes
Closed fracture-dislocation, IPJ, single toe
Closed fracture-dislocation, carpometacarpal joint
Closed fracture-dislocation, distal interphalangeal joint
Closed fracture-dislocation, interphalangeal joint thumb
Closed fracture-dislocation, knee joint
Closed fracture-dislocation, metacarpophalangeal joint
Closed fracture-dislocation, midtarsal joint
Closed fracture-dislocation, patello-femoral joint
Closed fracture-dislocation, proximal interphalangeal joint
Closed fracture-dislocation, subtalar joint
Closed fracture-dislocation, tarsometatarsal joint
Closed fracture-subluxation IPJ, unspecified
Closed fracture-subluxation acromio-clavicular joint
Closed fracture-subluxation digit
Closed fracture-subluxation digit, unspecified
Closed fracture-subluxation lunate (volar)
Closed fracture-subluxation of pelvis
Closed fracture-subluxation of sternum
Closed fracture-subluxation of the wrist
Closed fracture-subluxation other carpal
Closed fracture-subluxation peri-lunate trans-scaphoid
Closed fracture-subluxation radiocarpal joint
Closed fracture-subluxation shoulder
Closed fracture-subluxation shoulder joint
Closed fracture-subluxation, IPJ, multiple toes
Closed fracture-subluxation, IPJ, single toe
Closed fracture-subluxation, carpometacarpal joint
Closed fracture-subluxation, distal interphalangeal joint
Closed fracture-subluxation, foot
Closed fracture-subluxation, interphalangeal joint thumb
Closed fracture-subluxation, knee joint
Closed fracture-subluxation, metacarpophalangeal joint
Closed fracture-subluxation, midtarsal joint
Closed fracture-subluxation, patello-femoral joint
Closed fracture-subluxation, proximal interphalangeal joint
Closed fracture-subluxation, subtalar joint
Closed fracture-subluxation, tarsometatarsal joint
Closed fractures involving head with neck
Closed fractures of multiple sites of unspecified metacarpus
Closed fractures of phalanx or phalanges, multiple sites
Closed multiple fractures of hand bones
Closed multiple fractures of thoracic spine
Closed orbital blow-out fracture

Code descriptions - non-long bone fractures
Closed reduct fract bone and fixat functional bracing system
Closed reduction bone fract & fix with Gissane spike fixator
Closed reduction fracture bone and fixation to skeleton HFQ
Closed reduction fracture disloc joint & internal fixation
Closed reduction fracture small bone & fixation using screw
Closed reduction of bone fracture and external fixation NOS
Closed reduction of bone fracture and external fixation OS
Closed reduction of bone fracture and internal fixation NOS
Closed reduction of bone fracture and internal fixation OS
Closed reduction of dislocation of joint & internal fixation
Closed reduction of fracture
Closed reduction of fracture of finger
Closed reduction of fracture of hallux
Closed reduction of fracture of knee
Closed reduction of fracture of mandible NEC
Closed reduction of fracture of maxilla NEC
Closed reduction of fracture of metacarpus
Closed reduction of fracture of metatarsus
Closed reduction of fracture of nasal bone
Closed reduction of fracture of shoulder
Closed reduction of fracture of thumb
Closed reduction of fracture of toe
Closed reduction of fracture of wrist
Closed spinal fracture with cauda equina lesion
Closed spinal fracture with complete lumbar cord lesion
Closed spinal fracture with unspecified lumbar cord lesion
Closed tarsal fractures, multiple
Closed vertical fracture of ilium
Closed vertical fracture of sacrum
Cls spinal fracture with anterior cervcl cord lesion, C5-7
Cls spinal fracture with complete thorac cord lesion, T7-12
Cls spinal fracture with unspec cervical cord lesion, C1-4
Cls spinal fracture with unspec cervical cord lesion, C5-7
Cls spinal fracture with unspec thoracic cord lesion, T7-12
Cls spinal fracture wth complete thoracic cord lesion,T1-6
Collar bone fracture
Convalesc. after fracture Rx
Debridement of open fracture
Decompression of fracture of spine
Decompression of fracture of spine NOS
Delayed union of fracture
Delayed union of fracture
Depressed skull fracture NOS
Drug-induced osteoporosis with pathological fracture
Elevation of depressed fracture of cranium

Code descriptions - non-long bone fractures
Ethmoid sinus fracture
External fixation of bone NEC
External fixation of bone of face
External fixation of osteotomy NEC
Extraoral fixation of mandible
Extraoral fixation of maxilla NEC
Fatigue fracture of vertebra
Finger fracture
Fixation of bone fragment using Kirschner wire
Fixation of bone of face NOS
Fixation of fracture of spine
Fixation of fracture of spine NOS
Fixation of fracture of spine and skull traction HFQ
Fixation of fracture of spine using Harrington rod
Fixation of jaw NEC
Fixation of mandible
Fixation of mandible NOS
Fixation of maxilla
Fixation of maxilla NEC
Fixation of mid facial bones
Fixator of mandible
Fracture - traction
Fracture NOS
Fracture at wrist and hand level
Fracture dislocations and fracture subluxations
Fracture malunion or nonunion NOS
Fracture of acetabulum
Fracture of alveolus, closed
Fracture of alveolus, open
Fracture of base of skull
Fracture of base of skull NOS
Fracture of bone allograft
Fracture of bone autograft
Fracture of bone in neoplastic disease
Fracture of bone of hand
Fracture of bones NOS
Fracture of bony thorax, part unspecified
Fracture of calcaneus
Fracture of carpal bone
Fracture of carpal bone NOS
Fracture of clavicle
Fracture of clavicle NOS
Fracture of coccyx
Fracture of face bones
Fracture of facial bone NOS

Code descriptions - non-long bone fractures
Fracture of first cervical vertebra
Fracture of first metacarpal bone
Fracture of great toe
Fracture of ilium
Fracture of ill-defined bone of trunk NOS
Fracture of ill-defined bones of trunk
Fracture of inferior maxilla, closed
Fracture of lower jaw, closed
Fracture of lower jaw, open
Fracture of lumbar spine and pelvis
Fracture of lumbar vertebra
Fracture of malar and maxillary bones
Fracture of malar or maxillary bones, closed
Fracture of malar or maxillary bones, closed, NOS
Fracture of malar or maxillary bones, open
Fracture of malar or maxillary bones, open, NOS
Fracture of mandible
Fracture of mandible, closed
Fracture of mandible, closed, NOS
Fracture of mandible, open
Fracture of mandible, open, NOS
Fracture of metacarpal bone
Fracture of metatarsal bone
Fracture of nasal bones
Fracture of neck
Fracture of neck and trunk
Fracture of neck and trunk NOS
Fracture of one or more phalanges of foot
Fracture of one or more phalanges of foot NOS
Fracture of one or more phalanges of hand
Fracture of one or more phalanges of hand NOS
Fracture of one or more tarsal and metatarsal bones
Fracture of orbit NOS, closed
Fracture of orbit NOS, open
Fracture of orbital floor
Fracture of other facial bones, closed, NOS
Fracture of other facial bones,open, NOS
Fracture of other finger
Fracture of other metacarpal bone
Fracture of other parts of bony thorax
Fracture of other toe
Fracture of palate, closed
Fracture of patella
Fracture of patella, NOS
Fracture of pubis

Code descriptions - non-long bone fractures
Fracture of rib
Fracture of rib(s), sternum, larynx and trachea
Fracture of rib(s), sternum, larynx or trachea NOS
Fracture of sacrum
Fracture of scaphoid
Fracture of scapula
Fracture of scapula NOS
Fracture of second cervical vertebra
Fracture of skull
Fracture of skull NOS
Fracture of skull and facial bones
Fracture of spine with spinal cord lesion
Fracture of spine with spinal cord lesion NOS
Fracture of spine without mention of spinal cord injury
Fracture of spine without mention of spinal cord lesion NOS
Fracture of sternum
Fracture of talus
Fracture of tarsal and metatarsal bones NOS
Fracture of thoracic vertebra
Fracture of thumb
Fracture of transverse process of spine + spinal cord lesion
Fracture of transverse process spine - no spinal cord lesion
Fracture of unspecified bones
Fracture of upper jaw, closed
Fracture of upper jaw, open
Fracture of vault of skull
Fracture of vault of skull NOS
Fracture of vertebra with spinal cord lesion
Fracture of vertebra without spinal cord lesion
Fracture or disruption of pelvis
Fracture, cause unspecified
Fracture-dislocation or subluxation foot
Fracture-dislocation or subluxation knee
Fracture-dislocation or subluxation of wrist
Fracture-dislocation or subluxation shoulder
Fracture-dislocation/subluxation finger/thumb
Fractures involving head with neck
Fractures involving multiple body regions
Fractures involving thorax with lower back and pelvis
Fragility fracture due to unspecified osteoporosis
Frontal bone fracture
Frontal sinus fracture
H/O: fracture
H/O: fragility fracture
H/O: non-vertebral fracture

Code descriptions - non-long bone fractures
H/O: vertebral fracture
Halo skull traction for fracture of spine
Hand fracture - carpal bone
Hand fracture - metacarpal bone
Heel bone fracture
Hypertrophic non-union of fracture
Idiopathic osteoporosis with pathological fracture
Insertion of intramedullary fixation and cementing of bone
Intermaxillary fixation of mandible
Intermaxillary fixation of maxilla
Internal fixation of bone NEC
Internal fixation of bone NOS
Internal fixation of bone of face with plating system
Internal fixation of bone of face with wire
Internal fixation of fracture of orbit
Internal fixation of fracture of spine
Internal fixation of mandible NEC
Internal fixation of mandible with arch bars
Internal fixation of mandible with plating system
Internal fixation of mandible with wire
Internal fixation of maxilla NEC
Internal fixation of osteotomy NEC
Jaw fracture NOS
K wiring of fracture
Late effect of face fracture
Late effect of fracture of cervical vertebra
Late effect of fracture of lumbar vertebra
Late effect of fracture of skull and face bones
Late effect of fracture of spine/trunk without cord lesion
Late effect of fracture of thoracic vertebra
Late effect of multiple and unspecified fracture of bones
Late effect of skull fracture
Le Fort I fracture maxilla
Le Fort II fracture maxilla
Le Fort III fracture maxilla
Malunion and nonunion of fracture
Malunion of fracture
Manipulation of fracture and skeletal traction NEC
Manipulation of fracture of bone NEC
Manipulative reduction of fracture of spine
March fracture
Metatarsal bone fracture
Middle fossa fracture
Mult #skull/face + other bones, open, no intracranial injury
Mult #skull/face+other bones, closed + intracranial injury

Code descriptions - non-long bone fractures
Mult #skull/face+other bones, closed, no intracranial injury
Multiple closed fractures of cervical vertebrae
Multiple face fractures
Multiple fractures involving skull and facial bones
Multiple fractures involving skull or face with other bones
Multiple fractures involving skull/face with other bones NOS
Multiple fractures of cervical spine
Multiple fractures of fingers
Multiple fractures of foot
Multiple fractures of hand bones
Multiple fractures of hand bones NOS
Multiple fractures of lumbar spine and pelvis
Multiple fractures of metacarpal bones
Multiple fractures of ribs
Multiple fractures of sternum
Multiple fractures of thoracic spine
Multiple fractures, unspecified
Multiple open fractures of cervical vertebrae
Multiple rib fractures
Multiple skull fractures
Nonunion of fracture
Occiput bone fracture
Open fracture acetabulum
Open fracture acetabulum NOS
Open fracture atlas
Open fracture axis
Open fracture axis, odontoid process
Open fracture base of skull with intracranial injury
Open fracture base skull without mention intracranial injury
Open fracture capitate
Open fracture clavicle, lateral end
Open fracture clavicle, medial end
Open fracture clavicle, shaft
Open fracture cuboid
Open fracture cuneiforms
Open fracture dislocation of sacro-iliac joint
Open fracture dislocation wrist
Open fracture distal phalanx, toe
Open fracture finger distal phalanx
Open fracture finger distal phalanx, base
Open fracture finger distal phalanx, multiple
Open fracture finger distal phalanx, shaft
Open fracture finger distal phalanx, tuft
Open fracture finger metacarpal
Open fracture finger metacarpal base

Code descriptions - non-long bone fractures
Open fracture finger metacarpal head
Open fracture finger metacarpal neck
Open fracture finger metacarpal shaft
Open fracture finger metacarpal, multiple
Open fracture finger middle phalanx
Open fracture finger middle phalanx, base
Open fracture finger middle phalanx, head
Open fracture finger middle phalanx, neck
Open fracture finger middle phalanx, shaft
Open fracture finger proximal phalanx
Open fracture finger proximal phalanx, base
Open fracture finger proximal phalanx, head
Open fracture finger proximal phalanx, multiple
Open fracture finger proximal phalanx, neck
Open fracture finger proximal phalanx, shaft
Open fracture hamate
Open fracture intermediate cuneiform
Open fracture lumbar vertebra
Open fracture lumbar vertebra, burst
Open fracture lumbar vertebra, wedge
Open fracture lunate
Open fracture mandible (site unspecified)
Open fracture maxilla
Open fracture medial cuneiform
Open fracture metatarsal
Open fracture metatarsal base
Open fracture metatarsal neck
Open fracture metatarsal shaft
Open fracture metatarsal, multiple
Open fracture middle phalanx, toe
Open fracture multiple phalanges, toe
Open fracture multiple ribs
Open fracture nasal bone
Open fracture navicular
Open fracture nose
Open fracture of base of fifth metatarsal
Open fracture of bones, unspecified
Open fracture of calcaneus
Open fracture of carpal bone
Open fracture of carpal bone, unspecified
Open fracture of cervical spine
Open fracture of cervical spine with spinal cord lesion
Open fracture of clavicle
Open fracture of clavicle NOS
Open fracture of clavicle, unspecified part

Code descriptions - non-long bone fractures
Open fracture of fifth cervical vertebra
Open fracture of great toe
Open fracture of hyoid bone
Open fracture of ilium, unspecified
Open fracture of lumbar spine with spinal cord lesion
Open fracture of mandible, angle of jaw
Open fracture of mandible, body, other and unspecified
Open fracture of mandible, condylar process
Open fracture of mandible, multiple sites
Open fracture of mandible, ramus, unspecified
Open fracture of mandible, subcondylar
Open fracture of metacarpal bone(s)
Open fracture of metacarpal bone(s) NOS
Open fracture of metacarpal bone(s), site unspecified
Open fracture of one or more phalanges of foot
Open fracture of one or more phalanges of hand
Open fracture of one or more phalanges of hand NOS
Open fracture of other tarsal and metatarsal bones
Open fracture of pelvis NOS
Open fracture of phalanx or phalanges, multiple sites
Open fracture of phalanx or phalanges, unspecified
Open fracture of pubis
Open fracture of pubis NOS
Open fracture of rib, unspecified
Open fracture of sacrum with other spinal cord injury
Open fracture of sacrum with spinal cord lesion
Open fracture of scapula
Open fracture of scapula NOS
Open fracture of scapula, unspecified part
Open fracture of seven ribs
Open fracture of sixth cervical vertebra
Open fracture of skull NOS with intracranial injury
Open fracture of spine, unspecified,
Open fracture of talus
Open fracture of tarsal and metatarsal bones NOS
Open fracture of tarsal bone, unspecified
Open fracture of the patella
Open fracture of the scaphoid
Open fracture of thoracic spine with spinal cord lesion
Open fracture of thumb metacarpal
Open fracture of trachea
Open fracture of two ribs
Open fracture other facial bone
Open fracture patella, comminuted (stellate)
Open fracture patella, distal pole

Code descriptions - non-long bone fractures
Open fracture patella, proximal pole
Open fracture patella, transverse
Open fracture pelvis, anterior superior iliac spine
Open fracture pelvis, coccyx
Open fracture pelvis, iliac wing
Open fracture pelvis, ischial tuberosity
Open fracture pelvis, multiple pubic rami - stable
Open fracture pelvis, single pubic ramus
Open fracture pisiform
Open fracture proximal phalanx, toe
Open fracture rib
Open fracture sacrum
Open fracture scaphoid, proximal pole
Open fracture scaphoid, tuberosity
Open fracture scaphoid, waist, comminuted
Open fracture scaphoid, waist, oblique
Open fracture scaphoid, waist, transverse
Open fracture scapula, acromion
Open fracture scapula, blade
Open fracture scapula, coracoid
Open fracture scapula, glenoid
Open fracture scapula, neck
Open fracture sesamoid bone of hand
Open fracture sternum
Open fracture talus, body
Open fracture talus, neck
Open fracture thoracic vertebra
Open fracture thoracic vertebra, wedge
Open fracture thumb distal phalanx
Open fracture thumb distal phalanx, base
Open fracture thumb distal phalanx, shaft
Open fracture thumb distal phalanx, tuft
Open fracture thumb metacarpal shaft
Open fracture thumb proximal phalanx
Open fracture thumb proximal phalanx, base
Open fracture thumb proximal phalanx, neck
Open fracture thumb proximal phalanx, shaft
Open fracture trapezium
Open fracture trapezoid
Open fracture triquetral
Open fracture vault of skull with intracranial injury
Open fracture vault of skull without intracranial injury
Open fracture zygoma
Open fracture-dislocation IPJ, unspecified
Open fracture-dislocation acromio-clavicular joint

Code descriptions - non-long bone fractures
Open fracture-dislocation carpometacarpal joint
Open fracture-dislocation digit
Open fracture-dislocation digit, unspecified
Open fracture-dislocation multiple digits
Open fracture-dislocation of pelvis
Open fracture-dislocation of sternum
Open fracture-dislocation peri-lunate trans-scaphoid
Open fracture-dislocation radiocarpal joint
Open fracture-dislocation shoulder
Open fracture-dislocation sterno-clavicular joint, anterior
Open fracture-dislocation, IPJ, single toe
Open fracture-dislocation, distal interphalangeal joint
Open fracture-dislocation, foot
Open fracture-dislocation, interphalangeal joint thumb
Open fracture-dislocation, knee joint
Open fracture-dislocation, metacarpophalangeal joint
Open fracture-dislocation, metatarsophalangeal joint, single
Open fracture-dislocation, patello-femoral joint
Open fracture-dislocation, proximal interphalangeal joint
Open fracture-dislocation, subtalar joint
Open fracture-dislocation, tarsometatarsal joint
Open fracture-subluxation acromio-clavicular joint
Open fracture-subluxation digit
Open fracture-subluxation multiple digits
Open fracture-subluxation of pelvis
Open fracture-subluxation of sternum
Open fracture-subluxation of the wrist
Open fracture-subluxation peri-lunate trans-scaphoid
Open fracture-subluxation radiocarpal joint
Open fracture-subluxation, IPJ, single toe
Open fracture-subluxation, carpometacarpal joint
Open fracture-subluxation, distal interphalangeal joint
Open fracture-subluxation, foot
Open fracture-subluxation, interphalangeal joint thumb
Open fracture-subluxation, knee joint
Open fracture-subluxation, metacarpophalangeal joint
Open fracture-subluxation, metatarsophalangeal joint, single
Open fracture-subluxation, patello-femoral joint
Open fracture-subluxation, proximal interphalangeal joint
Open fractures calcaneus, intra-articular
Open fractures of multiple sites of unspecified metacarpus
Open multiple fracture of thoracic spine
Open multiple fractures of hand bones
Open orbital blow-out fracture
Open osteoclasis and internal fixation NEC

Code descriptions - non-long bone fractures
Open osteoclasis, angular correction & internal fixation HFQ
Open reduction injury growth plate and internal fixation HFQ
Open reduction of # dislocation of joint+fxn of jnt,unspec
Open reduction of fracture of mandible NEC
Open reduction of fracture of maxilla NEC
Open reduction of fracture of orbit
Open reduction of fracture of orbit and internal fixation
Open reduction of fracture of spine & excis facet of spine
Open reduction of fracture of spine NEC
Open surgical fracture of bone
Open surgical fracture of bone NOS
Open vertical fracture of sacrum
Orbital roof fracture
Os calcis fracture
Other and unqualified skull fractures
Other closed fracture-dislocation
Other closed fracture-subluxation
Other closed reduction of fracture of bone
Other closed reduction of fracture of bone NOS
Other fixation of bone
Other fixation of bone NOS
Other fracture-dislocation or subluxation
Other open fracture of pelvis
Other open fracture-dislocation
Other or multiple closed fracture of pelvis
Other or multiple closed fracture of pelvis NOS
Other or multiple open fracture of pelvis
Other primary external immobilisation of fracture
Other primary open reduction of fracture of bone
Other primary open reduction of fracture of bone NOS
Other reduction of fracture of spine
Other reduction of fracture of spine NOS
Other reduction of fracture of spine and stabilisation
Other specified closed fracture acetabulum
Other specified closed fracture pubis
Other specified closed fracture thoracic vertebra
Other specified decompression of fracture of spine
Other specified fixation of bone of face
Other specified fixation of fracture of spine
Other specified fixation of mandible
Other specified internal fixation of bone
Other specified open fracture acetabulum
Other specified open fracture of pubis
Other specified open surgical fracture of bone
Other specified other closed reduction of fracture of bone

Code descriptions - non-long bone fractures
Other specified other fixation of bone
Other specified other reduction of fracture of spine
Other specified other surgical fracture of bone
Other specified pathological fracture
Other specified reduction of fracture of facial bone
Other specified reduction of fracture of mandible
Other specified reduction of fracture of maxilla
Other specified secondary open reduction of fracture of bone
Other surgical fracture of bone
Other surgical fracture of bone NOS
Other/multiple open fracture of pelvis NOS
Outfracture of turbinates of nose
Packing of maxilla to correct blow-out fracture of orbit
Parietal bone fracture
Posterior decompression of fracture of spine
Posterior decompression of fracture of spine NEC
Posterior fossa fracture
Postmenopausal osteoporosis with pathological fracture
Postoophorectomy osteoporosis with pathological fracture
Postsurgical malabsorption osteoporosis with path fracture
Prim extraarticular reduction intraartic fracture bone NEC
Prim fixat fragment chondral cartilage intraartic fract bone
Prim open reduction fract small bone & fixation using screw
Prim open reduction fracture bone & extramedull fixation NOS
Prim open reduction fracture bone & intramedull fixation NOS
Prim open reduction fracture bone & intramedullary fixatn OS
Prim open reduction fragment bone & fixation using wire syst
Prim open reduction fragment of bone & fix - Herbert screw
Prim open reduction fragment of bone & fixation using screw
Primary arthroscopic reduction and fixation of fracture
Primary arthroscopic reduction of fracture
Primary bedrest stabilisation of spinal fracture
Primary cast immobilisation of fracture
Primary cast stabilisation of spinal fracture
Primary closed reduction # dislocation jnt+skeletal traction
Primary closed reduction # dislocation+fixation by wire(s)
Primary closed reduction # dislocation+other extrnal immobil
Primary closed reduction #+internal fixation with screw(s)
Primary closed reduction #+internal fixation with wire
Primary closed reduction #+other internal fixation
Primary closed reduction of # and skeletal traction NEC
Primary closed reduction of # dislocation+cast immobil
Primary closed reduction of fracture alone
Primary closed reduction of fracture and cast immobilisation
Primary closed reduction of fracture and external fixation

Code descriptions - non-long bone fractures
Primary closed reduction of fracture and skin traction
Primary closed reduction of fracture and wire fixation
Primary closed reduction of fracture dislocation alone
Primary cls reduc spinal fracture+skull traction stabilisatn
Primary collar stabilisation of spinal fracture
Primary external fixation of fracture
Primary functional bracing of fracture
Primary intraarticular fixation intraartic fracture bone NEC
Primary manipulative closed reduct fract dislocat joint NEC
Primary open reduc spinal #+internal fix+internal fixator
Primary open reduc spinal fracture+internal fix+plate
Primary open reduc spinal fracture+internal fix+rod system
Primary open reduc spinal fracture+internal fix+wire
Primary open reduc spinal fracture+other internal fix
Primary open reduct # dislocat joint comb int external fix
Primary open reduction # dislocation joint internal fix NEC
Primary open reduction # dislocation+other jnt stabilisation
Primary open reduction fract bone & extramedullary fixation
Primary open reduction fracture bone & intramedull fixation
Primary open reduction fracture patella fixat tension band
Primary open reduction of # dislocation+cast immobilisation
Primary open reduction of # dislocation+external fixation
Primary open reduction of # dislocation+fixation+plate(s)
Primary open reduction of # dislocation+fixation+screw(s)
Primary open reduction of # dislocation+wire fixation
Primary open reduction of #+other ext immobilisation
Primary open reduction of bone fracture & external fixation
Primary open reduction of fracture alone
Primary open reduction of fracture and cast immobilisation
Primary open reduction of fracture and functional bracing
Primary open reduction of fracture and skin traction
Primary open reduction of fracture dislocation alone
Primary open reduction of fracture dislocation of joint NEC
Primary open reduction of intraarticular fracture bone NOS
Primary open reduction of intraarticular fracture bone OS
Primary open reduction of intraarticular fracture of bone
Primary other external stabilisation of spinal fracture
Primary reduction intraarticular fract bone using arthrotomy
Primary skeletal traction of fracture
Primary skin traction of fracture
Primary wire fixation of fracture
Prmy open reduction #+int fxtn with multiple implant types
Prmy open reduction #+internal fixation with cerclage wiring
Prmy open reduction #+internal fxn with tension band wiring
Prmy open reduction #+other int(extramedullary) fixation

Code descriptions - non-long bone fractures
Prmy open reduction of #+internal fixation with K-wire
Prmy open reduction of #+internal fixation with plate NEC
Prmy open reduction of #+internal fixation with screw(s)
Prmy open reduction of fracture and external fixation
Prmy open reduction of fracture and skeletal traction
Pseudoarthrosis - fracture nonunion
Reduction of Le Fort 1 fracture of maxilla
Reduction of Le Fort 2 fracture of maxilla
Reduction of Le Fort 3 fracture of maxilla
Reduction of blowout fracture of orbital floor
Reduction of closed fracture of orbit bone
Reduction of fracture of alveolus of mandible
Reduction of fracture of alveolus of maxilla
Reduction of fracture of facial bone
Reduction of fracture of facial bone NOS
Reduction of fracture of jaw NEC
Reduction of fracture of mandible
Reduction of fracture of mandible NOS
Reduction of fracture of maxilla
Reduction of fracture of maxilla NOS
Reduction of fracture of nasal bones NEC
Reduction of fracture of nasoethmoid complex of bones
Reduction of fracture of zygomatic bones
Reduction of laryngeal fracture
Remanipulation of fracture dislocation alone
Remanipulation of fracture of bone NEC
Remanipulation of fracture of bone and external fixation HFQ
Removal of Kirschner wire internal bone fixator
Removal of external fixator NEC
Removal of fixation from fracture of orbit
Removal of fixation from mandible
Removal of fixation from maxilla
Removal of fixation from midfacial bone
Removal of internal fixation device NEC
Removal of spinal fixation system
Repair of fracture of cranium NEC
Revision to arthroscopic reduction and fixation of fracture
Revision to arthroscopic reduction of fracture
Revision to bedrest stabilisation of spinal fracture
Revision to cast immobilisation of fracture
Revision to closed reduction # + internal fixation with wire
Revision to closed reduction # + other internal fixation
Revision to closed reduction #+internal fixation with screws
Revision to closed reduction dislocation+fixation by wire(s)
Revision to closed reduction of # + oth ext immobilisation

Code descriptions - non-long bone fractures
Revision to closed reduction of # and cast immobilisation
Revision to closed reduction of # and external fixation
Revision to closed reduction of # and skeletal traction NEC
Revision to closed reduction of fracture alone
Revision to closed reduction of fracture and wire fixation
Revision to closed reduction of fracture dislocation alone
Revision to collar stabilisation of spinal fracture
Revision to external fixation of fracture
Revision to external fixation stabilisation spinal fracture
Revision to functional bracing of fracture
Revision to open reduction # dislocation+skeletal traction
Revision to open reduction fracture dislocation alone
Revision to open reduction of # and functional bracing
Revision to open reduction of # dislocation+fixation+wire(s)
Revision to open reduction of fracture alone
Revision to open reduction of fracture and external fixation
Revision to open reduction of fracture of bone
Revision to skin traction of fracture
Revision to wire fixation of fracture
Rib fracture NOS
Rotation diaphyseal osteotomy and external fixation HFQ
Rotation diaphyseal osteotomy and internal fixation HFQ
Rotational mal-union of fracture
Rvsn open reduc spinal fracture+internal fix+internl fixator
Rvsn open reduc spinal fracture+internal fix+plate
Rvsn open reduc spinal fracture+internal fix+rod system
Secondary open reduct fracture bone & external fixation HFQ
Secondary open reduction fracture disloc joint & fixation
Secondary open reduction fracture dislocation of joint NEC
Secondary open reduction of fracture of bone
Secondary open reduction of fracture of bone NOS
Secondary open reduction of intraarticular fracture of bone
Shoulder blade fracture
Shoulder fracture - open
Skull fracture NOS
Sphenoid bone fracture
Spinal extension traction for fracture of spine
Spinal traction for fracture of spine NEC
Sponanteous fracture
Sternum fracture NOS
Tarsal bone fracture
Temporal bone fracture
Thumb fracture excluding base
Toe fracture
Traction for fracture of jaw

Code descriptions - non-long bone fractures
Vertebroplasty of fracture of spine
Wrist fracture - closed
Wrist fracture - open
[Q] Fracture type qualifying terms
[Q] Fractures involving the epiphyseal plate
[Q] Open fracture grade 2
[Q] Refracture
[V]Convalescence after treatment of fracture
[V]Fracture follow-up
[V]Rehabilitation following fracture
[X]Closed multiple fractures unspecified
[X]Fracture of other & unspecified parts of wrist and hand
[X]Fracture of other metacarpal bone
[X]Fracture of other parts of neck
[X]Fracture of other parts of shoulder and upper arm
[X]Fracture of other specified cervical vertebra
[X]Fracture of other tarsal bones
[X]Fracture of shoulder and upper arm, unspecified
[X]Fracture of skull and facial bones, part unspecified
[X]Open multiple fractures unspecified
[X]Other osteoporosis with pathological fracture

6.16 Code descriptions identifying thermal injuries

Code descriptions - thermal injuries
[D]Burning of skin
[X]Burn of unspecified body region, unspecified degree
[X]Burns and corrosions
[X]Burns of mult reg, at least 1 burn of 3rd deg mentioned
[X]Burns of other and unspecified internal organs
[X]Burns of other parts of eye and adnexa
[X]Cause of accident burn / scald
[X]Exposr unspecif smoke fire/flame sch oth ins/pub adm area
[X]Exposur uncontrol fire not in building/structure occ home
[X]Exposur unspecif smoke fire/flame occ indust/constr area
[X]Exposur unspecif smoke fire/flame occurrn unspecif place
[X]Exposure to bonfire
[X]Exposure to controlld fire in building/structur occ home
[X]Exposure to controlled fire, not in building / structure
[X]Exposure to oth specif smoke fire+flames occurrn at home
[X]Exposure to smoke fire+flame undeterm intent occ at home
[X]Exposure to smoke, fire and flames
[X]Exposure to smoke, fire and flames, undetermined intent
[X]Exposure to uncontr fire in building/structur occ home
[X]Exposure to unspecifd smoke fire/flames occurrn at home
[X]Exposure to unspecified smoke, fire and flames
Abrasion/friction burn of finger, without infection
Abrasion/friction burn of foot and toe, without infection
Abrasion/friction burn of hand, without infection
Abrasion/friction burn of lower arm, without infection NOS
Abrasion/friction burn of lower limb, without infection
Abrasion/friction burn of lower limb, without infection NOS
Abrasion/friction burn of neck, without infection
Abrasion/friction burn of trunk, without infection NOS
Abrasion/friction burn shoulder/upper arm without infection
Abrasion/friction burn shoulder/upper arm, no infection, NOS
Accid burning caused by heat from electric heating appliance
Accident caused by clothes on fire from candle
Accident caused by clothes on fire from cigarette
Accident caused by clothes on fire from lighter
Accident caused by clothes on fire from matches
Accident caused by clothes on fire from welding torch
Accident caused by controlled fire in private dwelling
Accident caused by controlled fire in the open, bonfire
Accident caused by controlled fire in the open, trash fire
Accident caused by fire or flames NOS
Accident caused by fireworks
Accident caused by normal electric fire in private dwelling
Accident caused by normal electric fire other struct/build
Accident caused by normal gas fire in private dwelling

Code descriptions - thermal injuries
Accident caused by normal gas fire other structure/building
Accident caused by other fire and flames
Accident caused by other flame or fire NOS
Accident caused by unspecified fire
Accidental burn or other injury from electric current NOS
Accidental burning caused by acid
Accidental burning caused by ammonia
Accidental burning caused by caustic and corrosive substance
Accidental burning caused by caustic or corrosive NOS
Accidental burning caused by caustic oven cleaner etc
Accidental burning caused by hot object NOS
Accidental burning caused by hydrofluoric acid
Accidental burning caused by light bulb
Accidental burning caused by other caustic or corrosive
Accidental burning caused by other hot substance or object
Accidental burning caused by steam pipe
Accidental burning or scalding by steam from car radiator
Accidental burning or scalding caused by bitumen or tar
Accidental burning or scalding caused by chocolate
Accidental burning or scalding caused by coffee
Accidental burning or scalding caused by fat
Accidental burning or scalding caused by liquid metal
Accidental burning or scalding caused by milk
Accidental burning or scalding caused by other hot vapour
Accidental burning or scalding caused by plastic
Accidental burning or scalding caused by steam
Accidental burning or scalding caused by steam from kettle
Accidental burning or scalding caused by tea
Accidental burning/scalding by boiling water from kettle
Accidental burning/scalding by boiling water from saucepan
Accidental burning/scalding caused by boiling liquid, unspec
Accidental burning/scalding caused by boiling water, unspec
Accidental burning/scalding caused by hot liquid/vapour NOS
Accidental burning/scalding caused by soup, stew or curries
Accidentally burned by machinery
Accidents caused by clothes on fire, ACOF
Accidents caused by fire and flames
Acid chemical burn of cornea and conjunctival sac
ACOF-contr fire in private dwelling - brazier
ACOF-contr fire in private dwelling - normal charcoal fire
ACOF-contr fire in private dwelling - normal gas fire
ACOF-controlled fire in the open due to trash fire
Admit to burns unit
Aircraft fire on takeoff - parachutist injured
Alkaline chemical burn of cornea and conjunctival sac

Code descriptions - thermal injuries
Assessment of burn injuries
Assessment of levels of burns
Attention to dressing of burn of head or neck
Attention to dressing of burnt skin
Attention to dressing of burnt skin NEC
Blister of arm, second degree burn
Blister of face, head and neck, second degree burn
Blister of leg, second degree burn
Blister of trunk, second degree burn
Blister of wrist and hand, second degree burn
Burn - unspecified
Burn - unspecified
Burn and corrosion of hip and lower limb,except ankle & foot
Burn as a percentage of body surface involved NOS
Burn confined to eye and adnexa
Burn confined to eye and adnexa NOS
Burn contracture of skin
Burn dressing
Burn involving <10% of body surface (BS)
Burn involving >90% of body surface (BS)
Burn involving 10-19% of body surface (BS)
Burn involving 20-29% of body surface (BS)
Burn involving 30-39% of body surface (BS)
Burn involving 40-49% of body surface (BS)
Burn involving 50-59% of body surface (BS)
Burn involving 60-69% of body surface (BS)
Burn involving 70-79% of body surface (BS)
Burn of cornea NOS
Burn of eyelid NOS
Burn of internal organ NOS
Burn of internal organs
Burn of lower limbs
Burn of multiple specified sites
Burn of multiple specified sites NOS
Burn of the arm (excluding wrist and hand)
Burn of the arm (excluding wrist and hand) NOS
Burn of the face, head or neck
Burn of the face, head or neck NOS
Burn of the gastrointestinal tract
Burn of the gastrointestinal tract NOS
Burn of the gum
Burn of the larynx
Burn of the larynx, trachea and lung
Burn of the larynx, trachea or lung NOS
Burn of the lower limb NOS

Code descriptions - thermal injuries
Burn of the lung
Burn of the mouth and pharynx
Burn of the mouth or pharynx NOS
Burn of the mouth, unspecified
Burn of the oesophagus
Burn of the pharynx
Burn of the rectum
Burn of the small intestine
Burn of the stomach
Burn of the tongue
Burn of the trachea
Burn of the trunk
Burn of the trunk NOS
Burn of the vagina
Burn of the vagina and uterus
Burn of the vagina or uterus NOS
Burn of the wrist(s) and hand(s)
Burn of wrist or hand NOS
Burn resulting in eyeball rupture and destruction of eyeball
Burn: 10-14% of body surface, 10-14% BS full thickness
Burn: 10-14% of body surface,<10%/unsp BS full thickness
Burn: 10-19% of body surface NOS
Burn: 20-29% of body surface NOS
Burn: 20-29% of body surface,<10%/unspec BS full thickness
Burn: 30-39% of body surface NOS
Burn: 40-49% of body surface NOS
Burn: 40-49% of body surface, 40-49% BS full thickness
Burn: 50-59% of body surface NOS
Burn: 50-59% of body surface, 40-49% BS full thickness
Burn: 70-79% of body surface, 50-59% BS full thickness
Burn:<10% of body surface NOS
Burn:<10% of body surface, 10%/unspec BS full thickness
Burned while ship on fire
Burning bedclothes
Burning caused by conflagration in camping place
Burning caused by conflagration in house
Burning caused by conflagration in other structure/building
Burning caused by conflagration in private dwelling
Burning caused by conflagration in private dwelling NOS
Burns
Burns as a percentage of body surface (BS) involved
Burns NOS
Burns referral
burnterm
Cheek - 2nd degree burn

Code descriptions - thermal injuries
Chemical burn of eyelids and periocular area
Conjunctival burns
Corneal burns
Covering burnt skin with plastic bag
Debridement of burnt skin NEC
Debridement of burnt skin of head and neck
Deep full thickness burn of a finger, no loss of body part
Deep full thickness burn of abdom.wall, no loss of body part
Deep full thickness burn of ankle without loss of body part
Deep full thickness burn of ankle, with loss of body part
Deep full thickness burn of arm without loss of body part
Deep full thickness burn of axilla, with loss of body part
Deep full thickness burn of back without loss of body part
Deep full thickness burn of buttock, no loss of body part
Deep full thickness burn of buttock, with loss of body part
Deep full thickness burn of chest, with loss of body part
Deep full thickness burn of ear without loss of body part
Deep full thickness burn of elbow without loss of body part
Deep full thickness burn of eye without loss of body part
Deep full thickness burn of foot without loss of body part
Deep full thickness burn of foot, with loss of body part
Deep full thickness burn of forearm, no loss of body part
Deep full thickness burn of hand unsp, no loss of body part
Deep full thickness burn of knee without loss of body part
Deep full thickness burn of leg unsp, no loss of body part
Deep full thickness burn of leg without loss of body part
Deep full thickness burn of leg, with loss of body part
Deep full thickness burn of lower leg without loss of body
Deep full thickness burn of neck without loss of body part
Deep full thickness burn of palm hand, no loss of body part
Deep full thickness burn of scalp without loss of body part
Deep full thickness burn of shoulder, no loss of body part
Deep full thickness burn of the ear, with loss of body part
Deep full thickness burn of thigh without loss of body part
Deep full thickness burn of thumb without loss of body part
Deep full thickness burn of toe(s), with loss of body part
Deep full thickness burn of trunk without loss of body part
Deep full thickness burn of trunk, with loss of body part
Deep full thickness burn of upper arm, no loss of body part
Deep full thickness burn of wrist/hand, no loss of body part
Deep full thickness burn, without loss of body part, NOS
Deep partial thickness burn NOS
Deep partial thickness burn of a single finger
Deep partial thickness burn of back of hand
Deep partial thickness burn of multiple specified sites

Code descriptions - thermal injuries
Deep partial thickness burn of the ankle
Deep partial thickness burn of the arm, unspecified
Deep partial thickness burn of the back (excluding buttock)
Deep partial thickness burn of the breast
Deep partial thickness burn of the buttock
Deep partial thickness burn of the chest wall
Deep partial thickness burn of the chin
Deep partial thickness burn of the ear
Deep partial thickness burn of the elbow
Deep partial thickness burn of the eye
Deep partial thickness burn of the foot
Deep partial thickness burn of the forearm
Deep partial thickness burn of the hand, unspecified
Deep partial thickness burn of the knee
Deep partial thickness burn of the leg, unspecified
Deep partial thickness burn of the lower leg
Deep partial thickness burn of the palm of hand
Deep partial thickness burn of the scalp
Deep partial thickness burn of the scapular region
Deep partial thickness burn of the thigh
Deep partial thickness burn of the thumb
Deep partial thickness burn of the toe(s)
Deep partial thickness burn of the upper arm
Deep partial thickness burn of wrist
Deep third degree burn of finger with loss of a body part
Deep third degree burn of finger,without loss of a body part
Deep third degree burn of hand, without loss of a body part
Deep third degree burn of wrist, without loss of a body part
Dressing of burn
Dressing of burnt skin
Dressing of burnt skin NEC
Dressing of burnt skin of head or neck
DTF - Deep transverse frictions
Ear - 2nd degree burn
Erythema of arm, first degree burn
Erythema of head or neck, first degree burn
Erythema of leg, first degree burn
Erythema of trunk, 1st degree burn
Erythema of wrist and hand,first degree burn
Exploration of burnt skin NEC
Exploration of skin wound or burn
Eye - 2nd degree burn
Eyelid burns
Face burns
Fire in road vehicle NEC

Code descriptions - thermal injuries
Fire on aircraft while taking off
Fire on aircraft-flying - other person injured
First degree burn
First degree burn of finger
First degree burn of hand
First degree burn of multiple sites of the wrist or hand
First degree burn of thumb
First degree burn of wrist
Forehead - 2nd degree burn
Friction burns
Frictions
Full thickness burn NOS
Full thickness burn of a single finger
Full thickness burn of more than one finger
Full thickness burn of multiple sites of face, head or neck
Full thickness burn of multiple sites of the leg
Full thickness burn of multiple specified sites
Full thickness burn of the abdominal wall
Full thickness burn of the ankle
Full thickness burn of the arm
Full thickness burn of the arm, unspecified
Full thickness burn of the axilla
Full thickness burn of the back (excluding buttock)
Full thickness burn of the back of hand
Full thickness burn of the breast
Full thickness burn of the buttock
Full thickness burn of the cheek
Full thickness burn of the chest wall
Full thickness burn of the ear
Full thickness burn of the elbow
Full thickness burn of the eye
Full thickness burn of the face, head or neck
Full thickness burn of the foot
Full thickness burn of the forearm
Full thickness burn of the forehead
Full thickness burn of the hand, unspecified
Full thickness burn of the knee
Full thickness burn of the leg
Full thickness burn of the leg NOS
Full thickness burn of the leg, unspecified
Full thickness burn of the lip(s)
Full thickness burn of the lower leg
Full thickness burn of the neck
Full thickness burn of the nose
Full thickness burn of the palm of hand

Code descriptions - thermal injuries
Full thickness burn of the scalp
Full thickness burn of the shoulder
Full thickness burn of the thigh
Full thickness burn of the thumb
Full thickness burn of the thumb and finger(s)
Full thickness burn of the toe(s)
Full thickness burn of the trunk
Full thickness burn of the trunk, unspecified
Full thickness burn of the upper arm
Full thickness burn of the wrist
Full thickness burn of the wrist and hand
Full thickness burn of the wrist or hand NOS
Full thickness burn of unspecified part of the face or head
Head burns
House fire
Injury ?accidental, by burns or fire
Injury ?accidental, by scald
Late effect of burn NOS
Late effect of burn of arm or leg
Late effect of burn of arm, leg and foot
Late effect of burn of eye, head and neck
Late effect of burn of head or neck
Late effect of burn of upper limb
Late effect of burn of wrist and hand
Late effect of other burns
Late effects of accident caused by fire
Leg burns
Lip - 2nd degree burn
Operations on burnt skin
Other accident due to fire in other structure/building
Other burns of eyelids and periocular area
Other chemical burn of cornea and conjunctival sac
Other specified toilet to burnt skin
Partial thickness burn NOS
Partial thickness burn of multiple sites face, head or neck
Partial thickness burn of multiple sites of the leg
Partial thickness burn of multiple sites of the trunk
Partial thickness burn of multiple sites of the wrist/hand
Partial thickness burn of multiple specified sites
Partial thickness burn of the arm
Partial thickness burn of the arm NOS
Partial thickness burn of the face, head or neck
Partial thickness burn of the face, head or neck NOS
Partial thickness burn of the leg
Partial thickness burn of the leg NOS

Code descriptions - thermal injuries
Partial thickness burn of the trunk
Partial thickness burn of the trunk NOS
Partial thickness burn of the wrist and hand
Partial thickness burn of the wrist or hand NOS
Periocular burns
Removal of slough from burnt skin NEC
Scalds
Scalp - 2nd degree burn
Second degree burn
Second degree burn of finger
Second degree burn of hand
Second degree burn of thumb
Second degree burn of wrist
Self-scalding
Seq/burn+corros classfbl only accord extent/body surf involv
Sequelae of burn, corrosion and frostbite of lower limb
Sequelae of burn, corrosion and frostbite of trunk
Sequelae of burns, corrosions and frostbite
Smoke inhalation
Smoke inhalation
Smoke NOS from conflagration in house
Smoke NOS from conflagration in private dwelling
Smoke NOS from conflagration in private dwelling NOS
Smoke NOS from conflagration in structure or building
Smoke NOS from conflagration in tenement
Superficial burn NOS
Superficial burn of a single finger
Superficial burn of more than one finger
Superficial burn of multiple sites of the arm
Superficial burn of multiple sites of the face, head or neck
Superficial burn of multiple sites of the leg
Superficial burn of multiple specified sites
Superficial burn of the abdominal wall
Superficial burn of the ankle
Superficial burn of the arm
Superficial burn of the arm NOS
Superficial burn of the arm, unspecified
Superficial burn of the axilla
Superficial burn of the back (excluding buttock)
Superficial burn of the back of hand
Superficial burn of the breast
Superficial burn of the buttock
Superficial burn of the cheek
Superficial burn of the chest wall
Superficial burn of the chin

Code descriptions - thermal injuries
Superficial burn of the ear
Superficial burn of the elbow
Superficial burn of the eye
Superficial burn of the face, head or neck
Superficial burn of the face, head or neck NOS
Superficial burn of the foot
Superficial burn of the forearm
Superficial burn of the forehead
Superficial burn of the genitalia
Superficial burn of the hand, unspecified
Superficial burn of the knee
Superficial burn of the leg
Superficial burn of the leg NOS
Superficial burn of the leg, unspecified
Superficial burn of the lip(s)
Superficial burn of the lower leg
Superficial burn of the neck
Superficial burn of the nose
Superficial burn of the palm of hand
Superficial burn of the scalp
Superficial burn of the scapular region
Superficial burn of the shoulder
Superficial burn of the thigh
Superficial burn of the thumb
Superficial burn of the thumb and finger(s)
Superficial burn of the toe(s)
Superficial burn of the trunk
Superficial burn of the trunk NOS
Superficial burn of the upper arm
Superficial burn of the wrist
Superficial burn of the wrist and hand
Superficial burn of the wrist or hand NOS
Superficial burn of unspecified part of the face or head
Superficial burn of unspecified part of the trunk
Superficial frictions
Superficial part. thickness burn unspecified part face/head
Superficial partial thickness burn multiple specified sites
Superficial partial thickness burn NOS
Superficial partial thickness burn of a single finger
Superficial partial thickness burn of back (excl buttock)
Superficial partial thickness burn of back of hand
Superficial partial thickness burn of hand, unspecified
Superficial partial thickness burn of more than one finger
Superficial partial thickness burn of palm of hand
Superficial partial thickness burn of scapular region

Code descriptions - thermal injuries
Superficial partial thickness burn of the abdominal wall
Superficial partial thickness burn of the ankle
Superficial partial thickness burn of the arm, unspecified
Superficial partial thickness burn of the breast
Superficial partial thickness burn of the buttock
Superficial partial thickness burn of the cheek
Superficial partial thickness burn of the chest wall
Superficial partial thickness burn of the chin
Superficial partial thickness burn of the ear
Superficial partial thickness burn of the elbow
Superficial partial thickness burn of the eye
Superficial partial thickness burn of the foot
Superficial partial thickness burn of the forearm
Superficial partial thickness burn of the forehead
Superficial partial thickness burn of the genitalia
Superficial partial thickness burn of the knee
Superficial partial thickness burn of the leg, unspecified
Superficial partial thickness burn of the lip(s)
Superficial partial thickness burn of the lower leg
Superficial partial thickness burn of the neck
Superficial partial thickness burn of the nose
Superficial partial thickness burn of the scalp
Superficial partial thickness burn of the shoulder
Superficial partial thickness burn of the thigh
Superficial partial thickness burn of the thumb
Superficial partial thickness burn of the toe(s)
Superficial partial thickness burn of the upper arm
Superficial partial thickness burn of the wrist
Superficial partial thickness burn of thumb and finger(s)
Superficial partial thickness burn unspecified part of trunk
Tangent excision of burnt skin NEC
Tangent excision of burnt skin of head or neck
Third degree burn
Third degree burn of finger
Third degree burn of hand
Third degree burn of wrist
Toilet or clean burnt skin NEC
Toilet to burnt skin NOS
Train accident involving burning
Train accident involving explosion, fire or burning
Transverse frictions
Uncontrolled fire in grass
Uncontrolled fire in hay
Uncontrolled fire in mine
Uncontrolled lumber fire

Code descriptions - thermal injuries
Unspecified degree burn of finger
Unspecified degree burn of hand
Unspecified degree burn of the leg, unspecified
Unspecified degree burn of thumb
Unspecified degree burn of wrist
Unspecified degree of burn NOS
Unspecified thickness burn multiple sites face, head or neck
Unspecified thickness burn of a single finger
Unspecified thickness burn of more than one finger
Unspecified thickness burn of multiple sites of the arm
Unspecified thickness burn of multiple sites of the leg
Unspecified thickness burn of multiple sites of the trunk
Unspecified thickness burn of multiple sites of wrist/hand
Unspecified thickness burn of multiple specified sites
Unspecified thickness burn of the abdominal wall
Unspecified thickness burn of the ankle
Unspecified thickness burn of the arm
Unspecified thickness burn of the arm NOS
Unspecified thickness burn of the arm, unspecified
Unspecified thickness burn of the axilla
Unspecified thickness burn of the back (excluding buttock)
Unspecified thickness burn of the back of hand
Unspecified thickness burn of the breast
Unspecified thickness burn of the buttock
Unspecified thickness burn of the cheek
Unspecified thickness burn of the chest wall
Unspecified thickness burn of the chin
Unspecified thickness burn of the ear
Unspecified thickness burn of the elbow
Unspecified thickness burn of the eye
Unspecified thickness burn of the face, head or neck
Unspecified thickness burn of the face, head or neck NOS
Unspecified thickness burn of the foot
Unspecified thickness burn of the forearm
Unspecified thickness burn of the forehead
Unspecified thickness burn of the genitalia
Unspecified thickness burn of the hand, unspecified
Unspecified thickness burn of the knee
Unspecified thickness burn of the leg
Unspecified thickness burn of the leg NOS
Unspecified thickness burn of the lip(s)
Unspecified thickness burn of the lower leg
Unspecified thickness burn of the neck
Unspecified thickness burn of the nose
Unspecified thickness burn of the palm of hand

Code descriptions - thermal injuries
Unspecified thickness burn of the scalp
Unspecified thickness burn of the scapular region
Unspecified thickness burn of the shoulder
Unspecified thickness burn of the thigh
Unspecified thickness burn of the thumb
Unspecified thickness burn of the thumb and finger(s)
Unspecified thickness burn of the toe(s)
Unspecified thickness burn of the trunk
Unspecified thickness burn of the trunk NOS
Unspecified thickness burn of the upper arm
Unspecified thickness burn of the wrist
Unspecified thickness burn of the wrist and hand
Unspecified thickness burn of the wrist or hand NOS
Unspecified thickness burn of unspecified part of face/head
Unspecified thickness burn of unspecified part of the trunk

6.17 Code descriptions identifying poisonings

Code descriptions - medicinal poisonings
ACTH - adrenocorticotropic hormone poisoning
Accid. poisoning by other drugs acting on nervous system OS
Accidental poisoning by adrenalin
Accidental poisoning by amitriptyline
Accidental poisoning by amphetamine
Accidental poisoning by analgesics,antipyretic,antirheum NOS
Accidental poisoning by analgesics,antipyretic,antirheumatic
Accidental poisoning by anti-infectives
Accidental poisoning by anti-parkinsonism drug
Accidental poisoning by antibiotics
Accidental poisoning by anticholinergics
Accidental poisoning by anticonvulsant
Accidental poisoning by anticonvulsant + anti-parkinson drug
Accidental poisoning by anticonvulsant/anti-parkin drug NOS
Accidental poisoning by antidepressants
Accidental poisoning by antidepressants NOS
Accidental poisoning by antirheumatics
Accidental poisoning by antirheumatics NOS
Accidental poisoning by aspirin
Accidental poisoning by atropine
Accidental poisoning by barbiturates
Accidental poisoning by barbiturates NOS
Accidental poisoning by benzodiazepine-based tranquillisers
Accidental poisoning by bromides
Accidental poisoning by caffeine
Accidental poisoning by cannabis derivatives
Accidental poisoning by cardiovascular system drugs
Accidental poisoning by central appetite depressants
Accidental poisoning by chloral hydrate
Accidental poisoning by chlordiazepoxide
Accidental poisoning by chlorpromazine
Accidental poisoning by cholinergics
Accidental poisoning by cocaine
Accidental poisoning by codeine
Accidental poisoning by dental drugs
Accidental poisoning by diamorphine
Accidental poisoning by diazepam
Accidental poisoning by drugs NOS
Accidental poisoning by drugs acting on nervous system NOS
Accidental poisoning by drugs affecting blood constituents
Accidental poisoning by drugs, medicines and biologicals
Accidental poisoning by gastrointestinal system drugs
Accidental poisoning by hallucinogen NOS
Accidental poisoning by hallucinogens
Accidental poisoning by haloperidol

Code descriptions - medicinal poisonings
Accidental poisoning by heroin
Accidental poisoning by hormones and synthetic substitutes
Accidental poisoning by hyoscine
Accidental poisoning by ibuprofen
Accidental poisoning by imipramine
Accidental poisoning by indomethacin
Accidental poisoning by lignocaine
Accidental poisoning by local anaesthetic
Accidental poisoning by lysergide, LSD
Accidental poisoning by medazepam
Accidental poisoning by methadone
Accidental poisoning by mixed sedatives NEC
Accidental poisoning by monoamine oxidase inhibitors
Accidental poisoning by morphine
Accidental poisoning by mucous membrane drugs
Accidental poisoning by muscle + respiratory system drugs
Accidental poisoning by naproxen
Accidental poisoning by nitrazepam
Accidental poisoning by non-narcotic analgesics NOS
Accidental poisoning by noradrenalin
Accidental poisoning by opiate antagonists
Accidental poisoning by opium
Accidental poisoning by oth analgesics,antipyretic,antirheum
Accidental poisoning by oth central nervous syst depressants
Accidental poisoning by other drugs
Accidental poisoning by other drugs NOS
Accidental poisoning by other drugs OS
Accidental poisoning by other drugs acting on nervous system
Accidental poisoning by other non-narcotic analgesics
Accidental poisoning by other opiates
Accidental poisoning by other opiates NOS
Accidental poisoning by other psychotropic agents
Accidental poisoning by other sedatives and hypnotics
Accidental poisoning by other sedatives and hypnotics OS
Accidental poisoning by other tranquillisers
Accidental poisoning by other tranquillisers NOS
Accidental poisoning by otorhinolaryngological drugs
Accidental poisoning by paracetamol
Accidental poisoning by pentobarbitone
Accidental poisoning by pethidine
Accidental poisoning by phenobarbitone
Accidental poisoning by phenothiazine-based tranquillisers
Accidental poisoning by primarily systemic agents
Accidental poisoning by prochlorperazine
Accidental poisoning by psychotropic agents NOS

Code descriptions - medicinal poisonings
Accidental poisoning by pyrazole derivatives
Accidental poisoning by quinalbarbitone
Accidental poisoning by salicylates
Accidental poisoning by salicylates NOS
Accidental poisoning by sedatives and hypnotics NOS
Accidental poisoning by skin drugs
Accidental poisoning by skin, eye, ENT and dental drug NOS
Accidental poisoning by tranquillisers
Accidental poisoning by tranquillisers NOS
Accidental poisoning by unspecified drugs
Accidental poisoning by warfarin
Accidental poisoning by water,mineral,uric acid metab drugs
Accidental poisoning- benzodiazepine-based tranquilliser NOS
Accidental poisoning- phenothiazine-based tranquillisers NOS
Accidental poisoning-oth analgesic,antipyretic,antirheum NOS
Acetazolamide poisoning
Acetylcholine poisoning
Acidifying agent poisoning
Adrenal cortico-steroid poisoning
Adrenal cortico-steroid poisoning NOS
Adrenergic poisoning
Adrenochrome poisoning
Adverse reaction to acetylcysteine
Adverse reaction to ipecacuanha
Agents affecting blood constituents, causing poisoning
Alcohol deterrent poisoning
Allopurinol poisoning
Aluminium hydroxide poisoning
Amantadine poisoning
Aminophylline poisoning
Amitriptyline poisoning
Amphetamine poisoning
Amphotericin B poisoning
Ampicillin poisoning
Amylobarbitone poisoning
Anabolic steroid poisoning
Anaesthetic poisoning
Analeptic poisoning
Analgesic poisoning
Analgesic poisoning, NEC
Analgesic, antipyretic and antirheumatic drug poisoning
Analgesic, antipyretic or antirheumatic poisoning NOS
Androgen and anabolic poisoning
Androgen or anabolic poisoning NOS
Androgen poisoning

Code descriptions - medicinal poisonings
Antacid drug poisoning
Antacid drug poisoning NOS
Anterior pituitary hormone poisoning
Anthelmintic drug poisoning
Anti-common cold drug poisoning
Anti-depressant poisoning NOS
Anti-gastric acid drug poisoning
Anti-infective poisoning NOS
Antiallergic and antiemetic drug poisoning
Antiasthmatic poisoning NOS
Antibiotic poisoning
Antibiotic poisoning NOS
Anticholinesterase poisoning
Anticoagulant agonist poisoning
Anticoagulant agonist poisoning NOS
Anticoagulant poisoning
Anticoagulant poisoning NOS
Anticonvulsant and antiParkinsonian drug poisoning
Anticonvulsant or antiparkinsonian drug poisoning NOS
Anticonvulsant poisoning
Anticonvulsant poisoning NOS
Antidepressant poisoning
Antidiarrhoeal poisoning
Antiemetic poisoning
Antifungal antibiotic poisoning
Antihistamine poisoning
Antilipaemic and antiarteriosclerotic poisoning
Antimalarial drug poisoning
Antimalarial drug poisoning NOS
Antineoplastic and immunosuppressive poisoning
Antineoplastic or immunosuppressive poisoning NOS
Antiparkinsonian drug poisoning NOS
Antiparkinsonism drug poisoning
Antipyretic poisoning
Antirheumatic poisoning
Antirheumatic poisoning NOS
Antithyroid agent poisoning
Antitussive poisoning NOS
Aromatic analgesic poisoning NEC
Aromatic analgesic poisoning NOS
Arsenical anti-infective poisoning
Aspirin poisoning
Atropine poisoning
Autonomic nervous system drug poisoning
Azathioprine poisoning

Code descriptions - medicinal poisonings
Barbitone poisoning
Barbiturate poisoning
Barbiturate poisoning NOS
Benzodiazepine poisoning
Benzodiazepine poisoning NOS
Benzothiazide poisoning
Beta blocker poisoning
Biguanide poisoning
Biological substance poisoning
Bleomycin poisoning
Butabarbitone poisoning
Caffeine poisoning
Cannabis poisoning
Carbamate poisoning
Cardiac glycoside poisoning
Cardiac rhythm drug poisoning
Cardiovascular agent poisoning NOS
Cardiovascular drug poisoning
Cause of overdose - accidental
Central appetite depressant poisoning
Central nervous system depressants and anaesthetic poisoning
Central nervous system muscle-tone depressant poisoning
Central nervous system muscle-tone depressant poisoning NOS
Central nervous system stimulant poisoning
Central nervous system stimulant poisoning NOS
Cephalexin poisoning
Chelating agent poisoning
Chiniofon poisoning
Chloral hydrate poisoning
Chlorambucil poisoning
Chloramphenicol poisoning
Chlordiazepoxide poisoning
Chloroquine poisoning
Chlorpheniramine poisoning
Chlorpromazine poisoning
Cholinergic poisoning
Clonidine poisoning
Cocaine poisoning
Codeine (methylmorphine) poisoning
Colchicine poisoning
Coronary vasodilator poisoning
Corticotrophin poisoning
Cortisone derivative poisoning
Coumarin poisoning
Cyclandelate poisoning

Code descriptions - medicinal poisonings
Cyclophosphamide poisoning
Cytarabine poisoning
Dactinomycin poisoning
Daunorubicin poisoning
Dextromethorphan poisoning
Dextropropoxyphene poisoning
Diagnostic agent NEC, poisoning
Diazepam poisoning
Digoxin poisoning
Dihydrocodeine poisoning
Dioctyl sulphosuccinate poisoning
Diphenhydramine poisoning
Dipyridamole poisoning
Diuretic poisoning
Doxycycline poisoning
Drug and medicament poisoning NOS
Drug poisoning
Drug, medicament or biological substance poisoning NOS
Ear, nose and throat drug poisoning NEC
Ecstasy poisoning
Emetic drug poisoning
Emollient cathartic poisoning
Emollients, demulcents and protectant poisoning
Enzyme poisoning NEC
Ergot alkaloid poisoning
Erythromycin and macrolide poisoning
Erythromycin poisoning
Ethacrynic acid poisoning
Ethambutol poisoning
Ether poisoning
Expectorant poisoning
Eye drug poisoning
Eye drug poisoning NEC
Eye drug poisoning NOS
Ferric salt poisoning
Ferrous sulphate poisoning
Flucytosine poisoning
Flurazepam poisoning
Folic acid poisoning
Frusemide poisoning
Ganglion-blocker poisoning
Ganglion-blocker poisoning NOS
Gold salt poisoning
Gonadotrophin poisoning
Griseofulvin poisoning

Code descriptions - medicinal poisonings
H/O: repeated overdose
Hair treatment poisoning
Hallucinogen poisoning
Hallucinogen poisoning NOS
Haloperidol poisoning
Heavy metal agonist poisoning
Heavy metal anti-infective poisoning NOS
Heparin poisoning
Heroin poisoning
Hormone and synthetic substitute poisoning
Human fibrinogen poisoning
Hydantoin derivative poisoning
Hydroxyquinoline poisoning
Hydroxyzine poisoning
Hyoscine poisoning
Hypertensive agent poisoning NOS
Hypnotic poisoning
Ibuprofen poisoning
Imipramine poisoning
Immunosuppressive poisoning
Indomethacin poisoning
Injury ?accidental, poisoning by analgesic or anti-pyretic
Injury ?accidental, poisoning by drug or medicament NOS
Injury ?accidental, poisoning by other spec drug/medicament
Insulin poisoning
Insulins and antidiabetic poisoning
Iodide poisoning
Iron and iron compound poisoning
Irritant cathartic poisoning
Keratoplastic poisoning
Late effect of poison drug/medicament/biological substance
Levodopa (L-dopa) poisoning
Levothyroxine sodium poisoning
Lignocaine poisoning
Lithium level high - toxic
Local anti-infective and anti-inflammatory poisoning
Local astringent and detergent poisoning
Local astringent poisoning
Local detergent poisoning
Lorazepam poisoning
Lysergide (LSD) poisoning
MAOI - monoamine oxidase inhibitor poisoning
Magnesium sulphate poisoning
Magnesium trisilicate poisoning
Marihuana poisoning

Code descriptions - medicinal poisonings
Medazepam poisoning
Medicinal poisoning
Mefenamic acid poisoning
Meperidine (pethidine) poisoning
Meprobamate poisoning
Mercaptopurine poisoning
Methadone poisoning
Methocarbamol poisoning
Minocycline poisoning
Mitomycin poisoning
Mixed sedative poisoning NEC
Monoamine oxidase inhibitor poisoning
Morphine poisoning
Muscle drug poisoning
Nandrolone poisoning
Naproxen poisoning
Narcotic poisoning
Nitrate poisoning
Nitrazepam poisoning
Nitrofuran derivative poisoning
Non-narcotic analgesic poisoning NOS
Noradrenalin poisoning
Nystatin poisoning
Oestrogen poisoning
Oleandomycin poisoning
Opiate and narcotic poisoning
Opiate antagonist poisoning
Opiate or narcotic poisoning NOS
Opiate poisoning
Oral contraceptive poisoning
Orciprenaline poisoning
Other analgesic and antipyretic poisoning
Other analgesic or antipyretic poisoning NOS
Other and unspecified drug and medicament poisoning
Other anti-infective poisoning
Other anticonvulsant poisoning
Other antihistamine poisoning
Other antiprotozoal drug poisoning
Other antipsychotics/neuroleptics/tranquilliser poisoning
Other cathartic poisoning
Other central nervous system stimulant poisoning
Other digitalis glycoside poisoning
Other diuretic poisoning NOS
Other drug and medicament poisoning NOS
Other drug and medicament poisoning OS

Code descriptions - medicinal poisonings
Other hormone or synthetic derivative poisoning
Other hypertensive agent poisoning
Other non-narcotic analgesic poisoning
Other psychotropic agent poisoning
Other respiratory system drug poisoning
Other sedative and hypnotic poisoning
Other skin and mucous membrane drug poisoning
Other specific antibiotic poisoning
Other systemic agent poisoning
Other tranquilliser poisoning
Other vasodilator poisoning
Ovarian hormone and synthetic substitute poisoning
Overdose of biological substance
Overdose of drug
Oxymetholone poisoning
Oxytetracycline poisoning
Pancreatin poisoning
Papain poisoning
Papaverine poisoning
Paracetamol poisoning
Paramethadione poisoning
Parasympathomimetic poisoning
Penicillin G poisoning
Penicillin poisoning
Penicillin poisoning NOS
Penicillinase poisoning
Pentobarbitone poisoning
Peripheral nerve and plexus-blocking anaesthetic poisoning
Phenacetin poisoning
Phenobarbitone poisoning
Phenolphthalein poisoning
Phenothiazine poisoning
Phenoxybenzamine poisoning
Phenylbutazone poisoning
Phenytoin poisoning
Pilocarpine poisoning
Poisoning by angiotensin-converting-enzyme inhibitors
Poisoning by calcium-channel blockers
Poisoning by carbamazepine
Poisoning by drug and biological substances
Poisoning by glucocorticoids and synthetic analogues
Poisoning by histamine H2-receptor antagonists
Poisoning by oth & unspec antipsychotics & neuroleptics
Poisoning by primarily systemic agents
Poisoning by saline and osmotic laxatives

Code descriptions - medicinal poisonings
Poisoning by temazepam
Primidone poisoning
Procainamide poisoning
Prochlorperazine poisoning
Progestogen poisoning
Proguanil poisoning
Promazine poisoning
Propranolol poisoning
Prostaglandin poisoning
Protamine sulphate poisoning
Psilocybin poisoning
Psychostimulant poisoning
Psychotropic agent poisoning
Psychotropic agent poisoning NOS
Pyrazole derivative poisoning
Quinalbarbitone poisoning
Quinine poisoning
Respiratory system drug poisoning
Rifampicin poisoning
Salbutamol poisoning
Salicylate poisoning
Salicylate poisoning NOS
Salicylic acid salt poisoning
Sedative and hypnotic drug poisoning
Sedative and hypnotic drug poisoning NOS
Sedative poisoning
Skeletal muscle relaxant poisoning
Sleeping drug poisoning
Sodium morrhuate poisoning
Stimulant poisoning
Streptokinase poisoning
Streptomycin poisoning
Sulphadiazine poisoning
Sulphone poisoning
Sympathomimetic poisoning
Systemic agent poisoning NOS
Terpin hydrate poisoning
Testosterone poisoning
Tetracycline group poisoning
Tetracycline group poisoning NOS
Tetracycline poisoning
Theophylline poisoning
Thioridazine poisoning
Thyroglobulin poisoning
Thyroid hormone and thyroid derivative poisoning NOS

Code descriptions - medicinal poisonings
Thyroid hormone and thyroid derivatives poisoning
Topical and infiltration anaesthetic agent poisoning
Tranquilliser poisoning
Tranquilliser poisoning NOS
Trazodone poisoning
Trifluperidol poisoning
Trimethadione poisoning
Tripelennamine poisoning
Unspecified opium poisoning
Urate metabolism drug poisoning
Uric acid drug poisoning
Urokinase poisoning
Vitamin poisoning NEC
Vitamin poisoning NOS
Warfarin poisoning
Warfarin sodium poisoning
Water, mineral and urate metabolism poisoning
Water, mineral or uric acid metabolism poisoning NOS
[X] Adverse reaction to acetylcysteine
[X]Acc poison by and exposure to amphetamine - unspec places
[X]Accid poison/expos antiparkinson drug trade/service area
[X]Accid poison/expos to narcotic drug unspecif place
[X]Accid poison/expos to nonopioid analgesic unspecif place
[X]Accid poison/expos to oth autonomic drug unspecif place
[X]Accid poison/expos to oth/unsp drug/medic unspecif place
[X]Accid poison/expos to oth/unsp drug/medicam res institut
[X]Accid poison/expos to psychotropic drug at res institut
[X]Accident poison/exposure to narcotic drug at home
[X]Accident poison/exposure to nonopioid analgesic at home
[X]Accident poison/exposure to oth/unsp drug/medicam home
[X]Accident poison/exposure to other/unspec drug/medicament
[X]Accident poison/exposure to psychotropic drug at home
[X]Accident poison/exposure to sedative hypnotic at home
[X]Accident poisoning by and exposure to amphetamine - home
[X]Accident poisoning/exposure to antiepileptic
[X]Accident poisoning/exposure to antiparkinson drug
[X]Accident poisoning/exposure to hallucinogen
[X]Accident poisoning/exposure to narcotic drug
[X]Accident poisoning/exposure to nonopioid analgesic
[X]Accident poisoning/exposure to oth autonomic drug
[X]Accident poisoning/exposure to psychotropic drug
[X]Accident poisoning/exposure to sedative hypnotic
[X]Accidental poisoning by and exposure to amphetamine
[X]Accidental poisoning with SSRI
[X]Accidental poisoning with amitriptyline

Code descriptions - medicinal poisonings
[X]Accidental poisoning with antidepressant
[X]Accidental poisoning with aspirin
[X]Accidental poisoning with benzodiazepine
[X]Accidental poisoning with diazepam
[X]Accidental poisoning with heroin
[X]Accidental poisoning with ibuprofen
[X]Accidental poisoning with nitrazepam
[X]Accidental poisoning with paracetamol
[X]Accidental poisoning with sleeping tablets
[X]Accidental poisoning with temazepam
[X]Ment behav dis due use crack cocaine: acute intoxication
[X]Mental & behav dis due cannabinoids: acute intoxication
[X]Mental & behav dis due hallucinogens: acute intoxicatn
[X]Mental & behav dis due seds/hypntcs: acute intoxication
[X]Mental & behav dis due to use cocaine: acute intoxication
[X]Mental & behav dis due to use opioids: acute intoxication
[X]Mnt/beh dis due oth stim inc caffein: acute intoxication
[X]Overdose - SSRI
[X]Overdose - amitriptyline
[X]Overdose - amylobarbitone
[X]Overdose - antidepressant
[X]Overdose - aspirin
[X]Overdose - barbiturate
[X]Overdose - benzodiazepine
[X]Overdose - diazepam
[X]Overdose - heroin
[X]Overdose - ibuprofen
[X]Overdose - nitrazepam
[X]Overdose - paracetamol
[X]Overdose - sleeping tabs
[X]Overdose - temazepam
[X]Poisoning by drugs and biological substances
[X]Poisoning by oth & unspecif drugs & biologic substances
[X]Poisoning by other analgesics, not elsewhere classified
[X]Poisoning by other laxatives, incl intestin atonia drugs
[X]Poisoning by other psychotropic drugs, NEC

Code descriptions - non-medicinal poisonings
Accidental poisoning agricultural chemical preparations NOS
Accidental poisoning by CO - blast furnace gas
Accidental poisoning by CO - fuels in industrial use
Accidental poisoning by CO - kiln vapour
Accidental poisoning by CO- coal in domestic stove/fireplace
Accidental poisoning by CO- coke in domestic stove/fireplace
Accidental poisoning by CO- kerosene in domestic stove/fire
Accidental poisoning by acids
Accidental poisoning by acids NOS
Accidental poisoning by agricultural chemical preparations
Accidental poisoning by alcohol NOS
Accidental poisoning by alcohol, NEC
Accidental poisoning by alcoholic beverages
Accidental poisoning by arsenic and its compounds and fumes
Accidental poisoning by arsenic compounds
Accidental poisoning by arsenic, unspecified
Accidental poisoning by benzene
Accidental poisoning by beryllium and its compounds
Accidental poisoning by brass fumes
Accidental poisoning by bromobenzyl cyanide
Accidental poisoning by butane
Accidental poisoning by cadmium and its compounds
Accidental poisoning by carbamates
Accidental poisoning by carbaryl
Accidental poisoning by carbon monoxide - domestic fuel NOS
Accidental poisoning by carbon monoxide NOS
Accidental poisoning by carbon monoxide from oth source NOS
Accidental poisoning by carbon monoxide from other sources
Accidental poisoning by carbon monoxide from piped gas
Accidental poisoning by carbon monoxide-other domestic fuel
Accidental poisoning by caustic alkalis
Accidental poisoning by caustic alkalis NOS
Accidental poisoning by chlorates
Accidental poisoning by chlordane
Accidental poisoning by chlorine
Accidental poisoning by coal gas NOS
Accidental poisoning by cooking gas NOS
Accidental poisoning by copper salts
Accidental poisoning by corrosive aromatics
Accidental poisoning by corrosives and caustics NEC
Accidental poisoning by corrosives and caustics NOS
Accidental poisoning by cosmetics
Accidental poisoning by cyanides
Accidental poisoning by dieldrin
Accidental poisoning by diquat

Code descriptions - non-medicinal poisonings
Accidental poisoning by disinfectants
Accidental poisoning by ethanol, NOS
Accidental poisoning by exhaust gas from gas engine
Accidental poisoning by exhaust gas from motor vehicle NOS
Accidental poisoning by fertilisers
Accidental poisoning by foodstuffs and poisonous plants NOS
Accidental poisoning by fumigants
Accidental poisoning by fungicides
Accidental poisoning by fungicides NOS
Accidental poisoning by gas distributed by pipeline
Accidental poisoning by gas oils
Accidental poisoning by gases and vapours NOS
Accidental poisoning by gases or fumes on ship
Accidental poisoning by glues
Accidental poisoning by glues and adhesives
Accidental poisoning by heating gas NOS
Accidental poisoning by herbicides
Accidental poisoning by herbicides NOS
Accidental poisoning by household agents
Accidental poisoning by household agents NOS
Accidental poisoning by hydrochloric acid
Accidental poisoning by insecticides NOS
Accidental poisoning by iron compounds
Accidental poisoning by isopropanol
Accidental poisoning by kerosene
Accidental poisoning by lacquers
Accidental poisoning by lead and its compounds and fumes
Accidental poisoning by lead paints
Accidental poisoning by lead, NOS
Accidental poisoning by lead, unspecified
Accidental poisoning by lubricating oils
Accidental poisoning by malathion
Accidental poisoning by manganese and its compounds
Accidental poisoning by mercury and its compounds and fumes
Accidental poisoning by mercury fumes
Accidental poisoning by mercury, NOS
Accidental poisoning by mercury, unspecified
Accidental poisoning by metals + compounds and fumes NOS
Accidental poisoning by methanol
Accidental poisoning by methyl alcohol
Accidental poisoning by methyl bromide
Accidental poisoning by methylated spirit
Accidental poisoning by mixtures herbicides+plant food etc
Accidental poisoning by motor vehicle exhaust gas
Accidental poisoning by nickel compounds

Code descriptions - non-medicinal poisonings
Accidental poisoning by nitrogen oxides
Accidental poisoning by non-lead paints
Accidental poisoning by organic mercurials
Accidental poisoning by organochlorine insecticides
Accidental poisoning by organophosphorus insecticides
Accidental poisoning by organophosphorus insecticides NOS
Accidental poisoning by other adhesives
Accidental poisoning by other alcohols
Accidental poisoning by other cleaning agents
Accidental poisoning by other cleaning agents NOS
Accidental poisoning by other corrosives and caustics
Accidental poisoning by other ethyl alcohol and its products
Accidental poisoning by other foods
Accidental poisoning by other gases and vapours
Accidental poisoning by other gases and vapours NOS
Accidental poisoning by other gases and vapours OS
Accidental poisoning by other insecticides
Accidental poisoning by other metals + compounds and fumes
Accidental poisoning by other non-drug substances
Accidental poisoning by other paints and varnishes
Accidental poisoning by other solvents
Accidental poisoning by other solvents NOS
Accidental poisoning by other utility gas
Accidental poisoning by other utility gas + carbon monoxide
Accidental poisoning by paint or varnish NOS
Accidental poisoning by paraffin wax
Accidental poisoning by paraquat
Accidental poisoning by petrol
Accidental poisoning by petrol fuel or cleaner NOS
Accidental poisoning by petrol fuels and cleaners
Accidental poisoning by petrol products
Accidental poisoning by petrol solvents NOS
Accidental poisoning by petroleum fuels
Accidental poisoning by petroleum naphtha
Accidental poisoning by petroleum solvents
Accidental poisoning by phenol
Accidental poisoning by phosphine
Accidental poisoning by piped natural gas
Accidental poisoning by plant food
Accidental poisoning by polishes
Accidental poisoning by propane
Accidental poisoning by propoxur
Accidental poisoning by rodenticides
Accidental poisoning by rodenticides NOS
Accidental poisoning by scouring agents

Code descriptions - non-medicinal poisonings
Accidental poisoning by secondary propyl alcohol
Accidental poisoning by soap products
Accidental poisoning by sodium hydroxide
Accidental poisoning by solvent NOS
Accidental poisoning by sulphur dioxide
Accidental poisoning by sulphuric acid
Accidental poisoning by synthetic detergents and shampoos
Accidental poisoning by thallium
Accidental poisoning by thallium compounds
Accidental poisoning by toxaphene
Accidental poisoning by utility gas NOS
Accidental poisoning by white washes
Accidental poisoning by zinc phosphide
Accidental poisoning from berries
Accidental poisoning from berries and seeds
Accidental poisoning from berries or seeds NOS
Accidental poisoning from foodstuffs and poisonous plants
Accidental poisoning from mushrooms
Accidental poisoning from mushrooms and fungi NOS
Accidental poisoning from mushrooms and other fungi
Accidental poisoning from other fungi
Accidental poisoning from other plants
Accidental poisoning from seeds
Acetone causing toxic effect
Acids causing toxic effect
Acids causing toxic effect NOS
Arsenic causing toxic effect
Benzene causing toxic effect
Berries - toxic effect
Berries and other plants causing toxic effect
Carbon tetrachloride causing toxic effect
Caustic alkalis causing toxic effect
Caustic alkalis causing toxic effect NOS
Chlorinated hydrocarbon causing toxic effect
Chloroacetophenone causing toxic effect
Chromium causing toxic effect
Corrosive aromatics causing toxic effect NOS
Corrosive/acid/caustic alkali causing toxic effect NOS
Corrosives/acids/caustic alkalis causing toxic effect
Cyanides and hydrocyanic acid causing toxic effect
DDT causing toxic effect
Detergent toxic effect
Injury ?accidental, poisoning by agricultural chemicals
Injury ?accidental, poisoning by arsenic or its compounds
Injury ?accidental, poisoning by corrosive/caustic substance

Code descriptions - non-medicinal poisonings
Injury ?accidental, poisoning by gas in domestic use NOS
Injury ?accidental, poisoning by gases in domestic use
Injury ?accidental, poisoning by liquid petrol gas
Injury ?accidental, poisoning by motor vehicle exhaust gas
Injury ?accidental, poisoning by other carbon monoxide
Injury ?accidental, poisoning by other gases
Injury ?accidental, poisoning by other spec gas or vapour
Intoxication - alcohol
Late effect of poison due to nonmedical substance
Lead and lead compounds causing toxic effect
Lead compound causing toxic effect NOS
Lead compound poisoning
Liquefied petrol gas causing toxic effect
Malathion causing toxic effect
Mercury causing toxic effect
Mercury compound poisoning
Metals causing toxic effect NOS
Methanol causing toxic effect
Methyl alcohol causing toxic effect
Nickel compounds causing toxic effect
Nitric acid causing toxic effect
Non-medicinal agent causing toxic effect NOS
Nonmedicinal agent causing toxic effects
Organophosphate and carbamate causing toxic effect
Organophosphate and carbamate causing toxic effect NOS
Other metals causing toxic effect
Other metals causing toxic effect NOS
Other metals causing toxic effect OS
Other nonmedicinal substances causing toxic effect
Other pesticides causing toxic effect NEC
Other solvents causing toxic effect
Other solvents causing toxic effect
Other solvents causing toxic effect NOS
Other substance causing toxic effect
Paraffin wax causing toxic effect
Petrol unspecified causing toxic effect
Petroleum ether causing toxic effect
Petroleum product causing toxic effect
Petroleum product causing toxic effect NOS
Phenol causing toxic effect
Phosdrin causing toxic effect
Phosgene causing toxic effect
Plants - toxic effect
Potassium cyanide causing toxic effect
Potassium hydroxide causing toxic effect

Code descriptions - non-medicinal poisonings
Soap - toxic effect
Soap and detergent causing toxic effect
Sodium hydroxide causing toxic effect
Solvents causing toxic effect NOS
Toxic effect of paints and dyes, NEC
Toxic effect of tin and its compounds
Toxic encephalitis due to mercury
Toxic encephalitis due to thallium
Trichloroethylene causing toxic effect
[X]Acc poison/expos org solvent,halogen hydrocarb,res instit
[X]Acc poison/expos unspecif chemical school/pub admin area
[X]Accid poison/expos alcohol in street/highway
[X]Accid poison/expos alcohol trade/service area
[X]Accid poison/expos organ solvent,halogen hydrocarb, home
[X]Accid poison/expos to alcohol unspecif place
[X]Accid poison/expos to other gas/vapour unspecif place
[X]Accid poison/expos to unspecif chemical unspecif place
[X]Accid poison/expos unspecif chemical trade/service area
[X]Accid poison/exposure to organ solvent,halogen hydrocarb
[X]Accident poison/exposure to alcohol at home
[X]Accident poison/exposure to other gas/vapour at home
[X]Accident poison/exposure to other gas/vapour on farm
[X]Accident poison/exposure to pesticide at home
[X]Accident poison/exposure to unspecif chemical at home
[X]Accident poisoning/exposure to alcohol
[X]Accident poisoning/exposure to other gas/vapour
[X]Accident poisoning/exposure to pesticide
[X]Accident poisoning/exposure to unspecif chemical
[X]Accidental carbon monoxide poisoning
[X]Accidental poisoning from glue solvent
[X]Accidental poisoning with paraquat
[X]Accidental poisoning with weedkiller
[X]Evid of alcohol involv determind by level of intoxication
[X]Mental & behav dis due to use alcohol: acute intoxication
[X]Mental & behav dis due vol solvents: acute intoxication
[X]Toxic effect of other ingested (parts of) plant(s)
[X]Toxic effect of other insecticides
[X]Toxic effect of other specified substances
[X]Toxic effects of other specified gases, fumes & vapours
[X]Toxic effects of substances chiefly nonmedicinal source

Code descriptions - poisonings of unknown type
Accident/poisoning occurred in residential institution NOS
Accidental poisoning NOS
Accidental poisoning by other solid and liquid substances
Accidental poisoning by other solid and liquid substances OS
Accidental poisoning by solid and liquid substances NOS
Administration of activated charcoal
Causes of injury and poisoning
Causes of injury and poisoning NOS
H/O: poisoning
Injury ?accidental, poisoning by solid or liquid subst NOS
Injury ?accidental, poisoning by solid/liquid substances
Injury and poisoning
Injury and poisoning NOS
Late effect injury/poison/toxin effect/external cause NOS
Late effect of poison
Late effects injury/poisoning/toxic effects/external causes
Late effects of accidental poisoning
Other toxic agent polyneuropathy
Poisoning
Poisoning undetermined - accidentally or purposely inflicted
Unspecified substance causing toxic effect NOS
[V]Obs for suspected toxic effect from ingested substance
[V]Personal history of poisoning
[X] Injury and poisoning classification terms
[X]Accidental drug / other poisoning
[X]Accidental drug overdose / other poisoning
[X]Accidental poisoning by + exposure to noxious substances

6.18 Code descriptions identifying ADHD

Code descriptions - ADHD
ADD - Attention deficit disorder
Attention deficit disorder
Attention deficit with hyperactivity
Attention deficit without hyperactivity
Child attention deficit disorder
Child attention deficit disorder NOS
Childhood hyperkinetic syndrome
DAMP - Deficits in attention motor control and perception
Deficits in attention motor control and perception
Disorders of attention and motor control
Hyperkinetic syndrome NOS
[X]Attention deficit disorder
[X]Attention deficit disorder
[X]Attention deficit hyperactivity disorder
[X]Deficits in attention, motor control and perception
[X]Disturbance of activity and attention
[X]Hyperkinetic disorder, unspecified
[X]Hyperkinetic disorders
[X]Hyperkinetic reaction of childhood or adolescence NOS
[X]Hyperkinetic syndrome NOS
[X]Other hyperkinetic disorders

6.19 Drugs identifying ADHD

Drugs identifying ADHD
amfetamine/dexamfetamine sulphate
atomoxetine hydrochloride
dexamfetamine sulphate
methylphenidate hydrochloride
modafinil
pemoline

6.20 Code descriptions identifying behaviour disorder

Code descriptions - behaviour disorder
Aggressive behaviour
Aggressive unsocial conduct disorder
Aggressive unsocial conduct disorder NOS
Behaviour disorder
Behavioural problem
Behavioural problems at school
Childhood and adolescent oppositional disorder
Conduction disorders unspecified
H/O: behaviour problem
Mixed disturbance of conduct and emotion
Mixed disturbance of conduct and emotion NOS
Nonaggressive unsocial conduct disorder
O/E - irreverent behaviour
Other conduct disturbances
Other conduct disturbances NOS
Severely abnormal behaviour
Socialised conduct disorder
Socialised conduct disorder NOS
Stress reaction causing mixed disturbance of emotion/conduct
[V]Behavioural problems
[V]Mental and behavioural problems
[V]Other behavioural problems
[V]Other specified mental or behavioural problem
[X]Asocial personality disorder
[X]Behavioural/emotional disords onset childhood/adolescence
[X]Childhood behavioural disorder NOS
[X]Childhood conduct disorder NOS
[X]Childhood disorder of social functioning, unspecified
[X]Childhood emotional disorder, unspecified
[X]Conduct disorder associated with emotional disorder
[X]Conduct disorder confined to the family context
[X]Conduct disorder, solitary aggressive type
[X]Conduct disorder, unspecified
[X]Conduct disorders
[X]Depressive conduct disorder
[X]Emotional behavioural problems
[X]Hyperkinetic conduct disorder
[X]Hyperkinetic disorder associated with conduct disorder
[X]Mental and behavioural disorders
[X]Mild mental retardation, other impairments of behaviour
[X]Mixed disorder of conduct and emotions, unspecified
[X]Mixed disorders of conduct and emotions
[X]Oppositional defiant disorder
[X]Ot spc behav emotion disorder onst usual childhood adoles
[X]Oth behav emotion disorder onset usual occur childhd/adol

Code descriptions - behaviour disorder
[X]Other childhood disorders of social functioning
[X]Other conduct disorders
[X]Other mental retardation, other impairments of behaviour
[X]Other mixed disorders of conduct and emotions
[X]Personal history/other mental and behavioural disorders
[X]Personality and behav disorder brain dis dam and dysfunct
[X]Severe mental retardation, other impairments of behaviour
[X]Socialized conduct disorder

6.21 Code descriptions identifying learning disability

Code descriptions - learning disability
Learning difficulties
Learning difficulties
Learning disabilities administration status
Learning disabilities annual health assessment
Learning disabilities health action plan completed
Learning disabilities health action plan declined
Learning disabilities health action plan offered
Learning disabilities health action plan reviewed
Learning disabilities health assessment
Learning disability
Learning disability health examination
On learning disability register
Other specific learning difficulty
Seen in learning disabilities clinic
[X]Learn acquisition disab NOS
[X]Learning disability NOS
[X]Learning disorder NOS
[X]Moderate learning disability
[X]Severe learning disability

6.22 Code descriptions identifying cerebral palsy

Code descriptions - cerebral palsy
Cerebral palsy with spastic diplegia
Cerebral palsy, not congenital or infantile, acute
Spastic cerebral palsy

6.23 Code descriptions identifying femur fractures

Read code descriptions - femur fractures
Fracture of shaft of femur
Closed fracture of femur, shaft or unspecified part
Fracture of femur, NOS
Fracture of neck of femur
Other fracture of femur
Open fracture shaft of femur

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