

Child maltreatment and antisocial behaviour in the United Kingdom: Changing risks over time



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Abstract

This thesis examines whether the risks associated with child maltreatment have changed over time in the UK; investigating changing risks at the societal and individual level. By adopting a unique socioecological approach, the thesis aims to determine whether: (a) the national incidence of child maltreatment has changed over the last 150 years, and (b) the impacts of child maltreatment on the risk of antisocial behaviour change across an individual's life-course.

The following methods were used to address these research aims and overcome challenges in child maltreatment research: multiple measures of child maltreatment, pre-existing sources of historical epidemiological data, observational study designs, and analytical methods that are sensitive to repeated measures (e.g. time series analyses, latent growth curve analyses). Research included developing a novel data source on the incidence of child maltreatment over time (iCoverT data source), examining long-term trends in child maltreatment from 1858 to 2016, and analysing 50 years of longitudinal data from the 1958 British birth cohort study.

Results from examining societal risk over time showed that long-term trends in the incidence of child maltreatment have decreased since the 1850s. However, more recent trends have increased since 2000, especially for child protection registrations for emotional abuse and neglect. Results from examining risk across an individual's life-course found that child maltreatment is associated with an increased risk of antisocial behaviour, with a persistent and stable association remaining up to 50 years old. Together, these findings demonstrate the long-lasting burden of child maltreatment at the societal and individual level.

This thesis makes an important contribution to the literature by highlighting the role of time and epidemiological research methods in better understanding child maltreatment, and helps identify future directions for reducing the burden of child maltreatment.

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Publications

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- **Degli Esposti, M.**, Taylor, J., Humphreys, D. K., & Bowes, L. (2018). iCoverT: A rich data source on the incidence of child maltreatment over time in England and Wales. *PLoS ONE*, 13(8), e0201223.
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Journal articles in press

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Journal articles under review

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- El-Salahi, S., **Degli Esposti, M.**, & Wild, J. (under review). The effectiveness of resilience interventions for improving mental and physical ill health in high risk populations: A systematic review. *European Psychologist*.

Journal articles in preparation

- **Degli Esposti, M.**, & Bowes, L. (in preparation). Are prevalence rates for cyber-bullying increasing compared to face-to-face bullying? A comparison of self- and media-report. *Lancet Psychiatry*.

Declaration

The research described in this thesis was part of a larger interdisciplinary project combining History and Experimental Psychology. Although my research has been informed by an historical perspective, I have used quantitative analytical methods from developmental psychopathology and social epidemiology. I received funding for this D.Phil research from Andrew W. Mellon Foundation and Clarendon via The Oxford Research Centre in the Humanities (TORCH), University of Oxford, UK.

For Chapters 3 and 4, I identified, collected, and digitalised all of the data from primary sources archived by the UK government and one UK-wide charity. For Chapter 5, I collected data by systematically reviewing the existing literature. For Chapter 6, data collection and general dataset construction was completed by the 1958 British birth cohort study team over a period of 50 years and several waves of data collection. I used these datasets to identify, merge, and derive relevant data variables across study waves. I was responsible for generating all hypotheses and research questions, as well as designing the methods for each study, pre-registering and conducting all analyses, and writing up the research for publication.

All work in this thesis is original and is my own work, except as acknowledged in the text. This thesis has not been submitted for any other degree at any other university.

Chapter 1 Introduction

Child maltreatment is a major social and public health problem in the United Kingdom (UK; Gilbert, Widom, et al., 2009). In the UK, between 6% to 22% of individuals report experiences of maltreatment at some point during their childhood and 0.5% of children are placed under child protection every year (Bentley et al., 2018; Department for Education, 2015). Children who are maltreated face immediate risks (e.g. serious injury or death), as well as longer-term risks that may persist throughout their lives (Gilbert, Widom, et al., 2009). These longer-term risks include a range of poor mental health and physical health outcomes, including antisocial behaviour (Braga, Cunha, & Maia, 2018; Norman et al., 2012). In addition to the profound impact of child maltreatment on the individual and their family, it is estimated that each victim costs society £89,390 and £940,758 for non-fatal and fatal child maltreatment, respectively (Conti, Morris, Melnychuk, & Pizzo, 2017).

Over the last 150 years there have been drastic changes to child maltreatment definitions, laws, and public attitudes in the UK. Despite changing historical contexts and key shifts in child protection, few studies have investigated whether the risks associated with child maltreatment have also changed over time. As a result, current scientific research has limited insight on the long-term burden of child maltreatment. I will directly address these issues and investigate whether the risks associated with child maltreatment have changed over time. Specifically, I will adopt a unique socioecological approach; first studying changing risk at the societal level by mapping out the national incidence of child maltreatment over the last 150 years, and then researching changing risk at the individual level by examining whether the impacts of child maltreatment on the risk of antisocial behaviour change across an individual's life-course.

This chapter provides an overview of the relevant literature. It begins by defining child maltreatment, describes the importance of historical context and key changes over time, and then reviews the relevant literature on the risk of child maltreatment and the risk of antisocial behaviour following child maltreatment. The chapter concludes with a brief conceptual overview of this thesis, as a practical overview is provided in the following chapter (Chapter 2).

1.1 Defining child maltreatment

Child maltreatment is defined as “*any act or series of acts of **commission** or **omission** by a parent or other **caregiver** that results in **harm**, potential for harm, or threat of harm to a **child***” (Gilbert, Widom, et al., 2009; Leeb, Paulozzi, Melanson, Simon, & Arias, 2008). This definition addresses four main points.

First, acts of **commission** encompass overt actions that result in harm (physical abuse, sexual abuse, and emotional abuse) while acts of **omission** encompass the failure to provide for a child’s basic physical, emotional, or educational needs (neglect; Leeb et al., 2008). Physical and sexual abuse have received the most attention in the scientific literature, as well as precedence in legal systems and clinical practice (Behl, Conyngham, & May, 2003; Vachon, Krueger, Rogosch, & Cicchetti, 2015; Wolock & Horowitz, 1984). There is however a growing body of evidence documenting the harms associated with emotional abuse and neglect (Hildyard & Wolfe, 2002; Rutter, O’Connor, & English and Romanian Adoptees Study Team, 2004; Teicher, Samson, Polcari, & McGreenery, 2006), and meta-analytic evidence has found no appreciable differences in harm across types of child maltreatment (Norman et al., 2012). As a result, physical abuse, sexual abuse, emotional abuse, and neglect are now all widely recognised as types of maltreatment. Munchausen’s by Proxy, witnessing intimate-partner violence, and bullying are sometimes regarded as types of maltreatment (Bentley et al., 2018; Gilbert, Widom, et al., 2009), but in this thesis I will focus on the four most common and widely recognised types: physical abuse, sexual abuse, emotional abuse, and neglect (see Table 1.1 for definitions).

Second, **caregiver** refers to the perpetrator of child maltreatment. The caregiver is a person who, at the time of maltreatment, is responsible for the care and supervision of the child. This may include both primary caregivers (e.g. parents, guardians) or substitute caregivers (e.g. clergy, coaches, relatives, babysitters, teachers; Leeb et al., 2008). Although definitions of perpetrators may be extended to include strangers and other children (i.e. peer-victimisation; Bentley et al., 2018; Gallagher, Bradford, & Pease, 2002), primary caregivers are responsible for over 80% of child maltreatment (US Department of Health and Human Services, 2006). I will therefore treat child maltreatment as being predominantly perpetrated by parents and guardians.

Table 1.1. Definitions of child maltreatment.

	Definition
Child maltreatment	Any act or series of acts of commission or omission by a parent or other caregiver that results in harm, potential for harm, or threat of harm to a child. Harm does not need to be intended
Physical abuse	Intentional use of physical force or implements against a child that results in, or has the potential to result in, physical injury
Sexual abuse	Any completed or attempted sexual act, sexual contact or non-contact sexual interaction with a child by a caregiver
Emotional (or psychological) abuse	Intentional behaviour that conveys to a child that he/she is worthless, flawed, unloved, unwanted, endangered, or valued only in meeting another's needs. This includes harmful (unintentional) parent–child interactions: <i>“the persistent emotional maltreatment of a child such as to cause severe and persistent adverse effects on the child’s emotional development”</i> (Department for Education, 2015)
Neglect	Failure to meet a child’s basic physical, emotional, medical/dental, or educational needs; failure to provide adequate nutrition, hygiene, or shelter; or failure to ensure a child’s safety

Notes. Definitions adapted from Department for Education (2015); Gilbert, Widom, et al. (2009); Leeb et al. (2008).

Third, acts of maltreatment are defined as resulting in ***harm***, including the potential or threat of harm, even if harm is not the intended result (Department for Education, 2015; Gilbert, Widom, et al., 2009). Harm is defined as any acute disruption that affects the child’s health, survival, development, or dignity (World Health Organization, 2006). Harm may be immediate (e.g. broken bones) or delayed (e.g. depression, posttraumatic stress disorder (PTSD)). These broad definitions of harm mean that child maltreatment covers a range of experiences, which may vary in severity and timing (age of onset, frequency, chronicity). The severity and timing of maltreatment is still poorly understood due to inadequate definitions and measurement strategies (Manly, 2005; National Research Council, 1993). As this thesis analyses pre-existing data only (i.e. no primary data collection; see Chapter 2 for details), I was unable to adequately measure, thus research, the severity and/or timing of child maltreatment throughout this thesis.

Fourth, ***child*** refers to the victim of maltreatment. Child is typically defined as any individual from birth up to 18 years of age at the time of maltreatment. For the purposes of this thesis, maltreatment of an adult (aged 20 years or older) will not be considered as child maltreatment, regardless of the person’s emotional or intellectual age.

1.2 Historical context and changes over time

Child maltreatment, and responses to child maltreatment (child protection), have significantly changed over time in the UK. There have been shifts in social attitudes towards children and child rearing (Newson, 1979; Newson & Newson, 1963, 1965, 2013, 2017, 2018; Straus & Mathur, 1996), as well as a number of important changes to child protection legalisation, policy, and practice (C. Ball, 1998; Guardian, 2005; National Society for the Prevention of Cruelty to Children, 2018; Parker, 2015). In Chapter 3, I map out specific changes to definitions and recording practices that relate to my data on the incidence of child maltreatment over time. Here, I highlight why historical context is important (Figure 1.1), and then give a brief history of child maltreatment by summarising three periods in which child maltreatment attracted particularly high levels of interest: 1870s to 1914, 1960s to late 1980s, and from 2003 onwards. Figure 1.2 provides an overview of key changes for child maltreatment and child protection over time.

1.2.1 The importance of historical context: An ecological framework

The dominant theoretical perspective on the aetiology of child maltreatment is the ecological model (Garbarino, 1977; Scannapieco & Connell-Carrick, 2005; Sethi et al., 2013). The central tenet of the ecological model is that child maltreatment is determined by complex interactions between the child, their family, their immediate environment, and wider societal context (Figure 1.1). Bronfenbrenner (1979) first proposed the ecological model for human development, which was later adapted by Belsky who proposed the development–ecological model for child maltreatment (Belsky, 1980, 1993). According to Belsky, child maltreatment is a social–psychological phenomenon that must be understood in the wider context in which the family and child are embedded. Since then, there have been different versions of the ecological model, such as ‘transactional approach’ (Cicchetti & Rizley, 1981) and the ‘ecological–transactional model’ (Cicchetti & Lynch, 1993). While the earlier models focused on risk factors and the later models on risks following child maltreatment, the underlying arguments are the same (Scannapieco & Connell-Carrick, 2005). Consequently, it is widely accepted that societal context (cultural and historical) is key to understanding the risks associated with child maltreatment.

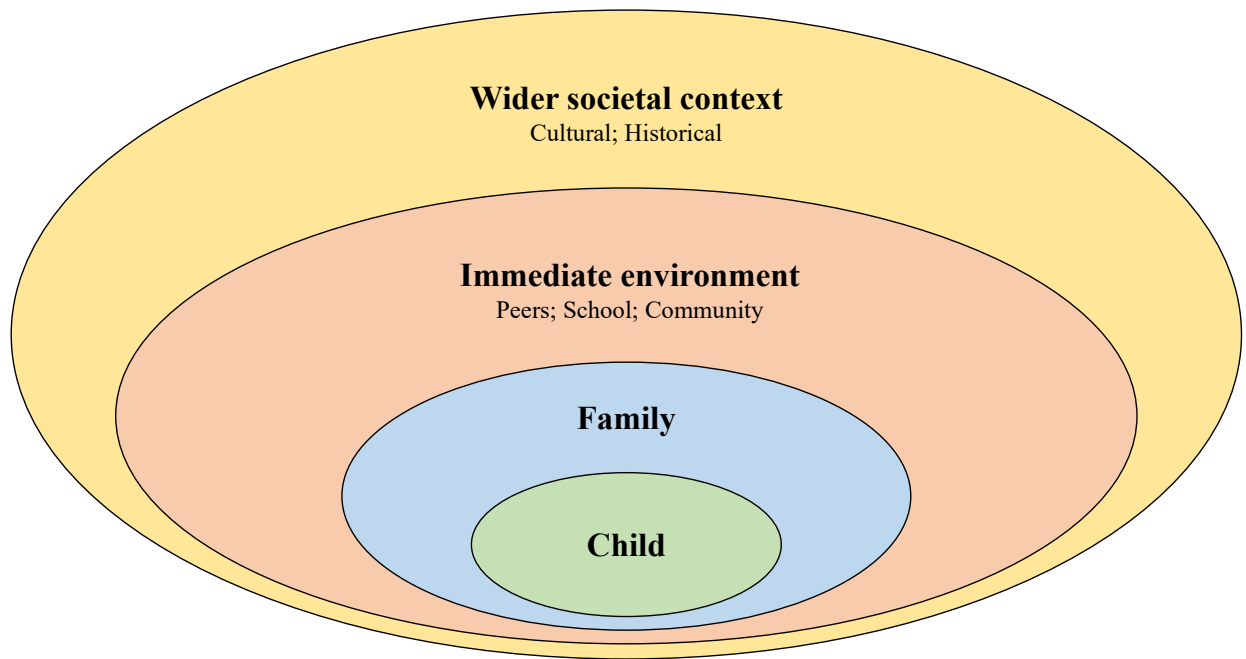


Figure 1.1. Schematic diagram of the ecological model of child maltreatment.

Adapted from Belsky (1980, 1993); Bronfenbrenner (1979).

A substantial body of literature is dedicated to identifying societal, specifically cultural, risk factors for child maltreatment. This research has helped to establish that cultural and social norms can influence child maltreatment (Korbin, 1991; Lansford et al., 2015; Mackenzie, Kotch, & Lee, 2011; Nadan, Spilsbury, & Korbin, 2015; Sidebotham, Heron, Golding, & The ALSPAC Study Team, 2002). For example, studies have found that children are more at risk of maltreatment when physical punishment is perceived to be socially acceptable (Fleckman, Taylor, Theall, & Andrinopoulos, 2019; Orhon, Ulukol, Bingoler, & Gulnar, 2006), while girls are more at risk of sexual abuse when traditional beliefs dictate that men have a right to control women through physical means (Jewkes, Penn-Kekana, & Rose-Junius, 2005; Mitra & Singh, 2007). However, far less attention has been paid to the historical context of child maltreatment (cf. Collishaw, Gardner, Maughan, Scott, & Pickles, 2012; Schoon, 2006). This is somewhat surprising given fundamental shifts in attitudes towards child rearing and definitional changes (Children Act, 2004; see Section 1.2.2 for details). In the 1960s and 1970s Newson and Newson conducted longitudinal surveys of child rearing practices in Nottingham (Newson, 1979;

Newson & Newson, 1963, 1965, 2013, 2017, 2018). The surveys revealed that smacking was used as a universal form of punishment with only 3% of four year olds never being smacked (Creighton, 1995; Newson, 1979). Detailed interviews with the parents further highlighted the normality and belief that corporal punishment was an appropriate way to discipline children. For example, parents said: “*A smack now is better than prison later*”, “*Spare the rod, spoil the child*”, and “*I think they should be smacked...I think there is no harm done at all — it just shows them the rights and wrong of things*” (Newson, 1979; Newson & Newson, 1963, 1965, 2013, 2017, 2018). Such attitudes are in stark contrast to current beliefs surrounding the use of physical punishment, and current British legalisation which states that battery does not ‘constitute reasonable punishment’ (Children Act, 2004; Gershoff, 2002; Gershoff & Bitensky, 2007; Lansford et al., 2017).

What is more, understanding historical context is becoming increasingly relevant for current research and practice (Bingham, Delap, Jackson, & Settle, 2016; Collishaw, Gardner, Maughan, Scott, & Pickles, 2012; Schoon, 2006; Schoon & Bynner, 2003). A number of high-profile cases of historical child abuse have recently emerged (see Section 1.2.2), and there is a growing literature on the long-term consequences of child maltreatment in older adults (see Section 1.4). In both incidences, individuals experienced child maltreatment within a different historical context to present day. Yet it is assumed that the risks associated with child maltreatment are static, even though social norms are known to impact child maltreatment and there have been substantial changes to child maltreatment over time (see also Section 1.2.2 below). This assumption needs to be tested to better understand and, in turn reduce, the burden of child maltreatment. There is therefore a need to investigate whether historical context and time have affected the societal and individual risks associated with child maltreatment.

1.2.2 Key changes over time: A brief history of child maltreatment

1.2.2.1 The discovery of child maltreatment (1870s–1914)

Child maltreatment was ‘discovered’ as a social problem in the 1870s (Radford et al., 2011). Although the maltreatment of children existed long before this date, it was the case of Mary Ellen in the United States that first attracted widespread attention in 1874. The severe physical

abuse, starvation, and neglect of Mary at the hands of her adoptive mother prompted the founding of the world's first child protection organisation in December 1874: the New York Society for the Prevention of Cruelty to Children (New York Society for the Prevention of Cruelty to Children, 2018; Radford et al., 2011).

Concern for child maltreatment was also beginning to grow in the UK in the late 19th century. In 1880, *The Lancet* pointed out the “*evils and injuries likely to result from the boxing of ears and the smacking of faces*”, discouraging the use of these ‘methods’ by school teachers (“The punishment of children [Editorial]”, 1880). In 1881, the Liverpool Mercury published a letter by the Reverend George Staite, who wrote: “*whilst we have a Society for the Prevention of Cruelty to Animals, can we not do something to prevent cruelty to children?*” (Hendrick, 1994; National Society for the Prevention of Cruelty to Children, 2006). Despite these concerns, Victorian social attitudes drew a clear distinction between public and private lives (i.e. the Englishman's Castle). In response to Staite, Lord Shaftesbury agreed that the problem of child maltreatment was ‘enormous’ and ‘indisputable’, but child maltreatment was also “*private, internal and domestic a character as to be beyond the reach of legalisation*” (Behlmer, 1982; Hendrick, 1994). It was not until 1883, when Thomas Agnew visited the Prevention of Cruelty to Children in New York, that the first child protection agency was set-up in the UK: the Liverpool Society for the Prevention of Cruelty to Children (National Society for the Prevention of Cruelty to Children, 2006). Subsequently, the National Society for the Prevention of Cruelty to Children (NSPCC) was established and the first act of parliament for the prevention of cruelty to children was passed in 1889 (Prevention of Cruelty to, and Protection of, Children Act, 1889 (‘Children's Charter’); Guardian, 2005; National Society for the Prevention of Cruelty to Children, 2006).

The end of the 19th century marked a turning-point in legal and social attitudes towards children. For the first time in UK history the Children's Charter allowed the State to intervene in relations between parents and children and made child maltreatment a crime (Hendrick, 1994). Between 1890 and 1900, new child protection legalisation was passed, and the NSPCC grew in power and size (National Society for the Prevention of Cruelty to Children, 2006). For example, an 1894 amendment to The Children's Charter extended definitions to include ‘mental

cruelty’, and the Prevention of Cruelty to Children Act (1904) enabled NSPCC inspectors to remove children from abusive or neglectful homes. However, in the following War Years (1914–1918 and 1939–1945) the intense interest in child maltreatment faded. Despite important child protection legalisation changes in 1932, 1933, and 1948 (Children and Young Persons Act, 1933; Children Act, 1948), child maltreatment did not re-attract high levels of attention until the 1960s (see Figure 1.2).

1.2.2.2 The re-discovery of child maltreatment (1960s–1980s)

Child maltreatment was ‘discovered’ as a medical problem in the 1960s. In 1962, the American paediatrician C. Henry Kempe published a seminal article on the ‘battered child syndrome’, which analysed x-rays and revealed unrecognised trauma fractures in very young children (Kempe, 1962). Kempe used the term ‘syndrome’; arguing that child maltreatment was not simply a consequence of poverty, but abusive parents were “*immature, impulsive, self-centred, hypersensitive and quick to react with poorly controlled aggression*” (Kempe, 1962). This re-conceptualisation identified child maltreatment as a medical disease (Hendrick, 1994).

In 1963, awareness of the ‘battered child syndrome’ emerged in the UK (Crane, 2015; Griffiths & Moynihan, 1963). Griffiths and Moynihan (1963) highlighted that battered babies were often misdiagnosed, and the occurrence of child maltreatment was being underestimated (Baher et al., 1976). In the early 1970s, further legalisation was passed in order to promote local activity and provision (e.g. Local Authority Social Services Act, 1970). However, it was not until the killing of Maria Colwell and the Colwell Inquiry in 1974 that the media and public began to focus their attention on child maltreatment. This new-found public interest, and related ‘moral panic’, helped to re-discover child maltreatment (Hendrick, 1994). In the following years, there were increased costs and efforts to improve child protection, including a number of important legislative changes and the introduction of the child protection register (Children Act, 1975; Children Act, 1989; Parton, 1985). For example, welfare spending by the UK government increased exponentially from £5 billion in 1974 to £113 billion in 2018 (UK Public Spending, 2018).

1.2.2.3 The re-discovery of child protection (2003–present day)

Child protection was re-discovered from 2003 to present day. The death of Victoria Climbié in 2000, and subsequent public inquiry, prompted new legalisation and major organisational change (Children Act, 2004; Laming, 2003). The Children Act (2004) tightened laws in relation to corporal punishment and introduced new local authority departments which combined education and social care responsibilities. The latter organisational changes intended a paradigm shift away from ‘child protection’ and towards the broader aim of ‘safeguarding and promoting the welfare of children’ (HM Treasury, 2003; Parton, 2010, 2014). Hence, from the early to mid-2000s the priority became prevention rather than protection. This new focus on prevention was heavily influenced by scientific research on risk and protective factors (Loeber & Farrington, 1998; Rutter, 1999). The idea was to use this evidence-base to inform early intervention, targeting known risk and protective factors to prevent problems, such as crime and antisocial behaviour, from developing (France & Utting, 2005).

These reforms provoked concern that the term ‘child protection’ had disappeared from the agenda and that the shift in focus towards preventative services and family support would send confusing, and potentially conflicting, messages to child health and welfare professionals (E. Munro & Calder, 2005). These concerns were realised following the death of Baby Peter Connelly in 2007. Baby Peter had been the subject of a child protection plan with the local authority Haringey — the same local authority involved with the failure to protect Victoria Climbié — and there had been over 60 contacts with child welfare services prior to his death. An intense and highly critical media response resulted in a re-focus on child protection from 2009 onwards (R. Jones, 2012; Warner, 2014). For example, the Laming Report on Baby Peter's death was entitled “*The protection of children in England*” (Laming, 2009), and in 2010 the government announced an independent review of child protection in England led by the experienced social worker Eileen Munro (E. Munro, 2010a, 2010b, 2011; Parton, 2012).

More recently, there have also been a number of high-profile scandals relating to historical cases of abuse. These historical cases have primarily involved child sexual abuse, and have included: Jimmy Saville and Operation Yewtree in 2012, Child Sexual Exploitation in Rochdale in 2013, the Goddard Inquiry into Child Sexual Abuse in England and Wales in 2015 (Indepen-

dent Inquiry into Child Sexual Abuse, 2018), and the Football Association internal review into child abuse sexual abuse in 2016 (Bingham et al., 2016). These highly publicised cases have sustained intense interest in child maltreatment, particularly sexual abuse, and have maintained the focus on child protection.

1.2.3 Summary: Historical context and changes over time

Historical context is key to understanding the risks associated with child maltreatment. Over the past 150 years there have been a number of fundamental changes to child maltreatment and, particularly since the 1970s, there have been increased governmental efforts aimed at improving child protection. This thesis will examine how the risks associated with child maltreatment may have also changed over time, both in terms of the risk of child maltreatment at the societal level (Section 1.3) and the risks following child maltreatment at the individual level (Section 1.4).

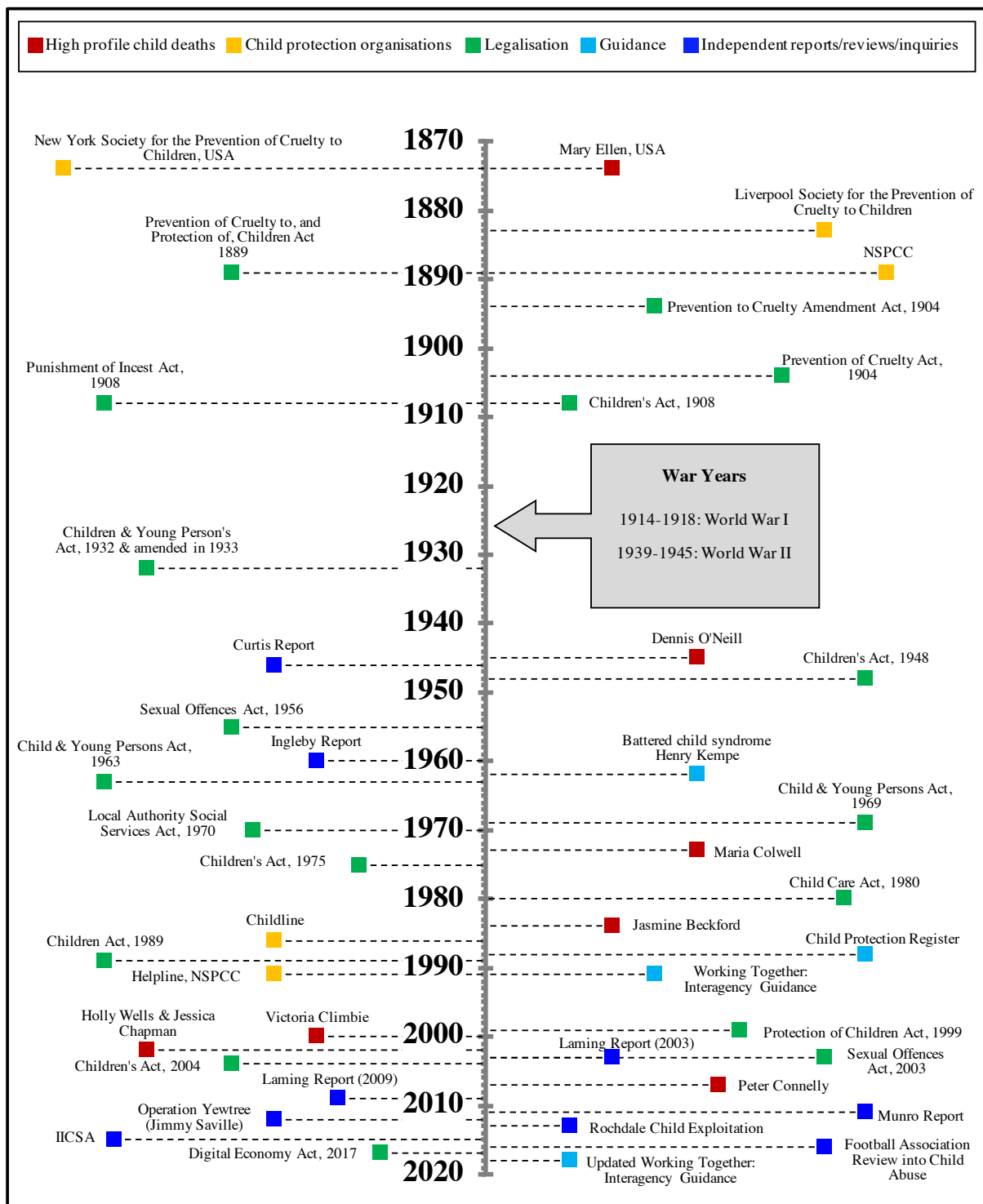


Figure 1.2. Key changes over time for child maltreatment and child protection in the UK.

1.3 The risk of child maltreatment

Children face a significant risk of maltreatment in the UK. The true extent of this risk is debated as estimates vary depending on the measurement method (e.g. self-report vs. official records), maltreatment type, and victim characteristics (e.g. gender, age). Estimates for the risk of child maltreatment also change over time. Although there are notable differences between countries (Gilbert, Widom, et al., 2009; Stoltenborgh, Bakermans-Kranenburg, Alink, & Ijzendoorn, 2015; Stoltenborgh et al., 2011), these will not be discussed as the focus of this thesis is child maltreatment in the UK. In the following section, I will refer to two types of measures for the risk of child maltreatment: cumulative prevalence and annual incidence. The cumulative prevalence of child maltreatment is the number of individuals who have experienced maltreatment at some point during their childhood, whereas the annual incidence of child maltreatment is the number of new cases of child maltreatment in a given year. Henceforth, these will be referred to as prevalence and incidence, respectively.

1.3.1 Prevalence and incidence of child maltreatment

Prevalence studies that use retrospective self-report estimate around 6%–22% of children experience maltreatment at some point during their childhoods (Cawson, Wattam, Brooker, & Kelly, 2000; Gilbert, Widom, et al., 2009; May-Chahal & Cawson, 2005; Radford et al., 2011). Although prevalence studies rarely use official records, one study identified that around 2% of children were investigated by social services for suspected abuse before their sixth birthday, of which 44% were placed on the child protection register (Sidebotham, 2000; Sidebotham & Heron, 2006). Incidence studies that use retrospective self-report estimate that around 3%–6% of children experience at least one type of maltreatment (Radford, Corral, Bradley, & Fisher, 2013), whilst studies that rely on official records estimate that around 5% of children are referred to social services and 0.5% of children are placed under child protection plans in the UK (Bentley et al., 2018; Department for Education, 2015). Both prevalence and incidence estimates highlight the discrepancy between measures of self-report and official records. Radford et al. (2013) estimated that yearly estimates were around 7–17 times greater when measured by

self-report instead of official child protection records, and a systematic review estimated that around 9% of children who are physically abused were investigated by child protection services (Woodman et al., 2008). The reasons behind these discrepancies, and related measurement problems, are discussed in Chapter 2 Section 2.1.1.

1.3.1.1 Maltreatment types

The risk of child maltreatment depends on the type of child maltreatment. May-Chahal and Cawson (2005) measured the prevalence of different maltreatment types in a large, UK sample. The authors found that 7% of respondents reported physical abuse, 11% sexual abuse, 6% emotional abuse, and 6% neglect (absence of care). A handful of studies have also measured the self-reported prevalence of sexual abuse only and estimate that around 10% (Baker & Duncan, 1985) to 22% (Gallagher et al., 2002) of children experience sexual abuse at some point during their childhoods. There are additional differences depending on the severity of child maltreatment. Radford et al. (2011) used retrospective self-report to measure the prevalence of child maltreatment, surveying a large, nationally representative sample. Between the ages 0 to 17 years, 22% experienced maltreatment while 13% experienced severe maltreatment at the hands of their primary caregiver. The authors considered maltreatment to be severe based on definitions used in criminal law and considered a number of factors, including the age of the child, the type of maltreatment, its frequency, injuries to the child, the use of a weapon, and whether there were multiple forms of maltreatment. The authors also identified significant maltreatment co-occurrence, whereby children who had been maltreated were at increased risk of experiencing other forms of victimisation (Radford et al., 2011; Radford, Corral, Bradley, & Fisher, 2013).

1.3.1.2 Characteristics of the victim (gender & age)

Victim characteristics, such as gender and age, affect the risk of child maltreatment. Although males and females are at a similar overall risk of experiencing child maltreatment (Gilbert, Widom, et al., 2009), there is evidence to suggest that more females than males experience sexual abuse (Cawson, Wattam, Brooker, & Kelly, 2000; Radford et al., 2011; Radford, Corral,

Bradley, & Fisher, 2013). There is also evidence to suggest that different age groups face different levels of risk. For example, Radford et al. (2013) estimated that the prevalence of child maltreatment was around 3% for children under 11 years old yet more than two-fold higher for children aged 11–17 years old.

1.3.2 Changing prevalence and incidence rates over time

1.3.2.1 Prevalence rates: Comparing different time periods

The time period has also been shown to influence the prevalence of child maltreatment. Denholm, Power, Thomas, and Li (2013) used the 1958 British birth cohort to retrospectively determine the prevalence of child maltreatment. The authors reported that the prevalence of maltreatment for children born in 1958 was broadly similar to current prevalence estimates. Around 14%–17% of individuals reported at least one type of child maltreatment. Prevalence rates for physical abuse (6%–9%) and emotional abuse (10%–13%) were similar to current estimates, but rates for sexual abuse 2%–3% were considerably lower in 1958 cohort. A more direct comparison of past and current child maltreatment examined whether prevalence rates had changed between population samples drawn in 1998 versus 2009 (Radford et al., 2011). This comparison identified reductions in physical and sexual abuse. For example, the prevalence of physical abuse significantly decreased from 13% in 1998 to 10% in 2009. These observations are consistent with findings from repeat population studies in the US, which show declining rates of physical and sexual violence since the 1990s (Finkelhor & Jones, 2006; Finkelhor, Turner, Ormrod, & Hamby, 2010; L. M. Jones, Finkelhor, & Halter, 2006).

1.3.2.2 Incidence rates: Trends in child maltreatment

Unlike prevalence rates, which can examine differences between time periods, annual incidence rates can be used to track year-on-year changes in the risk of child maltreatment by mapping out trends over time. Trends in child maltreatment are key to understanding the epidemiology of child maltreatment and evaluating whether historical changes, such as the increased child protection efforts since the 1970s (see above, Section 1.2.2), have reduced the risk of child maltreatment. In fact, following a special series published in 2009 (Gilbert, Kemp, et al., 2009;

Gilbert, Widom, et al., 2009), child health and welfare professionals identified the question “Are trends in child maltreatment decreasing?” as most needing answering by scientific research (Gilbert et al., 2012). Despite this, the current evidence on maltreatment trends in the UK is inconsistent and limited.

On the one hand, some research suggests that trends in violent child deaths in England and Wales have decreased since the 1970s (Hardelid, Davey, Dattani, & Gilbert, 2013; Pritchard & Sharples, 2008; Pritchard & Williams, 2010). Pritchard and colleagues used the World Health Organization’s (WHO) mortality data and reported significant reductions in violent child deaths and child abuse-related deaths from 1974 to mid-2000s, which they attributed to improvements in medicine and child protection (Pritchard & Sharples, 2008; Pritchard & Williams, 2010). An additional study found evidence for decreasing trends in child deaths due to injury between 1980 and 2010 (Hardelid et al., 2013). On the other hand, some studies have found mixed to no evidence for decreasing trends since the 1970s (Gilbert et al., 2012; Sidebotham, 2014; Sidebotham, Atkins, & Hutton, 2012). Sidebotham and colleagues examined trends in police-recorded homicides between 1974 and 2008. Although they found that rates in police-recorded homicides declined for infants (<1 year), there was no observable change for children (1–14 years) and even some evidence of increases for adolescents (15–19 years; Sidebotham, 2014; Sidebotham, Atkins, & Hutton, 2012).

A comprehensive review also found mixed evidence for decreasing trends. Gilbert et al. (2012) used three data sources to measure child maltreatment in England from the 1970s to 2008: violent child deaths, maltreatment-related hospital admissions, and child protection statistics. Trends were not consistent across these three data sources. There was evidence of significant decreases in violent child deaths, replicating previous studies (e.g. Pritchard & Sharples, 2008), but no change in the incidence of maltreatment-related hospital admissions. A more recent study has examined maltreatment-related hospital admissions and found evidence for increasing trends between 2005 and 2011 (Gonzalez-Izquierdo et al., 2014). Furthermore, the child protection and NSPCC activity has recently increased. For example, between 2015 and 2016 there was a 1.6% increase in the number of children placed on child protection plans, and between 2016 and 2017 there was a 21% increase in the number of contacts made to the

NSPCC helpline (Bentley et al., 2018; Gilbert et al., 2012).

1.3.3 Summary: The risk of child maltreatment

Estimates for the risk of child maltreatment in the UK vary depending on the measurement method, maltreatment type, and victim characteristics. Although estimates also change depending on the time period, there is mixed evidence on whether these changes reflect sustained decreases or increases in the risk of child maltreatment. Due to a lack of data, there is very little evidence on maltreatment trends before the 1970s and scientific research is yet to adequately answer the question: “Are long-term trends in child maltreatment decreasing?”

1.4 The risks following child maltreatment

A child who is maltreated faces immediate risks of serious harm (e.g. injury, death), as well as longer-term risks for a range of poor behavioural, mental health, and physical health outcomes (Norman et al., 2012). Stemming from the seminal work on the ‘cycle of violence’ (Widom, 1989a), antisocial behaviour is one of the most well-documented risks following child maltreatment (Dodge, Pettit, & Bates, 1997; Stouthamer-Loeber, Loeber, Homish, & Wei, 2001; Weiler & Widom, 1996). Antisocial behaviour is a public health concern in the UK; 3%–7% of children are diagnosed with ‘antisocial’ disorders and the problem of antisocial behaviour has been identified as the worst in Western Europe (Guardian, 2006; Maughan, Rowe, Messer, Goodman, & Meltzer, 2004; Meltzer, Gatward, Goodman, & Ford, 1999). Antisocial behaviour is also costly, increasing societal costs by at least ten-fold compared to healthy controls and, on average, each child with antisocial behaviour costs nearly £6,000 every year (Romeo, Knapp, & Scott, 2006; Scott, Knapp, Henderson, & Maughan, 2001).

1.4.1 Defining antisocial behaviour

Antisocial behaviour describes a wide variety of actions and attitudes that violate age-appropriate societal norms, and the personal or property rights of others (e.g. vandalism, hurting animals, setting fires, theft, and bullying/assault; Burt, 2009). It encompasses externalising behaviour and the most common child psychiatric disorders, oppositional defiant disorder (ODD) and conduct disorder (CD), as well as delinquency, crime, and antisocial personality disorder (ASPD) in adolescence and adulthood.

Antisocial behaviour is a heterogeneous construct with specific manifestations varying across individuals and across the developmental life-course. Accordingly, it is usually assumed that not all individuals who show antisocial behaviour are the same and, for theoretical, practical, and research purposes, antisocial behaviour is often subdivided into meaningful subtypes (Clements, 1996). Some typologies are based on different behavioural characteristics; such as aggressive vs. non-aggressive rule breaking behaviour (Burt, 2009), violent vs. non-violent delinquency (Nagin & Tremblay, 1999), or reactive vs. proactive aggression (Crick & Dodge,

1996). Other typologies are based on developmental patterns of antisocial behaviour across the life-course (e.g. developmental taxonomy theory (Moffitt, 1993)). This latter approach has proved the most influential; informing diagnostic criteria and subtyping in the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1994, 2013), and being invoked in the World Health Organization (2002)'s World Report on Violence and Health, and the National Institutes of Health (2004)'s State-of-the-Science Consensus Statement on Preventing Violence (Moffitt, 2006; Moffitt et al., 2008).

1.4.2 Child maltreatment and antisocial behaviour

Fifty-five years ago the *American Journal of Psychiatry* published an article entitled “*Violence begets violence — perhaps?*”. The article expressed the concern that children who were maltreated would “*become tomorrow’s murderers and perpetrators of other crimes of violence*” (Curtis, 1963). The ideas underlying ‘violence begets violence’ (also known as the ‘intergenerational transmission of violence’ and the ‘cycle of violence’) have been loosely applied to refer to different risks following different types of maltreatment (Widom, 1989a). Some researchers refer exclusively to physically abused children becoming physically abusive parents (J. D. Ball, 2009; Kaufman & Zigler, 1987), whilst others refer more broadly to the increased risk of antisocial behaviour following child maltreatment (World Health Organization, 2007). In line with my definitions of child maltreatment and antisocial behaviour, I will adopt this latter approach. In the first part of the section below (1.4.2.1), I will discuss theories that explain how maltreated children are at increased risk of antisocial behaviour. In the second part of this section (1.4.2.2), I will review the cross-sectional evidence on the relationship between child maltreatment and antisocial behaviour.

1.4.2.1 Theoretical overview of causal mechanisms

A number of causal mechanisms are able to explain an increased risk of antisocial behaviour following child maltreatment (Dodge, Bates, & Peitit, 1990). These include theoretical perspectives from: behavioural genetics (e.g. Caspi et al., 2002; Jaffee, 2012; Jaffee, Caspi, Moffitt, Polo-Tomás, & Taylor, 2007; Roth, 2013), neurophysiology (e.g. De Bellis, 2001; De Bellis

& Zisk, 2014), psychology (see below), and criminology (e.g. general strain theory (Agnew, 1992); social control theory (Gottfredson & Hirschi, 1990; Hirschi, 1969)). Because this thesis is grounded in psychology, I will now summarise three prominent psychological theories that describe intrapersonal causal mechanisms (social learning theory, attachment theory, and social information processing), before reviewing the cross-sectional evidence (Section 1.4.2.2).

Social learning theory. Social learning theory is arguably the most popular psychology theory for explaining the relationship between child maltreatment and antisocial behaviour. Bandura proposed that children acquired behaviours by modelling and reinforcement contingencies learned from social interactions (Bandura, 1973). The theory is based on the observation that children learn behaviours by imitating others. This observation has been demonstrated in a number of social experiments, such as the famous Bobo doll experiment (Bandura, Ross, & Ross, 1961), which found that children who observed aggressive models were more likely to show aggressive behaviours themselves. It was also argued that more salient models (i.e. parents) were more likely to result in imitation. As a result, children who were victims and/or observers of violence in the home are at risk of modelling their parents' behaviour, especially when such behaviours are followed by rewards such as compliance and/or interpersonal dominance over others.

In addition, children are at further risk of learning that violent behaviours are acceptable (Bandura, 1973). White and Straus (1981) suggested that physical punishment implies normative legitimacy of all types of violence. For example, one study found that individuals who experienced physical punishments during their childhoods that were not necessarily abusive (e.g. spanking), were more likely to perceive these behaviours as acceptable (Simons & Wurtele, 2010). Although this aspect of the social learning theory may be extended to potentially explain the relationship between child neglect and antisocial behaviour, the social learning theory better explains intrapersonal mechanisms between child physical, sexual, and emotional abuse and antisocial behaviour.

Attachment theory. Bowlby's attachment theory has also been critical for understanding intrapersonal mechanisms and can more easily explain the relationship between all types of child maltreatment and antisocial behaviour (Bowlby, 1969, 1977, 1980, 1982). Attachment theory

is based on the assumption that infants (6–12 months) are genetically predisposed to form attachments to caregivers in order to improve their chances of survival (Bowlby, 1969). These attachments and interactions with caregivers create an ‘internal working model’ of the world that acts as framework for future interpersonal interactions (Bowlby, 1980). If a caregiver acts in an abusive and/or neglectful way then secure attachment is disrupted, leading the child to develop a hostile internal representation of the world and others around them and increasing the risk of antisocial behaviour (Crittenden & Ainsworth, 1989). In line with the attachment theory, several studies have found that poor attachment predicts a range of later problems, including antisocial behaviour (Egeland & Carlson, 2004; Rodriguez & Tucker, 2011). Poor attachment typically falls under the category of ‘disorganised attachment’, where children display unusual or disorganised behaviours when distressed, including misdirected or stereotypical behaviour, simultaneous display of contradictory behaviours, stilling and freezing for substantial periods, and direct apprehension or even fear of the caregiver (Benoit, 2004). There is strong evidence linking disorganised attachment with maltreatment and antisocial behaviour (Fearon, Bakermans-Kranenburg, Van IJzendoorn, Lapsley, & Roisman, 2010; Van IJzendoorn, Schuengel, & Bakermans-Kranenburg, 1999). Furthermore, empirical evidence has shown that having an alternative loving and/or supportive caregiver (e.g. foster parent) is a protective factor (Egeland, Jacobvitz, & Papatola, 1987; Egeland, Jacobvitz, & Sroufe, 1988), and interventions aiming to promote secure-attachment (e.g. home-visiting) have been effective in improving behavioural problems for children who have been maltreated (Barlow et al., 2016; Moss et al., 2011).

Social information processing. An alternative explanation for the relationship between child maltreatment and antisocial behaviour, is that children who are maltreated show biases in social information processing (Dodge et al., 1990). The model argues that children’s social behaviour follows five sequential steps: encoding cues, interpreting social cues, accessing responses, evaluating responses, and enacting responses (Crick & Dodge, 1994). Dodge and colleagues hypothesised that these first four steps mediate the relationship between physical abuse and antisocial behaviour. Specifically, children who are abused go on to develop the following biases: (a) hypervigilance to hostile cues; (b) attributing hostile intentions to others; (c)

accessing more aggressive responses from memory; and (d) evaluating aggressive behaviour as positive. These biases then lead to an increased risk of antisocial behaviour. Thus, this general model of social information processing encompasses different aspects of other psychology theories, such as attachment theory. It also explains that maltreated children misperceive ambiguous interactions due to attentional and attributional biases towards social threat cues (Gibb, Schofield, & Coles, 2009; Gray, Baker, Scerif, & Lau, 2016; Jaffee, 2017; Pollak & Tolley-Schell, 2003).

1.4.2.2 Cross-sectional evidence

A large body of cross-sectional evidence shows an association between child maltreatment and antisocial behaviour, where individuals who experienced child maltreatment have higher levels, or a higher likelihood, of antisocial behaviour. Studies show that antisocial adults often report experiences of maltreatment during their childhoods (J. D. Ball, 2009; Byrd & Davis, 2009; Paolucci, Genuis, & Violato, 2001; Rangul Askeland, Evang, & Heir, 2011). For example, a large UK survey revealed that 32%–62% of prisoners reported experiences of maltreatment as a child (K. Williams, Papadopoulou, Booth, & Ministry of Justice, 2012). In the US, a series of surveys by the Bureau of Justice Statistics identified that between 6%–14% of male offenders and 23%–37% of female offenders reported experiences physical or sexual abuse during their childhoods (Harlow, 1999). Consequently, the cross-sectional association between child maltreatment and antisocial behaviour is well-replicated and is independent of gender or country (Widom, 2015).

1.4.3 Child maltreatment and antisocial behaviour across the life-course

Despite the numerous theories and cross-sectional evidence supporting a relationship between child maltreatment and antisocial behaviour, far fewer studies have examined whether this relationship changes across the life-course. This is problematic for three main reasons. First, antisocial behaviour typically changes within individuals as they age (cf. age-crime curve). Second, influential theories and clinical practice use developmental patterns to differentiate important subtypes of antisocial behaviour (see Section 1.4.1). Third, more recent longitudinal

evidence suggests that child maltreatment is associated with long-term risks, yet it is unclear whether the risk of antisocial behaviour changes over time. In the next section, I will address these three points in detail, highlighting the need for more longitudinal evidence examining the relationship between child maltreatment and antisocial behaviour across the life-course.

1.4.3.1 The age-crime curve

Antisocial behaviour is not stable across the life-course but changes within individuals as they age. The phenomenon was first described in the 1830s by Quetelet (1984) who identified the age-crime curve. The age-crime curve consistently shows that antisocial behaviour typically peaks in mid-adolescence and then decreases throughout late adolescence and early adulthood (Figure 1.3). This association between age and antisocial behaviour has been replicated across sexes, countries, time periods, data sources, and types of antisocial behaviour (DeLisi, 2015; Loeber & Farrington, 1998; Thornberry, 1997), and has been characterised as a ‘brute fact’ of antisocial behaviour research (Hirschi & Gottfredson, 1983). Antisocial behaviour is not a static construct, and thus the relationship between child maltreatment and antisocial behaviour cannot be adequately examined by measuring antisocial behaviour at only one time-point.

1.4.3.2 The developmental taxonomy of antisocial behaviour

Although there are a number of life-course theories of antisocial behaviour, Moffitt’s developmental taxonomy is the most empirically tested and influential (see Section 1.4.1). In its original formulation Moffitt identified two qualitatively distinct subtypes that have unique patterns of antisocial behaviour across the life-course (i.e. trajectories) and unique aetiologies (i.e. risk factors Moffitt, 1993). The first subtype, termed adolescence-limited (AL) antisocial behaviour, is the more common of the two. As the name suggests, AL antisocial behaviour is confined to adolescence and reflects a similar pattern to the age-crime curve, emerging in adolescence and then desisting in early adulthood (Figure 1.3). Moffitt theorised that the aetiology of AL antisocial behaviour is a result of social mimicry and the ‘maturity gap’ — a development period between an individual’s biological maturation and their access to adult privileges and responsibilities. AL antisocial behaviour is therefore a near-normal response that demonstrates

autonomy from parents, affiliation with peers, and helps to hasten social maturation. The second subtype, termed life-course persistent (LCP) antisocial behaviour, is comparatively rare (5%–10% of antisocial individuals). LCP antisocial behaviour is severe and chronic, emerging in childhood and persisting into adulthood. Unlike AL, LCP antisocial behaviour is pathological, with origins in neurodevelopmental deficits and early risk factors, including child maltreatment (Moffitt, 1993, 2003, 2006, 2018).

Despite mixed empirical support, the developmental taxonomy remains the dominant life-course theory of antisocial behaviour (Fairchild, Van Goozen, Calder, & Goodyer, 2013; Odgers et al., 2008; Raine et al., 2005; Vaughn et al., 2011). The theory has informed both research and clinical practice by demonstrating the importance of adopting a life-course perspective (Moffitt, 2006; Moffitt et al., 2008, see also Section 1.4.1). The theory also identifies child maltreatment as a risk factor for LCP antisocial behaviour only, further emphasising the need to adopt a life-course perspective when examining the relationship between child maltreatment and antisocial behaviour.

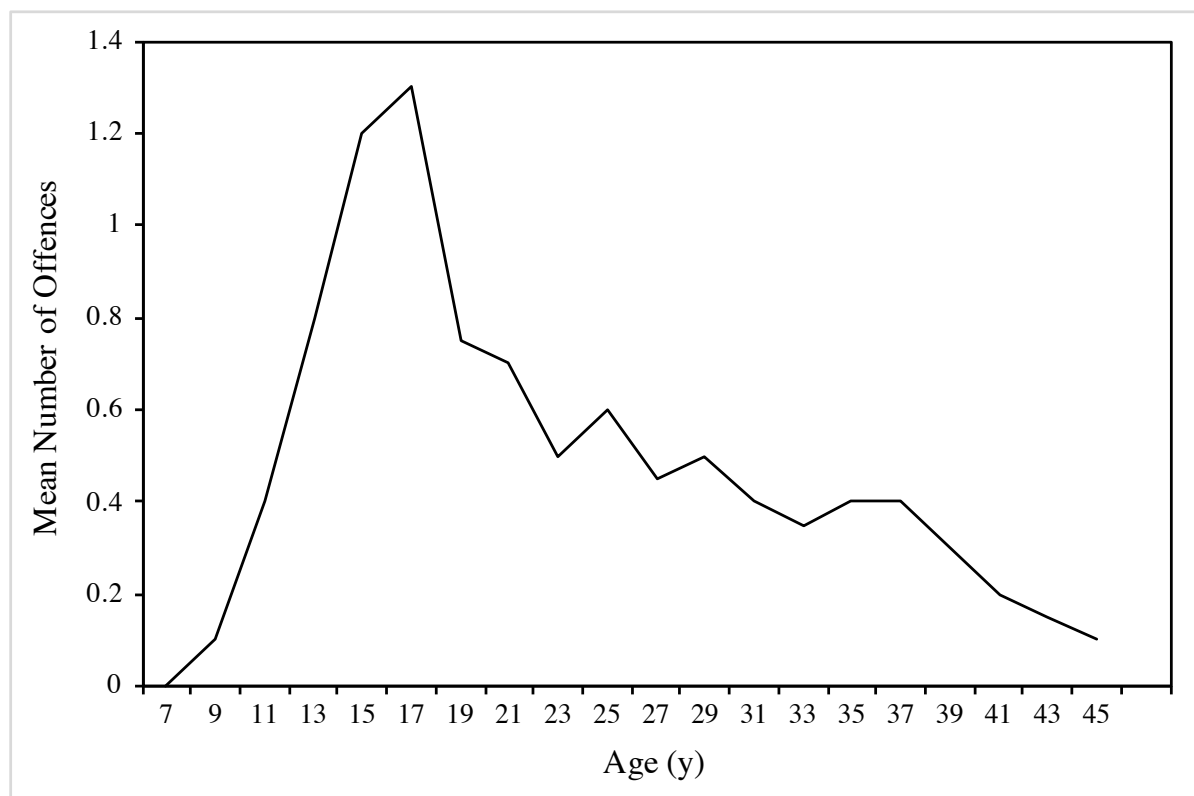


Figure 1.3. Schematic diagram of the age-crime curve (adapted from Sampson & Laub, 2003).

1.4.3.3 Longitudinal evidence

As described above, a large number of cross-sectional studies show that child maltreatment is associated with antisocial behaviour, but fewer longitudinal studies examine whether this association changes across an individual's life-course.

Unlike cross-sectional evidence, longitudinal evidence is not limited by measuring antisocial behaviour at only one time-point. This approach is thus able to capture the longitudinal course of antisocial behaviour and can be used to investigate the effects of child maltreatment on within-person change (Farrington, 1991). It is particularly important to investigate within-person change because this determines whether risks change or are stable over time. Such findings have key clinical implications. For example, if child maltreatment is associated with an increased risk of antisocial behaviour in childhood but this risk diminishes from childhood into adulthood; then emphasis should be placed on early interventions. If instead this risk increases from childhood into adulthood (i.e. 'sleeper effects'), or is persistent and stable; then there is a need for interventions to extend beyond the childhood period to include adulthood (Widom, 2017).

Almost 30 years ago, Widom (1989b) reviewed the empirical evidence on the relationship between child maltreatment and antisocial behaviour and concluded that there was a lack of prospective, longitudinal evidence. A handful of prospective longitudinal cohorts have since emerged, with the majority based in the US (e.g. Rochester Youth Development Study (C. Smith & Thornberry, 1995); see Chapter 5 for a full review). More recent reviews of this longitudinal evidence suggest that child maltreatment is associated with antisocial behaviour in childhood, adolescence, and adulthood (Braga, Cunha, & Maia, 2018; Braga, Gonçalves, Basto-Pereira, & Maia, 2017; Maas, Herrenkohl, & Sousa, 2008; Malvaso, Delfabbro, & Day, 2016; Widom, 2017; Wilson, Stover, & Berkowitz, 2009). However, these reviews have also shown that the longitudinal evidence is still limited. For example, a recent systematic review found that only eight out of 62 longitudinal studies measured antisocial behaviour from childhood into adulthood and none were UK-based (Malvaso et al., 2016). Again, this underlines the need for additional longitudinal evidence on the relationship between child maltreatment and antisocial behaviour across the life-course.

An empirical examination on whether there is a persistent and stable risk of antisocial behaviour is also increasingly important within the broader context of establishing the burden of child maltreatment. Emerging evidence indicates that child maltreatment is associated with chronic and long-term risks. Clinical samples have shown that child maltreatment is associated with chronic forms of psychopathology (Hovens et al., 2012, 2009; McCrory & Viding, 2015; Nanni, Uher, & Danese, 2012), while longitudinal cohort studies have shown that the risks associated with child maltreatment persist into mid-life (Archer, Pinto Pereira, & Power, 2017; Clark, Caldwell, Power, & Stansfeld, 2010; Clark, Rodgers, Caldwell, Power, & Stansfeld, 2007). Though this empirical evidence points towards the long-reaching impacts of child maltreatment, equivalent evidence is still needed to establish whether there is a persistent and stable risk of antisocial behaviour following child maltreatment.

1.4.4 Summary: Risks following child maltreatment

Antisocial behaviour is the most well-documented risk following child maltreatment. The majority of the current empirical evidence is cross-sectional; examining the association between child maltreatment and antisocial behaviour at only one time-point. There is also a rich literature showing that antisocial behaviour changes across an individual's life-course. However, there remains a lack of longitudinal evidence examining the relationship between child maltreatment and antisocial behaviour across the life-course.

1.5 A conceptual overview of the thesis

Child maltreatment occurs within a wider sociohistorical context. In the UK, there have been a number of key changes to child maltreatment and child protection since the 1870s yet changing historical contexts, and the passing of time, is often ignored in child maltreatment research. This thesis adopts a unique, socioecological perspective and aims to understand whether risks associated with child maltreatment have changed over time. As described throughout this introductory chapter, I will investigate changing risks in two ways. Firstly, I will examine the risk of child maltreatment at the societal level and how this risk has changed over time (RQ1). Secondly, I will examine the risk of antisocial behaviour following child maltreatment at the individual level and whether this risk changes across the life-course (RQ2).

The next chapter, Chapter 2, provides a practical overview of the thesis. It will address methodological challenges in child maltreatment research and the different research methods I used to overcome these challenges. Chapter 2 ends by providing a practical overview of the thesis, including an outline of its overall aims and structure and brief descriptions of the empirical chapters.

Chapter 2 **Methods: An epidemiological approach**

In the previous introductory chapter (Chapter 1), I introduced the two main questions underpinning this thesis: **RQ1)** Has the societal risk of child maltreatment changed over time? and **RQ2)** Does the risk of antisocial behaviour following child maltreatment change across an individual's life-course? Before conducting studies to address these questions (Chapters 3 – 6), it is important to consider relevant research challenges and use methods that are able to overcome these challenges.

Research on child maltreatment is complex as it faces a range of specific, as well as more general, methodological challenges (Ammerman, 1998; Fallon et al., 2010; Howing, Wodarski, Kurtz, & Gaudin, 1989; Milling Kinard, 1994; Milling Kinard & Heller, 1985). Challenges in measuring child maltreatment, data collection, study design, and data analysis were particularly critical in determining the methods used in this thesis. More specifically, these issues led me to use: multiple measures of child maltreatment, pre-existing epidemiological data, observational study designs, and analytical methods that are sensitive to repeated measures.

This chapter discusses some of the methodological challenges I faced when designing my research and describes how an epidemiological approach was able to overcome these challenges while still addressing my research questions. The chapter is not meant to be a comprehensive review of all the pitfalls in child maltreatment research (see instead Ammerman, 1998; Fallon et al., 2010; Howing, Wodarski, Kurtz, & Gaudin, 1989), but a demonstration of how salient issues informed my research methods. The chapter concludes by providing a practical overview of this thesis, including a brief description of the overall thesis aims and structure and details of the subsequent chapters.

2.1 Overcoming challenges in child maltreatment research

The section below describes issues in measuring child maltreatment, data collection, study design, and data analysis, and how they informed my decision to use an epidemiological approach to address my research questions. This process of choosing research methods to overcome methodological challenges is summarised in Table 2.1.

Table 2.1. Overcoming methodological challenges in child maltreatment research.

	Methodological challenge	My research method
Measuring child maltreatment (Section 2.1.1)	Official records underestimate child maltreatment whilst retrospective self-reports are subject to recall bias and prospective self-reports have only been collected in more recent UK surveys	Use multiple measures of child maltreatment: <i>Official records, retrospective and prospective self-report</i>
Data collection (Section 2.1.2)	Practical and ethical difficulties in collecting data on child maltreatment and recruiting large, representative samples	Harness pre-existing epidemiological data on child maltreatment: <i>Routinely collected administrative data and the 1958 British birth cohort</i>
Study design (Section 2.1.3)	Experimental designs (e.g. RCTs) cannot be ethically used and are not well-designed to answer my research questions	Use the best study design to answer my research questions: <i>Observational study designs</i>
Data analysis (Section 2.1.4)	Cross-sectional statistical methods are the easiest to use (e.g. regression) but often rely on inappropriate assumptions about repeated measures and can result in loss of information	Apply advanced statistical methods that are sensitive to repeated measures: <i>Time series analysis and latent growth curve modelling</i>

Notes. RCTS = Randomised controlled trials.

2.1.1 Measuring child maltreatment

Measuring child maltreatment is one of the first steps for any research as it identifies how many children and which children are at risk (World Health Organization, 2006). There are a handful of different methods for measuring child maltreatment. Prospective self-report is a popular measurement method but it has only been used in more recent UK surveys and comes with additional ethical complications, which I will address in Section 2.1.2 below. In this section, I

will instead focus on the two most popular and common measurement methods: official records and retrospective self-report. As outlined in Chapter 1 Section 1.3, these different measurement methods produce discrepant estimates for child maltreatment by orders of magnitude (Negri, Schneiderman, & Trickett, 2017; Radford, Corral, Bradley, & Fisher, 2013; L. M. Williams, 1994). On average, retrospective self-report suggests that child maltreatment is ten times more common than estimates derived from official records (Gilbert, Widom, et al., 2009). These discrepancies can be explained by the different strengths, limitations, and biases of each measurement method.

Official records are prospectively compiled by a third party who routinely collect data relating to incidents or cases of child maltreatment (e.g. child protection services, police). The main strength of this measurement method is its high validity and reliability (Everson et al., 2008; Kobulsky, Kepple, & Jedwab, 2018). Because official records are typically collected by services for operational purposes, most cases of child maltreatment are validated and there is a low rate of false positives. Official records are also prospectively collected in real-time and tend to contain reliable temporal information. The main limitation of this measurement method is that official records only measure the small proportion of children who are maltreated who come to the attention of authorities and thus only capture the ‘tip of the iceberg’ (Chang et al., 2004; Independent, 2014; Maier, Mohler-Kuo, Landolt, Schnyder, & Jud, 2013). It has been evidenced that official records underestimate the true number of children who are maltreated by around 10-fold (see Chapter 1 Section 1.3; Radford, Corral, Bradley, & Fisher, 2013; Woodman et al., 2008). There is also the additional problem that the few children who are seen by authorities are not fully representative of all cases of child maltreatment. There are biases in child protection services, such as surveillance and substantiation, that have led to the over-representation of poor and minority children in official records (Ards et al., 2012; Cross & Casanueva, 2009). For example, African American children are 1.6 times more likely to be found in child protection services than in the overall population, even though there is limited evidence for differences in actual rates of child maltreatment (Sedlak & Broadhurst, 1996).

Retrospective self-report typically asks individuals about their childhood experiences via a survey or structured interview. The strength of this measurement method is that it provides

valuable information about the large number of maltreatment cases that are missed by official records alone (Kendall-Tackett & Becker-Blease, 2004), as well offering a tool to collect information that was not originally collected by prospective measures (e.g. in the 1946, 1958 and 1970 British birth cohorts (Power & Elliott, 2006)). Compared to official records, retrospective self-report can more easily identify if an individual experienced maltreatment at any point during their childhood, and this measure of child maltreatment has been consistently associated with a plethora of poor outcomes (Brown, Cohen, Johnson, & Salzinger, 1998; Newbury et al., 2018; Reuben et al., 2016). Nevertheless, there are questions surrounding the validity and reliability of retrospective self-report. Studies have shown low levels of agreement between retrospective self-report and prospective self-report (Henry, Moffitt, Caspi, Langley, & Silva, 1994), contemporaneous parental reports (Maughan & Rutter, 1997; Newbury et al., 2018), and sibling corroboration (Robins et al., 1985). Other studies have shown that retrospective self-report has poor test-retest reliability (Colman et al., 2016; Fergusson, Horwood, & Nagin, 2000; Widom, Raphael, & DuMont, 2004). This may be because, unlike official records, retrospective self-report is subject to measurement errors from recall biases, respondents' subjective perception of event(s), socially desirable responding, and/or confounding from current mood and mental health (Drake & Jonson-Reid, 1999; Everson et al., 2008; Hardt & Rutter, 2004; Taber, 2010). Unlike prospective measures, retrospective self-report is also confounded by changing definitions and societal attitudes towards child maltreatment as individuals may re-evaluate childhood experiences as abusive when they may not have been considered abusive at the time (e.g. corporal punishment; see Chapter 1 Section 1.2.2).

The field is yet to agree on a 'gold standard' as neither official records or retrospective self-report are perfect measures of child maltreatment (Fallon et al., 2010). However, there is evidence supporting the use of both measures and studies have shown significant overlap in official records and retrospectively reported experiences of child maltreatment (Denholm, Power, Thomas, & Li, 2013; Dube, Williamson, Thompson, Felitti, & Anda, 2004; Hardt & Rutter, 2004; Kendall-Tackett & Becker-Blease, 2004; Widom & Shepard, 1996; L. M. Williams, 1994). This overlap is especially pronounced for severe cases of child maltreatment, and when retrospective self-report asks specific questions about childhood experiences (e.g. "I was

punched, kicked or hit or beaten with an object, or needed medical treatment”) rather than vague questions that are subject to interpretation (e.g. “I was neglected”). This suggests that the careful use of either method captures different aspects of child maltreatment and that the use of multiple methods would help to provide less biased measures of child maltreatment.

It is also possible to capitalise on the relative strengths of each method. For example, official records have superior temporal information as they are usually prospectively collected at regular time intervals. This means that official records are better suited for estimating incidence rates and tracking how these rates change over time (i.e. RQ1). On the other hand, retrospective self-report is a more comprehensive measure of any experience of maltreatment during an individuals’ childhood. This measure is therefore better suited for identifying which individuals have ever experienced child maltreatment and for examining whether these individuals are at subsequent risk of poor outcomes, such as antisocial behaviour (i.e. RQ2). As a result, it is possible to minimise measurement issues by using multiple measures of child maltreatment and matching the strengths of a measurement method to the appropriate research question.

2.1.2 Data collection

Collecting data on child maltreatment presents challenges for researchers. It is difficult to collect sufficient data on individuals who are maltreated (i.e. powered sample sizes) without using biased sampling strategies or unrepresentative samples (Ammerman, 1998). There are also ethical and legal considerations about whether research should disclose current cases of maltreatment, or whether research should even question children and adults about adverse events if subsequent support is not guaranteed (National Research Council, 1993; World Health Organization, 2006). Due to limited resources, these problems are accentuated for smaller-scale research projects like PhDs.

Some high-income countries have recognised and responded to this need for nationally representative, epidemiological data¹ on child maltreatment. Governments have invested in national efforts to collect these data, using three main data collection methods (Jud et al., 2013;

¹Nationally representative data on the incidence or prevalence of child maltreatment, how it is distributed across different groups of people, and its related causes and outcomes (“Chapter 1. What is epidemiology? [Editorial]”, 2018).

Krüger & Jud, 2015). Some countries regularly collect epidemiological data using professionally developed, cross-sectional serial surveys (e.g. US (NIS; Sedlak & Broadhurst, 1996), Canada (CIS; Trocmé et al., 2001), Netherlands (NPM; Euser, van IJzendoorn, Prinzie, & Bakermans-Kranenburg, 2010). Other countries, including the UK, collect epidemiological data by extracting relevant administrative data from official records (see also New Zealand, France, Australia). The third approach is to collect data by conducting prospective cohort studies, which follow a large nationally representative sample from birth into older adulthood ('from cradle to grave'; CLOSER, 2018; UK Data Service, 2018).

The UK is unique as it has a rich history of routinely collecting administrative data (e.g. Children in Need (CIN) census (E. R. Munro, Brown, & Manful, 2011; Office for National Statistics, 2009)) and running British birth cohort studies (e.g. 1946 National Survey of Health and Development (Wadsworth, Kuh, Richards, & Hardy, 2006), 1958 National Child Development Study (Power & Elliott, 2006), 1970 British Cohort Study (J. Elliott & Shepherd, 2006), 2000 Millennium Cohort Study (Connelly & Platt, 2014)). Ergo, there is already a wealth of epidemiological data on child maltreatment in the UK. Researchers have previously underlined that such data are currently underused (Bain, Chalmers, & Brewster, 1997; Drake & Jonson-Reid, 1999; Humphreys & Smith, 2013; Jorm, 2015). This underuse is particularly noteworthy given the movement towards the use of big epidemiological data and its promising potential to provide directly translatable, national-level evidence (DeLisi, 2018; Jorm, 2015; Jud et al., 2013; R. Smith, 2016). To overcome the data collection challenges, I decided to harness this rich resource by exclusively using pre-existing 'secondary' data on child maltreatment and prioritising nationally representative, epidemiological data to answer my research questions.

2.1.3 Study design

Researchers should *a priori* choose a study design to frame their empirical work. Medicine and the social sciences adopt a hierarchical system of classifying evidence depending on the type of study used. Subsequently, specific designs have taken precedence in the field and randomised controlled trials (RCTs) have long been considered the 'gold standard' (Burns, Rohrich, & Chung, 2011; Sackett, 1989).

RCTs are able to simulate a randomised experiment in people, examining the effects of an exposure (typically an intervention) on an outcome by randomly assigning individuals to an intervention or control condition (Fisher, 1992; Rosenbaum, 2005; Yates, 1964). If implemented correctly, random assignment creates two (or more) groups that, on average, are probabilistically similar to each other. Any group differences in the outcome post-intervention may therefore be attributed to the exposure (Cook, Campbell, & Shadish, 2002). These research design strengths led researchers, clinicians, and policy-makers to prioritise evidence from RCTs. Research even uses the ‘perfect RCT’ as a benchmark to evaluate non-randomised studies (Sterne et al., 2016). However, RCTs also have their limitations. They present practical and ethical complications and are not always feasible to implement (Rosenbaum, 2005; Sullivan, 2011). Within child maltreatment research, RCTs cannot be used if child maltreatment is conceptualised as the exposure because it is not ethical to purposefully expose children to maltreatment (cf. Bucharest Early Intervention Project (BEIP) study (Millum & Emanuel, 2007)).

Although this presents a challenge for child maltreatment research, it is important to acknowledge that a strict hierarchy of evidence is misleading. Researchers have criticised this classification system as being overly simplistic, and hierarchies of evidence have since been modified (Burns, Rohrich, & Chung, 2011; Centre for Evidence-Based Medicine, 2018; Guyatt et al., 2008; Murad, Asi, Alsawas, & Alahdab, 2016; Vandenbroucke, 1998). The main criticism is that different research questions require different study designs. For example, RCTs represent a strong experimental design for evaluating the effectiveness of an intervention but are not an appropriate for investigating the changing societal risk of child maltreatment in the UK (i.e. RQ1). The latter research question requires an observational study design that can quantify the relationship between time and the national incidence of child maltreatment, providing generalisable findings that can be applied to the UK population (Centre for Evidence-Based Medicine, 2018; Mann, 2003). To address and overcome the problems associated with child maltreatment research, I chose to move away from experimental designs and use the most appropriate design for my research questions: observational study designs.

2.1.4 Data analysis

There are different types of observational study designs, such as cross-sectional, case-control, and cohort studies (Mann, 2003). The type of observational study is not only determined by the type of data but also by the statistical methods used to analyse the data. Analytical approaches for observational study designs include descriptive, cross-sectional, longitudinal, and time series methods. Of these methods, descriptive and cross-sectional analytical are the most common — presumably because they are the most straightforward to understand and apply. This has resulted in an abundance of descriptive and cross-sectional studies in the literature (Ammerman, 1998; Krüger & Jud, 2015). It has also led to a methodological issue where researchers apply analytical methods that are insensitive to repeated measures. For example, it is common for researchers to use cross-sectional statistical methods to analyse longitudinal data (Goldstein, 2011; Preacher, Wichman, MacCallum, & Briggs, 2008).

This is problematic for two main reasons. First, a key assumption of more simplistic, cross-sectional statistical methods (e.g. t-test, ANOVA, regression) is that observations are independent of one another (i.e. not correlated). However, repeated measures are usually correlated (Goldstein, 2011; Hyndman & Athanasopoulos, 2018; Preacher, Wichman, MacCallum, & Briggs, 2008). For instance, with time series data the risk of child maltreatment in 1950 will be more closely related to the risk of child maltreatment in 1951 than in 2000 (i.e. autocorrelation), and with longitudinal data a person's antisocial behaviour score at 7 years old will be related to their antisocial behaviour score at 11 years old (within-in person correlation). Inappropriately assuming independence can result in underestimating standard errors and increasing Type I errors. Second, using methods that are insensitive to repeated measures can result in a loss of information. If a researcher is analysing longitudinal data using cross-sectional methods, they are only analysing between-person differences and they cannot analyse within-person differences (Farrington, 1991). In other words, even if a study uses longitudinal data, it does not mean that the study's results provide robust longitudinal evidence as appropriate statistical method(s) must also be applied. To avoid these drawbacks, I will use advanced statistical methods that are sensitive to repeated measures, such as time series analyses and latent growth curve modelling.

2.1.5 Summary: Overcoming challenges in child maltreatment research

In summary, child maltreatment research is plagued with methodological challenges; from measuring child maltreatment to analysing the data. I will implement research methods that are able to overcome some of these challenges (Table 2.1). I will therefore use observational study designs that use multiple sources of secondary data on child maltreatment and advanced statistical methods to capture changing risks over time. More generally, I will adopt an overarching epidemiological approach to answer my research questions.

2.2 A practical overview of the thesis

In the above section, I discussed the epidemiological approach that will be used in this thesis. Here I provide a practical overview: outlining the overall aims and structure of the thesis, and then describing the research questions, aims, and methods for each empirical chapter. The purpose of this overview is to give a summary of how this thesis aims, and is structured, to answer the two main research questions. More specific research background, aims, and methods are discussed in the subsequent empirical chapters.

2.2.1 Overall thesis aims and structure

This thesis examines whether the risks associated with child maltreatment have changed over time in the UK; investigating changing risks at the societal and individual level. The overall aim of this thesis is to examine the role of time on the burden of child maltreatment by addressing the following two research questions: **RQ1**) Has the societal risk of child maltreatment changed over time? and **RQ2**) Does the risk of antisocial behaviour following child maltreatment change across an individual's life-course?

To answer these research questions, the remainder of this thesis contains four empirical chapters (Chapters 3 – 6) and a discussion chapter (Chapter 7). The first two empirical chapters, Chapters 3 and 4, will address RQ1. The second two empirical chapters, Chapters 5 and 6, will address RQ2. Thus, there is a two-pronged approach to address the two main research questions in this thesis: the first chapters for each research question will systematically review the available evidence (i.e. Chapters 3 & 5), and the second chapters for each research question will empirically analyse relevant data (i.e. Chapters 4 & 6). These four empirical chapters are summarised in more detail below.

Chapter 7 draws together the empirical findings and discusses their implications for research, policy, and practice. The strengths and limitations of this thesis, as well as possible future directions for research, are also discussed in Chapter 7. References and appendices for all chapters are found at the end of the thesis.

2.2.2 Research questions and the empirical chapters

Table 2.2 and the text below summarise the four empirical chapters and how they relate to RQ1 and RQ2.

Table 2.2. A summary of the four empirical chapters and how they relate to the research questions.

Research question	Empirical chapter	Research aim	Research methods	
			Data	Design & analysis
RQ1) Has the societal risk of child maltreatment changed over time?	Chapter 3	To systematically review the available data and develop a useable data source on the incidence of child maltreatment over time	Multiple sources of routinely collected administrative data	Adapted systematic review methodology
	Chapter 4	To empirically analyse whether long-term trends in child maltreatment have increased or decreased	Eight indicators of child maltreatment from the iCoverT	Times series analysis, including generalised additive models with penalised regression splines
RQ2) Does the risk of antisocial behaviour following child maltreatment change across an individual's life-course?	Chapter 5	To systematically review the evidence on the relationship between child maltreatment and antisocial behaviour across the life-course	Prospective, longitudinal studies	Systematic review and meta-analysis
	Chapter 6	To empirically analyse whether child maltreatment is associated with a stable and persistent risk of antisocial behaviour across the life-course	Longitudinal data from the 1958 British birth cohort study	Latent growth curve analysis, including tests of longitudinal measurement invariance

Notes. iCoverT = a rich data source on the incidence of Child maltreatment over Time (Degli Esposti, Taylor, Humphreys, & Bowes, 2018a, 2018b).

2.2.2.1 RQ1) Has the societal risk of child maltreatment changed over time?

Chapter 3. Addresses the lack of useable data on incidence of child maltreatment by adapting systematic review methods to harness existing administrative data from official records relating to child maltreatment. This process involved digitalising, aggregating, and harmonising over 43,500 data points on child maltreatment, and resulted in developing a rich data source on the incidence of Child maltreatment over Time (iCoverT). A paper describing these methods and the iCoverT has been published in *PLoS One* (Degli Esposti, Taylor, et al., 2018b). The iCoverT, including its data and corresponding data documentation, has been made publicly available at the Open Science Framework (Degli Esposti, Taylor, et al., 2018a).

Chapter 4. Uses six datasets from the iCoverT data source to examine long-term trends in the incidence of child maltreatment between 1858 and 2016. This chapter uses time series methods, such as generalised additive models with penalised regression splines, to visualise long-term trends and analyse whether there have been sustained increases or decreases in the risk of child maltreatment. A paper based on this work is currently in press at *The Lancet Public Health* (Degli Esposti et al., 2019).

2.2.2.2 RQ2) Does the risk of antisocial behaviour following child maltreatment change across an individual's life-course?

Chapter 5. Systematically reviews the extant, prospective longitudinal evidence on the relationship between child maltreatment and antisocial behaviour across the life-course. A random-effects meta-analysis quantitatively synthesised this evidence to determine whether child maltreatment is associated with an increased risk of antisocial behaviour during childhood, adolescence, and adulthood.

Chapter 6. Investigates whether child maltreatment is associated with a persistent and stable risk of antisocial behaviour across the life-course. The chapter draws longitudinal data from the 1958 British birth cohort study, including retrospective and prospective measures of child maltreatment and measures of antisocial behaviour at 7, 11, 16, 23, 33, 42, and 50 years. The appropriateness of models of change was assessed by testing the longitudinal measurement invariance assumption for the repeated measures of antisocial behaviour. Once this was estab-

lished, the data were analysed using latent growth curve modelling under a structural equation modelling framework. This research and its findings are currently under review at the *Journal of American Academy of Child and Adolescent Psychiatry* (Degli Esposti, Pinto Pereira, & Bowes, 2018).

Chapter 3 Data on the incidence of child maltreatment over time (iCoverT)*

3.1 Abstract

OBJECTIVE: To harness existing data on child maltreatment and develop a useable data source on the incidence of child maltreatment over time in England and Wales.

METHOD: I adapted systematic review methods to identify, extract, and prepare relevant data on the incidence of child maltreatment. Data were relevant if they: (1) could be used to estimate the incidence of child maltreatment; (2) were nationally representative of England and Wales; (3) were collected prospectively; (4) were collected annually; and (5) were collected and available for a period of at least 25 years. Data quality was also assessed. If data satisfied the eligibility and quality criteria, data were manually extracted, digitalised, and linked over time. Each set of data was prepared as online databases with accompanying data documentation and made freely accesible at the Open Science Framework.

RESULTS: I identified six sources of official record data that satisfied the eligibility and quality criteria: Mortality Statistics, Homicide Index, Criminal Statistics, Child Protection Statistics, Children In Care Statistics, and NSPCC Statistics. These were developed into six online databases to form the incidence of Child maltreatment over Time (iCoverT) data source. The iCoverT includes over 43,500 data points, 272 variables, and spans from 1858 to 2016.

CONCLUSIONS: I used existing official records to develop a rich data source on the incidence of child maltreatment from 1858 to 2016 in England and Wales (the iCoverT).

* Chapter adapted from:

Degli Esposti, M., Taylor, J., Humphreys, D. K., & Bowes, L. (2018). iCoverT: A rich data source on the incidence of child maltreatment over time in England and Wales. *PLoS ONE*, 13(8), e0201223.

3.2 Introduction

The objective of this chapter was to develop a data source on the incidence of child maltreatment over time in England and Wales. As described in Chapters 1 and 2, research on child maltreatment faces a number of challenges; including measuring child maltreatment and establishing whether the societal risk of child maltreatment has significantly changed over time.

It is widely recognised that epidemiological data are needed to address these challenges and progress with child maltreatment research (Leeb et al., 2008). Researchers have typically responded to this need by conducting one-off community surveys to estimate the cumulative prevalence of child maltreatment in the general population (see Chapters 1 & 2). This has generated hundreds of cross-sectional studies in numerous countries and different populations (Jud, Fegert, & Finkelhor, 2016; Krüger & Jud, 2015; Leeb, Paulozzi, Melanson, Simon, & Arias, 2008). However, these studies have temporal limitations and are unable to track changes over time.

Regularly collected national incidence data are needed to better characterise the nature and extent of child maltreatment, and track changes over time (World Health Organization, 2006). As discussed in Chapter 2, some countries have started to regularly collect data on the incidence of child maltreatment at the national level. The United States, Canada and the Netherlands have developed professional surveys to prospectively collect incidence estimates (Jud, Fegert, & Finkelhor, 2016; Sedlak & Broadhurst, 1996; Trocmé et al., 2001), whereas England and Wales extract administrative data. Following the introduction of the Children Act (1989), England and Wales have routinely collected administrative data on the number of children referred to, and assessed by, social services (Children Act, 1989). These data have been compiled and published on a national database since 2008 under the revised children in need (CIN) census (E. R. Munro et al., 2011).

Although these data go some way in providing national incidence data on child maltreatment, considerable progress is still needed before there are sufficient data to investigate long-term trends and to implement robust statistical techniques, such as time series analyses. More comprehensive usable data sources are needed to advance current research and understanding.

This chapter addresses this need for incidence data on child maltreatment in England and Wales. I used transparent and systematic methods to harness pre-existing data and develop a data source that is suitable for research: the incidence of Child maltreatment over Time (iCoverT). This chapter describes: (1) developing the iCoverT data source; (2) the iCoverT itself; and (3) the utility of the iCoverT for future research and this thesis.

3.3 Developing the iCoverT

3.3.1 Overview

I adapted systematic review and routinely-collected data recommendations from the PRISMA and RECORD statements to devise a systematic strategy for identifying, investigating, and assessing pre-existing datasets of routinely collected data (Benchimol et al., 2015; Moher, Liberati, Tetzlaff, & Altman, 2009). Ethical approval was not required because all data were fully anonymised and publicly available before I accessed them. Out of 13 identified datasets, data from six datasets were extracted and prepared as six temporally consistent databases. These six databases on the incidence of child maltreatment over time, and their accompanying documentation, form the iCoverT (Figure 3.1). The iCoverT has been made into a freely accessible, online data source (Degli Esposti, Taylor, et al., 2018a).

3.3.2 Dataset identification

Three main search strategies were used to identify relevant datasets on the incidence of child maltreatment in England and Wales, including literature and internet searches using historically sensitive search terms and contact with experts within academia and health provision. I searched for datasets which met the following inclusion criteria: (1) data could be used to estimate the incidence of child maltreatment. Child maltreatment was defined¹ as one, or a combination of, neglect, physical abuse, sexual abuse and emotional abuse to a child aged 18 years old or under; (2) data were nationally representative of England and Wales, including or excluding Northern Ireland; (3) data were collected prospectively; (4) data were collected annually; and (5) data were collected and available for a period of at least 25 years. If data were overlapping, only the richest dataset was included. I identified 13 relevant datasets; six datasets were identified from literature searches, three from internet searches, and four from field experts (Figure 3.1).

¹Bullying by peers and witnessing intimate partner violence were not included in this definition.

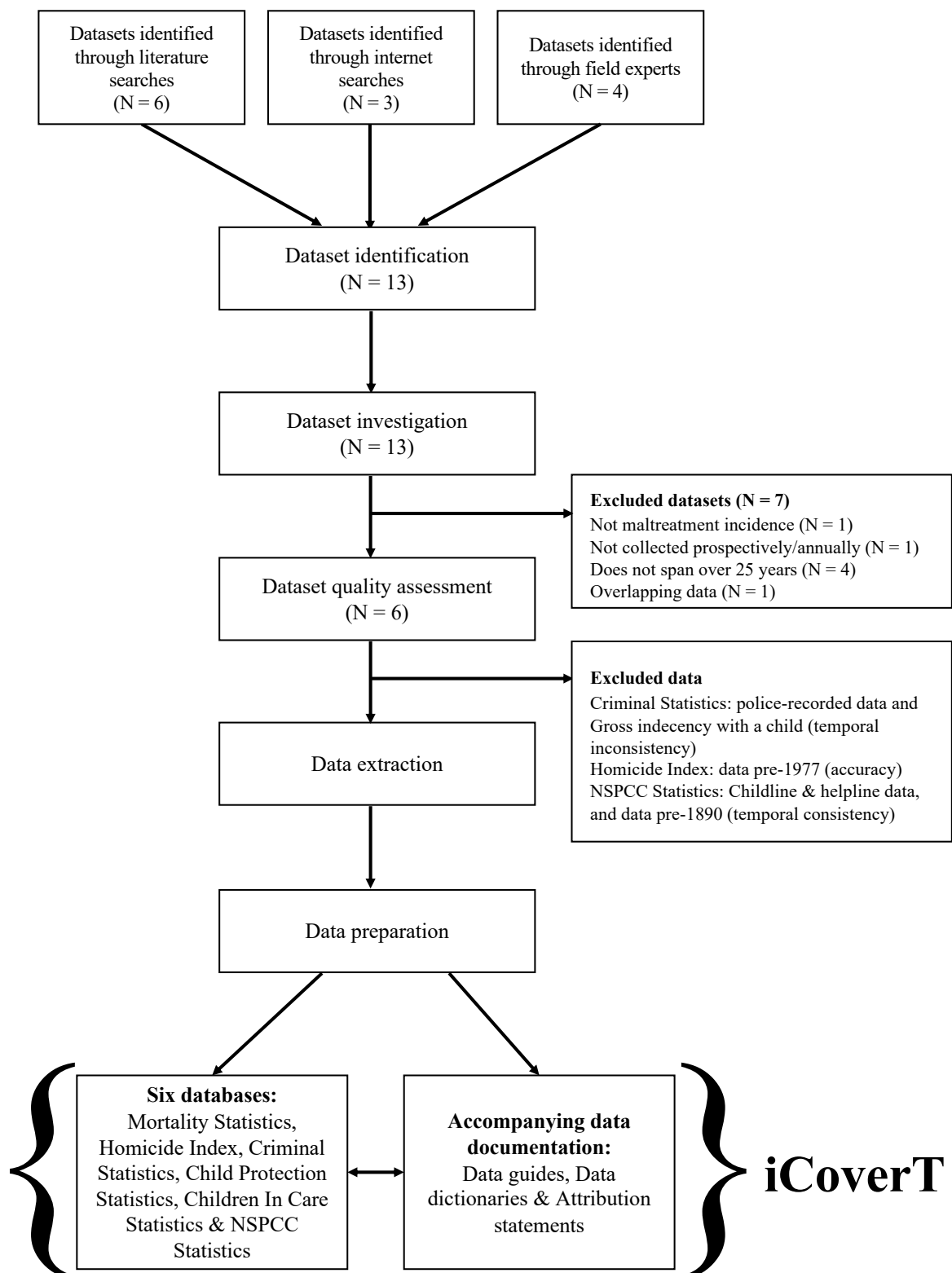


Figure 3.1. Schematic diagram illustrating the development of the iCoverT.

3.3.3 Dataset investigation and quality assessment

I investigated the 13 identified datasets by asking the following key questions: who collects the data, why are the data collected, when were the data collected, what data are collected, and where are the data located. Answers for each dataset were obtained by reading accompanying dataset information and contacting the authorities responsible for collecting, publishing and/or holding the data. I made 23 enquiries to different government departments, organisations, libraries and online data repositories, submitted nine Freedom of Information (FOI) requests, and visited seven libraries and archives. Following these investigations, seven datasets were excluded because they did not satisfy the inclusion criteria (Appendix A Table A.1), leaving the six included datasets: Mortality Statistics, Homicide Index, Criminal Statistics, Child Protection Statistics, Children In Care Statistics, and the National Society for Prevention of Cruelty to Children (NSPCC) Statistics.

I assessed the quality of the six remaining datasets using an adapted quality assessment tool (Bain, Chalmers, & Brewster, 1997; Joubert, Rao, Bradshaw, Vos, & Lopez, 2013; Rao, Lopez, Yang, Begg, & Ma, 2005). In line with the pre-specified rating guidance, I judged data quality to be good, satisfactory or problematic for eight quality criteria (representativeness, missingness, accuracy, temporal consistency, validity, definitions, timeliness, interpretability; Table 3.1). If a dataset was rated problematic on a criterion, I explored feasible strategies to address the problem. Datasets were rated satisfactory to good on the majority of criteria, except all datasets were rated to have problematic temporal consistency (Table 3.2). In addition, Children In Care Statistics showed problematic missingness and accuracy, Child Protection Statistics had problematic accuracy, and Criminal Statistics demonstrated problematic interpretability. Although no dataset was fully excluded due to unresolvable quality issues, four data variables were excluded due to unresolvable temporal consistency problems, and two were truncated due to unresolvable temporal consistency and accuracy problems (Appendix A Table A.2).

Table 3.1. Quality assessment tool for included datasets.

Quality criterion	Question	Rating	Rating guidance
Representativeness	Are data representative of children who are maltreated across England and Wales?	Good	Data are nationally representative, capturing all ages (<19 years), types (e.g. neglect, physical abuse, sexual abuse and emotional abuse) and severities of child maltreatment
		Satisfactory	Data are nationally representative, if not comprehensive, and capture more than one age group, type and/or severity of child maltreatment
		Problematic	Data are not nationally representative or only capture a specific subset of children who are maltreated in England and Wales. For example, deaths only from shaken baby syndrome or by Munchausen's by Proxy
Missingness	Are there missing data?	Good	Included variable(s) within the dataset are missing less than 5% of data items over time
		Satisfactory	Included variable(s) are missing less than or equal to 20% of data items over time
		Problematic	Included variable(s) are missing more than 20% of data items over time
Accuracy	Are the data consistently reported across publications?	Good	There is perfect agreement between different publications; the same figures are published for every data item
		Satisfactory	There is good agreement between different publications, with 80% or more figures being consistent across publications
		Problematic	There are data discrepancies between publications for more than 20% of the figures
Temporal consistency	Are the data measuring the same thing from year to year?	Good	There are no changes to the data, data format or data collection method over time
		Satisfactory	Despite some basic changes to the data, data format or data collection method over time, the data may still be considered to be a relative measure over time, and thus broadly temporally consistent
		Problematic	Substantial changes to the data, data format or data collection method take place, making the raw data difficult to compare over time

Quality criterion	Question	Rating	Rating guidance
Validity	Is the data collection method appropriate for measuring what it is meant to measure?	Good	The data collection method relies on suitable primary sources of information and follows a logical process of data collection and data aggregation, which is internally checked and validated
		Satisfactory	The data collection method relies on suitable primary sources of information and follows a logical process of data collection, but is not formally checked or validated
		Problematic	The data collection method does not use appropriate information and therefore there is no logical certainty that the data measure what they are said to measure
Definitions	Are data variables clearly defined?	Good	Clear definitions are provided for all variables
		Satisfactory	Variables are defined or are clearly labelled
		Problematic	No definitions are provided for the data variables and it is unclear what different variables are measuring
Timeliness	Are the data temporally precise?	Good	Data are collected with temporal information on when maltreatment occurred and can therefore be precisely aggregated according to a specified time interval (e.g. by calendar year)
		Satisfactory	Data are collected with temporal information on when a case was recorded and can therefore be precisely aggregated according to a specified time interval (e.g. by calendar year)
		Problematic	Data did not contain temporal information and therefore cannot be aggregated according to a specified time interval (e.g. by calendar year)
Interpretability	Are the data easy to understand and extract?	Good	The data is stored / published in an accessible and easily understandable way, where the data it is straightforward to extract and interpret
		Satisfactory	The data may be extracted and understood after studying relevant information which is provided in the same or related publications (e.g. contents pages)
		Problematic	The data are presented in a complicated format making it difficult to interpret and extract

Notes. Bespoke quality assessment tool adapted from existing guidance for routinely collected data (Bain, Chalmers, & Brewster, 1997; Joubert, Rao, Bradshaw, Vos, & Lopez, 2013; Rao, Lopez, Yang, Begg, & Ma, 2005).

Table 3.2. Quality assessment of included datasets.

Included dataset	Represent- ativeness	Missing- ness	Accuracy	Temporal consistency	Validity	Definitions	Timeliness	Interpretability
Mortality Statistics	Satisfactory	Good	Good	Problematic	Good	Good	Satisfactory	Satisfactory
Homicide Index	Satisfactory	Good	Good	Problematic	Good	Good	Satisfactory	Good
Criminal Statistics	Good	Satisfactory	Satisfactory	Problematic	Good	Good	Satisfactory	Problematic
Child Protection Statistics	Good	Satisfactory	Problematic	Problematic	Good	Good	Satisfactory	Good
Children In Care Statistics	Good	Problematic	Problematic	Problematic	Good	Good	Satisfactory	Satisfactory
NSPCC Statistics	Satisfactory	Good	Good	Problematic	Good	Satisfactory	Satisfactory	Good

Notes. NSPCC = The National Society for the Prevention of Cruelty to Children (UK).

3.3.4 Data extraction

I located, saved, and indexed all available data for the six included datasets using the online shareable reference manager Zotero. Data were found in various formats both within and across datasets. Data available electronically or via websites were saved directly to Zotero, whilst data only available as hardcopies at libraries and archives were photographed, uploaded, and indexed accordingly. Data extraction depended on the format of the original data and their sources. Data available as hardcopies or embedded within PDFs required manual extraction, whilst some data in excel or common separated value (CSV) formats were electronically copied across. Most data required year-by-year extraction from separate sources, whilst some data were part-collated across years (e.g. 5-year period). I systematically extracted all data, entering the data for each dataset into separate standardised CSV templates to generate six consistently formatted databases.

The reliability of the data extraction process and accuracy of extracted data were checked by embedding internal calculations within the databases to validate the relationships between data variables. For example, for the Children In Care Statistics database “Males in care in England and Wales” was checked to equal the sum of “Males in care in England” and “Males in care in Wales”. In addition, a second data extractor (Jonathan Taylor, History D.Phil Student) carried out independent data checks of 100% of the data. The average inter-rater agreement across databases was 99.1% and any discrepancies were discussed and resolved by consensus. Data were further visualised to identify any potential anomalies.

3.3.5 Data preparation

Following data extraction, I prepared the data in two main stages to generate six databases of complete, temporally consistent time series data.

3.3.5.1 Stage 1: Generating temporally consistent data

The quality assessment identified that all six databases suffered from temporal inconsistency problems due to various changes over time. These changes ranged from structural and organisational, to data and terminology. I investigated all changes over time and implemented appropriate data linkage strategies to address them. I employed five main strategies: (a) derived calculations to address temporal changes and generate equivalent data across years; (b) adopted broader categories to obtain consistent data variables across time; (c) identified and matched equivalent items over time; (d) consistently prioritised specific data sources; and (e) determined the change to have no substantial effect on the data (see Appendix A Table A.3 for full details). Despite addressing all temporal inconsistencies, not all strategies may comprehensively account for changes over time. I therefore recommend the inclusion of dummy variables in data analyses for specific changes, where dummy variables may be coded to represent these changes over time. These recommendations are described in Appendix A Table A.3.

3.3.5.2 Stage 2: Adjusting the data

I carried out data adjustments if: more than 20% of the data was missing, there were data idiosyncrasies, data did not cover a 12-month period, and data were inconsistently rounded. The Criminal Statistics and the Homicide Index databases did not require any data adjustments. Only one data variable from the Children In Care Statistics database was found to have more than 20% missing data, which was addressed using ad-hoc missing data imputations. Mortality Statistics, Child Protection Statistics, Children In Care Statistics, and NSPCC Statistics showed specific idiosyncrasies within their data. Each idiosyncrasy was minor and easily addressed. One year within the Children In Care Statistics database and two years within the NSPCC Statistics database did not cover the full 12-month period. For these three years, data were adjusted to account for missing months. Child Protection Statistics and Children In Care

Statistics data were inconsistently rounded over time. As a result, data variables were rounded to the same level of precision. Missing data imputations and data adjustments are described in Appendix A Table A.4.

3.3.6 Data documentation

I systematically and comprehensively documented all stages of dataset investigations and assessment, and data extraction and preparation. For each database, these details were synthesised and prepared as three types of data documentation: Data guides, Data dictionaries and Attribution statements. Data guides include background information obtained from dataset investigations, and where appropriate, more detailed information about data variables (context and definitions). Data dictionaries describe the contents, format, and structure of each database. Attribution statements document in full all data sources and corresponding permissions.

3.4 Describing the iCoverT

3.4.1 iCoverT structure

The iCoverT is a comprehensive data source on the incidence of child maltreatment over time, which is freely available from the Open Science Framework (Degli Esposti, Taylor, et al., 2018a). It consists of six separate databases, which are each accompanied by a set of three data documents (Data guide, Data dictionary, Attribution statement). An overview of the iCoverT is detailed in machine-actionable and readable Data Documentation Initiative (DDI) compliant metadata (XML and PDF format).

3.4.2 Database characteristics

Characteristics of the iCoverT databases are summarised in Table 3.3. Child Protection Statistics, Children In Care Statistics, Criminal Statistics, Homicide Index, Mortality Statistics and NSPCC Statistics are forms of administrative data, which have been annually collected over time. For all databases, data were first collected by local authorities or regional branches and then aggregated, checked and validated by centralised departments or headquarters to form national estimates. Centralised departments and headquarters include various government departments, from the Office for National Statistics to the Department of Health, and the NSPCC's London Headquarters. Further details for each database, including what they measure and their limitations, are described in the next chapter (Chapter 4 Table 4.1) and in Appendix B.

Five databases represent the number of victims of child maltreatment, be it children on the child protection register or child homicide victims, whereas one database represents the number of perpetrators of child maltreatment (Criminal Statistics). All databases cover England and Wales, with data from NSPCC Statistics also covering Northern Ireland. The average time range across databases is just under 90 years. Mortality Statistics is the oldest database collected since 1858 while Child Protection Statistics is the newest database first collected in 1988. Although I excluded more recent data from NSPCC Statistics due to temporal inconsistencies, all databases continue to be collected today.

Table 3.3. Summary of database characteristics.

Database	Data sources (permission)	Population	Geograph- ical area	Time range (intervals)	Data variables		
					Number	Additional information	Data Type Precision
Mortality Statistics	20 th and 21 st century mortality datasets, England and Wales, ONS (OGL)	Child deaths by homicide, unknown causes & undetermined intent	England & Wales	1858–2016 (annual)	73	Child's gender; child's age; cause of death	Count Integer
Homicide Index	Homicides in England and Wales, Home Office & ONS (OGL)	Police-recorded child homicides	England & Wales	1977–2016 (annual)	24	Child's gender; child's age	Count Integer
Criminal Statistics	Criminal statistics in England and Wales, Home Office & MoJ (OGL)	Persons accused of crimes against children	England & Wales	1893–2016 (annual)	15	Crime; person accused or found guilty	Count Integer
Child Protection Statistics	Children on the child protection register, England, DoH & DoE; Child protection register statistics for Wales, Welsh Government (OGL)	Children on the child protection register	England & Wales	1988–2016 (annual)	100	Country; child's gender; child's age; category of abuse; children on the register or new registrations	Count Nearest 5, 10 or 100
Children In Care Statistics	Children in care in England and Wales, DoH & DoE; Children in care of local authorities in Wales, Welsh Office (OGL)	Children in the care of local authorities	England & Wales	1949–2016 (annual)	37	Country; child's gender; child's age; children in care or entering care	Count Nearest 10 or 100

Database	Data sources (permission)	Population	Geograph- ical area	Time range (intervals)	Data variables		Data Type	Precision
					Number	Additional information		
NSPCC Statistics	Annual reports, NSPCC (NSPCC written permission under OGL)	Children helped by NSPCC	England, Wales & Northern Ireland	1890–1985 (annual)	23	NSPCC cases or children helped; child’s gender; child’s age; reason for referral; who made the referral	Count	Integer

Notes. Full details for each data source, including permissions, are documented in Appendix B and online (Degli Esposti, Taylor, et al., 2018a). ONS = Office for National Statistics; MoJ = Ministry of Justice; DoH = Department of Health; DoE = Department of Education; OGL = Open Government License; NSPCC = The National Society for the Prevention of Cruelty to Children (UK).

3.4.3 Descriptive statistics

In total, there are 272 data variables. These data variables include detailed information on the gender and age of victim, as well as information about the type of maltreatment, who reported the incident, and the country (e.g. England, Wales). All data are freely available online, and Table 3.4 shows descriptive statistics for main data variables on the overall number of child maltreatment incidents, and the victims' gender. All data are counts and range from 0 to 15,9407 depending on the database, data variable and year. Across databases, there is high degree of variance within data variables due to considerable year-on-year fluctuations.

3.4.4 Strengths of the iCoverT

The iCoverT has a number of strengths. The first strength lies in the systematic and transparent methods used to develop each database and their accompanying data documentation. All identified datasets underwent thorough investigations and were assessed against pre-specified inclusion and quality criteria. Data were manually extracted and checked in full by a second extractor. Despite complexities to the data extraction process, there was good agreement between extractors (99.1%) and further checks were carried out to ensure the accuracy of the data. In addition, I included unique steps to generate complete, temporally consistent data; applying data linkage strategies and data adjustments. I meticulously documented all stages of dataset identification, investigation, assessment, data extraction and preparation.

The second strength lies in the richness of the data; the iCoverT spans over 150 years, includes multiple data sources, and has additional information on victim characteristics and the type of maltreatment. The iCoverT consists of six databases with 272 data variables and spans from 1858 to 2016, extending current data sources by over 80 years. In addition, each of the six databases measure different aspects of child maltreatment. For example, NSPCC Statistics can capture all types of maltreatment and may also reflect public perceptions of child maltreatment, whereas Mortality Statistics and Homicide Index only capture severe cases of physical abuse and/or neglect that result in child death. Criminal Statistics, Child Protection Statistics and Children In Care Statistics measure responses to child maltreatment, as well its

occurrence. What each database measures and their specific limitations are described in more detail in the following chapter (Chapter 4 Table 4.1), however, an important strength of the iCoverT is that when these databases are used together, these limitations are at least partially addressed since each database has different strengths and limitations. The iCoverT also has additional information on: the gender and age of victims, and the type of child maltreatment. These supplementary details can offer valuable insights for practice and policy as they can identify whether there are differential risks for: males and females, age groups, and types of maltreatment.

Third, the databases are nationally representative of England and Wales. Research on this type of epidemiological data results in robust and translatable national-level evidence, which is most pertinent for informing public health policies and interventions. Lastly, because new relevant data will become available each year, the iCoverT has potential for maintenance and growth as a resource for research and public health surveillance.

3.4.5 Limitations of the iCoverT

The iCoverT also has several limitations. First, most data were not originally collected for research purposes. Although I exhaustively investigated and addressed all identified confounders, the data may be influenced by obscure operational processes and changing organisation priorities that I am unaware of (Maguire, Morgan, & Reiner, 2012). Second, the data must be analysed and interpreted in the context of how they were generated and recorded. Because the data are primarily administrative, routinely collected for operational purposes, this means that standard statistical assumptions of independence may not hold. To address these issues, I investigated all data sources and datasets to understand the processes underlying the generation of the data and aimed to develop data variables where data points were more likely to be independent. For Child Protection Statistics, I extracted data on the number of new registrations to the child protection register, as well as the number of children on the register. For Children In Care Statistics, I extracted data on the number of new children entering care, and when these data were not available from 1977–1982, I imputed these figures based on the number of new care periods (Appendix A Table A.4). For NSPCC Statistics, I extracted data on the number of new

children involved in cases each rather than the charity's annual caseload. These decisions were made to help guard against statistical non-independence, mainly arising from the same child being repeatedly recorded in the same year. Nevertheless, the data may still be non-independent, especially for the three databases on child protection activity, due to the nature of identifying and recording children at risk. For example, identifying a child at risk makes it more likely that another child from the same family (e.g. a sibling) is also identified. It is therefore important to consider such statistical non-independence when analysing these data and use appropriate analytical methods, such as robust standard errors, to address these violations of statistical assumptions and give more conservative estimates.

Third, while all data were reported annually, this temporal information may not necessarily reflect the occurrence of maltreatment in that specific year. This is particularly relevant for Mortality Statistics as previous research highlights a reporting delay in registering deaths (Hardelid et al., 2013). However, the most recent release found that the median delay in registration is only 5 days, which would minimally effect the temporal accuracy of these data (Office for National Statistics, 2017). Fourth, I identified the relevant dataset of Hospital Episode Statistics for Admitted Patient Care in England (NHS Digital, 2017). Despite extracting relevant data from 1999 to 2016 and identifying earlier data from 1980 to 1998, I was unable to include this dataset due to financial costs (NHS Digital quoted a minimum cost of £1800, which exceeded available funds).

Table 3.4. Descriptive statistics of main data variables.

Database	Main data variables	Time range	Observations	Missing observations	Mean (SD)	Min	Max
Mortality Statistics	Child ^a deaths caused by homicide	1858–2016	159	0	99.61 (55.26)	19	236
	Male ^a deaths caused by homicide	1858–2016	159	0	50.57 (28.63)	8	123
	Female ^a deaths caused by homicide	1858–2016	159	0	49.04 (27.52)	9	123
	Child ^a deaths caused by unknown causes	1858–2016	159	0	3470.24 (7426.14)	5	26179
	Male ^a deaths caused by unknown causes	1858–2016	159	0	1910.92 (4071.62)	3	14202
	Female ^a deaths caused by unknown causes	1858–2016	159	0	1559.32 (3355.31)	2	1197
	Child ^a deaths caused by injury of undetermined intent	1968–2016	49	0	49.10 (14.91)	26	91
	Male ^a deaths caused by injury of undetermined intent	1968–2016	49	0	29.71 (9.34)	14	60
	Female ^a deaths caused by injury of undetermined intent	1968–2016	49	0	19.39 (6.91)	7	38
Homicide Index	Child homicide victims ^b	1977–2016	40	0	69.63 (15.41)	38	100
	Male homicide victims ^b	1977–2016	40	0	37.73 (9.65)	18	61
	Female homicide victims ^b	1977–2016	40	0	31.85 (8.98)	18	56
Criminal Statistics	Persons ^c guilty of Cruelty to children	1893–2016	113	11	1040.12 (964.31)	89	3450
	Persons ^c guilty of Infanticide	1923–2016	87	7	9.74 (7.73)	0	39
	Persons ^c guilty of Abandoning a child under 2	1893–2016	113	11	2.43 (2.20)	0	10
	Persons ^c guilty of Unlawful sex with under 13s	1893–2016	112	12	68.88 (26.06)	17	136
	Persons ^c guilty of Unlawful sex with 13 to 16 year olds	1893–2016	112	12	302.02 (221.36)	34	792

Database	Main data variables	Time range	Observations	Missing observations	Mean (SD)	Min	Max
Child Protection Statistics ^d	Children ^e on the child protection register in England and Wales	1988–2016	29	0	37989.66 (7988.67)	27700	53400
	Males ^e on the child protection register in England and Wales	1988–2016	27	2	18685.19 (3689.77)	14300	26300
	Females ^e on the child protection register in England and Wales	1988–2016	27	2	18222.22 (3830.48)	13200	25200
Children In Care Statistics ^f	Children ^e in care in England and Wales	1949–2016	65	2	71455.38 (13493.53)	52100	101200
	Males ^e in care in England and Wales	1952–2016	61	3	40914.75 (9273.98)	27900	61000
	Females ^e in care in England and Wales	1952–2016	61	3	31424.59 (4235.43)	24300	41100
NSPCC Statistics ^g	Children ^e involved in NSPCC cases	1890–1985	96	0	92142.35 (34266.04)	7463	159407
	Males ^e involved in NSPCC cases	1940–1969	30	0	52896.97 (4384.12)	42022	62440
	Females ^e involved in NSPCC cases	1940–1969	30	0	50351.53 (4243.15)	39588	59125

Notes. ^aAged under 15 years old at time of death. ^bAged under 16 years old at time of death. ^cAged over 15 years old. ^dThe number of males and females on the child protection register do not add up to the total number of children as registrations were for unborn children and/or details were unknown (from approximately 0% to 3% depending on the year). In addition, some figures were reported to the nearest 100 (see Table 3.3) and this resulted in rounding error. ^eAged under 18 years old. ^fThe number of males and females do not add up to the total number of children in care as some figures were rounded to the nearest 100 (see Table 3.3) and this resulted in rounding error. ^gThe number of males and females do not add up to the total number of children involved in NSPCC cases as the data were not collected for the same periods of time. SD = standard deviation; Min = minimum; Max = maximum; NSPCC = The National Society for the Prevention of Cruelty to Children (UK).

3.5 Utility of the iCoverT

3.5.1 Future research

The iCoverT is a rich epidemiological data source for future research, extending current maltreatment incidence data in England and Wales by over 80 years (Bentley et al., 2017; Gilbert et al., 2012; Hardelid, Davey, Dattani, & Gilbert, 2013; E. R. Munro, Brown, & Manful, 2011; Sidebotham, Atkins, & Hutton, 2012). As a result, the iCoverT offers the statistical power to use advanced statistical methods, such as time series analyses. The databases are also well-suited to help answer key issues within child maltreatment research. The historical data can shed light on past maltreatment and help to contextualise current maltreatment, whilst more recent data can be used to monitor current and future rates of child maltreatment. The iCoverT may also be used to evaluate the impact of planned or unplanned interventions on the occurrence of child maltreatment (e.g. specific child protection efforts).

3.5.2 The thesis

For the purposes of this thesis, the iCoverT can be used to investigate whether the risk of child maltreatment has changed over time. There is currently limited and mixed evidence on trends in child maltreatment, and the field is yet to adequately answer the important question: “Are trends in child maltreatment decreasing?” (Gilbert et al., 2012, see also Chapter 1 Section 1.3). In the next chapter (Chapter 4), I will use data from the iCoverT and time series methods to examine long-term trends in the incidence of child maltreatment in England and Wales from 1858 to 2016. Chapter 4 will therefore directly address: **RQ1**) Has the societal risk of child maltreatment changed over time?

Chapter 4 Long-term trends in child maltreatment: A time series analysis of the iCoverT*

4.1 Abstract

OBJECTIVE: To determine whether long-term trends in the incidence of child maltreatment are increasing or decreasing in England and Wales.

METHOD: I used data from the iCoverT to estimate the national incidence of child maltreatment in England and Wales and examine long-term trends. I fitted Poisson regression models with year as the exposure and the number of victims or perpetrators of child maltreatment as the outcome (adjusted for population size). When a linear trend was not appropriate, I fitted generalised additive models with penalised regression splines to visualise changing trends.

RESULTS: There was a 90% (2.7 per 100 000 children) decrease in child mortality from 1858–2016, an 83% (6.7 per 100 000 adults) decrease in adults guilty of child cruelty/neglect from 1893–2016, but a 182% (328.7 per 100 000 children) increase in child protection registrations from 1988–2016. There were also more recent increases in crimes against children and children entering care from 2000–2016. In 2016, 40 children died by homicide and there were twice as many adolescent than infant deaths. In 2016, 68 000 children were placed on the child protection register and neglect and emotional abuse were the most common reasons.

CONCLUSIONS: Long-term trends in child maltreatment have decreased while there is some evidence to support more recent increases since 2000.

* Chapter adapted from:

Degli Esposti, M., *et al.* (in press). Long-term trends in child maltreatment in England and Wales: A time series analysis of official record data from 1858 to 2016. *Lancet Public Health*.

4.2 Introduction

The objective of this chapter was to establish whether the societal risk of child maltreatment has changed over time by analysing long-term trends in the incidence of child maltreatment in England and Wales. Child maltreatment is a major public health problem; its consequences are serious and can have long-lasting effects for the child, their family, and society as a whole (Gilbert, Widom, et al., 2009). Since the 1970s there have been increased costs and initiatives by the government to improve child protection (see Chapter 1 Section 1.2.2). However, it is unclear whether these child protection efforts have translated to sustained decreases in child maltreatment, and in 2009 child health and welfare professionals asked research to answer the question: “Are trends in child maltreatment decreasing?” (Gilbert et al., 2012).

There is limited evidence on whether child maltreatment is increasing or decreasing in England and Wales. On the one hand, several serious case reviews and a number of high-profile public inquiries have led the media and public to criticise child protection services and speculate that child maltreatment may be increasing (Bichard, 2004; Independent, 2018; E. Munro, 2011). There have also been recent increases in the number of children identified at risk. For example, between 2015 and 2016 there was a 1.6% increase in the number of children placed on child protection plans (Department for Education, 2017; Welsh Government, 2018), and in 2017 the NSPCC responded to their highest ever number of contacts (Bentley et al., 2017). On the other hand, these increases may not reflect an increasing problem but improvements in responding to child maltreatment or natural short-term fluctuations over time. When looking at sustained changes over time by examining long-term trends, studies have found that the number of violent child deaths have decreased since the 1970s which might suggest a real reduction in child maltreatment (Pritchard & Sharples, 2008; Sidebotham, 2014; Sidebotham, Atkins, & Hutton, 2012).

Because only a small proportion of unrepresentative cases result in child death, other sources of information are also needed to paint an accurate picture of child maltreatment. To the best of my knowledge, a series of NSPCC reports and only one study have used multiple sources to measure the incidence of child maltreatment over time (Bentley et al., 2018, 2017; Bentley,

O'Hagan, Raff, & Bhatti, 2016; Gilbert et al., 2012). The NSPCC reports used six sources to estimate how safe children are today but did not examine trends in child maltreatment (Bentley et al., 2018, 2017; Bentley, O'Hagan, Raff, & Bhatti, 2016). Gilbert and colleagues used three sources on child protection statistics, maltreatment-related hospital admissions, and violent child deaths, to examine trends in child maltreatment since the 1980s (Gilbert et al., 2012). Although they found no consistent evidence for increasing or decreasing trends, they showed that multiple sources can be used to more comprehensively estimate trends in child maltreatment. However, there are still other relevant sources, such as data on maltreatment-related crimes, that can be used to provide a richer and more detailed understanding of trends in child maltreatment (Degli Esposti, Taylor, et al., 2018b).

This chapter aims to investigate whether the risk of child maltreatment has changed over time by examining long-term trends across multiple sources. I use data from the iCoverT to estimate the annual incidence of child maltreatment from the earliest available year of data (1858) to present day (2016). I then use time series methods to examine long-term trends in child maltreatment and establish if, at the societal level, the risk of child maltreatment has significantly changed over time (RQ1).

4.3 Methods

4.3.1 Study design

This observational study used times series methods to analyse routinely collected data relating to child maltreatment. A study protocol was pre-registered on a WHO-compliant registry (Degli Esposti, 2018). Ethical approval was not required because all data were fully anonymised and publicly available.

4.3.2 Data

In Chapter 3, I described the iCoverT: a newly developed data source on the incidence of child maltreatment over time in England and Wales (Degli Esposti, Taylor, Humphreys, & Bowes, 2018a, 2018b). Here, I drew data from the iCoverT that could be used to estimate the incidence of child maltreatment. Incidence was defined as the number of new cases during a 12-month period. Child maltreatment was defined as a child experiencing neglect, physical, sexual, and/or emotional abuse. I used data for all available years and from all six sources: child mortality, police-recorded child homicides, crimes against children, child protection, children in care, and NSPCC statistics.

4.3.2.1 Outcomes

I identified eight indicators that could be used to estimate the incidence of child maltreatment. These indicators are summarised in Table 4.1 and described in full in Appendix B. The primary outcome was the number of child victims (<20 years of age) or adult perpetrators (>16 years of age) of child maltreatment during 12 months in England, including or excluding Wales. When additional information was available, the secondary outcomes were: (i) child's age, (ii) child's gender, and (iii) type of maltreatment.

4.3.2.2 Exposure

The primary exposure was a 12-month period (typically financial year) for all available years. Differences in data availability meant that indicators of child maltreatment covered different time periods. The longest available time period was from 1858 to 2016 for child mortality and the shortest available time period was from 1988 to 2016 for child protection statistics (see Table 4.1).

4.3.3 Adjusting for changes over time

When looking at trends over a long period of time it is important to consider other changing factors. I adjusted for three main changes over time. First, I controlled for population size by using population estimates for geographical areas to calculate incidence rates (for geographical areas see Appendix B). Second, I controlled for changes in population age structure by age-standardising these incidence rates (for age-specific populations see Appendix B). Third, I investigated and identified changes that may have affected the consistency of the data over time (for changes over time see Appendix B). These ranged from organisational changes to changes in recording practices. I followed iCoverT recommendations set-out in Chapter 3 by coding these changes as dummy variables (0 for the years before the change; 1 for the year of, and years after, the change), and including them in adjusted analyses if they significantly improved model fit ($p < 0.01$).

Table 4.1. Summary of indicators of child maltreatment.

Maltreatment indicator	Time period	Geographical area	Child maltreatment	Child population (years)	Additional information	Limitation(s)
Mortality Statistics: Child deaths by homicide/assault						
Child deaths caused by homicide, assault and injury purposely inflicted by other persons	1858–2016	England & Wales	Severe neglect and/or physical abuse	<20	Child's gender & age	Only severe cases of child maltreatment result in death. Does not differentiate between different perpetrators (e.g. age of the perpetrator)
Homicide Index: Police-recorded child homicides						
Police-recorded child homicides, including murder, manslaughter and infanticide	1977–2016	England & Wales	Severe physical abuse	<16	Child's gender & age	Only severe cases of child maltreatment result in death. Does not differentiate between different perpetrators (e.g. age of the perpetrator)
Criminal Statistics: Adults guilty* of child cruelty/neglect						
Adults found guilty of wilful assault, ill-treatment, neglect, abandonment, or exposure, in a manner likely to cause unnecessary suffering or injury	1893–2016	England & Wales	Neglect and/or physical abuse	<16	n/a	Measures the number of perpetrators — one perpetrator may have more than one victim
Criminal Statistics: Adults guilty* of sex with under 13s						
Adults found guilty of unlawful sexual intercourse with a child aged under 13	1893–2016	England & Wales	Sexual abuse	<13	n/a	Measures the number of perpetrators — one perpetrator may have more than one victim

Maltreatment indicator	Time period	Geographical area	Child maltreatment	Child population (years)	Additional information	Limitation(s)
Criminal Statistics: Adults guilty* of sex with 13–16s						
Adults found guilty of unlawful sexual intercourse with an adolescent aged 13 to 16	1893–2016	England & Wales	Sexual abuse	13–16	n/a	Measures the number of perpetrators — one perpetrator may have more than one victim. The proportion of cases that involved under-age sex with a romantic partner is unknown
Child Protection Statistics: Registrations to child protection register						
Registrations to the child protection register or children subject to a child protection plan. Reasons for registration include: grave concern, neglect, physical abuse, sexual abuse, and/or emotional abuse	1988–2016	England†	Neglect, physical, sexual and/or emotional abuse	<18	Child's gender & age; type of maltreatment	The number of registrations to the child protection register also measures the effectiveness of child protection services
Children In Care Statistics: Children entering care						
Children entering the care of local authorities. Children enter care via three main routes: care orders (circa 60%), voluntarily (circa 30%), and police involvement (protection or youth justice involvement; circa 10%). Care orders are made if the court has sufficient evidence to indicate that the child is either suffering from, or at risk of, significant harm, or the child is beyond parental control	1952–2016	England & Wales	Neglect, physical, sexual and/or emotional abuse	<18	n/a	Not all children entering care will have been maltreated (e.g. some enter care due to behavioural issues)

Maltreatment indicator	Time period	Geographical area	Child mal-treatment	Child population (years)	Additional information	Limitation(s)
NSPCC Statistics: Children helped by NSPCC						
Children involved in referrals to the NSPCC, which were opened as new cases	1910–1985†	England, Wales & Northern Ireland	Neglect, physical, sexual and/or emotional abuse	<18	Child’s gender and age	The number of children helped by the NSPCC depends on the presence of other agencies and on the charity’s capacity

Notes. Full details for each maltreatment indicator are described in Appendix B. *Adults found guilty is the total number of perpetrators involved in criminal cases found guilty at the magistrates’ and higher courts (Courts of Assizes, Quarter Sessions, Crown Court). The number of adults found guilty is a subset of those proceeded against. It does not include cases that were dropped (discontinued, withdrawn/dismissed, or acquitted); and it does include guilty verdicts without convictions. †Child Protection Statistics for Wales were excluded due to missing data problems. ‡NSPCC Statistics from 1986 onwards were excluded due to problems with the comparability of data over time. NSPCC = National Society for Prevention of Cruelty to Children (UK).

4.3.4 Statistical analysis

4.3.4.1 Descriptive statistics

I summarised maltreatment indicators in 25-year intervals starting from 1850 (1850–1874, 1875–1899, 1900–1924, 1925–1949, 1950–1974, 1975–1999, 2000–2016). I used these intervals as they provided a useful long-term overview and made it easier to compare indicators of child maltreatment over time.

4.3.4.2 Modelling long-term trends

To model long-term trends, I used Poisson regression with year as the exposure and the number of victims or perpetrators of maltreatment as the outcome. Age-specific population estimates (log-transformed) were included as an offset variable to adjust for changing population size and age structure. If dispersion tests indicated over-dispersion of data ($p < 0.05$), quasi-Poisson was used instead of Poisson regression (Cameron & Trivedi, 1990). I modelled long-term trends by fitting generalised linear models (GLMs) and then adjusting for changes over time (as described above).

GLMs assume a linear relationship between exposure and outcome variables. They therefore constrain trends to change at a constant rate and in one direction (i.e. a linear increase or decrease). I evaluated GLM fit to test whether changes in maltreatment incidence were appropriately modelled by linear trends. I plotted residuals against year, quantile–quantile plots, and autocorrelation functions. When specific patterns in the residuals clearly indicated that trends were not linear, I fitted generalised additive models (GAMs) with penalised natural cubic regression splines (Wood, 2006). I fitted GAMs because they relax the linear relationship between exposure and outcome variables, allowing trends to change at different rates and change direction. I guarded against over-fitting by using a restricted maximum likelihood smoothing selection approach, checking my use of the basis size rule, and re-inspecting residual plots for the GAMs (Kim & Gu, 2004).

Prior to any analyses, one outlier was identified and removed for adults guilty of sex with under 13s in 2004 following the enactment of the Sexual Offences Act (2003), which resulted

in a temporary recording change. Analyses were of complete cases since there was minimal missing data (Degli Esposti, Taylor, Humphreys, & Bowes, 2018a, 2018b). R (version 3.4.1) was used for all analyses (R Core Team, 2018).

4.3.4.3 Interpreting long-term trends

To interpret long-term trends, I examined annual percentage and overall change. I calculated annual percentage change and p values from the fitted GLMs. Annual percentage change describes whether trends linearly increase or decrease, as well as the average rate of change for each year. P values indicate whether these increases or decreases are significant. Because trends were mostly non-linear and showed poor GLM fit, I also calculated absolute and relative change (i.e. overall change). Absolute change is the raw overall difference between incidence rates for the earliest and most recent available year (e.g. 1858 and 2016, respectively), whereas relative change is the absolute change as a percentage of the incidence rate for the earliest available year (e.g. 1858).

I plotted age-standardised incidence rates and fitted models to visualise long-term trends. I plotted the model (GLM or GAM) that best fitted the data and thus most accurately visualised trends. Graphs plotting GLMs, irrespective of model fit, are shown in Appendix C.

4.4 Results

Tables 4.2 and 4.3 summarise child maltreatment indicators and how they change over time. Table 4.2 shows annual averages for child victims or adult perpetrators of child maltreatment, whilst Table 4.3 shows long-term trends in annual incidence rates.

Out of the eight indicators of child maltreatment, two measured child mortality (deaths by homicide/assault, police-recorded homicides), three measured crimes against children (child cruelty/neglect, sex with under 13s, sex with 13–16s), and three measured child protection activity (registrations to the child protection register, children entering care, children helped by NSPCC). Most indicators covered England and Wales, except for registrations to the child protection register which covered England only, and children helped by NSPCC which covered England, Wales and Northern Ireland (Table 4.1). Indicators covered different time-periods. For example, data for child mortality and crimes against children dated back to the late 1800s while data for child protection activity were collected from the second half of the 1900s. Indicators for child mortality and child protection activity had additional information on the child's age and gender, and child protection activity also had information on the type of child maltreatment.

Table 4.2. Annual averages for the number of child victims or adult perpetrators of child maltreatment.

Time period		1850– 1874	1875– 1899	1900– 1924	1925– 1949	1950– 1974	1975– 1999	2000– 2016
Child deaths by homicide/assault								
Gender (%)								
Males		220	160	130	90	100	70	50
Females		53.2%	51.4%	49.8%	48.7%	50.6%	55.1%	61.3%
Age (%)		46.8%	48.6%	50.2%	51.3%	49.4%	44.9%	38.7%
<1 year		78.4%	67.8%	61.7%	49.8%	32.4%	19.1%	16.0%
1–14 years		15.2%	24.4%	30.5%	38.9%	47.6%	45.9%	34.8%
15–19 years		6.4%	7.8%	7.8%	11.3%	20.0%	34.0%	49.2%
Police-recorded child homicides								
Gender (%)		n/a	n/a	n/a	n/a	n/a	80	60
Males		n/a	n/a	n/a	n/a	n/a	53.2%	55.9%*
Females		n/a	n/a	n/a	n/a	n/a	46.8%	44.0%*
Age (%)								
0–4 years		n/a	n/a	n/a	n/a	n/a	68.2%	65.7%
5–15 years		n/a	n/a	n/a	n/a	n/a	31.8%	34.3%
Adults guilty of child cruelty/neglect								
Adults guilty of sex with under 13s		n/a	2720	2490	880	620	200	580
Adults guilty of sex with 13–16s		n/a	80	60	40	80	90	60
Registrations to child protection register		n/a	60	70	150	560	370	380
Gender (%)								
Males		n/a	n/a	n/a	n/a	n/a	27100	40900
Females		n/a	n/a	n/a	n/a	n/a	48.7%*	49.4%*
Unborn/unknown details		n/a	n/a	n/a	n/a	n/a	50.2%*	47.3%*
		n/a	n/a	n/a	n/a	n/a	1.0%*	3.4%*

	Time period	1850– 1874	1875– 1899	1900– 1924	1925– 1949	1950– 1974	1975– 1999	2000– 2016
Age [†] (%)								
<1 year	1988–2012	n/a	n/a	n/a	n/a	n/a	13.5%*	15.5%*
1–15 years	1988–2012	n/a	n/a	n/a	n/a	n/a	83.1%*	78.8%*
16–18 years	1988–2012	n/a	n/a	n/a	n/a	n/a	2.2%*	1.7%*
Unborn/unknown details	1988–2012	n/a	n/a	n/a	n/a	n/a	2.2%*	1.7%*
Type of maltreatment [‡] (%)								
Neglect	1988–2016	n/a	n/a	n/a	n/a	n/a	25.8%	42.8%
Physical abuse	1988–2016	n/a	n/a	n/a	n/a	n/a	33.0%	15.0%
Sexual abuse	1988–2016	n/a	n/a	n/a	n/a	n/a	20.3%	7.1%
Emotional abuse	1988–2016	n/a	n/a	n/a	n/a	n/a	10.3%	26.4%
Children entering care	1952–2016	n/a	n/a	n/a	n/a	42000	35100	28700
Children helped by NSPCC	1910–1985	n/a	n/a	127900	105300	95900	38800	n/a
Gender (%)								
Males	1940–1969	n/a	n/a	n/a	50.9%	51.4%	n/a	n/a
Females	1940–1969	n/a	n/a	n/a	49.1%	48.6%	n/a	n/a
Age (%)								
0–4 years	1951–1985	n/a	n/a	n/a	n/a	44.0%	38.2%	n/a
5–18 years	1951–1985	n/a	n/a	n/a	n/a	56.0%	61.8%	n/a
Child population (<20 years; million)	1858–2016	6.2	8.1	12.3	12.5	13.9	13.5	13.3
Adult population (>16 years; million)	1893–2016	n/a	21.4	26.6	34.0	37.3	40.7	46.0

Notes. Numbers are annual averages for 25-year intervals starting from 1850 but the most recent time interval covered 17 years (2000–2016). Only child deaths by homicide/assault covered 17 years in the earliest time interval (1850–1874). *Does not add up to 100% due to rounding error. †Child's age for child protection registrations was not collected from 2013–2016. ‡Categories for type of maltreatment are mixed categories that are determined by primary concern for each registration. NSPCC = National Society for Prevention of Cruelty to Children (UK).

Table 4.3. Long-term trends in annual incidence rates of child maltreatment indicators.

	Time period	Best fitting model	Linear trends based on GLMs			Incidence rates		Overall change	
			Annual percentage change (%)	P value	Earliest available year	Latest available year	Absolute	Relative (%)	
Child deaths by homicide/assault	1858–2016	GAM	-1.5 (-1.6 to -1.4)	<0.0001	3.0	0.3	-2.7	-90.2	
	Gender								
	Males	1858–2016	GAM	-1.4 (-1.6 to -1.3)	<0.0001	1.6	0.2	-1.5*	-89.0
	Females	1858–2016	GAM	-1.5 (-1.7 to -1.4)	<0.0001	1.3	0.1	-1.2	-91.8
	Age								
	<1 year	1858–2016	GAM	-2.2 (-2.3 to -2.1)	<0.0001	30.4	0.3	-29.1	-95.8
Police-recorded child homicides	1858–2016	GAM	-0.4 (-0.5 to -0.3)	<0.0001	0.5	0.1	-0.4	-75.2	
	15–19 years	1858–2016	GAM	0.5 (0.3 to 0.6)	<0.0001	0.6	0.6	0.0	1.1
	1977–2016	GLM	-1.0 (-1.6 to -0.5)	0.0005	0.6	0.3	-0.3	-42.5	
	Gender								
	Males	1977–2016	GLM	-0.9 (-1.5 to -0.2)	0.0129	0.3	0.2	-0.1	-47.1
	Females	1977–2016	GLM	-1.2 (-1.9 to -0.5)	0.0010	0.3	0.2	-0.1	-37.7
Adults guilty of child cruelty/neglect	Age								
	0–4 years	1977–2016	GLM	-1.6 (-2.2 to -1.1)	<0.0001	1.6	0.7	-0.9	-58.5
	5–15 years	1977–2016	GLM	-0.5 (-1.3 to 0.4)	0.3120	0.2	0.2	-0.1*	-22.6
	Adults guilty of sex with under 13s	1893–2016	GAM	-2.9 (-3.1 to -2.6)	<0.0001	8.0	1.3	-6.7	-83.3
	Adults guilty of sex with 13–16s	1893–2016	GAM	-0.3 (-0.5 to -0.1)	0.0027	0.4	0.2	-0.2	-54.5
		1893–2016	GAM	0.8 (0.4 to 1.1)	<0.0001	0.3	1.3	1.0	318.9
Registrations to child protection register	1988–2016	GAM	3.4 (2.8 to 4.0)	<0.0001	180.4	509.1	328.7	182.2	
	Gender								
Males	1988–2016	GAM	3.5 (2.9 to 4.1)	<0.0001	86.3	253.3	167.0	193.5	

	Time period	Best fitting model	Linear trends based on GLMs			Incidence rates		Overall change	
			Annual percentage change (%)	P value	Earliest available year	Latest available year	Absolute	Relative (%)	
Females	1988–2016	GAM	3.1 (2.4 to 3.8)	<0.0001	94.1	246.1	152.0	161.6	
Age									
<1 year	1988–2012	GAM	3.3 (2.8 to 3.7)	<0.0001	433.2	1177.4	744.2	171.8	
1–15 years	1988–2012	GAM	2.2 (1.5 to 3.0)	<0.0001	198.1	437.8	239.7	121.0	
16–18 years	1988–2012	GAM	1.0 (-1.4 to 3.4)	0.4243	28.5	71.3	42.8	150.0	
Type of maltreatment									
Neglect	1988–2016	GAM	6.5 (5.7 to 7.3)	<0.0001	25.9	228.4	202.5	782.1	
Physical abuse	1988–2016	GAM	-1.8 (-2.9 to -0.7)	0.0030	50.9	49.9	-1.1 *	-2.1	
Sexual abuse	1988–2016	GAM	-3.4 (-4.7 to -2.1)	<0.0001	35.4	24.1	-11.3	-31.8	
Emotional abuse	1988–2016	GAM	10.3 (9.5 to 11.2)	<0.0001	6.0	180.1	174.1	2881.6	
Children entering care	1952–2016	GAM	-0.6 (-0.8 to -0.5)	<0.0001	270.3	246.9	-23.4	-8.7	
Children helped by NSPCC	1910–1985	GAM	-1.5 (-1.8 to -1.3)	<0.0001	1284.6	210.6	-1074	-83.6	
Gender									
Males	1940–1969	GAM	-0.9 (-1.2 to -0.6)	<0.0001	421.3	271.8	-149.5	-35.5	
Females	1940–1969	GAM	-1.0 (-1.4 to -0.7)	<0.0001	411.7	256.1	-155.7 *	-37.8	
Age									
0–4 years	1951–1985	GAM	-3.6 (-4.2 to -3.0)	<0.0001	1113.6	385.2	-728.4	-65.4	
5–18 years	1951–1985	GAM	-3.9 (-4.5 to -3.3)	<0.0001	611.2	157.1	-454.1	-74.3	

Notes. Age-standardised incidence rates are per 100 000 children or adults depending on the child maltreatment indicator. Annual percentage change (%), 95% confidence intervals, and p values were calculated from unadjusted GLMs. *Absolute change does not equal the difference between incidence rates for the earliest vs. latest (i.e. most recent) available year due to rounding error. GLMs = generalised linear models; GAMs = generalised additive models; NSPCC = National Society for Prevention of Cruelty to Children (UK).

4.4.1 Long-term trends in child maltreatment indicators

Long-term trends in child maltreatment indicators are illustrated in Figure 4.1.

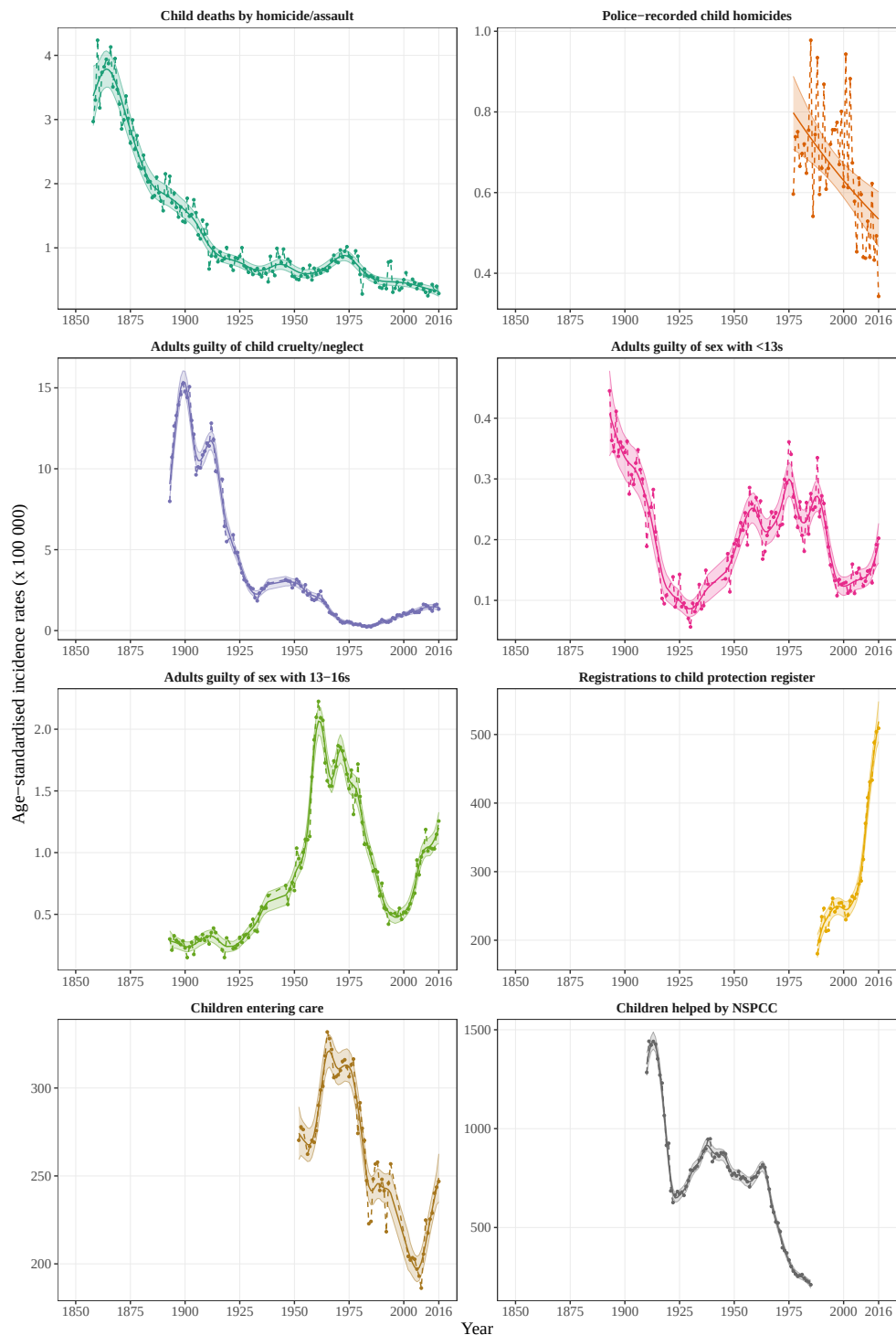


Figure 4.1. Trends in annual incidence rates of child maltreatment indicators.

Age-standardised incidence rates (x 100 000) for all available years and for each child maltreatment indicator. Dotted lines show raw incidence rates whilst solid lines show the best fitting model with shaded 95% confidence intervals. Y axes vary for different child maltreatment indicators. NSPCC = National Society for Prevention of Cruelty to Children (UK).

4.4.1.1 Child mortality

Deaths by homicide/assault and police-recorded homicides measured child mortality over time. Between 1858 and 2016, there was a 90% overall decrease in child deaths by homicide/assault (2.7 per 100 000 children). However, this decrease was non-linear as there were small increases between 1858–1870 and 1960–1975. Annual incidence rates for police-recorded child homicides did decrease in a linear fashion, although data were only available from 1977–2016. Police-recorded child homicides significantly decreased by 1% (95% CI 0.5–1.6) each year.

Child's gender and age. Figure 4.2 shows child mortality by child's gender and age at the time of death. Between 1858 and 2016, overall decreases were similar for male and female deaths (e.g. 89% vs. 92%) but were different for infant and adolescent deaths. Infant deaths decreased by 96% while adolescent deaths increased by 1%. A similar pattern was seen for police-recorded homicides when comparing younger (0–4 years) and older children (5–15 years) from 1977–2016 (Table 4.3).

4.4.1.2 Crimes against children

There were three crimes against children: child cruelty/neglect, sex with under 13s, and sex with 13–16s. Each crime followed a different trend from 1893–2016. Incidence rates for guilty perpetrators fell by 83% for child cruelty/neglect (6.7 per 100 000 adults) and by 55% for sex with under 13s (0.2 per 100 000 adults). Incidence rates for sex with 13–16s increased by 319% (1.0 per 100 000 adults). Despite these overall changes, all three crimes showed non-linear trends with sustained periods of increasing and decreasing rates.

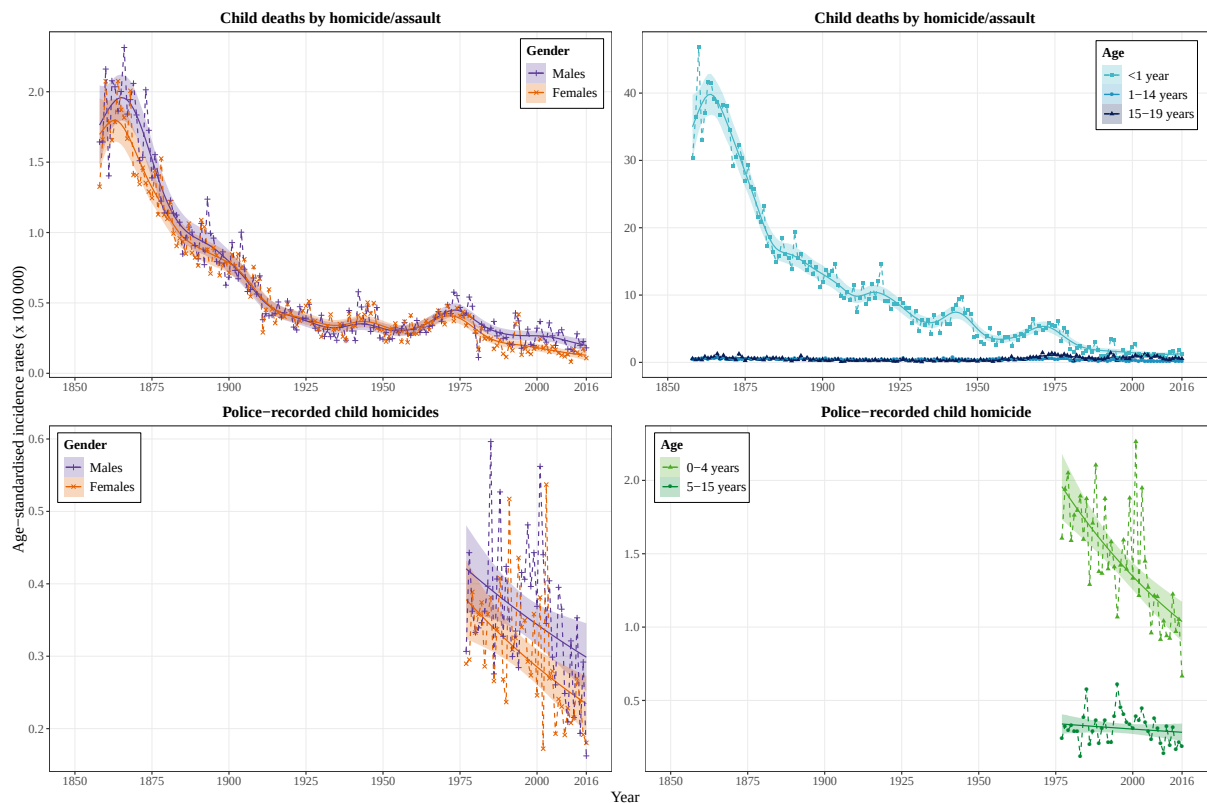


Figure 4.2. Trends in annual incidence rates of child mortality by gender and ages.

Age-standardised incidence rates (x 100 000) of child mortality by gender and age for all available years. Dotted lines show raw incidence rates whilst solid lines show best fitting models with shaded 95% confidence intervals. Y axes vary for different child maltreatment indicators.

4.4.1.3 Child protection activity

Two government collected statistics and one UK-wide charity (NSPCC) measured child protection activity. Even though these measures covered shorter time periods than child mortality and crime, incidence rates significantly changed over time. Overall, there was a 182% (328.7 per 100 000 children) increase for child protection registrations in 2016 compared to 1988, and a 9% (23.4 per 100 000 children) decrease for children entering care in 2016 compared to 1952. Incidence rates for children helped by NSPCC decreased in a non-linear fashion by 84% from 1910–1985.

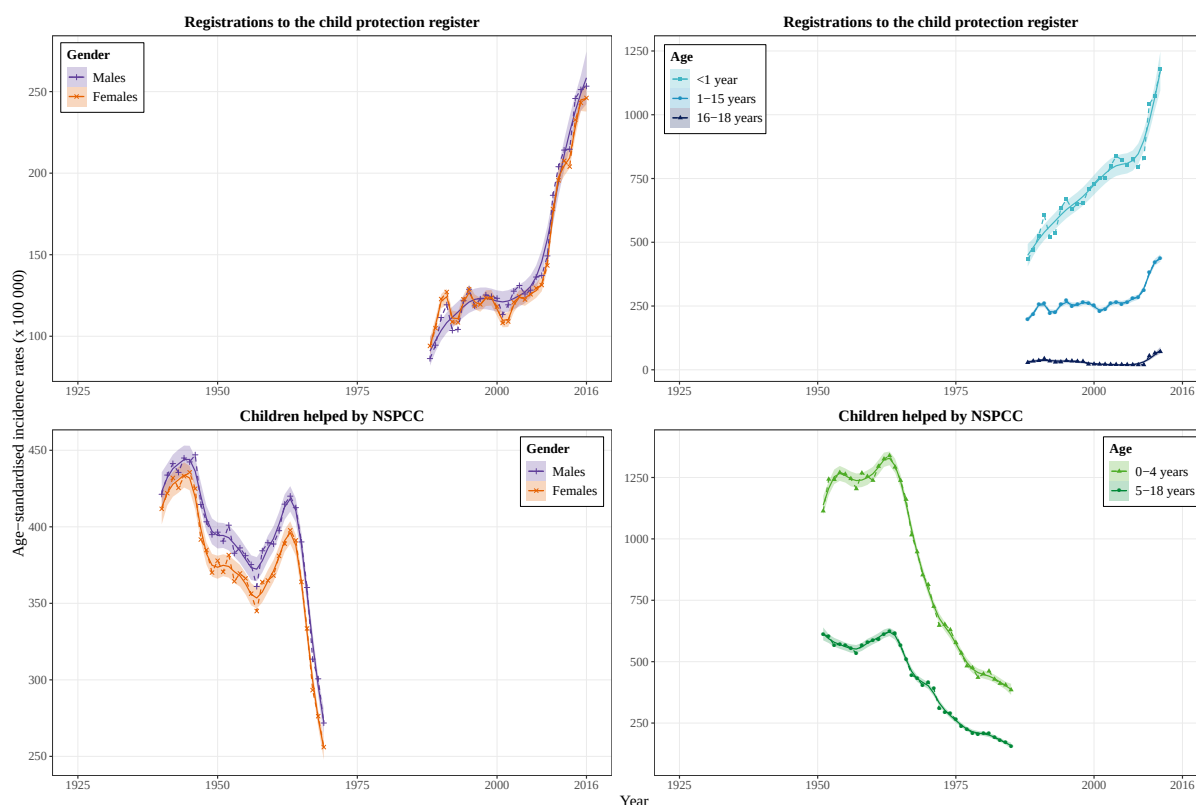


Figure 4.3. Trends in annual incidence rates of child protection activity by gender and age.

Age-standardised incidence rates (x 100 000) of child protection activity by gender and age for all available years. Dotted lines show raw incidence rates whilst solid lines show best fitting models with shaded 95% confidence intervals. Y axes vary for different child maltreatment indicators. NSPCC = National Society for Prevention of Cruelty to Children (UK).

Child's gender and age. Figure 4.3 shows child protection activity by child's gender and age. The proportion of males and females was similar and did not change over time. However, there were differences for different age groups. Between 1988 and 2012, there was a larger increase in infants placed on the child protection register (744.2 per 100 000 infants) than children (239.7 per 100 000 children). Adolescents showed the smallest increase (42.8 per 100 000 adolescents).

Type of child maltreatment. Trends in the type of child maltreatment are illustrated in Figure 4.4. In 1988–1999, physical abuse was the primary reason (33%) for a child being placed on a child protection register. By 2000–2016, the primary reason was neglect (43%). This change was mostly driven by large overall increases in registrations for neglect and emotional abuse from 1988–2016. Rates of registrations increased by over 782% for neglect and by 2282% for emotional abuse, whilst decreased by 2% for physical abuse and by 32% for sexual abuse.

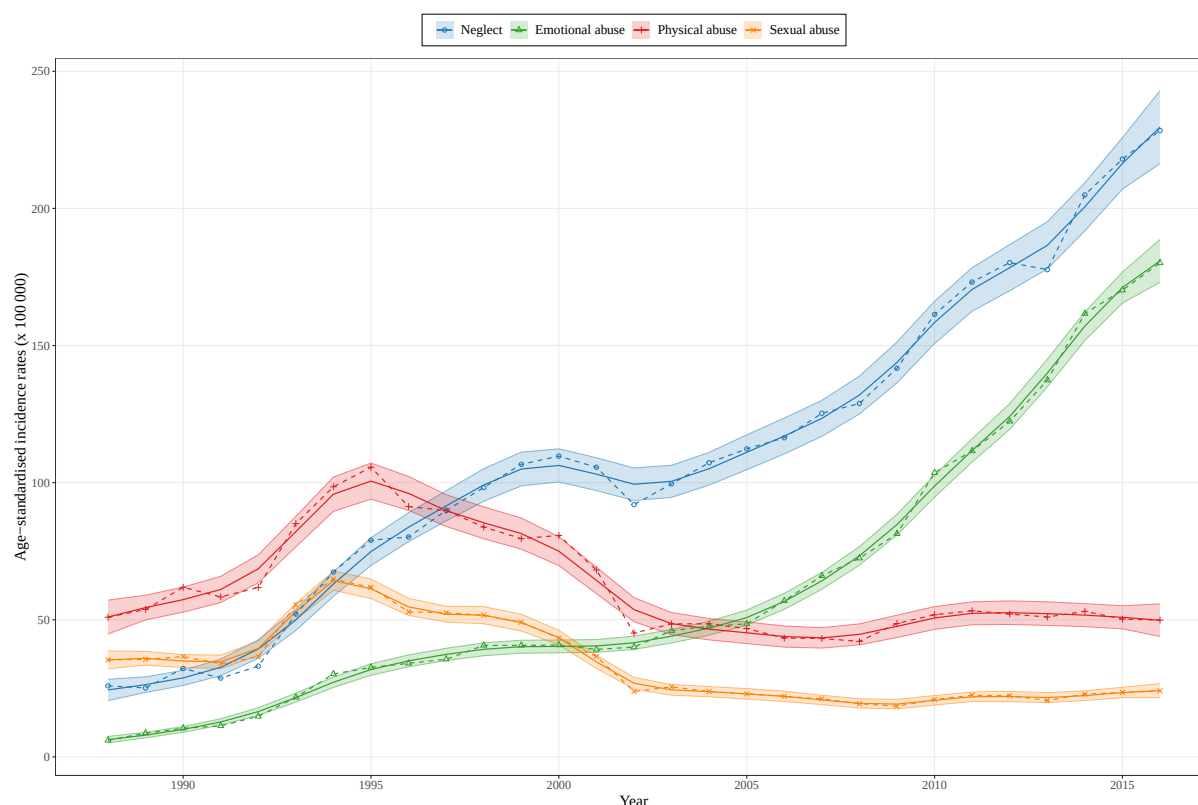


Figure 4.4. Trends in annual incidence rates of child protection registrations by type of maltreatment.

Age-standardised incidence rates (x 100 000) of child protection registrations by type of maltreatment for all available years. Dotted lines show raw incidence rates whilst solid lines show best fitting models with shaded 95% confidence intervals.

4.4.2 Long-term trends after adjusting for changes over time

Although a handful of changes affected the consistency of the data, long-term trends were not significantly affected. Data were mostly affected by changes to definitions or recording practices. For example: child deaths by homicide/assault were affected by different versions of the International Classification of Definitions (ICD); crimes against children were affected by new legalisation (e.g. Sex Offences Act, 1956); and child protection registrations were affected by the introduction of the Children In Need (CIN) census in 2010. Adjusting for these changes did not impact overall findings (Appendix C).

4.4.3 Recent trends in child maltreatment indicators

More recent trends show decreases in child mortality but increases in crimes against children and in child protection activity from 2000–2016 (Figure 4.1). Child deaths by homicide/assault

and police-recorded homicides continued to decrease. Both indicators estimated that there were 20 fewer child deaths in 2000–2016 compared to 1975–1999. However, these decreases were driven by large decreases for infant and younger child deaths and not by decreases for older children and adolescent deaths (Table 4.2). All three crimes and children entering care changed from decreasing to increasing trends from 2000 onwards. In addition, increases in the rate of registrations to the child protection register were particularly steep from 2000–2016. This pronounced increase was due to large increases in registrations for neglect and emotional abuse (Figure 4.4).

4.4.4 Current estimates for child maltreatment indicators

Current estimates for 2016 vary for different indicators of child maltreatment (Table 4.3). Child mortality was estimated at 0.3 deaths per 100 000 children by both measures. Males and females were at similar risk while adolescents (15–19 years) were at the highest risk of death by homicide/assault (0.6 deaths per 100 000 adolescents). The incidence of adults found guilty of child cruelty/neglect and sex with 13–16s was 1.3 per 100 000 adults. The incidence of adults found guilty of sex with under 13s was lower (0.2 per 100 000 adults). Child protection activity showed the highest incidence with 246.9 per 100 000 children entering care and 509.1 per 100 000 children being placed on the child protection register. Infants were around 3 times more likely to be placed on the child protection register than children (1–15 years) and 16 times more likely than adolescents (16–18 years). Neglect (228.4 per 100 000 children) and emotional abuse (108.1 per 100 000 children) were the most common reasons for being placed on the child protection register.

In 2016, these official records estimate that in England and Wales: 40 children died from homicide/assault, 1300 adults were guilty of crimes against children, 67 700 children were placed on the child protection register, and 34 100 children entered care.

4.5 Discussion

To the best of my knowledge, this chapter presents the first analysis of long-term trends in child maltreatment in England and Wales. The chapter's overall findings are that there have been significant changes to the risk of child maltreatment over time. Since the 1850s indicators of child maltreatment have mainly decreased, but there have also been notable increases for some indicators, time periods, sub-populations, and types of abuse. For example, there was a 90% decrease in child mortality from 1858–2016, an 83% decrease in adults guilty of child cruelty/neglect from 1893–2016, but a 182% increase in child protection registrations from 1988–2016. There were also more recent increases in crimes against children and children entering care from 2000–2016. Child's age and type of maltreatment emerged as important factors for long-term trends, as well as for current estimates. In 2016, adolescents (15–19 years) were twice as likely to die from homicide/assaults than infants (<1 year) and six times more likely than children (1–14 years). In 2016, the most common reason for a child to be placed on the child protection register was neglect, closely followed by emotional abuse.

I used eight indicators of child maltreatment from six sources to estimate trends in child maltreatment. Across indicators and sources, I found that long-term trends mostly decreased. There were sustained decreases in child mortality, adults guilty of crimes against children, children entering care, and children helped by NSPCC. These measures of child maltreatment have their limitations (see Table 4.1 and limitations below). The limitations however are different for each indicator and source. Therefore, consistently finding sustained decreases across indicators provides strong evidence that long-term trends in child maltreatment have decreased.

There was also strong evidence for more recent increases in child maltreatment. Although child mortality continued to decrease, all three crimes against children and children entering care increased since 2000. In addition, child protection registrations increased at a quicker rate from 2000–2016. These findings echo recent concerns that child maltreatment may be increasing (Bentley et al., 2018, 2017; Independent, 2018). Further work is needed to establish whether child maltreatment has recently become more common or whether child protection services have improved at identifying children at risk of child maltreatment. Either way, child

maltreatment continues to be a major public health problem as official records show that 40 children died by homicide/assault and 68 000 children were at serious risk of child maltreatment in 2016.

Consistent with previous observations, violent deaths have decreased more for younger children than for older children or adolescents (Pritchard & Sharples, 2008; Sidebotham, 2014; Sidebotham, Atkins, & Hutton, 2012). Between 1858 and 2016, there was a large 96% reduction in infant deaths yet a 1% increase for adolescent deaths. The same pattern was seen for sexual crimes against children as there was a 55% decrease in adults guilty of sex with under 13s but a 319% increase in adults guilty of sex with 13–16s. In 2016, more adolescents died by homicide/assault than any other age group. However, fewer adolescents were placed on the child protection register than any other age group. Future research should examine whether adolescents represent an increasingly vulnerable age group, and child protection should respond to this potentially increasing need.

In 1988, physical abuse was the most common reason for placing a child on the child protection register. By 2016, neglect was the most common reason and was around five times more common than physical abuse. This change was due to large increases in registrations for neglect (782%) and emotional abuse (2882%), as well as decreases in registrations for physical abuse (2%) and sexual abuse (32%). These observations are in line with recent UK self-report estimates for neglect (Radford et al., 2011; Radford, Corral, Bradley, & Fisher, 2013). US studies have also found that physical and sexual abuse (but not neglect) have significantly decreased since the 1990s (Finkelhor & Jones, 2004; L. M. Jones, Finkelhor, & Halter, 2006). It is unclear whether these recent increases are because of an increasing problem or whether they reflect real improvements in recognising, and responding to, neglect and emotional abuse. Given that there have been substantial changes in attitudes towards neglect and emotional abuse, whereby these types of maltreatment have become less socially acceptable (see 1 Section 1.2.2), it is arguably more likely that these increases are primarily driven by an increased awareness of the harms associated with neglect and emotional abuse (Barlow & Schrader McMillan, 2010; Hildyard & Wolfe, 2002). This highlights the importance of considering these changing societal norms and using specific, objective measures of child maltreatment when retrospectively studying past

experiences of child maltreatment and when tracking incidence rates over time.

This chapter has several limitations. Firstly, official records underestimate the incidence of child maltreatment because many maltreated children are not identified by authorities (Everson et al., 2008, see also Chapter 2). Secondly, each indicator has its own limitations (Table 4.1). Limitations for child mortality are that it only captures severe cases of child maltreatment, does not differentiate between types of perpetrators (e.g. adult vs. peer victimisation), and it may be measuring improvements in medical interventions rather than violence against children. Limitations for adults found guilty of crimes, children entering care, and child protection registrations, are that they may be reflecting changes in thresholds which are determined by changing policies and practices. Limitations for children helped by NSPCC statistics are that it heavily depends on whether other agencies are responsible for protecting children and the charity's capacity. Because of the latter, I excluded NSPCC data from 1884 to 1910 as this was a period of rapid NSPCC center expansion (from 52 to 1774) but then stabilised (National Society for the Prevention of Cruelty to Children, 1932). Thirdly, I did not investigate the effects of wider secular changes or examine causes that may explain trends in child maltreatment (e.g. reductions in child labour and poverty, introduction of the NHS, economic recessions). Finally, official record data are generally not as good quality as data specifically collected for research. However, to ensure the quality of the data I used systematic and transparent methods to extract, prepare, and link the data over time (for full details see Chapter 3). I also investigated and adjusted for changes that may have affected the consistency of the data (e.g. changes to recording practices; Degli Esposti, Taylor, et al., 2018b).

4.6 Conclusions

4.6.1 Research, policy and practice

The chapter findings show that national estimates for child mortality and crimes against children have decreased since the 1900s, while child protection activity has increased since the 1990s. I also found evidence across different sources that child maltreatment has increased since 2000. In 2016, adolescents were the most vulnerable age group to die by homicide, and neglect and emotional abuse were the most common types of registrations to the child protection register. Overall these findings lead me to conclude that child maltreatment continues to be a pressing issue in England and Wales and should remain a public health priority. Future research should seek to understand if more recent trends have increased, if adolescents are particularly vulnerable, and if neglect and emotional abuse are increasing. Future child protection policies and practices should aim to respond to these areas of growing need.

4.6.2 The thesis

For this thesis, the chapter findings help to establish that the societal risk of child maltreatment has significantly changed over time; answering RQ1. The findings show that the national incidence of child maltreatment has mainly decreased from the 1850s to 2016, especially for severe cases of maltreatment and physical and sexual abuse. The findings also highlight critical increases for some indicators, time periods, sub-populations, and types of abuse, which I have already discussed above. Together, the results demonstrate the importance of time in understanding the risk of child maltreatment at the societal level.

The second main question for this thesis pivots around changing risks following child maltreatment at the individual level, specifically: **RQ2)** Does the risk of antisocial behaviour following child maltreatment change across an individual's life-course? In the remaining two empirical chapters I will address this question (Chapters 5 & 6). In the next chapter (Chapter 5), I systematically review the extant prospective, longitudinal evidence on the relationship between child maltreatment and antisocial behaviour across the life-course. A subsequent meta-analysis

of this evidence aims to identify whether child maltreatment is associated with an increased risk of antisocial behaviour during childhood, adolescence, and adulthood.

Chapter 5 Child maltreatment and antisocial behaviour across the life-course: A systematic review & meta-analysis

5.1 Abstract

OBJECTIVE: To systematically review existing longitudinal evidence on the relationship between child maltreatment and antisocial behaviour across the life-course.

METHOD: I included prospective, longitudinal studies investigating the relationship between child maltreatment and antisocial behaviour across the life-course in high-income countries. I systematically searched for published and unpublished studies conducted between January 1948–2016 using EMBASE, MEDLINE, PsycINFO, Scopus, along with 14 other electronic databases and eight websites. Two researchers independently assessed for inclusion and quality using pre-specified eligibility criteria and an adapted Newcastle–Ottawa Scale.

RESULTS: The searches yielded 4,462 unique citations, of which 23 studies satisfied the eligibility criteria ($n = 18,613$). Only three included studies modelled within-person change in antisocial behaviour over time (i.e. longitudinal analytical methods), thus a cross-sectional data synthesis was required. Random effects meta-analyses revealed significant associations between child maltreatment and antisocial behaviour during childhood (Cohen's $d = 0.60$; 95% CI 0.37–0.82), adolescence (Cohen's $d = 0.37$; 95% CI 0.22–0.52), and adulthood (Cohen's $d = 0.31$; 95% CI 0.14–0.47).

CONCLUSIONS: The current evidence indicates that child maltreatment is associated with antisocial behaviour during childhood, adolescence, and adulthood. Due to the limited use of longitudinal analytical methods, this evidence cannot establish whether the magnitude of this risk remains stable across the life-course or whether it changes with time (i.e. RQ2).

5.2 Introduction

The objective of this chapter was to systematically review the current longitudinal evidence on the relationship between child maltreatment and antisocial behaviour across the life-course. Stemming from seminal work on the “cycle of violence” (Widom, 1989a), antisocial behaviour is one of the most well-documented risks following child maltreatment (Dodge, Pettit, & Bates, 1997; Stouthamer-Loeber, Loeber, Homish, & Wei, 2001; Weiler & Widom, 1996). Antisocial behaviour describes a wide variety of actions and attitudes that violate age-appropriate societal norms, and the personal or property rights of others (e.g. vandalism, hurting animals, setting fires, theft, and bullying/assault). Antisocial behaviour presents major global health issues in its own right (Romeo et al., 2006), encompassing the most common child psychiatric disorders, oppositional defiant disorder (ODD) and conduct disorder (CD), and increasing societal costs by at least ten-fold compared to healthy controls (Scott et al., 2001). Despite this, the extent of the risk of antisocial behaviour following child maltreatment is undetermined. Specifically, it is unclear whether the risk of antisocial behaviour persists or changes across the life-course.

As outlined in Chapter 1 Section 1.4, most of the current evidence examining the relationship between child maltreatment and antisocial behaviour is cross-sectional. A recent meta-analysis found that the majority of studies were not only cross-sectional, but also solely relied on retrospective self-report to measure child maltreatment (Wilson et al., 2009). This is problematic for three main reasons. First, studies using retrospective self-report find stronger associations between child maltreatment and antisocial behaviour than longitudinal evidence, which may be attributed to confounding, such as common method variance (Negri et al., 2017). Second, cross-sectional evidence is unable to establish directionality via temporal ordering, and thus cannot consider whether child characteristics, such as antisocial behaviour, may evoke maltreatment (Ge et al., 1996). Third, antisocial behaviour is not static but changes within individuals as they age. For example, only a small proportion of individuals who show antisocial behaviour in adolescence also show antisocial behaviour in adulthood (Moffitt, 2003). Consequently, child maltreatment may be associated with antisocial behaviour during adolescence but not during adulthood, or may be associated with antisocial behaviour during adulthood but not

during childhood or adolescence (i.e. ‘sleepers effects’; Widom, 2017).

Well-designed prospective longitudinal studies are able to address these methodological limitations and, importantly, can determine whether the risk of antisocial behaviour is persistent and stable or whether it changes across the life-course (Farrington, 1991; Malinosky-Rummell & Hansen, 1993; Malvaso, Delfabbro, & Day, 2018; Thornberry, Knight, & Lovegrove, 2012). However, at the time of designing this systematic review in 2015 [PROSPERO 2015: CRD42015029515], previous reviews did not focus on these types of well-designed observational studies (Maas, Herrenkohl, & Sousa, 2008; Norman et al., 2012; Wilson, Stover, & Berkowitz, 2009). Although a number of more recent reviews have since focused on these study types, they have examined antisocial behaviour within a single developmental period (Braga, Cunha, & Maia, 2018; Braga, Gonçalves, Basto-Pereira, & Maia, 2017). To the best of my knowledge, no systematic review has synthesised the prospective, longitudinal evidence on the relationship between child maltreatment and antisocial behaviour across the life-course.

This chapter aims to review the longitudinal evidence on the relationship between child maltreatment and antisocial behaviour across the life-course, focusing on well-designed observational studies. I performed a systematic review of the existing literature and used meta-analytical methods to quantitatively synthesise the associations between child maltreatment and antisocial behaviour in childhood, adolescence, and adulthood. In doing so, I aimed to establish whether child maltreatment is associated with a persistent risk of antisocial behaviour across the life-course, thus addressing RQ2.

5.3 Methods

I followed general recommendations from the PRISMA 2009 statement for the processing and reporting of results (Moher et al., 2009). Meta-analyses conformed to guidelines set out by the Meta-analysis of Observational Studies in Epidemiology (MOOSE; Stroup et al., 2000). A review protocol was registered in advance, pre-specifying methods and study inclusion criteria [PROSPERO 2015: CRD42015029515].

5.3.1 Eligibility criteria

I included all studies that satisfied the inclusion criteria and that did not meet the exclusion criteria. Studies could be published or unpublished, and could be reported in any language.

Types of studies. Prospective, longitudinal studies that use observational (i.e. non-experimental) study designs to investigate the relationship between child maltreatment and antisocial behaviour. These studies were eligible for inclusion if original empirical research was reported, and if there was enough numerical information to calculate at least one effect size for the association between child maltreatment and antisocial behaviour.

Types of participants. Studies that recruited male and/or female participants who were living in high-income countries (defined according to the World Bank during the study publication year) and born after 1948 (after the introduction of the Children Act (1948)). I included studies with representative samples of the general population, recruiting from the community through random, stratified or total sampling. I excluded studies with non-representative samples through convenience sampling and/or recruiting from non-representative settings (e.g. prison or health-care settings).

Exposure. Studies that focused on exposure to maltreatment in childhood. I included studies that clearly defined maltreatment as the occurrence of one, or a combination of, physical abuse, neglect, sexual abuse and emotional maltreatment. Maltreatment in childhood was defined as exposure to maltreatment before the age of 18 years old. I excluded studies that focused on other childhood adversity types, such as war, poverty, witnessing interpersonal violence, and harsh discipline practices. I included studies that measured child maltreatment prospec-

tively (i.e. prior to the assessment of antisocial behaviour) using measures with proven validity and reliability (e.g. Maltreatment Classification System (MCS; Barnett, Manly, & Cicchetti, 1993), Childhood Experience of Care and Abuse Questionnaire (CECA-Q; Bifulco, Bernazzani, Moran, & Jacobs, 2005)). I also excluded studies that did not demonstrate explicit temporal order, whereby the ascertainment of child maltreatment did not precede the assessment of antisocial behaviour. For example, cross-sectional designs using self-report to measure child maltreatment and antisocial behaviour concurrently were excluded.

Comparison group. Studies that compared individuals who experienced child maltreatment with at least one comparison group of individuals who did not experience child maltreatment.

Outcome. Studies that focused on antisocial behaviour as an outcome. I included studies that broadly defined antisocial behaviour as clinical diagnoses of oppositional defiant disorder (ODD), conduct disorder (CD), and antisocial personality disorder (ASPD), or as valid and reliable measures of their constituent symptoms (e.g. externalising behaviours, delinquency, criminality). I excluded studies that: (i) defined antisocial behaviour as the absence of prosocial behaviour; (ii) focused narrowly on specific subsets of antisocial behaviour, such as bullying perpetration and sexual offences; and (iii) exclusively studied psychopathologies that are often co-morbid with antisocial behaviour (e.g. attention deficit hyperactivity disorder (ADHD), schizophrenia, substance abuse disorders).

Additional exclusion criteria. I excluded studies that analysed child maltreatment or antisocial behaviour as mediators or moderators of other constructs, as well as studies that focused on neurobiological or genetic factors that influence the association between child maltreatment and antisocial behaviour. These studies would warrant a separate review and are beyond the scope of this chapter and the thesis as a whole.

5.3.2 Search strategy

To comprehensively identify studies reporting on the association between child maltreatment and antisocial behaviour, I employed three different search methods. First, I searched EMBASE, MEDLINE, PsycINFO, Scopus, along with 14 other electronic databases, for studies published between January 1948 and December 2016. I used the Boolean operator “AND” to

combine search terms relating to following three concepts: prospective longitudinal studies, child maltreatment, and antisocial behaviour. Vocabulary terms for the same concepts were linked by the Boolean operator “OR”, and the truncation and explosion of terms were used to capture variations in terminology (see Appendix D Table D). Second, to capture grey literature I searched eight relevant websites, including LONGSCAN, NSPCC and Social Care Institute for Excellence (SCIE). Third, I screened reference lists of identified relevant reviews, hand-searched issues of the journals *Child Abuse & Neglect* and *Development and Psychopathology* that were published from January 2011 to January 2016, and contacted subject experts to identify unpublished or on-going research. All searches were conducted in English.

5.3.3 Study selection

I assessed study eligibility by following a two-stage process: title and abstract screening, full-text article retrieval, and full-text article screening. I completed all three phases and screened all identified studies. A second reviewer (Richard D Sale, Medical Doctor) completed the third phase, independently assessing a randomly selected 10% of studies. There was high inter-rater agreement (94.9%), and disagreements were resolved by consensus. Reviewers were not masked to journals or authors of the studies.

Where there were multiple studies that used overlapping samples, or multiple publications for the same study, I selected only one study for inclusion in this review. The selection of one study was based on the following, pre-specified hierarchical criteria: (a) the study best addressed the relationship between child maltreatment and antisocial behaviour across the life-course; (b) the study was published in a peer-reviewed journal; (c) the study operationalised antisocial behaviour as psychiatric diagnoses or otherwise adopted the broadest operationalisation of antisocial behaviour (e.g. externalising behaviours over violent offences); (d) the study had the longest follow-up; (e) the study used the most appropriate subsample; and (f) the study presented numerical results that could be converted into the chosen summary statistic, Cohen’s *d* (see Section 5.3.5 below).

5.3.4 Data extraction and quality assessment

I developed a standardised data extraction form, which included publication details, project names, sampling design, setting, sample characteristics (size, earliest decade of birth, gender and ethnicity), operationalisations and measures of child maltreatment and antisocial behaviour, when antisocial behaviour was assessed, and study findings. Because the majority of included studies did not use longitudinal analytical methods, I used a cross-sectional approach to code and synthesise the outcome data. More specifically, I coded when antisocial behaviour was assessed according to three main development periods: childhood (0–11 years), adolescence (12–16 years), and adulthood (≥ 17 years). Where the age range of when antisocial behaviour was assessed straddled developmental periods, coding was determined by degree of overlap, age averages, and study context. For example, if antisocial behaviour was assessed in individuals aged 9–14 years with a mean age of 13 years old, this would be coded as “adolescence”. Whereas, if the study also assessed antisocial behaviour in individuals aged 14–17 years, with a mean age of 16 years, then the former would instead be coded as “childhood”, and the latter as “adolescence” (P. Cohen, Brown, & Smailes, 2001).

Where studies reported on multiple measures of antisocial behaviour, I selected one measure per developmental period (childhood, adolescence, adulthood) based on the following, pre-specified hierarchical criteria: (a) the outcome was assessed using measures with proven validity and reliability; (b) the outcome was operationalised as psychiatric diagnoses or otherwise adopted the broadest operationalisation of antisocial behaviour; (c) the outcome relied on official records or clinical interviews; (d) the outcome was assessed most frequently over the study period; and (e) the outcome was reported with numerical results that could be converted into the chosen summary statistic, Cohen’s *d* (see Section 5.3.5 below).

The data extraction form also included an adapted version of the Newcastle–Ottawa Scale for assessing the quality of cohort studies (Wells et al., 2000). Each study was assessed based on three main areas of risk of study bias: selection bias, comparability of maltreated and non-maltreated groups, and outcome assessment (length of follow-up, type of assessment and response rate). There were nine pre-defined quality criteria; one star was awarded per criterion and there was a maximum number of 9 stars (see Appendix D Table D.2). I completed the

data extraction and quality assessment, and contacted ten corresponding authors for additional information. These results were blindly checked by the second reviewer at a later time-point, this reviewer also extracted data from a random 50% of included studies. Again, inter-rater agreement for data extraction and coding was high (98.3%).

5.3.5 Statistical analyses

Due to a lack of longitudinal analyses, a cross-sectional approach was used to quantitatively synthesise the evidence on the relationship between child maltreatment and antisocial behaviour across the life-course. Three separate random-effects meta-analyses were conducted to examine the associations between child maltreatment and antisocial behaviour in: childhood, adolescence, and adulthood. These meta-analyses used the DerSimonian and Laird method to incorporate sampling and study-level errors (DerSimonian & Laird, 1986), and were carried out in Stata version 14 (StataCorp, 2015).

5.3.5.1 Effect size calculations

I chose Cohen's d as the principal summary measure, where values of above 0 reflected increased levels of antisocial behaviour in maltreated compared to non-maltreated individuals. I used the Binomial Effect Size Display (BESD) to help meaningfully interpret the magnitude of the effect sizes (Lipsey & Wilson, 2001). The BESD displays the difference between two proportions, such as the difference between the rate of antisocial behaviour in maltreated individuals vs. non-maltreated individuals (Rosenthal & Rubin, 1982; Rosnow, Rosenthal, & Rubin, 2000)

I extracted one effect size for each developmental period per study to maintain independent effects, and I prioritised adjusted effect sizes to reduce confounding. However, if no adjusted effect sizes were reported, unadjusted effect sizes were used (see sensitivity analysis below). Extracted data were converted to Cohen's d using standard computational techniques (Borenstein, Hedges, Higgins, & Rothstein, 2009; Chinn, 2000; J. Cohen, 1992; Lipsey & Wilson, 2001). For example, for converting from a correlation r to Cohen's d I used: $d = \frac{2r}{\sqrt{1-r^2}}$; and for converting from a log odds ratio to Cohen's d I used: $d = \text{LogOddsRatio} \times \frac{\sqrt{3}}{\pi}$.

5.3.5.2 Testing for heterogeneity

Heterogeneity of effect sizes between studies was quantitatively assessed using Cochran's Q and I^2 statistics. The latter represents heterogeneity in percentages, where 0%, 25%, 50% and 75% indicates zero, low, moderate, and high heterogeneity, respectively (Higgins, Thompson, Deeks, & Altman, 2003).

5.3.5.3 Publication bias

To visually assess for potential publication bias, I created funnel plots and contour-enhanced funnel plots. To formally assess for significant small-study effects, I performed Egger's test (Egger, Smith, Schneider, & Minder, 1997), the statistical analogue of the Galbraith radial plot.

5.3.5.4 Sensitivity analyses

I assessed the undue influence of individual studies on the overall meta-analyses, testing changes in the summary effect size estimate across permutations that iteratively omitted each study. Via subgroup analyses, I assessed the sensitivity of meta-analytic results to different operationalisations of child maltreatment and antisocial behaviour. I also tested the moderation of the meta-analytical results by gender (% female) through meta-regression. Finally, I explored potential confounding by variables (e.g. socio-economic status (SES), race) on a subsample of studies that reported both unadjusted and adjusted effect sizes.

5.4 Results

The search yielded 4,462 unique citations. Of these, 3,661 did not meet the inclusion criteria based on their titles and abstracts. Full-text articles were retrieved for the remaining 801 to be assessed in more detail. Of these, 23 studies satisfied the eligibility criteria, providing prospective longitudinal evidence on the relationship between child maltreatment and antisocial behaviour in general population samples in high-income countries (Figure 5.1). These 23 studies were included in subsequent meta-analyses and assessed a total of 18,613 participants (6,191 maltreated; 12,422 non-maltreated).

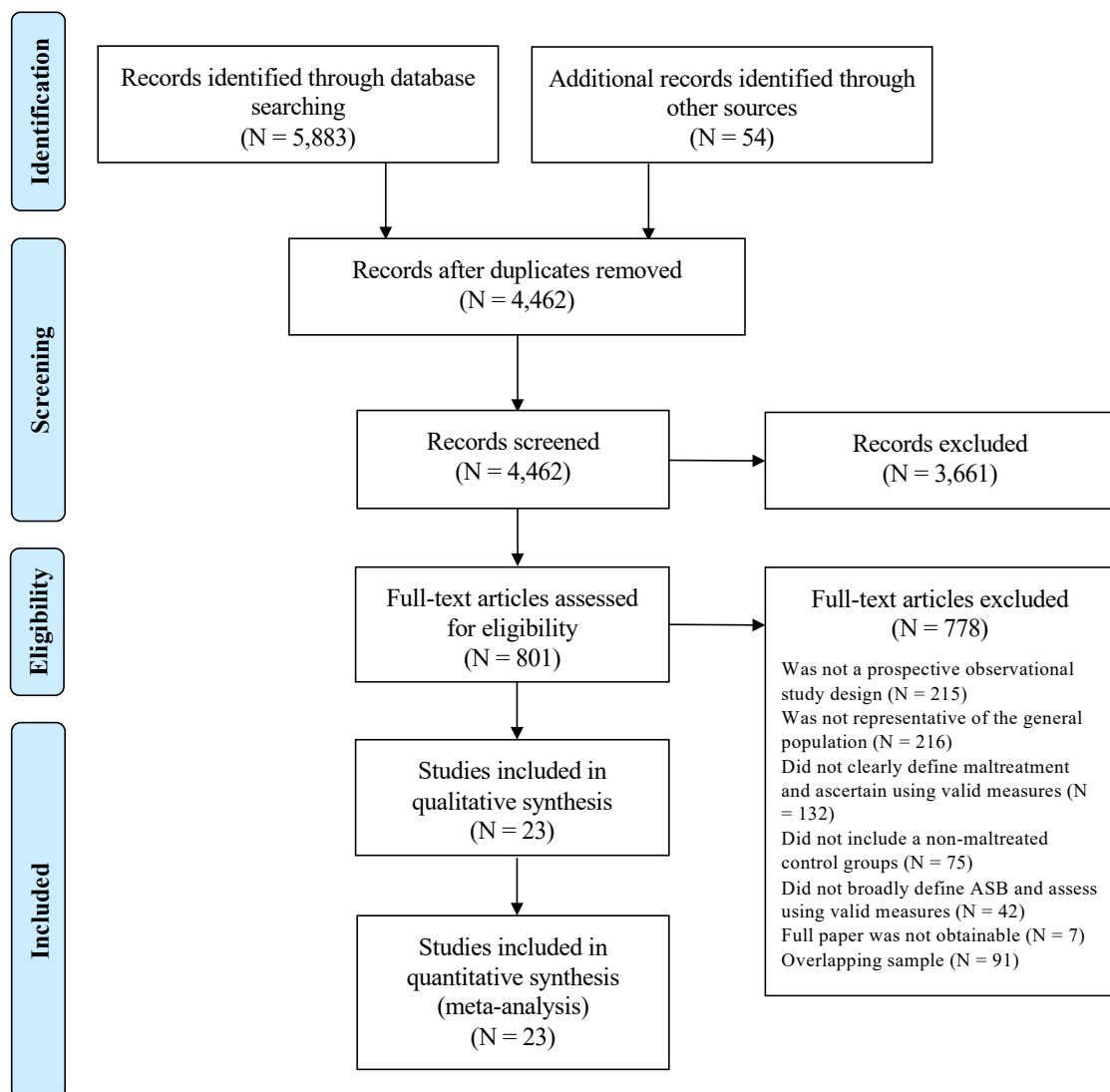


Figure 5.1. Flow diagram illustrating the process from study identification to inclusion.

5.4.1 Study characteristics

The characteristics of the 23 included studies are summarised in Table 5.1. Studies were published between 1992 to 2014, and were conducted across four countries, with the majority in the USA (78.3%; $n = 18$) and none in the UK. The study samples ranged from a total number of participants of 61 to 1,147. The majority of the study samples consisted of both males and females, while three studies assessed only males (Lemmon, 1999; Stouthamer-Loeber, Loeber, Homish, & Wei, 2001; Stouthamer-Loeber, Wei, Homish, & Loeber, 2002) and one study assessed only females (Siegel & Williams, 2003).

5.4.1.1 Study designs

There were two types of study designs: case-control and longitudinal cohort studies. Twelve studies were case-control designs; sampling a maltreated group from official records of child maltreatment (i.e. 'cases') and sampling a non-maltreated group from the nearest equivalent population, such as the same community (i.e. 'controls'). Only one of these studies did not match controls on key variables (e.g. gender, race, SES; Zingraff, Leiter, Johnsen, & Myers, 1994). The remaining 11 studies were longitudinal cohort studies, which sampled from the general population, including schools and community registers.

The majority of studies (87%) use cross-sectional methods to analyse group differences in antisocial behaviour at different time-points between maltreated and non-maltreated individuals. Only three studies modelled within-person change in antisocial behaviour, applying longitudinal statistical methods to analyse the association between child maltreatment and antisocial behaviour across the life-course (Flynn, Cicchetti, & Rogosch, 2014; Godinet, Li, & Berg, 2014; Stouthamer-Loeber, Loeber, Homish, & Wei, 2001). Flynn et al. (2014) used cross-lagged structural equation modelling to examine the stability of antisocial behaviour across adolescence and adulthood, Godinet et al. (2014) used multilevel modelling to analyse whether child maltreatment predicted antisocial behaviour trajectories from childhood to adolescence, and Stouthamer-Loeber et al. (2001) tested whether child maltreatment predicted pre-defined antisocial behaviour pathways from childhood to adolescence.

Table 5.1. Characteristics of included studies.

Study	Study design (country)	Sample characteristics		Child maltreatment		Antisocial behaviour	
		N (maltreated; controls)	Female (%)	Operationalisation (measure)	Age range (y)	Operationalisation (measure)	Developmental period
Bolger and Patterson (2001)	Cohort (USA)	214 (107; 107)	49	Maltreatment (official records)	n/s	Aggressive behaviour (self-report (YSR))	Childhood
	Cohort (USA)	622 (31; 591)	50	Neglect, physical abuse (official records)	0–18	Disruptive disorders (psychiatric diagnoses (DSM-III-R))	Childhood, adolescence, adulthood
Cutajar et al. (2010)	Cohort (Australia)	5365 (2688; 2677)	n/s	Sexual abuse (official records)	0–16	CD & ASPD (psychiatric diagnoses (ICD))	Childhood, adulthood
de Paul and Arruabarrena (1995)	Case-control (Spain)	66 (41; 25)	n/s	Neglect, physical abuse (official records)	0–11	Externalising behaviour (teacher report (TRF))	Childhood
Egeland, Yates, Appleyard, and van Dulmen (2002)	Cohort (USA)	140 (14; 126)	n/s	Physical abuse (official records)	0–5	Externalising behaviour & CD (care-giver report (CBCL), self-report (YSR), psychiatric diagnoses (DSM-III-R))	Childhood, adolescence, adulthood
	Case-control (USA)	96 (61; 35)	56	Maltreatment (official records)	0–5	CD (psychiatric diagnoses (DSM-III-R))	Childhood
Famularo, Kinscherff, and Fenton (1992)	Case-control (USA)	635 (407; 228)	41	Neglect, emotional, physical, sexual abuse (official records)	0–9	Externalising behaviour (self-report questionnaires (YSR))	Adolescence, adulthood
Flynn et al. (2014)	Cohort (USA)	484 (95; 389)	52	Maltreatment (official records)	0–4	Externalising behaviour (care-giver report (CBCL))	Childhood, adolescence
Godinet et al. (2014)	Case-control (USA)						

Study	Sampling design (country)	Sample characteristics			Child maltreatment		Antisocial behaviour	
		N (maltreated; controls)	Female (%)	Operationalisation (measure)	Age range (y)	Operationalisation (measure)	Developmental period	
Horwitz, Widom, McLaughlin, and White (2001)	Case-control (USA)	1147 (637; 510)	49	Maltreatment (official records)	0–11	ASPD (psychiatric diagnoses (DSM-III-R))	Adulthood	
Kaplan et al. (1998)	Case-control (USA)	198 (99; 99)	50	Physical abuse (official records)	0–16	Disruptive disorders (psychiatric diagnoses (DSM-III-R))	Adolescence	
Lansford et al. (2007)	Cohort (USA)	574 (69; 505)	48	Physical abuse (parental report)	0–5	Delinquency / criminality (official criminal records)	Adolescence, adulthood	
Lemmon (1999)	Case-control (USA)	632 (267; 365)	0	Maltreatment (official records)	0–18	Delinquency / criminality (official criminal records)	Adolescence	
Ligezinska, Firestone, Manion, McIntyre, and Ensom (1996)	Case-control (Canada)	84 (41; 43)	57	Extrafamilial sexual abuse (official records)	5–16	Externalising behaviour (care-giver report (CBCL))	Childhood	
Mills et al. (2013)	Cohort (Australia)	5098 (357; 4741)	48	Maltreatment (official records)	3–11	Externalising behaviour (self-report (YSR))	Adolescence	
Salzinger, Rosario, and Feldman (2007)	Case-control (USA)	153 (78; 75)	39	Physical abuse (official records)	0–10	Delinquency / criminality (self-report of delinquency (SRD))	Adolescence	
Siegel and Williams (2003)	Case-control (USA)	411 (206; 205)	100	Sexual abuse (official records)	1–12	Delinquency / criminality (official criminal records)	Adolescence, adulthood	
Stouthamer-Loeber et al. (2001)	Cohort (USA)	506 (52; 454)	0	Maltreatment (official records)	0–18	Delinquency / criminality (official criminal records)	Adolescence	

Study	Sampling design (country)	Sample characteristics			Child maltreatment		Antisocial behaviour	
		N (maltreated; controls)	Female (%)	Operationalisation (measure)	Age range (y)	Operationalisation (measure)	Developmental period	
Stouthamer-Loeber et al. (2002)	Cohort (USA)	298 (94; 204)	0	Maltreatment (official records)	0–13	Delinquency / criminality (care-giver report (CBCL), self-report (SRD & YSR), teacher report (TRF))	Childhood	
Swanston et al. (2003)	Case-control (Australia)	117 (49; 84)	77	Sexual abuse (official records)	4–15	Delinquency / criminality (official criminal records)	Adolescence	
Thornberry, Ireland, and Smith (2001)	Cohort (USA)	856 (172; 684)	27	Maltreatment (official records)	0–17	Externalising behaviour (care-giver report (CBCL))	Adolescence, adulthood	
Toth and Cicchetti (1996)	Case-control (USA)	61 (29; 32)	49	Maltreatment (official records)	7–12	Externalising behaviour (teacher report (TRF))	Childhood	
Trickett, Aber, Carlson, and Cicchetti (1991)	Case-control (USA)	132 (58; 74)	36	Physical abuse (official records)	0–8	Aggressive behaviour (care-giver report (CBCL))	Childhood	
Zingraff et al. (1994)	Case-control (USA)	724 (539; 185)	54	Maltreatment (official records)	0–18	Delinquency / criminality (official criminal records)	Adolescence	

Notes. Maltreatment includes neglect, emotional, physical and sexual abuse. ASPD = Antisocial Personality Disorder; CBCL = Child Behaviour Checklist (Achenbach & Edelbrock, 1979); CD = Conduct Disorder; n/s = not specified; SES = Socio-Economic Status; SRD = Self-Report Delinquency Scale (D. S. Elliott & Huizinga, 1983); TRF = Teacher-Report Form (Edelbrock & Achenbach, 1984); YSR = Youth Self-Report (Achenbach, 1991).

5.4.1.2 Measuring child maltreatment

All studies measured child maltreatment prospectively, ascertaining the presence or absence of child maltreatment before measuring antisocial behaviour. Child maltreatment was mainly measured using official records (medical, court or Child Protection Services (CPS)). One study used parental report (Lansford et al., 2007) and no studies used self-report. Maltreatment predominately occurred in pre-adolescence (52.2%; $n = 12$), with an average age range of 1 to 12 years old. One study did not specify the exact age range that maltreatment occurred; instead it was stated that maltreatment occurred “in childhood” (Bolger & Patterson, 2001).

5.4.1.3 Operationalising and measuring antisocial behaviour

Five studies operationalised antisocial behaviour as psychiatric diagnoses, eight studies as delinquency or criminality, and 10 studies as externalising or aggressive behaviours. Two studies’ operationalisations of antisocial behaviour varied depending on the wave of data collection (Egeland, Yates, Appleyard, & van Dulmen, 2002; Lansford et al., 2007). The measurement method depended on the study’s operationalisation of antisocial behaviour. Typically, studies that operationalised antisocial behaviour as psychiatric diagnoses used clinical interviews, whilst criminal or delinquent behaviours were measured by arrest or offence records, and externalising or aggressive behaviours by questionnaires. The questionnaires most frequently used to measure externalising or aggressive behaviours, were the Achenbach questionnaires for caregivers (Child Behaviour Checklist (CBCL; Achenbach & Edelbrock, 1979)), teachers (Teacher Report Form (TRF; Edelbrock & Achenbach, 1984)), and self-report (Youth Self-Report (YSR; Achenbach, 1991)).

5.4.1.4 Quality assessment

The quality assessment of included studies found that the maximum number of Newcastle–Ottawa Scale stars awarded was 7/9 (8.7%; $n = 2$ (P. Cohen, Brown, & Smailes, 2001; Lansford et al., 2007)), and the minimum was 1/9 (4.4%; $n = 1$ (Toth & Cicchetti, 1996)). The most common methodological limitation identified was the absence of controlling for antisocial behaviour at the start of the study. A second recurring methodological difficulty was the representativeness

of individuals who were maltreated. This stemmed from the heavy reliance on official records which, although likely to have a low rate of false positives, has the caveat of capturing a specific subset of the maltreated population. Appendix D Table D.2 details the quality assessment for each study.

5.4.2 Child maltreatment and antisocial behaviour in childhood, adolescence, and adulthood

Effects sizes on the association between child maltreatment and antisocial behaviour ranged from 0.01 to 1.13, where child maltreatment was consistently associated with higher levels of antisocial behaviour in all studies. Because only three studies used longitudinal analytical methods (see Section 5.4.1.1 above), and only two studies measured antisocial behaviour across all three developmental periods (P. Cohen, Brown, & Smailes, 2001; Egeland, Yates, Appleyard, & van Dulmen, 2002), I separately meta-analysed the associations for antisocial behaviour in childhood ($n = 11$), adolescence ($n = 14$), and adulthood ($n = 8$). Figure 5.2 graphically shows the number of studies measuring antisocial behaviour during different developmental periods.

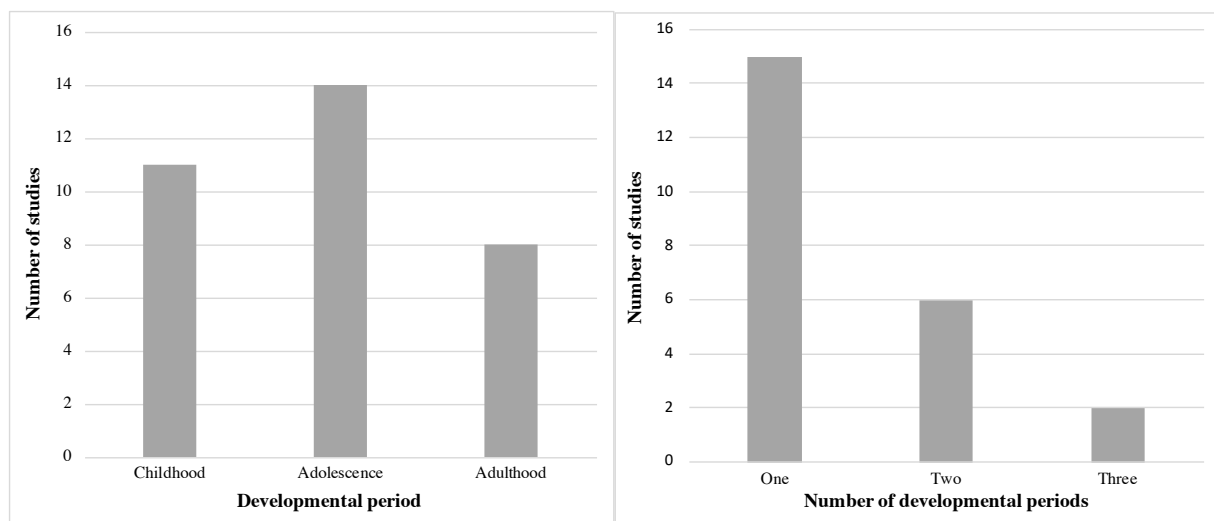


Figure 5.2. Bar charts showing: (a) the number of studies reporting on antisocial behaviour during different developmental periods (*left panel*); (b) the number of studies reporting on 1, 2 or 3 different developmental periods (*right panel*).

The forest plots for these three meta-analyses on the associations between child maltreatment and antisocial behaviour in childhood, adolescence, and adulthood are shown in Figure 5.3. I identified significant heterogeneity and high estimated proportions of true heterogeneity across studies that reported on antisocial behaviour in childhood ($Q = 34.14$, $df = 10$, $p < .001$; $I^2 = 70.7\%$), adolescence ($Q = 71.86$, $df = 13$, $p < .001$; $I^2 = 81.9\%$), and adulthood ($Q = 21.55$, $df = 7$, $p < .001$; $I^2 = 67.5\%$).

The association between child maltreatment and antisocial behaviour in childhood was tested using 11 studies and a total of 7,652 participants. The results showed that, compared to non-maltreated individuals, individuals who were maltreated displayed significantly higher levels of antisocial behaviour in childhood (Cohen's $d = 0.60$; 95% CI 0.37–0.82). According to the BESD, this medium effect size is equivalent to 64% of maltreated individuals showing above-median levels of antisocial behaviour compared to 35% of non-maltreated individuals.

Two further meta-analyses examined the associations between child maltreatment and antisocial behaviour in adolescence and in adulthood. For antisocial behaviour in adolescence, 14 studies with a total of 11,150 participants were included. For antisocial behaviour in adulthood, eight studies with a total of 9,750 participants were included. The meta-analytic results indicated that relative to non-maltreated individuals, maltreated individuals showed significantly higher levels of antisocial behaviour both in adolescence (Cohen's $d = 0.37$; 95% CI 0.22–0.52) and in adulthood (Cohen's $d = 0.31$; 95% CI 0.14–0.47). These smaller effect sizes for adolescence and adulthood translated to approximately 57%-60% of maltreated individuals showing above-median levels of antisocial behaviour compared to 40%-42% of non-maltreated individuals.

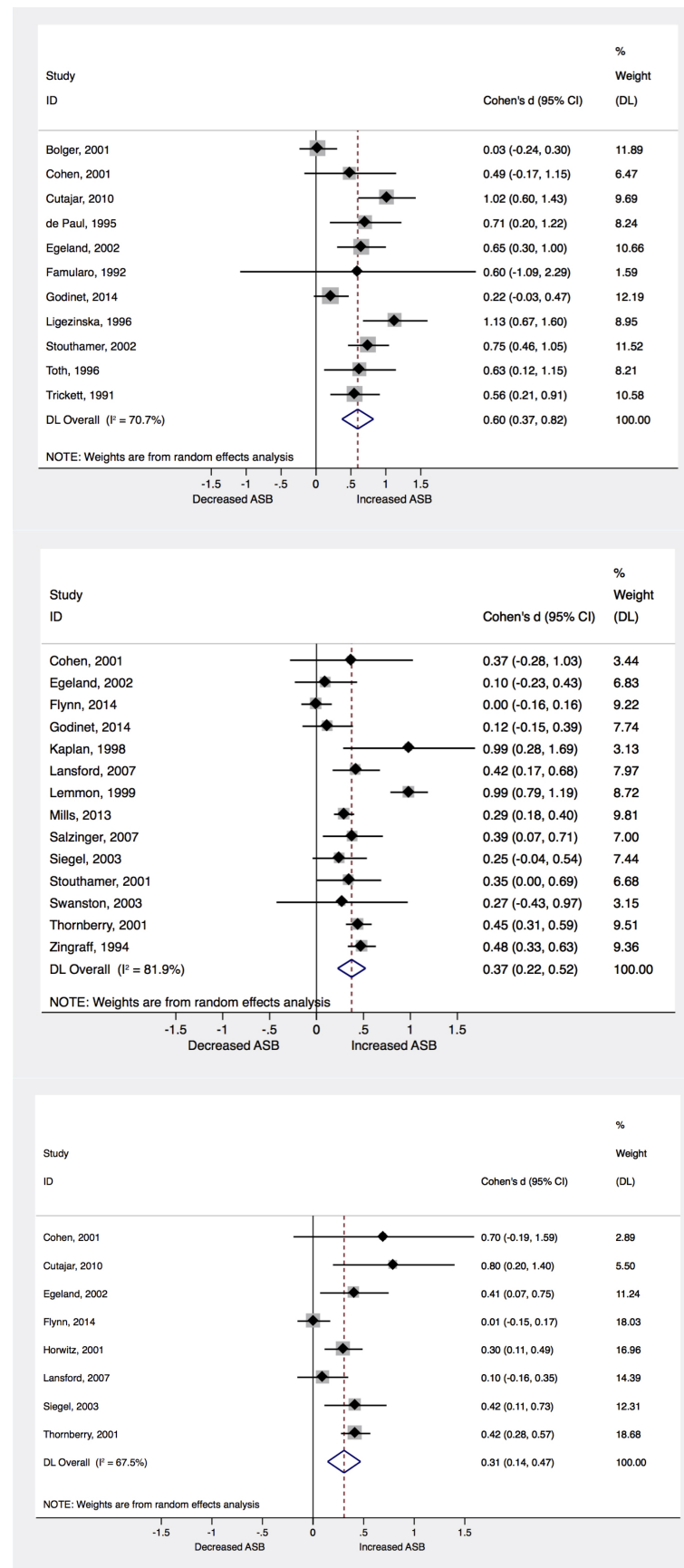


Figure 5.3. Forest plots showing the results of random-effects meta-analyses investigating the associations between: (a) child maltreatment and ASB in childhood (*top panel*); (b) child maltreatment and ASB in adolescence (*middle panel*); (c) child maltreatment and ASB in adulthood (*bottom panel*). ASB = antisocial behaviour.

5.4.3 Additional analyses

To explore the effect of potential sources of artefact, bias and/or identify meaningful study differences, I performed the following additional analyses.

5.4.3.1 Publication bias analysis

To visually assess the possibility of publication bias, three funnel plots, corresponding to the three developmental periods, were drawn. The funnel plot for studies in adolescence showed no asymmetry. The two funnel plots for childhood and adulthood were ambiguous due to the smaller number of studies included. However, when supplemented with corresponding contour-enhanced funnel plots, it was evident that studies were not missing within areas of statistical non-significance. This suggests that funnel asymmetry was not simply due to publication bias (Peters, Sutton, Jones, Abrams, & Rushton, 2008). Figure 5.4 shows the three funnel plots and three contour-enhanced funnel plots. Furthermore, Egger's tests were not significant across all three developmental periods: childhood ($B = 0.12$, $SE = 0.28$; $p = 0.17$) adolescence ($B = 0.34$, $SE = 0.15$; $p = 0.84$), and adulthood ($B = 0.12$, $SE = 0.16$; $p = 0.35$). In combination, small-study effects or selection biases attributable to publication bias were not evident.

5.4.3.2 Undue influence analysis

For all three meta-analyses, I tested the possibility of undue influence of individual studies on the overall results. In each case, every study was individually omitted in turn. For childhood, adolescence and adulthood, 11, 14 and 8 permutations, respectively, were carried out. However, in no case did a point estimate lie outside the 95% confidence interval of the overall results of the meta-analyses, nor did any point estimate differ in significance relative to the overall results. These observations strongly suggest that no individual study exerted undue influence on the three meta-analyses.

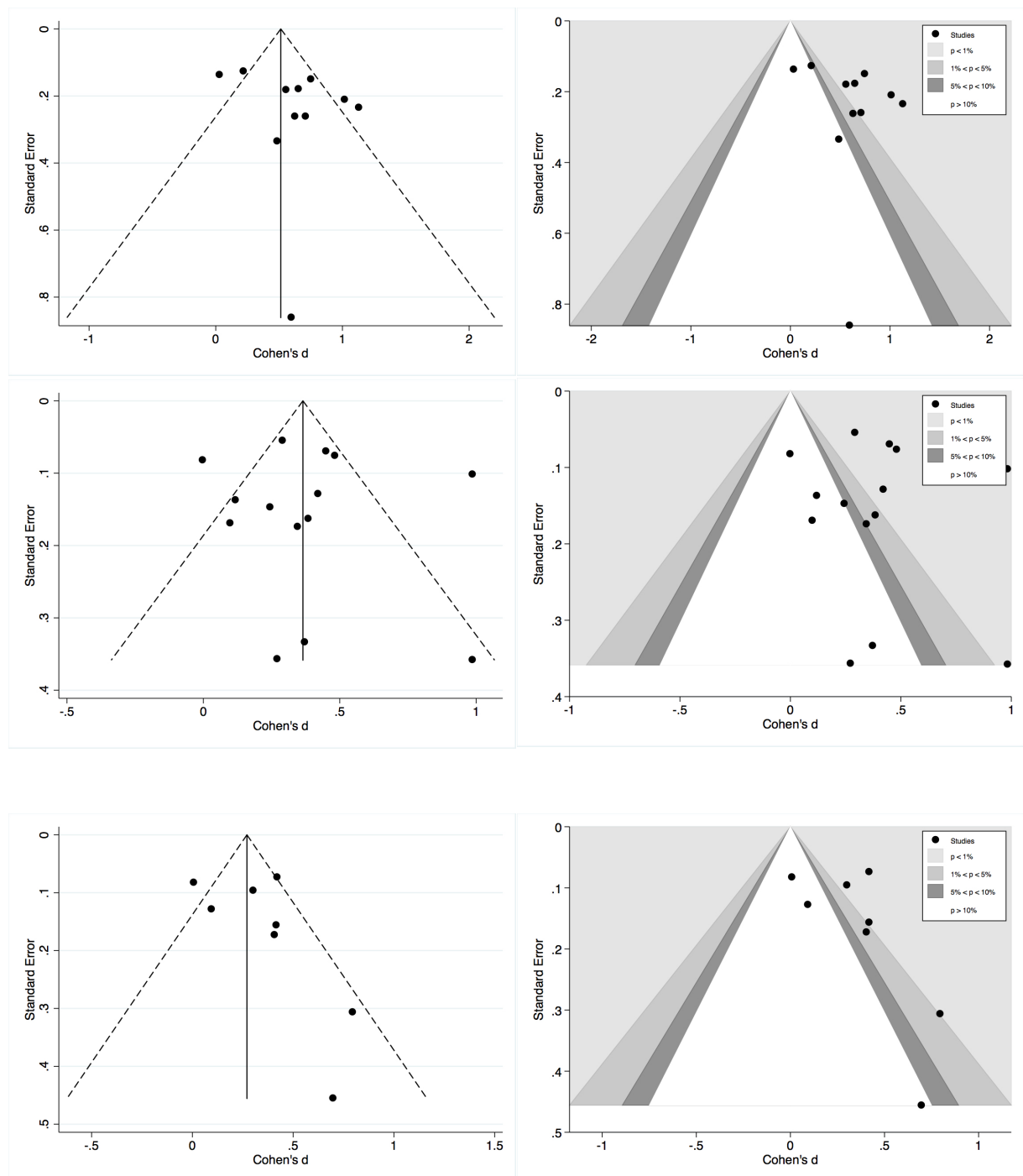


Figure 5.4. Funnel plot (*left-hand side*) with pseudo 95% confidence limits and contour-enhanced funnel plot (*right-hand side*) of Standard Error by Cohen's d for antisocial behaviour in: (i) childhood (*top panel*), (ii) adolescence (*middle panel*), and (iii) adulthood (*bottom panel*).

5.4.3.3 Subgroup analyses

Since there was significant heterogeneity across studies, I carried out a series of subgroup analyses to test for, and potentially identify, any meaningful differences between studies.

Types of child maltreatment. I examined whether meta-analytic results varied depending on different types of child maltreatment. Physical abuse only was significantly associated with higher levels of antisocial behaviour during childhood (Cohen's $d = 0.75$; 95% CI 0.28–1.21), adolescence (Cohen's $d = 0.28$; 95% CI 0.12–0.43), and adulthood (Cohen's $d = 0.44$; 95% CI 0.23–0.65). Whereas, neglect only was not significantly associated with higher levels of antisocial behaviour during childhood (Cohen's $d = 0.46$; 95% CI -0.20–1.13), adolescence (Cohen's $d = 0.15$; 95% CI -0.15–0.45), and adulthood (Cohen's $d = 0.24$; 95% CI -0.54–1.02). Sexual abuse and emotional abuse were not significantly associated with antisocial behaviour in any of the three developmental periods. This suggests that individuals who experience physical abuse may be at increased risk of antisocial behaviour compared to other types of child maltreatment, and physical abuse may even be driving the overall association between child maltreatment and antisocial behaviour. However, physical abuse was also the most studied type of child maltreatment ($n = 7$) compared to neglect ($n = 6$), sexual abuse ($n = 3$), and emotional abuse ($n = 1$). Consequently, these differences between types of child maltreatment may instead reflect a statistical artefact due to the subgroup analyses being underpowered.

Operationalisations of antisocial behaviour. I conducted subgroup analyses to assess the sensitivity of meta-analytic results to different operationalisations of antisocial behaviour. I chose to carry out subgroup analyses only on studies reporting on antisocial behaviour in adolescence as the larger number of studies promised the highest statistical power. The included studies operationalised antisocial behaviour as psychiatric diagnoses ($n = 2$), delinquency or criminality ($n = 7$), and externalising or aggressive behaviours ($n = 5$). I found that childhood maltreatment was significantly associated with higher levels of antisocial behaviour in adolescence, regardless of whether antisocial behaviour was operationalised as psychiatric diagnoses (Cohen's $d = 0.67$; 95% CI 0.06–1.27), criminality/delinquency (Cohen's $d = 0.48$; 95% CI 0.26–0.70), or externalising/aggressive behaviours (Cohen's $d = 0.21$; 95% CI 0.04–0.38).

Gender. Again using the largest number of studies available in a meta-analysis ($n = 13$),

I examined for the moderation of the meta-analytical results by gender (% female). The meta-regression demonstrated that the association between child maltreatment and antisocial behaviour in adolescence was not significantly moderated by gender ($b = -0.476$, $p = 0.125$).

Unadjusted vs. adjusted associations. I explored potential confounding by analysing a subset of studies that reported data on both unadjusted and adjusted associations. Studies adjusted for a range of key variables, including gender, race, age, SES, and family characteristics. Child maltreatment was significantly associated with higher levels of antisocial behaviour in adolescence, and had similar effect sizes, regardless of whether the analyses did or did not adjust for potentially confounding variables (Cohen's $d = 0.42$; 95% CI 0.26–0.58; Cohen's $d = 0.45$; 95% CI 0.24–0.65, respectively).

5.5 Discussion

In this chapter I examined the prospective, longitudinal evidence on the relationship between child maltreatment and antisocial behaviour across the life-course. The present systematic review and meta-analysis of well-designed observational studies indicated that child maltreatment was associated with an increased risk of antisocial behaviour during childhood, adolescence, and adulthood. Effect sizes ranged from small to medium. The largest effect size was for antisocial behaviour during childhood, followed by antisocial behaviour during adolescence then adulthood. Compared to their non-maltreated counterparts, rates of antisocial behaviour were approximately 29% higher in maltreated children, 20% higher in maltreated adolescents, and 15% higher in maltreated adults. Although this reduction in effect sizes from childhood to adulthood might suggest that the risk of antisocial behaviour following child maltreatment decreases as individuals age, the current evidence was unable to directly test this finding. This was because only three studies used longitudinal methods to analyse within-person change and only two studies measured antisocial behaviour during all three developmental periods (i.e. from childhood to adulthood). As a result, there was a lack of existing evidence on whether the risk of antisocial behaviour changes across an individual's life-course (i.e. RQ2).

5.5.1 Strengths and limitations

This chapter has important strengths, including the pre-registration of the systematic review protocol on PROSPERO to reduce researcher bias and increase transparency. I employed stringent eligibility criteria, pooling high-quality longitudinal evidence. I carried out additional analyses to assess for publication bias and potential confounding. In addition, I carried out a series of subgroup analyses and meta-regressions to investigate any important differences between studies (see Section 5.4.3.3).

Nevertheless, the findings should be evaluated in the context of the following main limitations. First, the meta-analytical results are limited by the small number of studies. Although I screened nearly 6000 titles and abstracts, and initially identified 113 eligible studies, the number of included studies was dramatically reduced to 23, due to multiple publications on the same and

overlapping samples. For example, one longitudinal cohort study generated 31 relevant articles, of which I could only include one (Horwitz, Widom, McLaughlin, & White, 2001). Second, when faced with multiple studies reporting on the same sample, I selected studies based on a set of pre-specified criteria. I cannot discount the possibility that using different selection criteria, and thus including different studies, may have altered the meta-analytical results.

Third, child maltreatment is a complex, multidimensional construct (Manly, 2005), which was operationalised in different ways across studies. These different operationalisations, namely different types of child maltreatment (neglect, physical abuse, sexual abuse, emotional abuse), may explain some of the heterogeneity between studies as subgroup analyses indicated that only physical abuse was significantly associated with antisocial behaviour. However, these additional analyses were based on a limited number of studies and, stemming from the seminal literature on the ‘cycle of violence’ (Widom, 1989a), physical abuse was the most studied type of child maltreatment ($n = 7$). Consequently, the non-significant associations for neglect, sexual abuse, and emotional abuse may be due to wider confidence intervals rather than smaller effect sizes (i.e. a lack of statistical power). Establishing whether all types of child maltreatment are significantly associated with antisocial behaviour should be a priority for future research since it has important clinical implications for identifying individuals at risk and for designing targeted interventions.

5.5.2 What this chapter adds

This chapter systematically reviews and quantitatively synthesises the longitudinal evidence and finds that child maltreatment is associated with an increased risk of antisocial behaviour during childhood, adolescence, and adulthood. The review of the existing literature highlighted a lack of evidence on whether this risk is persistent and stable, or whether it changes across the life-course. This systematic review, and subsequent reviews since (Braga, Cunha, & Maia, 2018; Malvaso, Delfabbro, & Day, 2016), have not identified any existing studies that use longitudinal analytical methods and repeated measures of antisocial behaviour from childhood into adulthood to address: **RQ2**) Does the risk of antisocial behaviour following child maltreatment change across an individual’s life-course?

The next chapter (Chapter 6) will directly address the final research question of this thesis, RQ2. Specifically, Chapter 6 will use latent growth curve modelling and 50 years of longitudinal data from the 1958 British birth cohort study to empirically test whether child maltreatment is associated with a persistent and stable risk of antisocial behaviour across the life-course.

Chapter 6 Child maltreatment and the risk of antisocial behaviour across the life-course*

6.1 Abstract

OBJECTIVE: To establish whether the risk of antisocial behaviour following child maltreatment is persistent and stable across the life-course.

METHOD: I drew 50 years of longitudinal data from the 1958 British birth cohort ($n = 8,088$). Data included different types of child maltreatment (neglect, physical, sexual abuse) and measures of antisocial behaviour at 7, 11, 16, 23, 33, 42, and 50 years. Latent growth curve models were used to model the longitudinal course of antisocial behaviour across childhood (7–16 years) and adulthood (23–50 years) as a function of child maltreatment. Analyses were adjusted for covariates; including biological, family, and social characteristics.

RESULTS: Child maltreatment was associated with higher levels of antisocial behaviour across the life-course, independently of other potentially confounding factors. Antisocial behaviour was 16%–35% higher during childhood and 50%–118% higher during adulthood in individuals who were maltreated. Individuals who experienced multiple types of maltreatment were at the greatest risk of antisocial behaviour. Each additional maltreatment type was associated with a 12% and 51% increase in antisocial behaviour during childhood and adulthood, respectively. There was limited evidence that child maltreatment was associated with within-person rates of change, indicating that these associations did not change over time.

CONCLUSIONS: Child maltreatment is associated with an increased risk of antisocial behaviour, with a persistent and stable association remaining up to age 50.

* Chapter adapted from:

Degli Esposti, M., *et al.* (under review). Child maltreatment and the risk of antisocial behaviour: A population-based cohort study spanning 50 years. *JAACAP*.

6.2 Introduction

The objective of this chapter was to examine if the risk following child maltreatment changes over time by empirically testing whether child maltreatment is associated with a persistent and stable risk of antisocial behaviour at the individual level. Child maltreatment places individuals at risk of a range of poor behavioural, mental health, and physical health outcomes (Kisely et al., 2018; Norman et al., 2012). Antisocial behaviour is one of the most costly and well-documented risks following child maltreatment (see Chapter 1 Section 1.4). My systematic review and meta-analysis of the current longitudinal evidence (Chapter 5), as well as reviews since (Braga, Cunha, & Maia, 2018; Braga, Gonçalves, Basto-Pereira, & Maia, 2017; Widom, 2017), suggest that this risk of antisocial behaviour may persist from childhood into mid-adulthood. However, longitudinal studies are yet to empirically test whether child maltreatment is associated with a persistent and stable risk of antisocial behaviour across the life-course (see Chapter 5), and thus the life-long burden of child maltreatment remains unclear.

Most studies investigating associations between child maltreatment and antisocial behaviour have been limited by measuring antisocial behaviour at only one time-point, typically during childhood or adolescence (Assink et al., 2015; Wilson, Stover, & Berkowitz, 2009, see also Chapter 5 Section 5.4.1.1). This approach does not capture the longitudinal course of antisocial behaviour and is unable to investigate the effects of child maltreatment on within-person change (Farrington, 1991). It is particularly important to investigate within-person change because this determines whether risks change or are stable over time. Such findings have key clinical implications. For example, if child maltreatment is associated with an increased risk of antisocial behaviour in childhood but this risk diminishes from childhood into adulthood; then emphasis should be placed on early interventions. If instead this risk increases from childhood into adulthood (i.e. ‘sleeper effects’), or is persistent and stable; then there is a need for interventions to extend beyond the childhood period to include adulthood (Widom, 2017).

Longitudinal cohort studies are able to investigate the effects of child maltreatment on within-person change (Farrington, 1991). Existing analyses of these studies have been shaped by life-course theories of antisocial behaviour (e.g. Stouthamer-Loeber et al., 2001). Moffitt’s

developmental taxonomy theory is one of the most valuable and influential life-course theories of antisocial behaviour (Fairchild, Van Goozen, Calder, & Goodyer, 2013; Moffitt, 2006, see also Chapter 1 Section 1.4.3). I discussed the developmental taxonomy theory in Chapter 1 Section 1.4.3.2, but to summarise, it explains the age-crime curve by arguing that there are distinct subgroups who show different patterns of within-person change (e.g. adolescence-limited and life-course persistent trajectories). Longitudinal studies have typically adopted a similar approach and used group-based trajectory modelling techniques, such as growth mixture modelling, to analyse within-person change (Odgers et al., 2008). This analytical approach first extracts classes (i.e. subgroups) of trajectories and then tests whether child maltreatment predicts class membership. Although this approach helps to identify at-risk subgroups, it has been heavily criticised as it assumes that between-person differences in antisocial behaviour trajectories are categorically instead of continuously distributed (Bauer, 2007). Even if this unlikely assumption holds, it requires researchers to identify the correct number of classes and does not directly examine the association between child maltreatment and within-person change (Bauer & Curran, 2003). Additional analytical approaches are therefore needed to determine whether the risk of antisocial behaviour changes over time and to identify at what points during the life-course interventions may be best targeted.

In this chapter, I investigate whether child maltreatment is associated with a persistent and stable risk of antisocial behaviour from childhood through to mid-adulthood (7–50y). I use prospective and retrospective measures of child maltreatment and latent growth curve modelling to analyse a large, UK population-based cohort study (the 1958 British birth cohort). Specifically, I aim to answer RQ2 by addressing the following two questions: 1) Is child maltreatment associated with higher levels of antisocial behaviour across the life-course? 2) Do (any) observed associations between child maltreatment and antisocial behaviour change over time? Demonstration that child maltreatment is associated with higher levels of antisocial behaviour across the life-course would indicate a persistent risk. Demonstration that this association does not change over time would indicate a stable risk.

6.3 Methods

6.3.1 Sample

The 1958 British birth cohort is a population-based sample of 18,558 UK men and women, including all births in one week in March 1958 ($n = 17,638$) and immigrants recruited at 7, 11, and 16y ($n = 920$). Information was collected from parents, teachers, and doctors throughout childhood (birth, 7, 11, 16y), and from cohort members throughout adulthood (23, 33, 42, 45, 50y). The sample for this study consists of 8,088 participants who completed questions on antisocial behaviour at 50y and who also completed questions on child maltreatment at age 45 years (see Figure 6.1). Ethical approval was given for various surveys including at 45y by South-East Multi-centre Research Ethics Committee (MREC ref. 01/1/44) and at 50y by the London MREC (ref. 08/H0718/29).

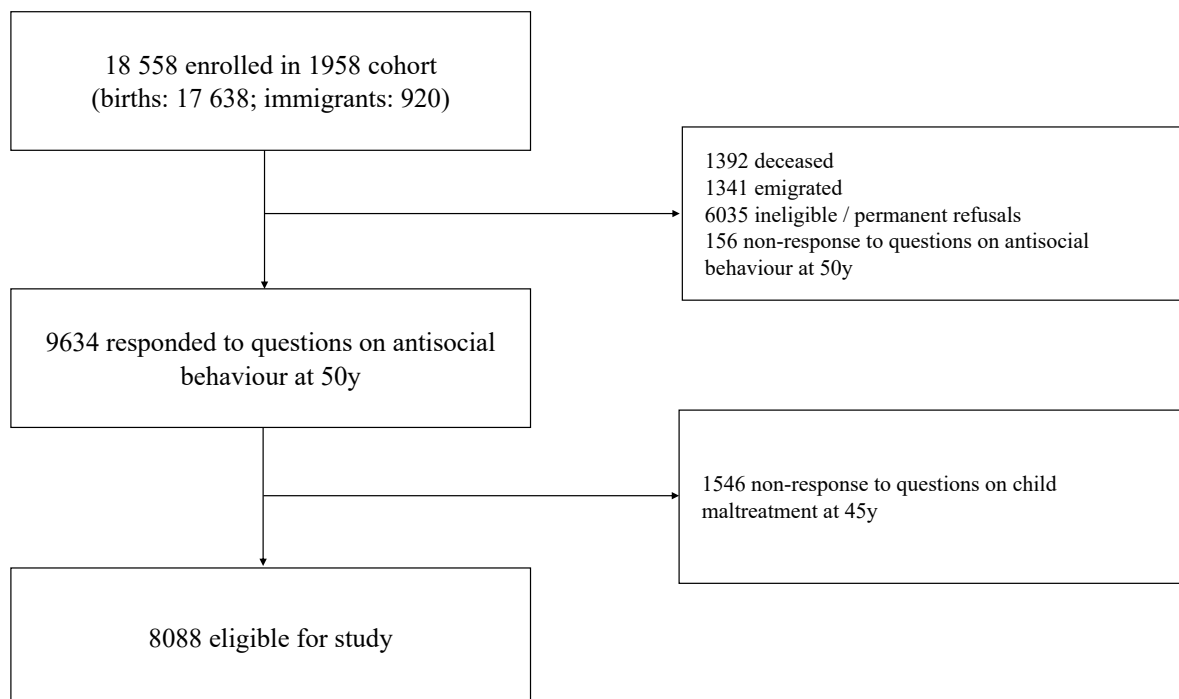


Figure 6.1. Flow diagram of study sample drawn from the 1958 British birth cohort (for full cohort details see Power & Elliott, 2006).

6.3.2 Measures

6.3.2.1 Child maltreatment

Prospective information on neglect was collected at 7 and 11y from structured interviews with the child's parent and from questionnaires completed by their teacher. I summed 11 indicators of neglect to derive a summed score (range: 0–11). I then created a binary variable, where participants scoring ≥ 3 on at least 6 indicators were classified as neglected. This method is in line with previous studies (Archer et al., 2017). Retrospective information on child maltreatment by a parent up to 16y was collected at 45y using a Computer-Assisted Self Interviewing (CASI) questionnaire. Questions on childhood maltreatment were based on the Australian Path Through Life Study (Rosenman & Rodgers, 2006). I created three binary variables for emotional, physical, and sexual abuse. The number of maltreatment types was derived by creating a summed score from the binary variables (range: 0–4); including neglect, emotional, physical, and sexual abuse. See Table 6.1 for more detail.

Table 6.1. Measures of child maltreatment in the 1958 British birth cohort.

Child maltreatment (age)	1958 cohort variables	Age of ascertainment (method)
Neglect (7 & 11y)	Child looks underfed or undernourished, or scruffy or dirty	7 & 11y (T)
	Mother never, or hardly ever, takes child out	7 & 11y (T)
	Father never, or hardly ever, takes child out	7 & 11y (T)
	Mother shows little or no interest in child's education progress	7 & 11y (T)
	Father shows little or no interest in child's education progress	7 & 11y (T)
	Mother and father never, or hardly ever, reads to or with the child	7y (P)
Emotional abuse (0–16y)	I was verbally abused by a parent	45y (S)
	I suffered humiliation, ridicule, bullying or mental cruelty from a parent	45y (S)
Physical abuse (0–16y)	I was physically abused by a parent — punched, kicked or hit or beaten with an object, or needed medical treatment	45y (S)
Sexual abuse (0–16y)	I was sexually abused by a parent	45y (S)

Notes. For corresponding definitions of child maltreatment see Table 1.1. Table is adapted from Archer et al. (2017). (S) = self-report; (T) = teacher-report; (P) = parent-report; y = years.

6.3.2.2 Antisocial behaviour

Antisocial behaviour was broadly defined as actions that violate societal norms and the personal or property rights of others (e.g. fighting, destroying property, excessive anger). For childhood antisocial behaviour, I used three indicators that were consistently collected across all three child surveys (7, 11, 16y): “destroys/destroys belongings”, “fights children” and “is disobedient” (Rutter, Tizard, & Whitmore, 1970a). Parents reported the frequency of their child’s behaviour on a Likert-type scale (never (0); sometimes (1); frequently (2)). For adulthood antisocial behaviour, I used three indicators that were collected across all four adult surveys (23, 33, 42, 50y): “often get in a violent rage”, “often annoyed/irritated” and “things often get on your nerves” (Rutter, Tizard, & Whitmore, 1970b). Participants reported whether each statement was accurate (no (0); yes (1)). At each age, I created a composite measure for childhood antisocial behaviour (range: 0–6) and adulthood antisocial behaviour (range: 0–3) by summing their respective indicators. I checked the validity of these measures of antisocial behaviour by examining whether scores were correlated with a previously validated measure of externalising behaviour at 7y and criminality at 42y (police arrests and cautions; Clark et al., 2007). All antisocial behaviour scores were significantly associated with externalising behaviour and criminality ($p < .001$).

6.3.2.3 Longitudinal measurement invariance of antisocial behaviour

I also checked the reliability of these measures of childhood and adulthood antisocial behaviour. A key assumption of longitudinal analyses of within-person change is that the metric used to measure antisocial behaviour is equivalent across time (i.e. longitudinal measurement invariance), and therefore that any observed changes can be attributed to actual changes in antisocial behaviour. I tested whether it was reasonable to assume that the metrics for antisocial behaviour were broadly the same across childhood (7–16y) and, separately, across adulthood (23–50y). I used longitudinal confirmatory factor analysis to fit a series of measurement models, sequentially adding model constraints to simulate longitudinal measurement invariance (Liu et al., 2017; Mehta, Neale, & Flay, 2004). These additional constraints did not significantly deteriorate model fit, indicating that longitudinal measurement invariance held. I also explored the

practical significance of potential violations of longitudinal measurement invariance by comparing predicted probabilities for less versus more restrictive measurement models (Liu & West, 2018; Mehta, Neale, & Flay, 2004). These potential violations were trivial, further indicating that the measures of antisocial behaviour were reliable over time. Full details on testing longitudinal measurement invariance, including methods and results, are found in Appendix E.

6.3.2.4 Covariates

Covariates were identified *a priori* as biological, family, and social characteristics associated with child maltreatment and antisocial behaviour (Murray & Farrington, 2010; Thornberry et al., 2014). Biological factors included: sex, birth weight (adjusted for sex and gestational age), maternal age at birth, and maternal smoking after 4 months of pregnancy (non-smoker/smoker). Family factors included: parent divorce/separation/desertion by 7y (yes/no), parent death by 7y (yes/no), family contact with mental health services by 11y (yes/no), and family contact with crime by 11y (yes/no). Social factors included: socio-economic position at birth (professional/managerial; skilled non-manual; skilled manual; unskilled or no male head (Registrar General's Social Class (RGSC))), household crowding at 7y (≥ 1.5 people per room), and housing tenure at 7y (owner/occupier; renter; other). All factors were measured prospectively and assessed using parental report, except for birth weight which was ascertained from clinical records.

6.3.3 Statistical analyses

Prior to main analyses, I regressed antisocial behaviour at all ages (7, 11, 16, 23, 33, 42, 50y) on child maltreatment. All subsequent analyses modelled childhood (7–16y) and adulthood (23–50y) separately because they used different measures of antisocial behaviour.

Latent growth curve models (LGCM) were fitted to examine the association between child maltreatment and the longitudinal course of antisocial behaviour. I fitted unconditional LGCMs to the repeated measures of antisocial behaviour (model specifications are depicted in Figure 6.2). These unconditional models were used to estimate the initial level (i.e. intercept) and rate of change (i.e. linear slope) required to account for the observed antisocial behaviour

scores across childhood and adulthood in the absence of any predictor variables (i.e. child maltreatment). After establishing appropriate unconditional LGCMs, I investigated associations between child maltreatment and the initial level and rate of change in antisocial behaviour by including child maltreatment in a series of conditional LGCMs. Specifically, I investigated associations for: (i) each type of child maltreatment as binary variables (neglect, emotional, physical, sexual abuse); (ii) the number of maltreatment types as a categorical variable (0, 1, 2, ≥ 3 types); and (iii) per additional type of maltreatment as a continuous variable. I adjusted all conditional LGCMs for the covariates listed above, and then adjusted for other types of child maltreatment. Throughout, child maltreatment and covariates were conceptualised as time constant predictors. All analyses were conducted in R (version 3.5.0) using the lavaan package (R Core Team, 2018; Rosseel, 2012). A data analysis plan was published *a priori* at the Open Science Framework (Degli Esposti, Pinto Pereira, & Bowes, 2018).

To help interpret the results of the LGCMs, I report mean percentage differences in initial level and rate of change in antisocial behaviour between maltreated and non-maltreated individuals (e.g. individuals who were physically abused and individuals who were not physically abused, respectively). I calculated these percentages for initial levels by dividing the mean difference between maltreated and non-maltreated individuals' initial levels by the mean initial level for non-maltreated individuals, and then multiplying by 100. I used the same method to calculate mean percentage differences for rates of change.

6.3.3.1 Model estimator and fit

LGCMs were estimated using robust maximum likelihood estimation (Rhemtulla, Brosseau-Liard, & Savalei, 2012). Because model fit indices based on χ^2 are overly sensitive to large sample sizes, LGCM fit was evaluated using comparative fit index (CFI > 0.90), root mean square error of approximation (RMSEA < 0.10), and standardised root mean square residual (SRMR < 0.05 ; Preacher et al., 2008). I prioritised model fit indices from complete case analyses as pooled model fit indices from multiple imputed datasets are overly sensitive to between-dataset variance (Enders, 2010). To visualise the associations between child maltreatment and the initial level and rate of change in antisocial behaviour, I plotted model-fitted estimates and

corresponding 95% CIs.

6.3.3.2 Missing data

The study sample was broadly representative of the surviving cohort (Atherton, Fuller, Shepherd, Strachan, & Power, 2008). To minimise data loss, I used multiple imputation using chained equations to impute missing data for: child maltreatment (range: 0.4%–8.9%); childhood antisocial behaviour (range: 12.0%–24.2%); adulthood antisocial behaviour (range: 0.1%–15.7%); and covariates listed above (range: 0.0%–15.7%). Imputation models included all study variables, as well as additional auxiliary variables that have been identified as predictors of non-response in the cohort: height at 7y, cognitive ability at 7y, internalising and externalising behaviour at 7y, episodes in care by 7y, and social class at 42y (Atherton et al., 2008). Imputation models were run in R using the mice package and pooled using runMI in the semTools package (van Buuren & Groothuis-Oudshoorn, 2011). In line with previous recommendations, analyses were carried out across the 20 imputed datasets, as well as for complete case analysis (Little & Rubin, 2014). Observations were similar for both; I therefore report results based on multiple imputation in this chapter and results from complete case analyses in Appendix F.

6.4 Results

The prevalence of child maltreatment varied from 1.4% (sexual abuse) to 9.5% (neglect), and 18.1% experienced at least one type of maltreatment (Table 6.2). The mean antisocial behaviour score decreased across childhood from 7y to 16y but was relatively stable across adulthood from 23y to 50y.

Table 6.2. Prevalence of child maltreatment and antisocial behaviour in the study sample.

	Total (n = 8088)		Males (n = 3954)	Females (n = 5134)
	n	%	%	%
Type of child maltreatment (0–16y)				
Neglect	7368 ^a	9.47	4.87	4.6
Emotional abuse	7849	8.88	3.58	5.3
Physical abuse	8025	5.58	2.79	2.79
Sexual abuse	8055	1.35	0.2	1.15
No. of maltreatment types^b (0–16y)				
0	5817	81.91	82.59	81.25
1	958	13.49	13.37	13.6
2	255	3.59	3.34	3.83
3–4	72	1.01	0.69	1.32
	n	Mean (SD)	Mean (SD)	Mean (SD)
Childhood antisocial behaviour^c (7–16y)				
7y	7047	1.39 (1.10)	1.60 (1.12)	1.19 (1.05)
11y	6888	1.08 (0.98)	1.27 (1.00)	0.91 (0.93)
16y	6118	0.32 (0.69)	0.33 (0.69)	0.31 (0.68)
Adulthood antisocial behaviour^d (23–50y)				
23y	7009	0.32 (0.57)	0.27 (0.52)	0.36 (0.62)
33y	7251	0.27 (0.55)	0.24 (0.50)	0.30 (0.60)
42y	7856	0.38 (0.64)	0.36 (0.61)	0.40 (0.66)
50y	8078	0.35 (0.64)	0.27 (0.59)	0.41 (0.69)

Notes. Percentages (%) are given for categorical variables and means and standard deviations for continuous variables. Values are based on the included sample (n = 8088) but n varies due to missing data. SD = standard deviation; y = years.

^a Those complete on ≥ 6 of 11 neglect items.

^b Includes neglect, emotional, physical, sexual abuse.

^c Range 0–6, where higher scores indicate higher levels of antisocial behaviour.

^d Range 0–3, where higher scores indicate higher levels of antisocial behaviour.

6.4.1 Preliminary analyses

Table 6.3 shows mean differences in maltreated and non-maltreated individuals' antisocial behaviour at 7, 11, 16, 23, 33, 42, and 50y. Neglect and physical abuse were significantly associated with antisocial behaviour at all ages, where individuals who experienced these types of maltreatment had higher levels of antisocial behaviour ($p < .05$). Emotional abuse was associated with higher levels of antisocial behaviour at all ages except for 7y. Sexual abuse was associated with higher levels of antisocial behaviour from 16y onwards. There was a dose-response relationship between the number of maltreatment types and antisocial behaviour at all ages; for example, at 7y associations ranged from 0.28 (95% CI: 0.21 to 0.36) for a single type of maltreatment to 0.35 (95% CI: 0.07 to 0.62) for ≥ 3 types of child maltreatment.

Table 6.3. Mean difference in antisocial behaviour from 7 to 50 years, by child maltreatment.

Childhood antisocial behaviour ^a			Adulthood antisocial behaviour ^b				
7y	11y	16y	23y	33y	42y	50y	
Type of child maltreatment							
Neglect	0.48 (0.40 to 0.57)	0.44 (0.36 to 0.52)	0.33 (0.26 to 0.4)	0.14 (0.09 to 0.19)	0.15 (0.10 to 0.20)	0.06 (0.01 to 0.11)	0.13 (0.08 to 0.18)
Emotional abuse	0.09 (-0.01 to 0.19)	0.11 (0.03 to 0.19)	0.22 (0.15 to 0.29)	0.21 (0.16 to 0.26)	0.26 (0.21 to 0.31)	0.26 (0.21 to 0.31)	0.23 (0.18 to 0.28)
Physical abuse	0.22 (0.10 to 0.34)	0.28 (0.19 to 0.38)	0.24 (0.16 to 0.32)	0.18 (0.12 to 0.24)	0.24 (0.18 to 0.31)	0.20 (0.13 to 0.26)	0.11 (0.05 to 0.17)
Sexual abuse	-0.04 (-0.27 to 0.19)	0.03 (-0.17 to 0.24)	0.28 (0.12 to 0.45)	0.30 (0.16 to 0.43)	0.40 (0.26 to 0.54)	0.21 (0.09 to 0.34)	0.17 (0.04 to 0.29)
No. of maltreatment types ^c							
0	Ref	Ref	Ref	Ref	Ref	Ref	Ref
1	0.28 (0.21 to 0.36)	0.28 (0.21 to 0.35)	0.23 (0.18 to 0.29)	0.16 (0.12 to 0.20)	0.15 (0.11 to 0.19)	0.13 (0.09 to 0.18)	0.16 (0.12 to 0.20)
2	0.26 (0.12 to 0.40)	0.35 (0.23 to 0.47)	0.34 (0.23 to 0.44)	0.22 (0.15 to 0.29)	0.32 (0.25 to 0.39)	0.21 (0.13 to 0.28)	0.21 (0.14 to 0.28)
3–4	0.35 (0.07 to 0.62)	0.27 (0.06 to 0.47)	0.44 (0.25 to 0.64)	0.34 (0.20 to 0.49)	0.42 (0.29 to 0.55)	0.32 (0.19 to 0.45)	0.20 (0.07 to 0.32)
Per additional maltreatment	0.17 (0.13 to 0.22)	0.18 (0.14 to 0.22)	0.18 (0.15 to 0.22)	0.12 (0.10 to 0.15)	0.15 (0.13 to 0.18)	0.11 (0.09 to 0.14)	0.11 (0.08 to 0.13)

Notes. All coefficients are unadjusted and unstandardised (B (95% confidence interval)). Coefficients for childhood (7–16y) and adulthood (23–50y) antisocial behaviour are therefore not directly comparable.

^a Range 0–6, where higher scores indicate higher levels of antisocial behaviour.

^b Range 0–3, where higher scores indicate higher levels of antisocial behaviour.

^c Includes neglect, emotional, physical, sexual abuse.

6.4.2 Latent growth curve models

Figure 6.2 graphically represents unconditional LGCMs. In the unconditional LGCMs, antisocial behaviour decreased steeply and linearly across childhood (7–16y), with an 8% reduction in antisocial behaviour each year. Antisocial behaviour linearly increased by less than 1% each year across adulthood (23–50y). Model fit indices for LCGMs are shown in Appendix G Tables G.1 and G.2.

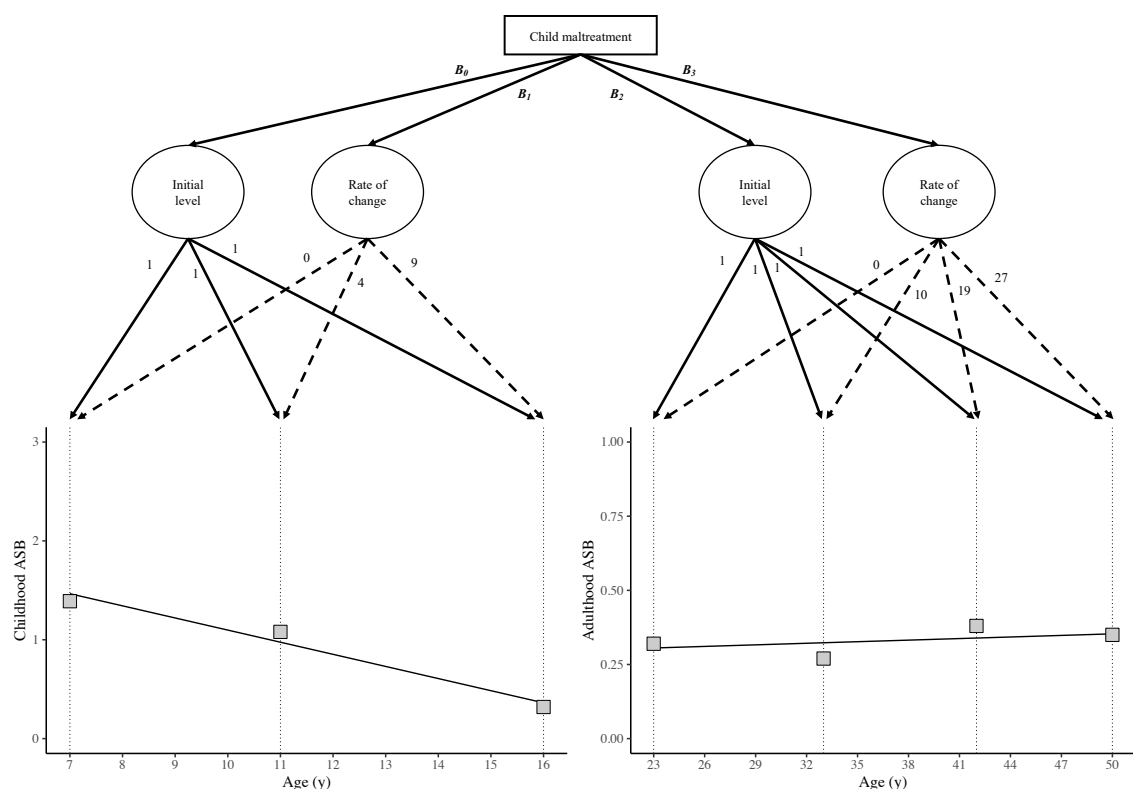


Figure 6.2. Initial levels and rates of change in antisocial behaviour across childhood (7–16y) and adulthood (23–50y).

Observed mean values of antisocial behaviour (squares) and model-fitted linear changes (black lines) are represented. The initial level (intercept), rate of change (slope), and their loadings are indicated (rate of change loadings equal distance in years from the first measurement of antisocial behaviour in childhood (7y) and in adulthood (23y)). Coefficients (B_{0-3}) estimate the associations between child maltreatment and initial levels and rates of change in antisocial behaviour and are reported in Table 6.4. ASB = antisocial behaviour; y = years.

Figure 6.3 and Tables 6.4 and 6.5 show mean differences in initial levels and rates of change in antisocial behaviour by child maltreatment. Initial levels indicate whether child maltreatment is associated with higher levels of antisocial behaviour at 7y during childhood and at 23y during adulthood. Rate of change indicates whether these associations change over time.

Neglect was associated with higher levels of antisocial behaviour at 7y (B_0 : 0.493; SE: 0.051; $p < .001$), where antisocial behaviour was 35% higher in individuals who were neglected versus not neglected. Although this association persisted across childhood, it significantly decreased over time as neglect was also associated with a steeper rate of change (B_1 : -0.018; SE: 0.006; $p = .007$). Emotional abuse was not associated with antisocial behaviour at 7y but was associated with a shallower rate of change (B_1 : 0.015; SE: 0.006; $p = .010$). This meant that by 16y emotional abuse was associated with higher levels of antisocial behaviour. There was some evidence that sexual abuse followed a similar pattern. Physical abuse was associated with higher levels of antisocial behaviour at 7y (B_0 : 0.239; SE: 0.060; $p < .001$), and this association did not significantly change across childhood. Childhood antisocial behaviour was therefore 16% higher in individuals who were physically abused compared to individuals who were not physically abused.

All types of child maltreatment were associated with higher levels of antisocial behaviour at 23y and these associations did not significantly change across adulthood. As a result, adulthood antisocial behaviour was: 50% higher in individuals who were neglected versus not neglected, 80% higher in individuals who were emotionally abused versus not emotionally abused, 75% higher in individuals who were physically abused versus not physically abused, and 118% higher in individuals who were sexually abused versus not sexually abused.

The number of maltreatment types was associated with higher levels of antisocial behaviour (Figure 6.4). Each additional type of child maltreatment corresponded to a 12% increase in antisocial behaviour during childhood (B_0 : 0.173; SE: 0.024; $p < .001$) and a 51% increase in antisocial behaviour during adulthood (B_3 : 0.137; SE: 0.014; $p < .001$). These associations did not significantly change across childhood or adulthood.

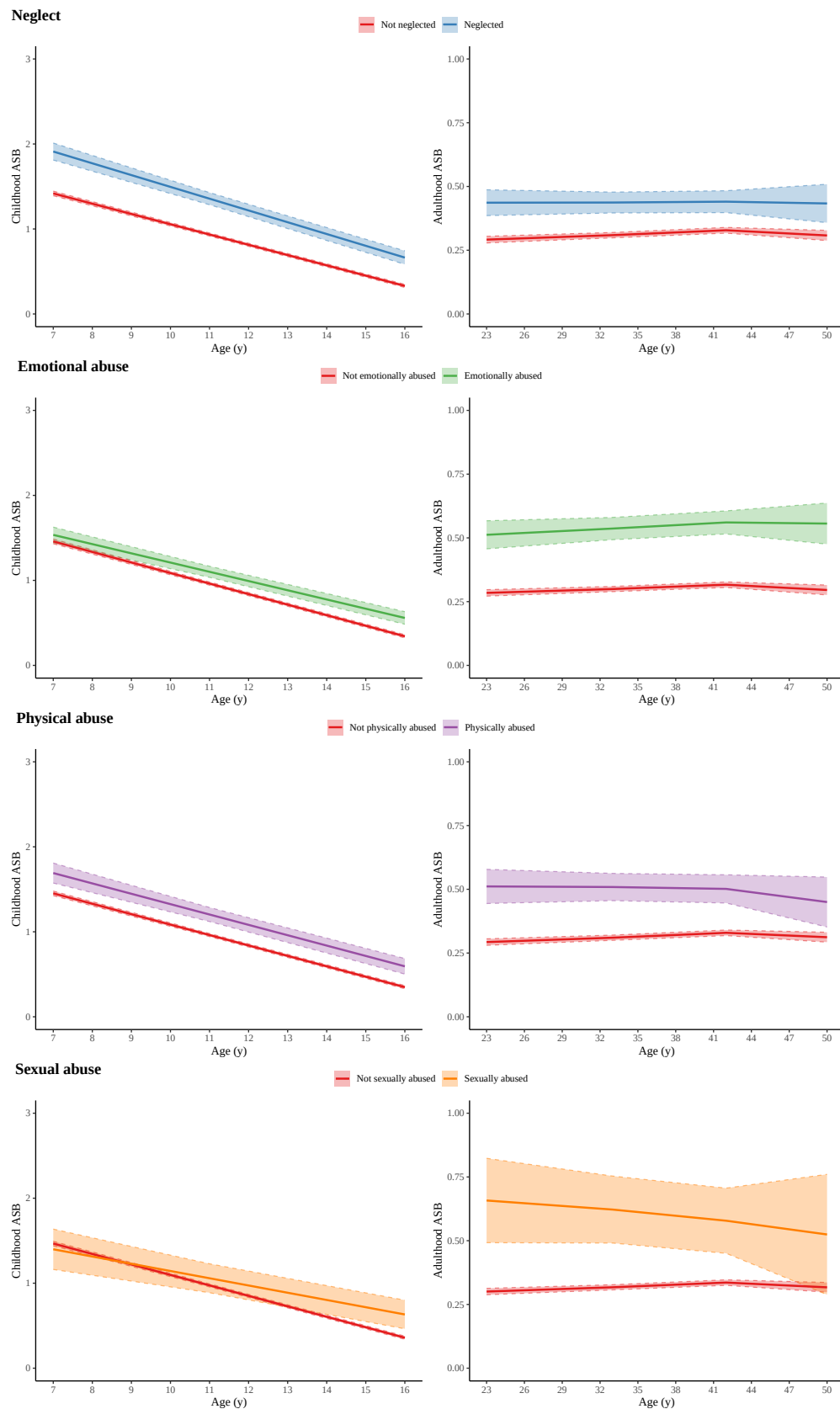


Figure 6.3. Mean difference in initial level and rate of change in antisocial behaviour across childhood (7–16y) and adulthood (23–50y), by child maltreatment.

Measures of antisocial behaviour are different for childhood (range: 0–6) and adulthood (range: 0–3). ASB = antisocial behaviour; y = years.

Table 6.4. Mean difference in initial level and rate of change in childhood antisocial behaviour, by child maltreatment.

Childhood antisocial behaviour (7–16y) ^a						
Unadjusted		Adjusted for covariates ^b		Adjusted for covariates ^b & other maltreatment types ^c		
	Initial level	Rate of change	Initial level	Rate of change	Initial level	Rate of change
Type of child maltreatment						
Neglect	0.493 (0.051) ^{***}	-0.018 (0.006) ^{**}	0.374 (0.053) ^{***}	-0.017 (0.007) [*]	0.371 (0.053) ^{***}	-0.017 (0.007) [*]
Emotional abuse	0.077 (0.046)	0.015 (0.006) [*]	0.044 (0.046)	0.013 (0.006) [*]	-0.011 (0.053)	0.015 (0.007) [*]
Physical abuse	0.239 (0.060) ^{***}	0.001 (0.008)	0.138 (0.060) [*]	0.003 (0.008)	0.141 (0.069) [*]	-0.008 (0.009)
Sexual abuse	-0.068 (0.121)	0.038 (0.014) ^{**}	-0.085 (0.120)	0.026 (0.014)	-0.144 (0.121)	0.022 (0.014)
No. of maltreatment types ^c						
0	Ref	Ref	Ref	Ref	Ref	Ref
1	0.292 (0.042) ^{***}	-0.006 (0.005)	0.212 (0.042) ^{***}	-0.005 (0.005)	n/a	n/a
2	0.281 (0.071) ^{***}	0.007 (0.009)	0.199 (0.070) ^{**}	0.007 (0.009)	n/a	n/a
3–4	0.301 (0.137) [*]	0.014 (0.017)	0.172 (0.132)	0.012 (0.018)	n/a	n/a
Per additional maltreatment	0.173 (0.024) ^{***}	0.001 (0.003)	0.121 (0.024) ^{***}	0.001 (0.003)	n/a	n/a

Notes. All coefficients are unstandardised (B (standard error)). Coefficients for childhood and adulthood antisocial behaviour are therefore not directly comparable. Initial level (i.e. intercept) represents the level of antisocial behaviour at 7y and rate of change (i.e. slope) represents linear change from 7–16y.

^a Mean (standard error) for childhood antisocial behaviour (7–16y): initial level = 1.466 (0.014); rate of change = -0.123 (0.002).

^b Includes: sex; birth weight (adjusted for sex and gestational age); maternal age at birth; maternal smoking after 4 months of pregnancy; parent divorce/separation/desertion by 7y; parent death by 7y; family contact with mental health services by 11y; family contact with crime by 11y; socioeconomic position at birth; household crowding at 7y; and housing tenure at 7y.

^c Includes neglect, emotional, physical, sexual abuse.

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 6.5. Mean difference in initial level and rate of change in adulthood antisocial behaviour, by child maltreatment.

Adulthood antisocial behaviour (23–50y) ^a						
Unadjusted			Adjusted for covariates ^b		Adjusted for covariates ^b & other maltreatment types ^c	
	Initial level	Rate of change	Initial level	Rate of change	Initial level	Rate of change
Type of child maltreatment						
Neglect	0.145 (0.026) ^{***}	-0.002 (0.001)	0.096 (0.028) ^{***}	-0.001 (0.001)	0.090 (0.028) ^{***}	-0.001 (0.001)
Emotional abuse	0.228 (0.028) ^{***}	0.001 (0.001)	0.201 (0.030) ^{***}	0.001 (0.001)	0.156 (0.034) ^{***}	0.003 (0.002)
Physical abuse	0.218 (0.034) ^{***}	-0.002 (0.002)	0.191 (0.036) ^{***}	-0.002 (0.002)	0.070 (0.042)	-0.003 (0.002)
Sexual abuse	0.357 (0.084) ^{***}	-0.006 (0.004)	0.277 (0.090) ^{**}	-0.006 (0.004)	0.171 (0.091)	-0.006 (0.004)
No. of maltreatment types ^c						
0	Ref	Ref	Ref	Ref	Ref	Ref
1	0.152 (0.021) ^{***}	0.000 (0.001)	0.126 (0.023) ^{***}	0.001 (0.001)	n/a	n/a
2	0.263 (0.042) ^{***}	-0.001 (0.002)	0.228 (0.044) ^{***}	-0.001 (0.002)	n/a	n/a
3–4	0.400 (0.086) ^{***}	-0.005 (0.004)	0.321 (0.089) ^{***}	-0.004 (0.004)	n/a	n/a
Per additional maltreatment	0.137 (0.014) ^{***}	-0.001 (0.001)	0.115 (0.015) ^{***}	0.000 (0.001)	n/a	n/a

Notes. All coefficients are unstandardised (B (standard error)). Coefficients for childhood and adulthood antisocial behaviour are therefore not directly comparable. Initial level (i.e. intercept) represents the level of antisocial behaviour at 23y, and rate of change (i.e. slope) represents linear change from 23–50y.

^a Mean (standard error) for adulthood antisocial behaviour (23–50y): initial level = 0.306 (0.006); rate of change = 0.002 (0.000).

^b Includes: sex; birth weight (adjusted for sex and gestational age); maternal age at birth; maternal smoking after 4 months of pregnancy; parent divorce/separation/desertion by 7y; parent death by 7y; family contact with mental health services by 11y; family contact with crime by 11y; socioeconomic position at birth; household crowding at 7y; and housing tenure at 7y.

^c Includes neglect, emotional, physical, sexual abuse.

* $p < .05$; ** $p < .01$; *** $p < .001$.

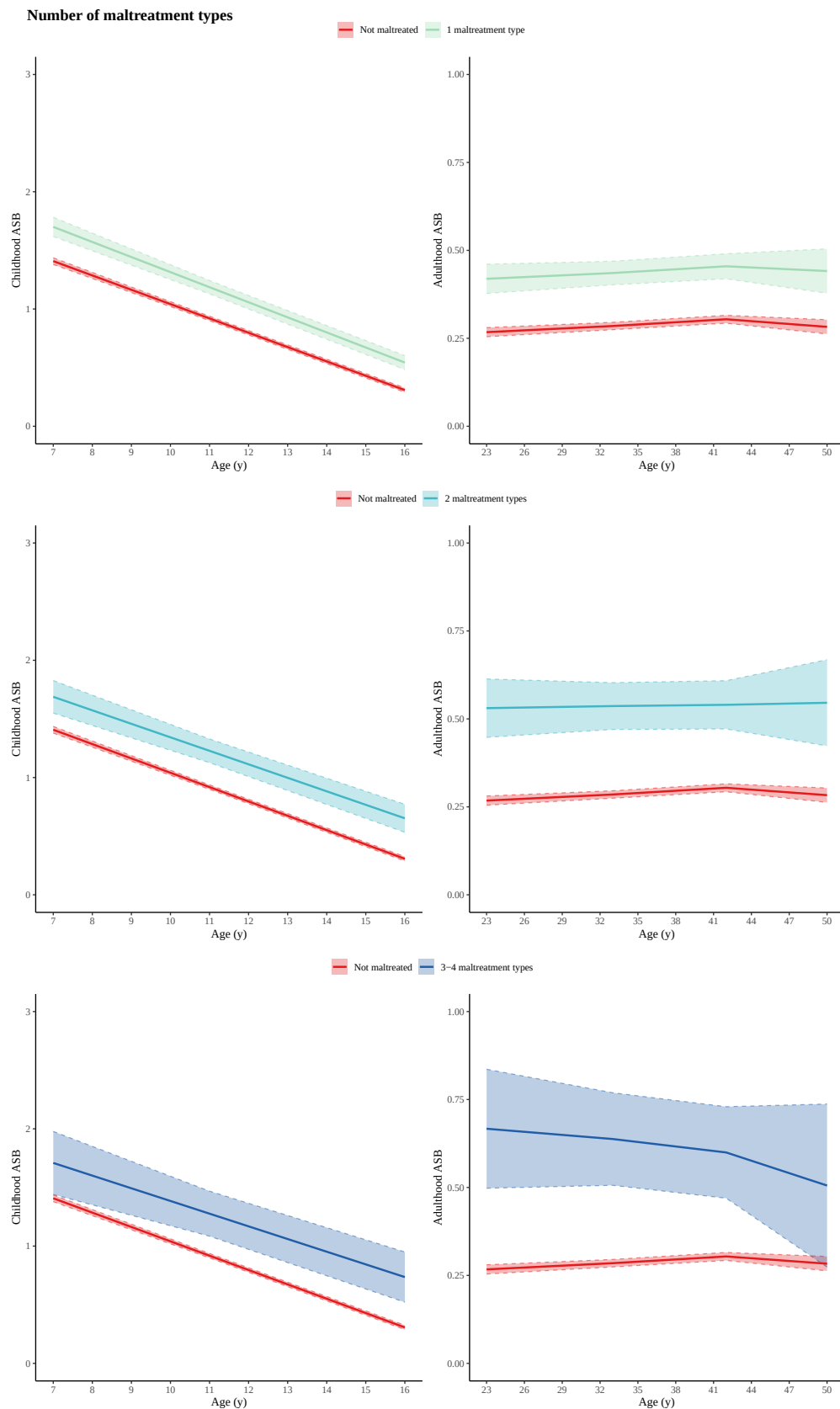


Figure 6.4. Mean difference in initial level and rate of change in antisocial behaviour across childhood (7–16y) and adulthood (23–50y), by number of maltreatment types.

Maltreatment types include neglect, emotional, physical, sexual abuse. Measures of antisocial behaviour are different for childhood (range: 0–6) and adulthood (range: 0–3). ASB = antisocial behaviour; y = years.

Adjusting for covariates attenuated, but did not significantly affect, associations for neglect, emotional and physical abuse. For example, the difference in antisocial behaviour at 7y between neglected and non-neglected individuals reduced from 35% (B_0 : 0.493; SE: 0.051; $p < .001$) to 19%. (B_0 : 0.374; SE: 0.053; $p < .001$). Covariate adjustments did significantly affect the association between sexual abuse and rate of change in antisocial behaviour across childhood (B_1 : 0.026; SE: 0.014; *ns*). Adjusting for covariates and other types of maltreatment also attenuated associations, and only significantly affected the association between physical abuse and levels of antisocial behaviour across adulthood (B_2 : 0.070; SE: 0.042; *ns*; see Table 6.5 and Appendix G Figure G.1).

6.5 Discussion

This chapter uses a large, population-based cohort to investigate whether child maltreatment is associated with a persistent and elevated stable risk of antisocial behaviour from childhood (7y) into mid-life (50y). Child maltreatment was associated with a persistent risk of antisocial behaviour across the life-course, independently of other potentially confounding factors. Antisocial behaviour was 16%–35% higher during childhood and 50%–118% higher during adulthood in individuals who were maltreated. This increased risk of antisocial behaviour was mostly stable over time as there was limited evidence that child maltreatment was associated with within-person rates of change. These results indicate that individuals who are maltreated face a persistent and elevated stable risk of antisocial behaviour throughout their lives.

The chapter's longitudinal analysis of a nationally representative UK sample highlights the long-reaching impacts of child maltreatment. I found that child maltreatment was associated with an increased risk of antisocial behaviour from childhood (7y) to adulthood (50y), and this risk was independent of a range of biological, family, and social characteristics. This evidence for a persistent risk of antisocial behaviour is consistent with previous studies, which have demonstrated that child maltreatment is associated with antisocial behaviour in early adulthood (Braga et al., 2018). It is also consistent with studies showing that child maltreatment is associated with an increased risk of poor mental and physical health outcomes, even into the fifth decade of life (Archer, Pinto Pereira, & Power, 2017; Kisely et al., 2018). Unlike previous studies however, I used latent growth curve modelling to directly investigate the association between child maltreatment and within-person change to determine whether the risk of antisocial behaviour changed over time (see Chapter 5). I found limited evidence to suggest that the risk of antisocial behaviour changed across the life-course, neither improving or deteriorating with time. Instead there was evidence that the association between child maltreatment and antisocial behaviour was stable over time. These observations demonstrate the long-lasting burden of child maltreatment, and from a clinical and policy perspective, highlight the importance of longer-term support; extending interventions beyond the childhood period to include adulthood.

I also identified sub-groups that were particularly at risk of antisocial behaviour. After con-

trolling for other maltreatment types, individuals who were neglected or emotionally abused were most consistently at risk of antisocial behaviour throughout their lives. Although much research has focused on the relationship between physical abuse and antisocial behaviour (the ‘cycle of violence’ (Widom, 2017)), this finding points towards neglect and emotional abuse as the driving risk factors. This indicates that a simple social learning mechanism, where individuals model behaviours that they observe, cannot fully explain the relationship between child maltreatment and antisocial behaviour (Bandura, 1978, see Chapter 1 Section 1.4.2.1). It also adds to a growing body of evidence documenting the harms associated with neglect and emotional abuse (Kisely et al., 2018; Norman et al., 2012; Vachon, Krueger, Rogosch, & Cicchetti, 2015). When looking at the number of maltreatment types, I found a dose-response relationship — individuals who experienced more types of maltreatment had higher levels of antisocial behaviour. This is particularly important given that maltreatment subtypes tend to co-occur (Dong et al., 2004), suggesting that individuals who have experienced multiple types of maltreatment may be at the greatest risk. This observation echoes well-replicated findings on adverse childhood experiences (ACEs), which shows that the number of ACEs rather than the type of experience is the main predictor of poor health outcomes (Felitti et al., 1998; Hughes et al., 2017). Together this evidence highlights the importance of recognising the equivalence of harms for all types of maltreatment, and that shifting a focus to multiple maltreatment types and/or specific combinations of maltreatment types may be a more helpful approach for guiding public health and clinical intervention.

Despite this chapter having many strengths, there are also several limitations to consider. First, I primarily ascertained child maltreatment using retrospective (45y) self-report as only prospective measures of childhood neglect were available. Measuring child maltreatment is plagued with research challenges, and each method of ascertainment has its limitations. For example, relying on official reports of maltreatment underestimate true prevalence while there are concerns surrounding the validity and reliability of using retrospective self-report (Colman et al., 2016; Fergusson, Horwood, & Nagin, 2000; Widom, Raphael, & DuMont, 2004). In addition, I found that the prospective measure of neglect was more strongly associated with antisocial behaviour in childhood compared to adulthood, and associations for retrospectively

reported child maltreatment were generally stronger for antisocial behaviour in adulthood compared to childhood. This may indicate that proximity in time between when child maltreatment and antisocial behaviour were measured may be confounding these associations and potentially over-estimating true relationships.

Second, because this study aimed to comprehensively examine change in antisocial behaviour across the life-course I selected measures for antisocial behaviour that were consistently collected. The measure used for childhood antisocial behaviour is in line with conventional indicators for antisocial behaviour (e.g. “fights other children”) yet may be confounded with childhood maltreatment as it is based on parental report (i.e. an emotionally abusive parent may be more likely to report that their child is disobedient). The measure used for adulthood antisocial included less conventional indicators for antisocial behaviour (e.g. “things often get on your nerves”). This measure may also capture other types of psychopathology, such as depression, but I tested the validity of these measures of antisocial behaviour and found they were highly correlated with externalising behaviour and criminality. I was also unable to model the full longitudinal course of antisocial behaviour from 7y to 50y due to differences in the measures of childhood and adulthood antisocial behaviour. These differences meant that childhood and adulthood antisocial behaviour were modelled separately. As a result, I could not analyse the period between 16y and 23y, or directly compare the stability of the association between child maltreatment and antisocial behaviour across childhood (7–16y) and child maltreatment and antisocial behaviour across adulthood (23–50y). This highlights the need for longitudinal studies to harmonise data collection and take consistent measures over time.

Third, though respondents in mid-adulthood were generally representative of the surviving cohort (Atherton et al., 2008), it is likely that individuals who were maltreated and/or who are severely antisocial have been lost to follow-up. For example, the prevalence of neglect was under-represented in the included study sample (9.5%) compared to the complete sample from the 1958 British birth cohort (12.5%). However, previous work on potential attrition bias relating to child maltreatment in this cohort suggests that effects are negligible for associations with mental health at 50 years (Geoffroy, Pinto Pereira, Li, & Power, 2016). I also addressed missing data by following current guidelines for multiple imputation (Enders, 2010; Little &

Rubin, 2014). Nevertheless, it is possible that a bias still exists and that reported associations are conservative estimates for the child maltreatment-antisocial behaviour relationship. Fourth, even though I adjusted associations for several biological, family and social characteristics, I cannot rule out the role of residual confounding. Fifth, due to the overlapping temporal order between the measures of child maltreatment (0–16y) and childhood antisocial behaviour (7–16y), I also cannot rule out reverse causation. Finally, the analyses are unable to determine causality but only point towards a probabilistic relationship between child maltreatment and antisocial behaviour across the life-course.

6.6 Conclusions

In conclusion, the chapter's results provide longitudinal evidence that child maltreatment is associated with a persistent and elevated stable risk of antisocial behaviour across a 50-year period. Thus, the findings help to extend the existing literature by directly addressing RQ2 (cf. Chapter 5), and establishing that, at the individual level, the risk of antisocial behaviour following child maltreatment did not significantly change over time in this nationally representative UK sample. Future research should aim to replicate these findings using other cohort studies and additional poor health outcomes. Meanwhile, it is important to not underestimate the long-reaching impacts of child maltreatment when considering the burden of child maltreatment on individuals and societies. In order to begin to reduce this burden, clinicians and policy-makers should aim to provide long-term support for individuals who are maltreated, including supporting older adults who may have experienced maltreatment as a child.

Chapter 7 General discussion

7.1 Summary of the thesis

This thesis aimed to investigate whether the risks associated with child maltreatment have changed over time in the UK. I used a unique socioecological approach and epidemiological research methods to examine changing risks at the societal and individual level. In order to examine risk at the societal level, I systematically developed a novel data source on the national incidence of child maltreatment (Chapter 3), and then used this data source to analyse long-term trends in child maltreatment from 1858 to 2016 (Chapter 4). In order to examine risk at the individual level, I systematically reviewed the existing longitudinal evidence on the relationship between child maltreatment and antisocial behaviour (Chapter 5), and then analysed 50 years of longitudinal data from the British birth cohort study to establish whether the impacts of child maltreatment on the risk of antisocial behaviour change across an individual's life-course (Chapter 6).

7.1.1 Has the societal risk of child maltreatment changed over time?

Chapter 3 addressed the lack of useable data on incidence of child maltreatment by systematically searching for existing routinely collected data on child maltreatment in the UK. Searches identified six sources of official record data: Mortality Statistics, Homicide Index, Criminal Statistics, Child Protection Statistics, Children In Care Statistics, and NSPCC Statistics. I manually extracted, digitalised, and harmonised these data over time to develop a rich data source on the incidence of child maltreatment over time from 1858 to 2016 (the iCoverT data source; Degli Esposti, Taylor, Humphreys, & Bowes, 2018a, 2018b). The iCoverT extends current data sources by over 80 years and includes multiple indicators of child maltreatment, adding significant complexity to our ability to estimate the incidence of child maltreatment and investigate changes over time. In addition, the process of developing the iCoverT identified a number of definitional, legal, organisational, and structural changes over time (Appendix A Table A.3), as well as substantial variation in the number of victims and perpetrators of child maltreatment

depending across years (Chapter 3 Table 3.4).

Chapter 4 quantitatively analysed data from the iCoverT to examine whether the risk of child maltreatment changed over time. Specifically, I used quasi-Poisson regression and generalised additive models with penalised regression splines to determine whether long-term trends in child maltreatment have increased or decreased from 1858 to 2016. Results showed that the overall risk of child maltreatment has decreased since the 1850s, independently of changing population size, age-structure, and changes that may have affected the consistency of the data over time (e.g. definitional changes). However, these decreases over time were non-linear and results also showed more recent increases in the risk of child maltreatment since 2000. In addition, trends varied depending on the maltreatment indicator, age of the victim, and type of child maltreatment. For example, overall decreases were more pronounced in younger victims (e.g. infant deaths (<1 year)) but there was limited evidence for overall decreases in older victims (e.g. adolescent deaths (15–19 years)). Between 1988 and 2016, there were significant decreases in child protection registrations for physical and sexual abuse whereas large increases in child protection registrations for neglect and emotional abuse.

Chapters 3 and 4 thus found that the societal risk of child maltreatment has significantly changed over time. Although these changes depend on the measurement method, victim's age, and the type of child maltreatment, long-term trends indicate that overall the risk of child maltreatment has decreased since the 1850s. More recent trends suggest a potentially increasing risk of child maltreatment since 2000.

7.1.2 Does the risk of antisocial behaviour following child maltreatment change across an individual's life-course?

Chapter 5 systematically reviewed the existing, prospective longitudinal evidence on the relationship between child maltreatment and antisocial behaviour across the life-course. Searches identified 23 relevant studies but only three studies used longitudinal analytical methods to analyse within-person change in antisocial behaviour over time. I quantitatively synthesised the current evidence by carrying out three separate meta-analyses on the associations between child maltreatment and antisocial behaviour in childhood, adolescence, and adulthood. The meta-

analytic results showed that child maltreatment was significantly associated with increased levels of antisocial behaviour in all three developmental periods. However, this cross-sectional evidence was unable to answer whether the increased risk of antisocial behaviour following child maltreatment changed across the life-course.

Chapter 6 investigated the changing risk following child maltreatment by empirically testing whether child maltreatment is associated with a persistent and stable risk of antisocial behaviour across the life-course. The chapter longitudinally analysed 50 years of data from the 1958 British birth cohort study, including retrospective and prospective measures of child maltreatment and repeated measures of antisocial behaviour from 7 to 50 years old. Latent growth curve analyses found that child maltreatment was associated with higher levels of antisocial behaviour independently of other potentially confounding factors, but there was limited evidence that child maltreatment was also associated with within-person rate of change in antisocial behaviour. As a result, child maltreatment was associated with a persistent and elevated stable risk of antisocial behaviour from 7 to 50 years old. Individuals who experienced multiple types of maltreatment were at the greatest risk of antisocial behaviour and, after controlling for the maltreatment co-occurrence, individuals who were neglected and emotionally abused were most consistently at risk of antisocial behaviour throughout their lives.

Chapters 5 showed that child maltreatment is associated with antisocial behaviour across different developmental periods, and identified a lack of longitudinal evidence. Although the cross-sectional meta-analyses in this chapter suggested that the impact of child maltreatment on the risk of antisocial behaviour might be smaller in adulthood compared to childhood, these analyses were unable to directly address this research question. Chapter 6 on the other hand, was able to address changing risk across an individual's life-course, and found that the risk of antisocial behaviour following child maltreatment did not diminish with time. Such evidence underlines the long-reaching impact of child maltreatment, affecting an individual even up to 50 years after their maltreatment experience.

7.1.3 Changing risks over time

The research described in this thesis provides evidence that the risk of child maltreatment in the UK has changed over time, while the risk of antisocial behaviour following child maltreatment is stable across an individual's life-course. Although the results show a significant reduction in the national incidence of child maltreatment, the results also identify some potentially concerning recent trends at the societal level, especially for neglect and emotional abuse and for adolescent victims. At the individual level, this thesis finds that the impact of child maltreatment on the risk of antisocial behaviour is stable and can persist over 50 years. Overall, this evidence highlights the high potential burden of child maltreatment on societies and individuals, and demonstrates the importance of time when researching the risks associated with child maltreatment.

7.2 Originality of the research

Each of the four empirical chapters make an original contribution to child maltreatment research (Chapters 3 – 6). Chapter 3 describes a novel adaptation of systematic review methodology to harness pre-existing routinely collected data and develop a data source suitable for research. This approach addresses the lack of data on the incidence of child maltreatment by responding to calls to better use routinely collected data (Bain, Chalmers, & Brewster, 1997; Drake & Jonson-Reid, 1999; Humphreys & Smith, 2013; Jorm, 2015; Leeb, Paulozzi, Melanson, Simon, & Arias, 2008). The methods used in Chapter 3 have been meticulously and transparently documented, and can therefore be replicated across different fields (Degli Esposti, Taylor, et al., 2018b). In addition to these methods, Chapter 3 presents a newly developed data source on the incidence of child maltreatment over time in England and Wales (the iCoverT). The iCoverT spans from 1858 to 2016, and includes six unique sources of data, 272 variables, and over 43,500 data points. The iCoverT data source is freely available online for future child maltreatment research (Degli Esposti, Taylor, et al., 2018a).

Chapter 4 describes an observational study that examines long-term trends in child maltreatment. This study makes the following original contributions. First, it uses eight indicators from six separate sources of official record data (Degli Esposti, Taylor, et al., 2018b). Most studies are limited to using only one data source to examine trends in child maltreatment (Gonzalez-Izquierdo et al., 2014; Hardelid, Davey, Dattani, & Gilbert, 2013; Pritchard & Sharples, 2008; Pritchard & Williams, 2010; Sidebotham, 2014; Sidebotham, Atkins, & Hutton, 2012). Second, the study extends previous research by analysing over 80 years of previously unused data (Bentley et al., 2018; Gilbert et al., 2012). Third, a time series analysis of these data found that there have been overall decreases in the incidence of child maltreatment since the 1850s, particularly for violent child deaths and crimes against children. The analysis also found evidence for increasing trends across all indicators since 2000, and identified diverging trends for different age groups and types of child maltreatment. These findings help to explain why the existing evidence on maltreatment trends was mixed and inconclusive (Gilbert et al., 2012, see below for more details).

Although reviews have since investigated the relationship between child maltreatment and antisocial behaviour across the life-course (Braga, Cunha, & Maia, 2018; Braga, Gonçalves, Basto-Pereira, & Maia, 2017; Malvaso, Delfabbro, & Day, 2016), the systematic review and meta-analysis presented in Chapter 5 was the first. At the time of designing the systematic review [PROSPERO 2015: CRD42015029515], it was novel in two main ways: (i) adopted previous recommendations and synthesised evidence from well-designed prospective longitudinal studies (Malvaso, Delfabbro, & Day, 2018; Thornberry, Knight, & Lovegrove, 2012); and (ii) examined whether child maltreatment was associated with an increased risk of antisocial behaviour across the life-course. The results of the systematic review highlighted a lack of longitudinal evidence modelling within-person change in antisocial behaviour across the life-course. The results of the meta-analysis added to the literature by showing that child maltreatment conferred significant risk of antisocial behaviour in childhood, adolescence, and adulthood. These results have been replicated in subsequent reviews (Braga, Cunha, & Maia, 2018; Braga, Gonçalves, Basto-Pereira, & Maia, 2017; Malvaso, Delfabbro, & Day, 2016).

Chapter 6 describes a longitudinal analysis of the relationship between child maltreatment and antisocial behaviour from 7 to 50 years old. This empirical investigation makes original contributions in the following ways. The study used 50 years of nationally representative data to prospectively measure child maltreatment and repeatedly measure antisocial behaviour across the life-course. Unlike existing studies (e.g. P. Cohen et al., 2001, for more references see Chapter 5), the study applies latent growth curve analysis to examine the relationship between child maltreatment and within- and between-person change, and finds that child maltreatment is associated with a persistent and elevated stable risk of antisocial behaviour. Consequently, Chapter 6 presents the novel finding that child maltreatment is associated with an increased risk of antisocial behaviour up to 50 years after the experience of maltreatment.

7.3 General strengths and limitations

The research described in this thesis has a number of important strengths and limitations. Specific study strengths and limitations are discussed in the relevant sections at the end of each empirical chapter (Chapters 3 – 6). In the following section, I will discuss the general strengths and limitations of the thesis by evaluating the research methods and approaches used across the four empirical chapters.

7.3.1 Evaluation of the research methods

As outlined in Chapter 2, throughout this thesis I used multiple measures of child maltreatment, existing sources of epidemiological data, observational study designs, and analytical methods that are sensitive to repeated measures, in order to overcome methodological challenges in child maltreatment research. I will therefore evaluate the strengths and limitations of these four methodological decisions below, followed by an overall evaluation of my epidemiological approach.

7.3.1.1 Multiple measures of child maltreatment

The main strength of using multiple measures of child maltreatment is that, when combined, multiple measures give a less biased and more accurate estimate of how many and which children are at risk (Ards et al., 2012; Dube, Williamson, Thompson, Felitti, & Anda, 2004; Hardt & Rutter, 2004; Kendall-Tackett & Becker-Blease, 2004). The multiple measures and six data sources used to estimate child maltreatment in Chapters 3 and 4 help to overcome the specific limitations and biases of each measure and offer a richer picture of child maltreatment over time (see Chapter 4 for more details). Results that are replicated across multiple measures of child maltreatment thus provide convincing, converging evidence. An additional strength of the child maltreatment measures used in Chapters 3 and 4 is that they were drawn from official records. Official records of child maltreatment have high validity and reliability, as well as containing sensitive temporal information (Everson et al., 2008; Kobulsky, Kepple, & Jedwab, 2018). Consequently, official records are well-suited to estimate the annual incidence of child maltreatment

and track changes over time.

Chapters 5 and 6 also used multiple measures of child maltreatment. The longitudinal studies reviewed by Chapter 5 used official records and parental report to ascertain the presence or absence of child maltreatment, whereas Chapter 6 used prospective parental- and teacher-report and retrospective self-report. Although there are questions surrounding the validity and reliability of retrospective self-report (Widom et al., 2004), the measures used from the 1958 British birth cohort study in Chapter 6 have been previously researched and validated (Archer, Pinto Pereira, & Power, 2017; Clark, Rodgers, Caldwell, Power, & Stansfeld, 2007; Denholm, Power, Thomas, & Li, 2013; Geoffroy, Pinto Pereira, Li, & Power, 2016). Notably, the question items asked about specific childhood experiences (e.g. ‘I was punched, kicked or hit or beaten with an object, or needed medical treatment’) in order to minimise interpretation and the re-evaluation of childhood experiences (Rosenman & Rodgers, 2006). Any self-report questions that were vague and unspecific (e.g. ‘I was neglected’) were not used.

Despite these strengths, it is important to acknowledge that Chapters 3 and 4 exclusively relied on official records, as did 22 out of the 23 studies reviewed in Chapter 5. This is a limitation because it is well-established that official records underestimate the true incidence and prevalence of child maltreatment, only capturing the ‘tip of the iceberg’ (Chang et al., 2004; Maier, Mohler-Kuo, Landolt, Schnyder, & Jud, 2013). The findings presented in Chapters 3 – 5 may therefore only apply for officially reported cases of child maltreatment rather than all cases of child maltreatment. In comparison, Chapter 6 relies exclusively on self-report as official records are not available for the 1958 British birth cohort study. Self-report is subject to measurement errors from recall biases, respondents’ subjective perception of event(s), socially desirable responding, confounding from current mood and mental health, reluctance to disclose and/or the forgetting of unwanted experiences (Hardt & Rutter, 2004). Although I chose previously validated measures that asked about specific childhood experiences (see above), relying primarily on self-report to ascertain child maltreatment is problematic and may over-estimate the association between child maltreatment and antisocial behaviour. These measurement limitations are important to consider when interpreting the results presented in this thesis.

7.3.1.2 Existing sources of epidemiological data

One of the major strengths of this thesis is its use of rich, epidemiological data from existing sources. Chapters 3 and 4 harnessed over 43,500 data points on child maltreatment that spanned from 1858 to 2016 and that covered England and Wales. Chapter 5 reviewed longitudinal studies that recruited from the general population, and Chapter 6 drew 50 years of longitudinal data from 8,088 individuals from the 1958 British birth cohort study. Therefore, the research presented in this thesis used large, nationally representative samples. Such epidemiologic data is able to provide robust, directly translatable, national-level evidence (R. Smith, 2016). What is more, this thesis responds to numerous calls to better use existing sources of data sources, with Chapter 3 proposing methods on how to systematically harness these underused data sources (Bain, Chalmers, & Brewster, 1997; Drake & Jonson-Reid, 1999; Humphreys & Smith, 2013; Jorm, 2015; Montori, Saha, & Clarke, 2004). This methodological approach can not only economically obtain a wealth of data, but can also obtain information that cannot be collected prospectively (e.g. data on the incidence of child maltreatment in 1858).

However, there are drawbacks to using pre-existing data sources. Most underused data sources are administrative and/or operational in nature and are not designed for research purposes. There may thus be obscure operational processes that may affect the quality of the data. Although I thoroughly investigated all data sources and controlled for any potential confounds (e.g. adjusting for data collection changes over time), research that is designed to answer specific questions and that prospectively collects its data is superior. Relatedly, only relying on secondary data means that it is not always possible to measure or study an area of interest. Research is instead confined to what data exist and what data are available. These limitations meant that I was unable to comprehensively research different dimensions of child maltreatment (e.g. chronicity, timing, types) as these finer-grained measures did not exist. I also faced obstacles around data availability. For example, when developing the iCoverT data source I submitted nine FOI requests to obtain some data and failed to obtain other relevant data (e.g. Hospital Episode Statistics for Admitted Patient Care in England (NHS Digital, 2017) and recent NSPCC Childline and Helpline data; see Chapter 3 for full details).

7.3.1.3 Observational study designs

The empirical research described in this thesis employed observational (i.e. non-experimental) study designs. The strengths of observational study designs are that they are often the only practical and ethical method of studying various problems, especially within child maltreatment research (Mann, 2003). In addition, specific observational studies are well-suited to address specific research questions (Centre for Evidence-Based Medicine, 2018). For instance, an observational study that analyses time series data over time is able to examine changing trends (i.e. Chapter 4), and a prospective longitudinal cohort study is able to quantify the relationship between an exposure and outcome of interest (i.e. Chapter 6). A key strength of this thesis is that I chose *a priori* the study design that was best suited to address my research questions. This is evidenced as I pre-registered a protocol for each study online (PROSPERO 2015: CRD42015029515; Degli Esposti, 2018; Degli Esposti, Pinto Pereira, & Bowes, 2018).

In addition to these study protocols, and in response to concerns about reproducibility in psychological research (Gilmore, Diaz, Wyble, & Yarkoni, 2017; Open Science Collaboration, 2015), I have systemically and transparently documented my research methods. For example, the methods used to develop the iCoverT, the iCoverT data source itself (including corresponding data documentation: Data guides, Data dictionaries and Attribution statements), and R code, have all been made freely accessible online (Degli Esposti, Taylor, Humphreys, & Bowes, 2018a, 2018b). Moving towards openness in research encourages and enables future work to interrogate, and thus potentially replicate and add to, the findings described in this thesis.

Despite these research strengths, the observational study designs used in Chapters 4 – 6 are not designed to determine causality. Unlike RCTs, observational study designs do not have a randomised control group to guard against risk of bias, such as biases due to confounding (Sterne et al., 2016). Chapter 4 mapped out long-term trends in child maltreatment, it did not examine the impact of wider secular changes or specific child protection changes on maltreatment trends. A limitation of Chapter 6 is that it cannot establish whether the increased risk of antisocial behaviour was caused by child maltreatment. Though these questions are certainly of research interest, it is important to stress that they were not the focus of this thesis.

7.3.1.4 Analysing repeated measures

Another strength of the research in this thesis is the use of statistical methods that are sensitive to repeated measures, such as time series analyses and latent growth curve modelling. Researchers often inappropriately apply statistical methods that are insensitive to repeated measures. For instance, 87% of the longitudinal studies reviewed in Chapter 5 used cross-sectional methods to analyse between-person (i.e. group) differences in antisocial behaviour. Only three out of 23 also analysed within-person change in antisocial behaviour (Flynn, Cicchetti, & Rogosch, 2014; Godinet, Li, & Berg, 2014; Stouthamer-Loeber, Loeber, Homish, & Wei, 2001)).

The data analyses outlined in Chapters 4 and 6 are advantageous in three key ways. First, the analyses do not assume that observations are independent which, when incorrect, can increase Type I errors (e.g. autocorrelation for time series data (Chapter 4)). Second, the analyses do not result in loss of information (e.g. failing to analyse within-person change in antisocial behaviour (Chapter 6)). Third, these more sensitive and advanced analytical methods are able to address new research questions that have not been tested previously (i.e. RQ1 and RQ2).

There are some limitations to using more complex analytical methods. Both time series analyses and latent growth curve modelling make several assumptions about the data that should be tested. Notably, when modelling change using latent growth curve analysis, it is important to test whether any identified change can be attributed to actual changes rather than to changes in how the measure is working (i.e. the metric) over time (Liu et al., 2017; Liu & West, 2018; Odgers et al., 2008). Although I explicitly tested this assumption of longitudinal measurement invariance (see Appendix F), it is only possible to probabilistically examine the feasibility of these assumptions. What is more, the use of complex analytical methods typically means that the output is more complex for a general medical audience to interpret. For these reasons, I supplemented the results sections in Chapters 4 and 6 with diagrams and graphs to help visualise the findings.

7.3.2 Evaluation of the overarching epidemiological approach

There are key strengths to the overarching epidemiological approach I have used in this thesis. First, I used multiple measures of child maltreatment to better estimate how many and which children are at risk. Second, each empirical study used large, nationally representative samples that are able to provide translatable national-level evidence. Third, I harnessed underused sources of data to develop a novel and rich data source of child maltreatment over time. Fourth, at all stages I have systematically used and documented my research methods, embodying open science. Fifth, I have used study designs and advanced statistical methods to address my research questions and appropriately analyse repeated measures.

There are also a handful of overall limitations. First, there is no ‘gold standard’ for measuring child maltreatment. The measures used in each chapter have their own biases and drawbacks (see the discussion sections of Chapters 3 – 6 for more details). Second, using secondary data from pre-existing data sources restricts research to what data are available, and these data tend to be poorer quality than data that are prospectively collected for specific research questions. Third, observational study designs are unable to control for bias and confounding as well as RCTs. The empirical research in this thesis is thus unable to address causality. Fourth, advanced statistical methods give more complex results that can be difficult to interpret, especially for a general medical audience.

7.4 Implications for research

7.4.1 Trends in child maltreatment

The literature on trends in child maltreatment in the UK is limited and inconclusive (see Chapter 1 Section 1.3; see also Gilbert et al., 2012). Chapter 4 extends the current evidence by using multiple measures of child maltreatment to map out trends over 150 years, and identified sustained decreases in child mortality, adults guilty of crimes against children, children entering care, and children helped by the NSPCC. This provides strong evidence that long-term trends in child maltreatment have decreased and is consistent with previous studies documenting decreases in violent child deaths since the 1970s (Pritchard & Sharples, 2008; Sidebotham, 2014; Sidebotham, Atkins, & Hutton, 2012). However, Chapter 4 also finds that crimes against children and child protection statistics have increased since 2000. These results help to reconcile and explain why, despite most scientific evidence showing sustained decreases, there are concerns that child maltreatment are increasing (Bentley et al., 2018, 2017; Independent, 2018). Future research should aim to determine whether these recent increases reflect an increasing problem or improvements in recognising and responding to child maltreatment.

7.4.2 Burden of child maltreatment

There is accumulating evidence for the long-lasting burden of child maltreatment on individuals (Gilbert, Widom, et al., 2009). Chapter 5 further demonstrates that the association between child maltreatment and antisocial behaviour endures into adolescence and adulthood (Braga, Cunha, & Maia, 2018; Braga, Gonçalves, Basto-Pereira, & Maia, 2017), whilst Chapter 6 adds to the increasing number studies showing that child maltreatment is associated with poor physical and mental health outcomes even into the fifth decade of life (Archer, Pinto Pereira, & Power, 2017; Clark, Caldwell, Power, & Stansfeld, 2010; Geoffroy, Pinto Pereira, Li, & Power, 2016; Kisely et al., 2018). Furthermore, Chapter 6 found that this risk of antisocial behaviour is stable and persistent, and thus does not ameliorate with time or as individuals age. Current evaluations may therefore underestimate the social and economic burden of child maltreatment

by underestimating the long-lasting impacts of child maltreatment (Conti et al., 2017). Together, these results highlight the high burden of child maltreatment, and the importance of providing long-term support for individuals who have experienced maltreatment as a child.

7.4.3 Types of child maltreatment

Of the four widely recognised types of child maltreatment — physical abuse, sexual abuse, emotional abuse, and neglect (Leeb et al., 2008) — physical and sexual abuse have attracted the most attention within research (Behl, Conyngham, & May, 2003; Vachon, Krueger, Rogosch, & Cicchetti, 2015; Wolock & Horowitz, 1984). Studies focusing on physical abuse have particularly dominated antisocial behaviour research due to the seminal ‘cycle of violence’ hypothesis (see Chapter 5; Widom, 1989a). Despite this, emotional abuse and neglect emerged as important types of child maltreatment across the empirical chapters. In Chapter 4, substantial increases in the number of emotional abuse and neglect cases were driving the overall increases in the number of registrations to the child protection register as the number of physical and sexual abuse cases decreased over time. In Chapter 6, emotional abuse and neglect were most consistently associated with antisocial behaviour across the life-course. Both observations are in line with a growing body of evidence on, and an increasing recognition for, the harms associated with emotional abuse and neglect (Kisely et al., 2018; Norman et al., 2012; Rutter, O’Connor, & English and Romanian Adoptees Study Team, 2004; Vachon, Krueger, Rogosch, & Cicchetti, 2015).

7.4.4 Investigating changing risks over time

The role of time is often ignored in child maltreatment research (Chapter 1). This thesis draws attention to this neglected area of research and shows that investigations of changing risk over time can shed new light on, and provide additional evidence for, better understanding child maltreatment. A recurring difficulty when investigating changing risks was ensuring that the data were consistent over time. I had to develop systematic methods to extract and harmonise the routinely collected data to examine trends over time (Chapters 3 and 4). I also had to identify equivalent repeated measures of antisocial behaviour to be able to analyse risk across

the life-course. These processes highlighted the critical value of consistent data collection for research. Although the UK has a rich history of collecting epidemiological data from administrative sources and the British birth cohort studies, these data collection processes and the measures used were not always consistent or comparable over time. Such changes limit the utility of data. For example, in the 1958 British birth cohort study antisocial behaviour was measured differently during childhood (7–16 years) and adulthood (23–50 years), and this prevented me from comparing and analysing the stability of risk across the full life-course (see Chapter 6). Research should therefore aim to harmonise data collection and use consistent measures to maximise the utility and potential of data.

7.5 Implications for policy and practice

This thesis demonstrates that child maltreatment continues to be a pressing issue in the UK since it is associated with a long-lasting burden at both the societal and individual level. Child maltreatment should thus remain a public health priority. In addition, each chapter provides the following implications for policy and practice.

Chapter 3 highlights the importance of routinely collecting administrative data on child mortality, maltreatment-related crimes, and child protection activity. It demonstrates that these data collected by the UK Government can be used as a rich resource for research, as well as a public health surveillance tool (Degli Esposti, Taylor, et al., 2018b). Future policies should ensure that these invaluable data sources continue to be collected going forward, whilst future recording practices should ensure that the high quality of these data are maintained. Furthermore, policies and practices should acknowledge that while adapting to changing needs is of course crucial for child protection, the consistency of data collection and recording practices over time should also be considered as unnecessary changes can undermine the reliability, and thus utility, of the data.

Chapter 4 has a number of important implications for policy and practice. Most notably this chapter describes the current risk of child maltreatment in the UK, how risks have changed over time, and identifies particularly vulnerable populations. The results show an increase in rates of child maltreatment since the 2000s, especially for neglect and emotional abuse. For example, between 1988 and 2016 the rates of child protection registrations increased by 782% for neglect and by 2282% for emotional abuse. As a result, neglect and emotional abuse are now the most common reasons for placing a child on the child protection register. Policies should respond to this finding by increasing the amount of funding and resources dedicated to these types of child maltreatment, and child protection practices should make sure that they are well-equipped to identify and support children who have experienced neglect and/or emotional abuse. Chapter 4 also finds that adolescents are particularly vulnerable. In 2016, adolescents were most likely age group to die by homicide yet they were the least likely to be placed on the child protection register. This discrepancy between risk and protection should be noted by policy-makers and

practitioners as it suggests that child protection services may be failing to help these older children who are facing serious immediate harm.

Chapter 5 identifies a lack of well-designed prospective longitudinal evidence on the relationship between child maltreatment and antisocial behaviour. Despite a wealth of longitudinal cohort studies in the UK (e.g. 1958 British birth cohort study), my systematic review did not find a UK study that satisfied my inclusion criteria. The majority of the evidence instead came from US, with a few studies also coming from Australia. This underlines the continued need for high-quality epidemiological evidence in the UK. Future policies should make it a priority to fund and support the maintenance and analysis of existing British birth cohort studies (e.g. CLOSER, 2018), as well funding a new wave of birth cohort studies, so that researchers have the resources to address important questions on the distribution and causes of diseases; in turn helping to prevent and respond to illness in the UK (see “Chapter 1. What is epidemiology? [Editorial]”, 2018).

Chapter 6 found that older adults (aged 50 years) may still be vulnerable following childhood experiences of maltreatment. This was particularly true for older adults who experienced multiple types of maltreatment, neglect and/or emotional abuse. These findings add to a growing body of evidence emphasising that the life-long burden of child maltreatment (including neglect and emotional abuse) should not be underestimated (e.g. Kisely et al., 2018). In order to begin to reduce this burden on individuals and societies, clinicians and policy-makers should aim to provide immediate and long-term support for at-risk populations, as well as tailor interventions for older adults who experienced maltreatment during their childhoods.

7.6 Future directions

Child maltreatment should remain a research priority. The findings from this thesis suggest that future research should: (a) further develop and maintain rich data sources on child maltreatment; (b) explore recent trends and establish whether child maltreatment is increasing, especially for adolescents and for emotional abuse and neglect; (c) evaluate macro-level causes affecting the rates of child maltreatment (e.g. national-level changes to child protection); (d) extend the current evidence on the life-time risks following child maltreatment; and (e) develop effective interventions for victims of child maltreatment, including older adults.

Through the development of the iCoverT data source, this thesis goes some way to address the need for better epidemiological data on child maltreatment (World Health Organization, 2006). However, additional sources of epidemiological data on child maltreatment are still needed. For example, the iCoverT provides UK estimates for the incidence but not for the prevalence of child maltreatment. Two NSPCC funded studies have carried out large, nationally representative surveys to estimate the prevalence of child maltreatment in the UK in 1998 and 2009 (May-Chahal & Cawson, 2005; Radford et al., 2011; Radford, Corral, Bradley, & Fisher, 2013). In line with current research in the US (e.g. Finkelhor et al., 2010), future research in the UK should replicate these surveys to also be able to compare prevalence rates over time and examine changing trends and characteristics of child maltreatment. One of the benefits of these surveys is its ability to collect more detailed information about victim characteristics (e.g. age-groups) and types of child maltreatment (e.g. emotional abuse and neglect). These prevalence data would supplement the incidence data, and thus help to establish if and how child maltreatment is changing.

In addition to developing new data sources, it is also important to maintain and update existing data sources on child maltreatment, such as the iCoverT. Because all methods and data were transparently documented and are openly available, this encourages future research to use this data source and also enables its future maintenance. Updating and tracking these incidence estimates going forward will be an invaluable public health tool for monitoring child maltreatment and evaluating the progress of child protection. Time series data, like regularly collected

incidence rates, are well-suited to examine causal factors via quasi-experimental study designs. For example, interrupted time series regressions are able to evaluate the impact of specific legalisation changes or high-profile scandals (e.g. Baby P, Jimmy Saville (Chapter 1 Section 1.2.2)) on the incidence of child maltreatment (Bernal, Cummins, & Gasparrini, 2017; Hyndman & Athanasopoulos, 2018). Such investigations would help to identify what factors may be driving trends, evaluate the effectiveness of public health interventions, and improve child protection at the national-level.

Future research should aim to extend the current evidence on the life-time risks following child maltreatment. This thesis demonstrates the long-lasting effects of child maltreatment on the risk of antisocial behaviour. To better establish the burden and cost of child maltreatment on individuals and societies, more longitudinal evidence is needed to determine whether these effects extend beyond 50 years, and across other physical and mental health outcomes. Additional studies should also aim to replicate these findings using other nationally representative cohorts (e.g. 1946 National Survey of Health and Development (Wadsworth et al., 2006), 1970 British Cohort Study (J. Elliott & Shepherd, 2006), Millennium Cohort Study (Connelly & Platt, 2014)). Such replication would not only strengthen the current evidence, but would also enable future research to disentangle age, period, and cohort effects (Yang, 2013). Data linkage with child protection records is a promising direction for research, offering the potential for new information on child maltreatment to be collected and combined with existing longitudinal cohort studies. Although the use of data linkage is increasing, there are a number of practical and ethical obstacles to overcome before these methods can be applied to the British birth cohort studies (Cutajar et al., 2010; Holman et al., 2008; Howe, 1998). Nevertheless, identifying which cohort members were known to child protection services during their childhoods would be an invaluable source for future research.

Epidemiological research is essential for establishing how often child maltreatment occurs in different populations and why (“Chapter 1. What is epidemiology? [Editorial]”, 2018). Medical, psychological, neurobiological, and genetic research can better interrogate the causal mechanisms by which child maltreatment places individuals at risk of poor physical and mental health outcomes. Via the use of converging research methods, such as RCTs, experimental

designs, neuroimaging, and genetic profiling, these disciplines can begin to identify causal processes and mediating and moderating variables that may act as risk and protective factors (Centre for Evidence-Based Medicine, 2018). Research should continue to focus on causal mechanisms to develop (and evaluate) targeted, evidence-based interventions (Craig et al., 2008). This thesis shows the importance of a life-course perspective, which should also be adopted when examining causal processes. Furthermore, the findings from this thesis indicate that, in order to reduce the burden of child maltreatment, long-term support is needed for individuals who are maltreated. The majority of current interventions for child maltreatment focus on children, and are thus designed to be delivered during childhood (e.g. Nurse–Family Partnership, Child–Parent Psychotherapy (MacMillan et al., 2009)). However, many individuals who are maltreated do not come to the attention of authorities until adulthood. Future research should therefore focus on extending current interventions beyond the childhood period, providing long-term support for all individuals who are maltreated, including older adults.

7.7 Conclusions

Child maltreatment continues to be a major public health problem in the UK. Although there have been sustained improvements to child protection and overall reductions in rates of child maltreatment since its ‘discovery’ in the 1870s, more recent trends suggest that the problem might be increasing, particularly for adolescents and emotional abuse and neglect. Furthermore, the risks following child maltreatment are significant and long-lasting, affecting individuals even 50 years after their maltreatment experience. The passing of time alone does not seem to ameliorate these risks. Presently, emotional abuse and neglect are the most common reason for being placed on the child protection register, and these types of maltreatment seem to confer the most persistent risk of antisocial behaviour. Together, these findings emphasise the importance of maintaining child maltreatment as a public health priority. Additional research is needed to evaluate and improve child protection, and long-term interventions are needed to better support individuals who were maltreated as a child. Such evidence may hold the key to reducing the burden of child maltreatment on societies and individuals.

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Appendices

Appendix A Additional information on the iCoverT (Chapter 3)

Tables

A.1	Excluded datasets and reason(s) for exclusion.	193
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Table A.1. Excluded datasets and reason(s) for exclusion.

Excluded dataset	Reason(s) for exclusion
Annual reports, Barnardo's	Inclusion criteria 1 Contact with the Barnardo's Archive and Administration Officer identified that their data did not definitively measure the number of children helped by Barnardo's as the types of projects, services, and home run by Barnardo's changed drastically. As a result, the data could not be used to estimate the incidence of child maltreatment
Child death reviews, England, Department for Education	Inclusion criteria 5 Data on child death reviews collected from local safeguarding children boards was first introduced in April 2008. Thus, the data did not cover a period of at least 25 years
Child sexual exploitation and abuse, National Strategic Assessment, National Crime Agency	Inclusion criteria 5 Data pertaining to child sexual exploitation and abuse were first published in 2014. As a result, the data did not cover a period of at least 25 years
Crime Survey England and Wales, Office for National Statistics	Inclusion criteria 5 The two relevant indicators of child maltreatment incidence: "Victimisation of children aged 10 to 15" and "Abuse during childhood" were first collected from 2008/09 and 2014/15, respectively. As a result, the data did not cover a period of at least 25 years
Hospital Episode Statistics, Admitted patient care, England, Department of Health, NHS England	Inclusion criteria 5 "Admitted patient care: External causes" data were collected from 1989/90. However, the data were only published from 1998/99. A FOI request was placed with the Department of Health to obtain the earlier unpublished data from 1989/90 to 1997/98. This request, and subsequent appeal, were rejected under Section 12(1) of the FOI Act, where public authorities are not obliged to comply with a request for information if it estimates the cost of complying would exceed the appropriate limit. A subsequent Data Access Request application was placed with NHS digital. Although this application was approved, the minimum cost was estimated at £1800 (excluding VAT), which exceeded available funds. As a result, the unpublished data were not obtained, and the remaining published data did not cover a period of at least 25 years
Report on the work of the Prison Department, Statistical tables, Home Office	Overlapping data Prison statistics overlapped with criminal statistics. Because prison statistics covered a shorter time period than criminal statistics (first published in 1923) this dataset was excluded
Child abuse and neglect in the UK today, NSPCC (Radford et al., 2011)	Inclusion criteria 3 & 4 The data were retrospective self-report, which were collected on two separate occasions (1998/99 and 2009). The data were therefore not prospective or annually collected

Notes. Prior to 1 April 2012 the Crime Survey for England and Wales was known as the British Crime Survey and was published by the Home Office. FOI = Freedom of Information; VAT = Value-Added Tax; NSPCC = The National Society for the Prevention of Cruelty to Children (UK).

Table A.2. Excluded and truncated data variables with reason(s) for exclusion.

Dataset	Data variables	Excluded or truncated	Reason(s) for exclusion
Criminal Statistics	Police-recorded data (e.g. “Offences known to the police”)	Excluded	Unresolvable temporal consistency problems In 1998, changes to the HOCR clarified that the recording of crimes by police should be based on the number victims rather than recording the occurrence of the offence (Povey, Prime, & Home Office, 1999). In 2002, the NCRS introduced changes to bring about a more victim-centred approach and increase consistency between forces. The NCRS resulted in around a 23% increase in the number of police-recorded incidences of minor violent offences (Simmons, Legg, & Hosking, 2003), affecting offences against children. As a result, police-recorded minor violent offences were excluded due to problematic temporal consistency
	Data relating to the offence Gross indecency with a child	Excluded	Unresolvable temporal consistency problems Sexual Offences Act (2003), enacted May 2004, repealed the offence of Gross indecency with a child. After 2004 only historic offences were prosecuted, rendering Gross indecency with a child data pre- and post-2004 incomparable
Homicide Index	Homicide Index data pre-1977	Truncated	Unresolvable accuracy problems Prior to 1977, Homicide Index data are held in a mix of electronic and paper formats. Following a consultation with the Home Office, data pre-1977 were not considered to be accurate
NSPCC Statistics	Childline data	Excluded	Unresolvable temporal consistency problems Although Childline was founded in 1986, contact with NSPCC’s Duty Information Specialist identified that due to changes in recording, data pre- and post-2009/10 were not comparable
	Helpline data	Excluded	Unresolvable temporal consistency problems Contact with NSPCC’s Duty Information Specialist identified that due to changes in recording, data pre- and post-2007/08 were not comparable
	Data relating to caseload and number of persons helped by the NSPCC pre-1889/90	Truncated	Unresolvable temporal consistency problems The NSPCC national society was founded in 1889. Data for the five years previously consisted of aggregate data from local societies, which were not comparable to the national figures from 1889/90 onwards

Notes. HOCR = Home Office Counting Rules; NCRS = National Crime Recording Standard; NSPCC = The National Society for the Prevention of Cruelty to Children (UK).

Table A.3. Summary of changes over time, data linkage strategies and dummy variable recommendations.

Database	Changes over time	Data linkage strategy	Dummy variable
Mortality Statistics	Recording change The process of implementing ICD codes to cause of death changed over years, first from manual to automatic coding and then changes to the software used (e.g. introduction of IRIS software in January 2014)	Strategy E: No substantial effect I studied the potential impact of such changes by examining existing research. The Office for National Statistics have carried out a handful of studies to examine the impact of changes to the coding process. These studies found that such change had marginal effects. For example, the introduction of the IRIS software only affected 5% of coded deaths (Office for National Statistics, 2014). As a result, I determined the recording change to have no substantial effect	Not recommended
	Data change From 1858 to 2016 the classification of cause of death changed according to evolving ICD codes, therefore codes were often inconsistent across time periods where the ICD version had been modified	Strategy B: Broader category Following and extending previous methodological approaches (Sidebotham et al., 2012), I classified causes of death according to three broader categories: Homicides/assault; Undetermined intent; and Unknown cause. Full details specified in the Homicide Index Data guide Degli Esposti, Taylor, et al. (2018a)	Recommended
	Data change From 1858 to 2016, the age categories varied over time	Strategy B: Broader category I extracted broader age categories which were consistent over time, including a category of 75+ to deal with notable changes to the average life expectancy	Recommended

Database	Changes over time	Data linkage strategy	Dummy variable
Homicide Index	Recording change Changes to the recording rules HOCR in 1998 and NCRS in 2002 aimed to make police recorded crime more consistent and victim-oriented Definition change The Corporate Manslaughter and Corporate Homicide Act (2007), which came into force on April 2008, meant that definitions of homicide now included corporate manslaughter Time interval change From 1977 to 1997, police-recorded crime was reported for 12-month periods ending 31st December. In 1997/98 this 12-month period changed to ending 31st March Data change From 1977 to 2016 the age categories varied over time. For example, from 1977 to 1992 the category “under 5 years” was collected and from 1993 onwards this was divided into two categories of “under 1 year” and “from 1 to 4 years”	Strategy E: No substantial effect Although police-recorded crime were subject to recording changes, these changes did not affect the recording of homicides. This is because the recording rules emphasised a victim-oriented approach and victims may not report incidents in the case of homicides. The number of homicides were therefore not affected by the recording change (Povey et al., 1999) Strategy E: No substantial effect Data visualisations indicated that the number of child homicides decreased from 2008 to 2009, indicating that the broadening of the homicide definition did not significantly increase the number of child homicide victims Strategy E: No substantial effect As data were still consistently collected every 12 months, this change was not considered to have a substantial effect on the data Strategy B: Broader category I extracted broader age categories that could be matched over time. For example, “under 5 years” which involved adding together “under 1 year” and “from 1 to 4 years” from 1993 onwards	Not recommended Not recommended Recommended Not recommended
Criminal Statistics	Structural change Following the enactment of the Courts Act (1971) in January 1972, Courts of Assizes and Quarter Sessions were replaced by a single Crown Court with the power to sit anywhere in England and Wales, and deals with all indictable offences	Strategy A: Derived equivalent data Before 1972, I added together figures from quarter sessions and courts of assizes to get a single figure that was comparable to the Crown Court from 1972 onwards	Recommended

Database	Changes over time	Data linkage strategy	Dummy variable
	Organisational change The Criminal Law Act (1977) re-classified offences and cruelty to and neglect of children became triable-either-way from 1979 onwards. Prior to 1979, Cruelty to and neglect of children was two separate offences that was either tried on indictment (offence no. 11) or summarily (offence no. 109) Source change Until 2007, the Home Office was responsible for publishing the Criminal Statistics dataset. From May 2007, the newly formed Ministry of Justice subsumed the responsibility Data change Until 1991, the number of persons cautioned were not published in the annual reports. However, from 1992 onwards “persons cautioned” were added to the number of persons found guilty (i.e. reports presented the number of “persons cautioned and found guilty”) Definition change Definitional changes for Cruelty to and neglect of children included: Children & Young Person Act (1933), enacted November 1933, changed the age of male victims from under 14 to under 16; Children Act (1989), enacted October 1991, amended the words “has the custody, charge or care of” to “has responsibility for”; Serious Crime Act (2015), enacted March 2015, makes explicit that cruelty includes psychological suffering	Strategy A: Derived equivalent data Before 1979, offence numbers 11 and 109 were added together to form a single total to represent Cruelty to and neglect of children. This figure was comparable to the single figure published from 1979 onwards Strategy C: Matched equivalent items The equivalent data were identified and matched in the pre-2007 Home Office and post-2007 Ministry of Justice publications Strategy A: Derived equivalent data In order to calculate the number of “persons found guilty” from 1992 onwards, the number of “persons cautioned” was subtracted from “persons cautioned and found guilty” Strategy E: No substantial effect It was determined that the legal definition was not drastically altered over time and therefore the effect of the definition change was not determined to be substantial	Recommended Recommended Not recommended Recommended

Database	Changes over time	Data linkage strategy	Dummy variable
	Definition change Definitional changes for Unlawful sexual intercourse with a girl under 13 and with a girl between 13 and 16: Sexual Offences Act (1956), enacted January 1957, changed “defilement of girls” to “unlawful sexual intercourse”; Sexual Offences Act (2003), enacted May 2004, redefined the offences to “sexual activity” with a child (boys & girls) and further categorised offences in terms of harm (1,2,3) and culpability (A, B)	Strategy C: Matched equivalent items Following investigations, it was determined that post-2004 the offence numbers 21.1 and 22.1 (i.e. harm 1) including culpability A and B best represented the offences Unlawful sexual intercourse with a girl under 13 and Unlawful sexual intercourse with a girl between 13 and 16, respectively	Recommended
	Terminology change Published reports inconsistently used the terms “found guilty” and “convicted”	Strategy A: Derived equivalent data For each inconsistent time period (9 identified), the different uses of “found guilty” and “convicted” were outlined. By understanding the criminal system, and changes to this over time, I used sub-divisions within these categories (e.g. “proceeded against”, “withdrawn/dismissed”) to derive temporally consistent figures for “found guilty” and “convicted”	Not recommended
	Data collection change The data collection method changed in 2010. Prior to 2010, the data were collected from local authorities via aggregate CPR (1–3) returns. From 2010 onwards, the data were collected via the CIN. The two data collection methods are broadly similar but changed the emphasis from national to child level data	Strategy E: No substantial effect This data collection change resulted in some cases being reported multiple times as new information was reporting on already open cases. However, this issue has subsequently resolved, and data visualisations indicate that there were no abrupt increases (beyond the typical long-term trend), which suggests that this only marginally affected aggregate figures	Recommended
Child Protection Statistics	Source change In 2003, the Department of Education subsumes the responsibility from Department of Health for publishing England child protection statistics	Strategy C: Matched equivalent items From 2003 onwards, equivalent Department of Education publications were identified and matched	Not recommended

Database	Changes over time	Data linkage strategy	Dummy variable
Children In Care Statistics	Data change The categories of abuse changed over time. These changes included a shift from recording only pure categories of abuse and specific mixed categories of abuse to only recording “mixed categories” of abuse from 2002 onwards, which may count a child more than once Data change From October 1991 the abuse category “grave concern” was discontinued as it was not recommended in Working Together guidance under the Children Act (1989) issued by the Department of Health and Welsh Office in 1991 Data collection change Up until 1998, data on children in the care of local authorities were derived from SSDA903 returns. For this period, the SSDA903 was completed and submitted by local authorities for all children in their care. However, from 1998 to 2003 the SSDA903 only covered a one third sample of children in care, those with a day of birth divisible by three. A new return was also introduced, called the CLA100, which was intended to provide provisional national figures (a fast track method of producing estimates). From 2004, the CLA100 return was discontinued and the SSDA903 reverted to collecting data from all children and became web-based	Strategy A: Derived equivalent data For data prior to 2002 and Welsh data, I derived mixed categories by adding together relevant pure categories and specific mixed categories of abuse. The equivalence of these figures was checked using the overlapping periods Strategy E: No substantial effect The category of “grave concern” was gradually discontinued over a 3-year period, therefore the data were not abruptly, substantially affected Strategy D: Data prioritisation I investigated the differences between the SSDA903 and CLA100 data collection methods. The items on both returns were designed to be comparable, as a result there were little differences between them. However, I found that the CLA100 produced provisional, less accurate and detailed figures, than the SSDA903. I addressed the data collection changes by prioritising figures derived from SSDA903 returns for all available years, including the 1998 to 2003 period where national figures were derived from a one third sample	Recommended Not recommended Recommended

Database	Changes over time	Data linkage strategy	Dummy variable
	Source change The Home Office and then Department of Health (England) collects data from all local authorities in England and Wales up until 31st March 1991. From 1 April 1991, the Department of Health collected data from local authorities in England only, and the Welsh Office becomes responsible for collecting data from local authorities in Wales Source change In 2003, the Department of Education subsumes the responsibility from Department of Health for publishing England child in care statistics Time interval change From 1949 to 1954, Children In Care data were collected for a 12-month period ending 30th November. From 1955/56 onwards these 12-month period changed to ending 31st March Terminology change When the Children Act (1989) came into force in October 1991 the Children In Care data were archived and a newly re-designed “Children Looked After” dataset was introduced	Combined strategies A, C & D I extracted from Children in care England and Wales reports (combined figures) up until 1991. From 1992 onwards, data for England and for Wales were extracted from separate reports and then added together Strategy C: Matched equivalent items From 2003 onwards, equivalent Department of Education publications were identified and matched Strategy E: No substantial effect As data were still consistently collected every 12 months, this change was not considered to have a substantial effect on the data Strategy C: Matched equivalent items Prior to October 1991, children were referred to as being ‘in care’ when the Children Act (1989) came into force in 1991 children in care of local authorities were referred to as being “looked after”. I found the change in terminology to effect labels only, as the data collection method and data were otherwise equivalent. I matched up data variables referring to children in care prior to 1991 to children looked after from 1991 onwards	Recommended Not recommended Recommended Not recommended

Database	Changes over time	Data linkage strategy	Dummy variable
NSPCC Statistics	Geographical change From 1890 to 1907 the NSPCC statistics covered England, Wales, Ireland and Scotland. However, NSPCC stopped working in Scotland in July 1907, therefore from 1908 onwards the statistics no longer covered Scotland. Up to 1956 the NSPCC Statistics covered England, Wales and Ireland. However, in March 1956 the ISPCC was founded and the NSPCC only worked in Northern Ireland from 1957 onwards Time interval change From 1890 to 1946 data were collected for 12-month periods ending 31st March. In 1947, this changed to a 12-month period ending 28 or 29 February, in 1970 this changed to ending 31st December, and in 1974 this changed to ending 30th September Data change The data categories for age changed over time. For example. From 1951 to 1978, children aged under 5 were categorised as “Under 2 years” and “2 to under 5 years” but from 1979 onwards these were combined into one category (“Under 5 years”) Data change The data categories for who referred the NSPCC case changed over time. For example, from 1921 to 1969 the categories consisted of: the general public (including parents and relatives), police officials, school officials, other officials, and NSPCC society officials. However, from 1970 onwards, these categories changed to: officials, general public (excluding parents and relatives), parents, and other relatives	Strategy E: No substantial effect I was unable to determine the true effect of these geographical changes, but after consultation with a NSPCC Duty Information Specialist, I determined that the data were still comparable over time	Recommended
		Strategy E: No substantial effect As data were still consistently collected every 12 months, this change was not considered to have a substantial effect on the data	Recommended
		Strategy B: Broader category I extracted and calculated the broader age categories of “Under 5 years” and “5 years and over”, these categories were consistent over time	Not recommended
		Strategy B: Broader category I extracted and calculated two broader categories of the general public (including parents and relatives) and officials (including police, school, other, and NSPCC) to make these categories comparable over time	Not recommended

Database	Changes over time	Data linkage strategy	Dummy variable
	Data change The data categories for the type of NSPCC case changed over time. Most notably, the type of offence of “corruption of morals” was no longer reported from 1953, instead two new categories of “moral danger” and “immoral offences”	Strategy A: Derived equivalent data Following consultation with a NSPCC Duty Information Specialist, I identified that corruption of morals pre-1953 was equivalent to the sum of “moral danger” and “immoral offences” post-1953	Not recommended

Notes. A dummy variable is a binary variable representing temporal change. Dummy variables are created by identifying the year of change; years before this change are coded as 0, and the year of change and years after change are coded as 1. ICD = International Classification of Diseases; HOCR = Home Office Counting Rules; NCRS = National Crime Recording Standard; CIN = Children in Need; CPR = Child Protection Return; SSDA903 = Social Services Department Annual statistical return; CLA100 = Children Looked After annual statistical return; NSPCC = The National Society for the Prevention of Cruelty to Children (UK); ISPPC = Irish Society for the Prevention of Cruelty to Children.

Table A.4. Summary of data adjustments.

Database	Data adjustments
Mortality Statistics	Data idiosyncrasies For the year 1858, only a summed figure for male and female homicide victims aged 15 to 24 years was given, instead of a two category age breakdown of victims aged 15 to 19 years and 20 to 24 years. I calculated a 3-year average for the ratio between victims aged 15 to 19 years and aged 20 to 24 years. Data for 1858 were then multiplied by these ratios to approximate figures for the age categories 15 to 19 years and 10 to 24 years. All resulting figures were rounded to the nearest integer
Child Protection Statistics	Data idiosyncrasies Welsh data relating to the age and gender of children on the child protection register for the year 1992, and the gender of children who were de-registered in England for the years 2010 to 2012, were provisional. Provisional data consisted of raw local authority data which had not been adjusted to account for missing data, deriving national estimates. To address this and derive national estimates, I adjusted the data via the following two-steps: 1. Summed the provisional figures to calculate the raw data total only (including missing data) 2. For each year, calculated the ratio between raw data total and given national estimates $Ratio = \frac{Given\ national\ estimate}{Raw\ data\ total}$ 3. Multiplied the raw data by this ratio to derive national estimates and adjust for missing data Precision (rounding) Over time, children in care data were inconsistently reported to the nearest 5, 10 or 100. All data were therefore rounded to the highest common level of precision, which was typically 5 or 10 for Welsh data, and 100 for English data. These rounding adjustments may result in some rounding errors
Children In Care Statistics	Data imputations Missing data for the number of new children in care during the years 1952 to 1976. However, from 1952 to 1982 data on the number of new care periods in care are reported. Care periods are a period in which a child is continuously in care. I therefore carried out the following two-step ad-hoc data imputation to derive data for the missing years 1952 to 1976: 1. For 6 years (1977–1982) data for new children and new care periods were both reported. I therefore established the average ratio between new children and new care periods from 1977 to 1982 $AverageRatio = \sum \frac{New\ children}{New\ care\ periods}$ 2. This average ratio was then used as a multiplicative factor and multiplied with the number of new care periods for each year from 1952 to 1976

Appendix A. Additional information on the iCoverT (Chapter 3)

Database	Data adjustments
	Data idiosyncrasies During the year 1970/71, amendments set out in the Children & Young Person Act (1969) para. 7(2) of Schedule 4 stated that children who would have been subject to an approved school order, or to supervision following release from approved school, on the 31 st December 1970 were now deemed to be in care. As a result, there was an abrupt increase of children in care. To adjust for this artificial increase, the number of children affected by this amendment was subtracted from the appropriate figures 12-month period Data for the year 1991/92 figure only covered 6 months (October 1991 to March 1992). All 1991/92 figures were therefore multiplied by 2 to account for the missing 6 months. All resulting figures were rounded to the nearest integer Precision (rounding) Over time, children in care data were inconsistently reported to the nearest 10 or 100. All data were therefore rounded to the highest common level of precision, which was typically 10 for Welsh data, and 100 for English data. These rounding adjustments may result in some rounding errors
NSPCC Statistics	Data idiosyncrasies For the years 1915 to 1920, a summed total of the number of war enquiries for the number of NSPCC cases and children helped was given. I divided these figures by the number of years (n=5) and added them to non-war enquiries for each respective year. For the year 1968/69 the age of children helped by the NSPCC was only given as a percentage of the total number of children. I calculated these percentages and entered them as raw data. All resulting figures were rounded to the nearest integer 12-month period Data for the year 1946/47 only covered 11 months (April 1946 to February 1947). All 1946/1947 figures were therefore divided by 11 and multiplied by 12 to derive 12-month estimates. Data for the year 1973/74 only covered 9 months (1 st January 1974 to 30 th September 1974). All 1973/74 figures were therefore divided by 9 and multiplied by 12 to derive 12-month estimates. All resulting figures were rounded to the nearest integer

Notes. Full details of data adjustments for each database are detailed in the Data dictionaries (Degli Esposti, Taylor, et al., 2018a). NSPCC = The National Society for the Prevention of Cruelty to Children (UK).

Appendix B Descriptions of data sources & maltreatment indicators (Chapters 3 & 4)

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Table B.1. Description of Mortality Statistics (sources, indicators, definitions, and changes over time).

MORTALITY STATISTICS	
Data source	Mortality Statistics Database, iCoverT
Primary source(s)	The 20th century mortality files, England and Wales, 1901–2000, <i>Office for National Statistics</i> The 21st century mortality dataset, England and Wales, 2001–16, <i>Office for National Statistics</i>
Geographical area	England & Wales
Time period	1858–2016
Inter-rater agreement	97.1%
Maltreatment indicator(s)	Deaths caused by homicide
Definition(s)	Deaths caused by homicide, assault and injury purposely inflicted by other persons
Unit(s) of analysis	Number of child deaths by homicide during 12 months ending 31 st December
Child population	<20 years
Denominator population	<20 years (Mid-year population estimates for England and Wales from <i>Office for National Statistics</i>)
Additional information	Gender: • Males • Females Age: • Infant (<1 year) • Child (1–14 years) • Adolescent (15–19 years)
Change(s) over time	Data (1901, 1911, 1921, 1931, 1940, 1950, 1968, 1979, 2001): from 1858 to 2016 there have been 10 different versions of ICD codes for classifying causes of death (ICD1–10). Full details specified in the Mortality Statistics Data guide (Degli Esposti, Taylor, et al., 2018a)

Notes. Where appropriate, denominator populations were broken-down into age specific groups, including: <1 year, 1–14 years, and 15–19 years separately. Age-specific breakdowns were available from 1911 to 2016, age breakdowns were therefore derived pre-1911 via ad-hoc data imputations. Specifically, I imputed a 3-year average of the fraction of a relevant age group over of the total population for the years 1911 to 1913. The total population estimates for 1858 to 1910 were then multiplied by this average fraction to obtain age-specific population estimates. In 1921 & 1922 missing data for the age group 15–19 years, were imputed by a 3-year average (1918–1920) multiplied by total population (and added together to get <20 years). From 1921 to 1960 missing data for the age groups <1 year and 1–14 years, were imputed by a 3-year average of 0–4 years as a denominator (1918–1920) and then multiplied by this 0–4 years population. iCoverT = data source on the incidence of Child maltreatment over Time; ICD = International Classification of Diseases.

Table B.2. Description of Homicide Index (sources, indicators, definitions, and changes over time).

HOMICIDE INDEX	
Data source	Homicide Index Database, iCoverT
Primary source(s)	Homicide Index, <i>Home Office</i>
Geographical area	England & Wales
Time period	1977–2016
Inter-rater agreement	99.8%
Maltreatment indicator(s)	Child homicides
Definition(s)	Police-recorded child homicides, including murder, manslaughter and infanticide
Unit(s) of analysis	Number of child homicides during 12 months ending 31 st December or 31 st March
Child population	<16 years
Denominator population	<16 years (Mid-year population estimates for England and Wales from <i>Office for National Statistics</i>)
Additional information	Gender: • Males • Females Age: • 0–4 years • 5–15 years
Change(s) over time	Time interval (1998): the 12 month data collection period changed from ending on 31 st December until 1997, to ending on 31 st March from 1998 onwards (i.e. shift from calendar to financial year)

Notes. Where appropriate, denominator populations were broken-down into age specific groups, including: 0–4 years and 5–15 years separately. iCoverT = data source on the incidence of Child maltreatment over Time.

Table B.3. Description of Criminal Statistics (sources, indicators, definitions, and changes over time).

CRIMINAL STATISTICS	
Data source	Criminal Statistics Database, iCoverT
Primary source(s)	Criminal statistics in England and Wales, <i>Home Office</i> Criminal justice system statistics quarterly: December, <i>Ministry of Justice</i>
Geographical area	England & Wales
Time period	1893–2016
Inter-rater agreement	99.7%
Maltreatment indicator(s)	Three criminal offences: 1. Child cruelty/neglect 2. Sexual intercourse with under 13s 3. Sexual intercourse with 13–16s
Definition(s)	Adults found guilty of the following three notifiable criminal offences relating to child maltreatment: 1. Child cruelty/neglect (offence no. 11, 109): “Any person who has attained the age of sixteen years and has responsibility for any child or young person under that age, wilfully assaults, ill-treats, neglects, abandons, or exposes him, or causes or procures him to be assaulted, ill-treated, neglected, abandoned, or exposed, in a manner likely to cause him unnecessary suffering or injury to health (including injury to or loss of sight, or hearing, or limb, or organ of the body, and any mental derangement) ...” Children & Young Person Act (1933) section 1(1) 2. Sexual intercourse with under 13s (offence no. 21) “...to have unlawful sexual intercourse with a girl under the age of thirteen” Sexual Offences Act (1956) section 5 3. Sexual intercourse with 13–16s (offence no. 22) “...to have unlawful sexual intercourse with a girl not under the age of thirteen but under the age of sixteen” Sexual Offences Act (1956) section 6
Unit(s) of analysis	Number of adults (>16 years) found guilty during 12 months ending 31 st December
Child population	<16 years
Denominator population	>16 years (Mid-year population estimates for England and Wales from <i>Office for National Statistics</i>)
Additional information	n/a

CRIMINAL STATISTICS	
Change(s) over time	Structural (1972): implementation of the Courts Act (1971) in January 1972 replaced courts of assizes and quarter sessions with a single Crown Court Organisational (1979): new offence grouping system implemented by Part III of the Criminal Law Act (1977) in July 1978 re-classified the offence child cruelty/neglect as triable-either-way Source (2007): from May 2007, the newly formed Ministry of Justice subsumed the responsibility from the Home Office in collating and publishing criminal statistics Definitions: • Legal definition changes to child cruelty/neglect (1934, 1991, 2015) – Children & Young Person Act (1933; enacted November 1933) changed age of male victims from under 14 to under 16 – Children Act (1989; enacted October 1991) amended the words “has the custody, charge or care of” to “has responsibility for”. – Serious Crime Act (2015; enacted March 2015) made explicit that cruelty includes psychological suffering • Legal definition changes to sexual intercourse with under 16s (1957 & 2004) – “Defilement of girls” changed to “unlawful sexual intercourse” with the implementation of the Sexual Offences Act (1956; enacted January 1957) – Sexual Offences Act (2003; enacted May 2004), repealed section 5 & 6 of the 1956 Act and redefined these sexual offences to “sexual activity” and with a child rather than a girl. These offences were further sub-categorised by harm (1,2,3) and culpability (A,B)

Notes. Adults found guilty is the total number of perpetrators involved in criminal cases found guilty at the magistrates’ and the Crown Court. The number of adults found guilty is a subset of those proceeded against. It does not include cases which were dropped (discontinued, withdrawn/dismissed, or acquitted); and it does include guilty verdicts without convictions. Age-specific population estimates for adults aged >16 years were only available from 1911 to 2016. Before 1911, these age-specific population estimates were derived via ad-hoc data imputations. Specifically, I imputed a 3-year average of the fraction of a relevant age group over of the total population for the years 1911 to 1913. The total population estimates for 1893 to 1910 were then multiplied by the average of this fraction to obtain population estimates for adults aged >16 years. iCoverT = data source on the incidence of Child maltreatment over Time.

Table B.4. Description of Child Protection Statistics (sources, indicators, definitions, and changes over time).

CHILD PROTECTION STATISTICS	
Data source	Child Protection Statistics Database, iCoverT
Primary source(s)	Children and adolescents on child protection register, England, <i>Department of Health</i> Referrals, assessments, and children and adolescents on the child protection registers, England, <i>Department for Education</i> Characteristics of children in need, England, <i>Department for Education</i> Child protection register: statistics for Wales, <i>Welsh Office</i>
Geographical area	England
Time period	1988–2016
Inter-rater agreement	99.5%
Maltreatment indicator(s)	Registrations to child protection register
Definition(s)	Registrations to the child protection register or children subject to a child protection plan. Reasons for registration include: grave concern, neglect, emotional abuse, physical abuse, and/or sexual abuse
Unit(s) of analysis	Number of registrations to the child protection register during 12 months ending 31 st March
Child population	<18 years
Denominator population	>20 years (Mid-year population estimates for England from <i>Office for National Statistics</i>)
Additional information	Gender: • Males • Females • Unborn or unknown details Age: • Infant (<1 year) • Child (1–15 years) • Adolescent (16–18 years) • Unborn or unknown details Reason for registration (mixed categories): • Neglect • Physical abuse • Sexual abuse • Emotional abuse

Appendix B. Descriptions of data sources & maltreatment indicators (Chapters 3 & 4)

CHILD PROTECTION STATISTICS	
Change(s) over time	Data collection (2010): data collection method changed from CPR1–3 annual statistical returns to the CIN census in 2010 Data (1992): Working Together Guidance, issued in October 1991, discontinued ‘grave concern’ as a reason for registration

Notes. Where appropriate, denominator populations were broken-down into country and age-specific groups, including: <1 year, 1–15 years and 16–18 years separately. iCoverT = data source on the incidence of Child maltreatment over Time; CPR1–3 = Child Protection Register statistical returns, versions 1 to 3; CIN = Children In Need census.

Table B.5. Description of Children in Care Statistics (sources, indicators, definitions, and changes over time).

CHILDREN IN CARE STATISTICS	
Data source	Children In Care Statistics Database, iCoverT
Primary source(s)	Children in care in England and Wales, <i>Department for Health</i> Children looked after in England, <i>Department for Education</i> Children in care of local authorities in Wales, <i>Welsh Office</i>
Geographical area	England & Wales
Time period	1949–2016
Inter-rater agreement	98.7%
Maltreatment indicator(s)	Children entering care
Definition(s)	Children entering the care of local authorities (i.e. ‘looked after’). Children enter care via three main routes: care orders (circa 60%), voluntarily (circa 30%), and police involvement (protection or youth justice involvement; circa 10%). Care orders are made if the court has sufficient evidence to indicate that the child is either suffering from, or at risk of, significant harm, or the child is beyond parental control (Children Act, 1989)
Unit(s) of analysis	Number of children entering care during 12 months ending 30 th November or 31 st March
Child population	<18 years
Denominator population	>20 years (Mid-year population estimates for England and Wales from <i>Office for National Statistics</i>)
Additional information	n/a
Change(s) over time	Source (1992): data on children in care in England and Wales were jointly reported by the Department for Health from 1949 to 1991. However, from 1992 onwards the data were divided into two separate reports, one for England (Department of Health/Education) and one for Wales (Welsh Office) Data collection (1998 & 2003): from 1998 to 2003 the SSDA903 only covered a one third sample of children in care and were adjusted by a multiplicative factor to derive national estimates Time interval (1956): the 12 month data collection period changed from ending on 30 th November until 1954, to ending on 31 st March from 1956 onwards

Notes. Where appropriate, denominator populations were broken-down into country and age specific groups, including: England & Wales separately. Children In Care Database has prevalence information on the total number of children in care, broken-down by gender and age; however, there is no equivalent information for the incidence indicator (children entering care). iCoverT = data source on the incidence of Child maltreatment over Time; SSDA903 = Social Services Department Annual statistical return.

Table B.6. Description of NSPCC Statistics (sources, indicators, definitions, and changes over time).

NSPCC STATISTICS	
Data source	NSPCC Statistics Database, iCoverT
Primary source(s)	NSPCC annual reports, <i>NSPCC</i>
Geographical area	England, Wales & Northern Ireland
Time period	1910–1985
Inter-rater agreement	99.7%
Maltreatment indicator(s)	Children involved in NSPCC cases
Definition(s)	Children involved in NSPCC referrals which were opened as new cases and dealt with by the NSPCC
Unit(s) of analysis	Number of children involved in new NSPCC cases during a 12-month period
Child population	<18 years
Denominator population	<20 years (Mid-year population estimates for England, Wales and Northern Ireland from <i>Office for National Statistics</i>)
Additional information	Gender: • Males • Females Age: • 0–4 years • 5–18 years
Change(s) over time	Geography (1957): the NSPCC data covered Scotland up to 1907, and changed from covering all of Ireland to Northern Ireland only in 1956 Time intervals (1946, 1970, 1974): from 1890 to 1946 data were collected for 12-month periods ending 31 st March. In 1947, this changed to a 12-month period ending 28 th / 29 th February in 1970 this changed to ending 31 st December, and in 1974 to ending 30 th September

Notes. Where appropriate, denominator populations were broken-down into age specific groups, including: 0–4y and 5–18y separately. Age-specific breakdowns for England and Wales were available from 1911 to 1985, age breakdowns were therefore derived pre-1911 via ad-hoc data imputations. Specifically, I imputed a 3-year average of the fraction of a relevant age group over of the total population for the years 1911 to 1913. The total population estimates for 1910 were then multiplied by this average fraction to obtain age-specific population estimates. In 1921 & 1922 missing data for the age group 15–19 years, were imputed by 3-year average (1918–1920) multiplied by total population (and added together to get <20y). Age-specific breakdowns for Northern Ireland were available from 1954 to 1985, age breakdowns were therefore derived pre-1954 via ad-hoc data imputations. Specifically, I imputed a 3-year average of the fraction of a relevant age group over of the total population for the years 1954 to 1956. The total population estimates for 1910 to 1953 were then multiplied by this average fraction to obtain age-specific population estimates. iCoverT = data source on the incidence of Child maltreatment over Time; NSPCC = National Society for Prevention of Cruelty to Children (UK).

Appendix C Unadjusted GLMs & GLMs adjusted for changes over time (Chapter 4)

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Table C.1. Long-term trends in annual incidence rates of child maltreatment indicators after adjusting for changes over time.

	Time period	Significant changes over time (year)	Linear trends based on adjusted GLMs	
			Annual percentage change (%; 95% CI)	P value
Child deaths by homicide/assault				
Gender	1858–2016	ICD2 (1911); ICD5 (1940); ICD8 (1968)	-2.1 (-2.3 to -1.9)	<0.0001
Males	1858–2016	ICD2 (1911); ICD5 (1940); ICD8 (1968); ICD10 (2001)	-2.2 (-2.5 to -2.0)	<0.0001
Females	1858–2016	ICD2 (1911); ICD5 (1940); ICD8 (1968); ICD9 (1979)	-2.0 (-2.2 to -1.7)	<0.0001
Age				
<1 year	1858–2016	ICD5 (1940); ICD8 (1968); ICD9 (1979)	-2.5 (-2.7 to -2.4)	<0.0001
1–14 years	1858–2016	ICD8 (1968); ICD9 (1979); ICD10 (2001)	-0.3 (-0.5 to -0.2)	<0.0001
15–19 years	1858–2016	ICD6&7 (1950); ICD8 (1968)	-1.0 (-1.3 to -0.7)	<0.0001
Police-recorded child homicides	1977–2016	n/a	n/a	n/a
Gender				
Males	1977–2016	n/a	n/a	n/a
Females	1977–2016	n/a	n/a	n/a
Age				
0–4 years	1977–2016	n/a	n/a	n/a
5–15 years	1977–2016	n/a	n/a	n/a
Adults guilty of child cruelty/neglect	1893–2016	Organisational (1979)	-3.5 (-3.7 to -3.3)	<0.0001
Adults guilty of sex with under 13s	1893–2016	Structural (1972)	-0.8 (-1.1 to -0.5)	<0.0001
Adults guilty of sex with 13–16s	1893–2016	Structural (1972); organisational (1979); Sex Offences Act (1956)	1.1 (0.4 to 1.8)	0.0037
Registrations to child protection register	1988–2016	Data collection (2010)	1.8 (1.2 to 2.3)	<0.0001
Gender				

	Time period	Significant changes over time (year)	Linear trends based on adjusted GLMs	
			Annual percentage change (%)	P value
Males	1988–2016	Data collection (2010)	1.7 (1.2 to 2.3)	<0.0001
Females	1988–2016	Data collection (2010)	1.1 (0.5 to 1.7)	0.0012
Age				
<1 year	1988–2012	Data collection (2010)	2.8 (2.3 to 3.2)	<0.0001
1–15 years	1988–2012	Data collection (2010)	1.1 (0.6 to 1.6)	0.0002
16–18 years	1988–2012	Data collection (2010)	-3.3 (-4.3 to -2.2)	<0.0001
Type of maltreatment				
Neglect	1988–2016	Data (1992)	5.7 (5.0 to 6.3)	<0.0001
Physical abuse	1988–2016	Data (1992); data collection (2010)	-4.7 (-6.0 to -3.3)	<0.0001
Sexual abuse	1988–2016	Data (1992); data collection (2010)	-6.5 (-8.1 to -4.9)	<0.0001
Emotional abuse	1988–2016	Data (1992); data collection (2010)	7.7 (6.6 to 8.8)	<0.0001
Children entering care	1952–2016	Time (1956)	-0.7 (-0.8 to -0.5)	<0.0001
Children helped by NSPCC	1910–1985	Time intervals (1946; 1970)	-0.9 (-1.1 to -0.6)	<0.0001
Gender				
Males	1940–1969	n/a	n/a	n/a
Females	1940–1969	n/a	n/a	n/a
Age				
0–4 years	1951–1985	Time intervals (1970); geography (1957)	-3.2 (-4.1 to -2.3)	<0.0001
5–18 years	1951–1985	Time intervals (1974); geography (1957)	-3.8 (-4.6 to -3.0)	<0.0001

Notes. Annual percentage change (%) and p values were calculated from adjusted GLMs. Significant changes over time were defined as $p < .01$ and details for all changes over time are found in Appendix B. Blank cells (n/a's) are because model fit was not significantly improved when adjusting for changes over time. GLMs = generalised linear models; CI = confidence interval; ICD = International Classification of Diseases; NSPCC = National Society for Prevention of Cruelty to Children (UK).

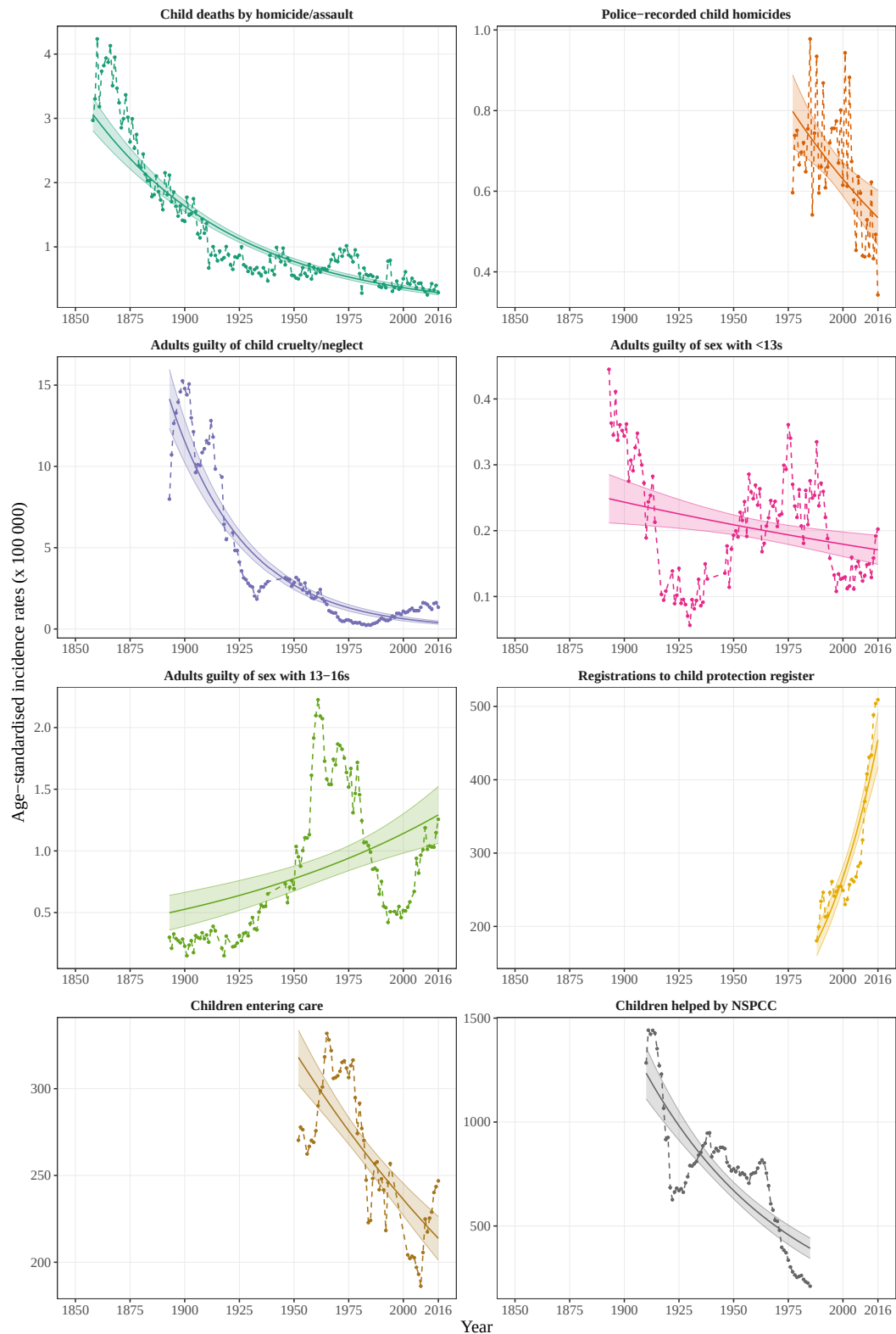


Figure C.1. Trends in annual incidence rates of child maltreatment indicators (unadjusted GLMs).

Age-standardised incidence rates (x 100 000) for all available years and for each child maltreatment indicator. Dotted lines show raw incidence rates whilst solid lines show unadjusted GLMs with shaded 95% confidence intervals. Y axes vary for different child maltreatment indicators. GLMs = generalised linear models; NSPCC = National Society for Prevention of Cruelty to Children (UK).

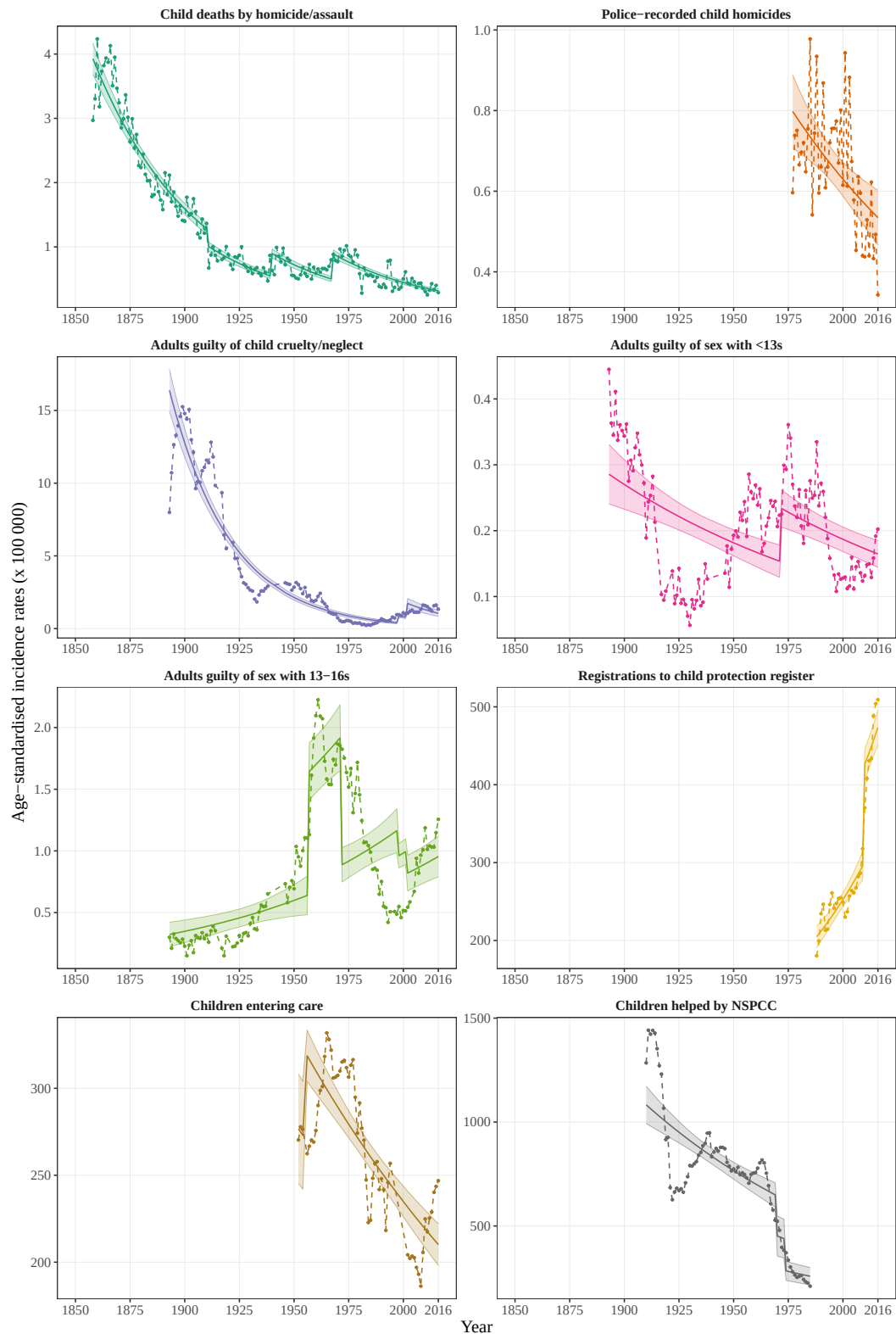


Figure C.2. Trends in annual incidence rates of child maltreatment indicators (adjusted GLMs).

Age-standardised incidence rates (x 100 000) for all available years and for each child maltreatment indicator. Dotted lines show raw incidence rates whilst solid lines show adjusted GLMs with shaded 95% confidence intervals. Y axes vary for different child maltreatment indicators. GLMs = generalised linear models; NSPCC = National Society for Prevention of Cruelty to Children (UK).

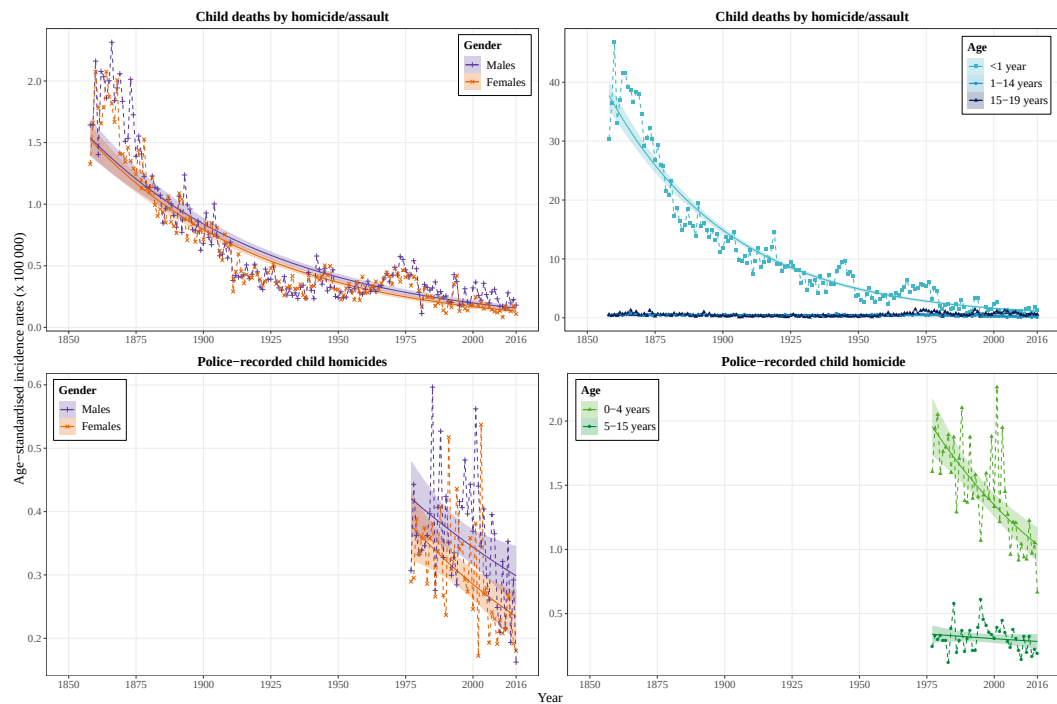


Figure C.3. Trends in annual incidence rates of child mortality by gender and age (unadjusted GLMs).

Age-standardised incidence rates (x 100 000) of child mortality by gender and age for all available years. Dotted lines show raw incidence rates whilst solid lines show unadjusted GLMs with shaded 95% confidence intervals. Y axes vary for different child maltreatment indicators. GLMs = generalised linear models.

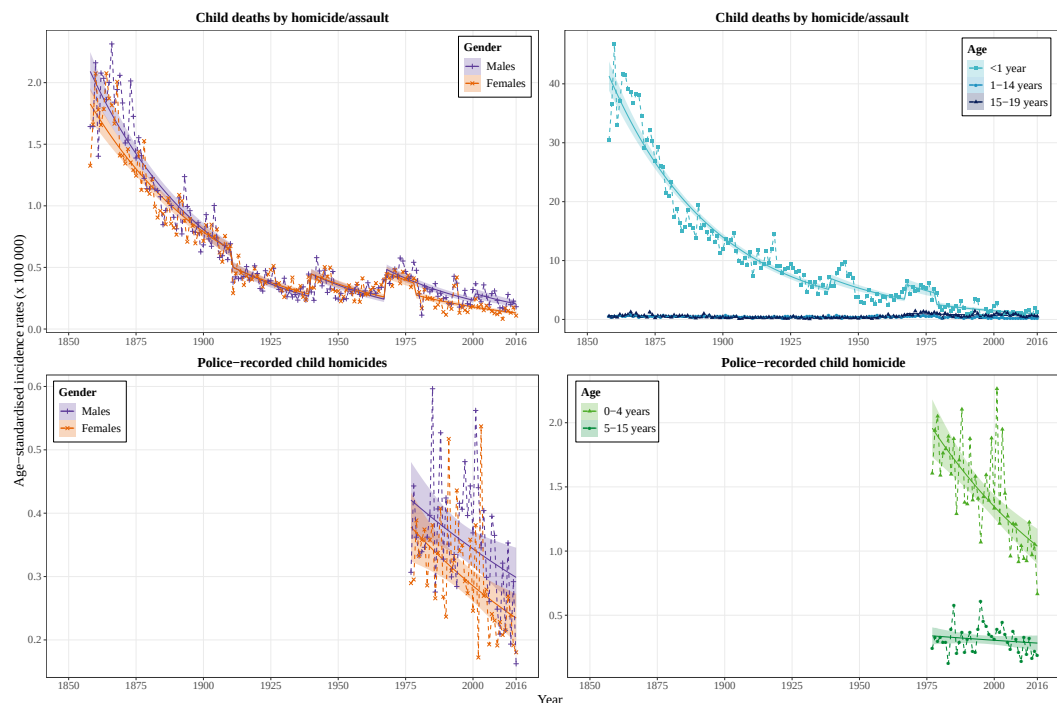


Figure C.4. Trends in annual incidence rates of child mortality by gender and age (adjusted GLMs).

Age-standardised incidence rates (x 100 000) of child mortality by gender and age for all available years. Dotted lines show raw incidence rates whilst solid lines show adjusted GLMs with shaded 95% confidence intervals. Y axes vary for different child maltreatment indicators. GLMs = generalised linear models.

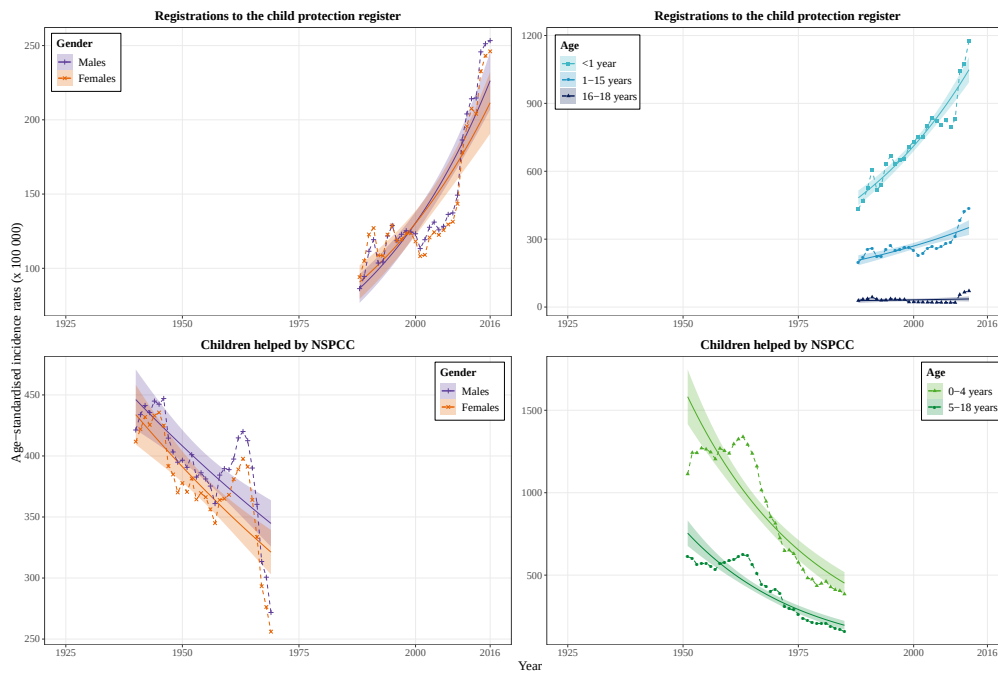


Figure C.5. Trends in annual incidence rates of child protection activity by gender and age (unadjusted GLMs).

Age-standardised incidence rates (x 100 000) of child protection activity by gender and age for all available years. Dotted lines show raw incidence rates whilst solid lines show unadjusted GLMs with shaded 95% confidence intervals. Y axes vary for different child maltreatment indicators. GLMs = generalised linear models; NSPCC = National Society for Prevention of Cruelty to Children (UK).

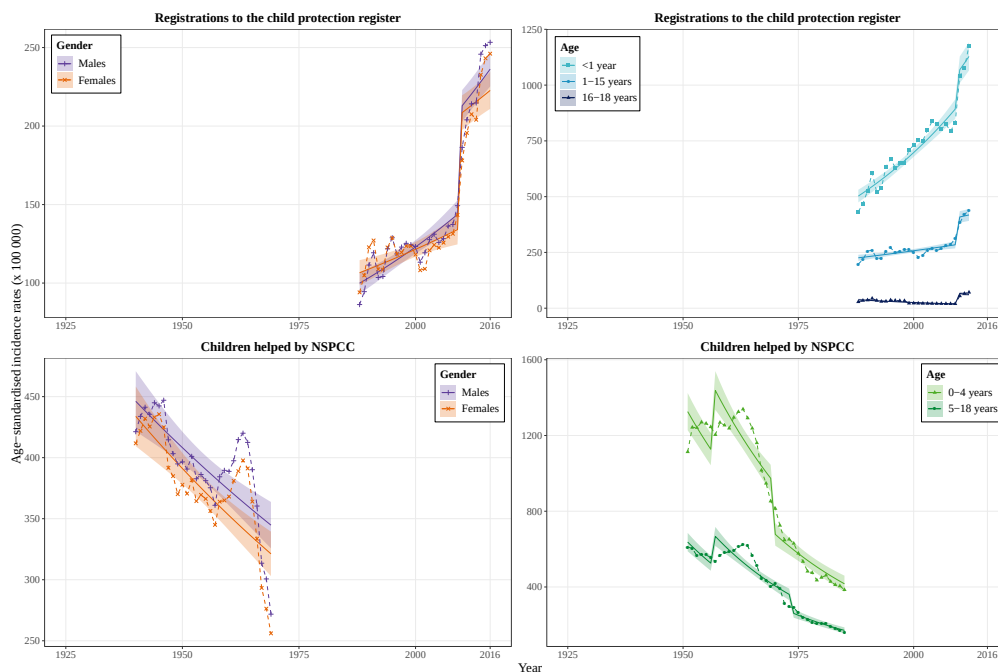


Figure C.6. Trends in annual incidence rates of child protection activity by gender and age (adjusted GLMs).

Age-standardised incidence rates (x 100 000) of child protection activity by gender and age for all available years. Dotted lines show raw incidence rates whilst solid lines show adjusted GLMs with shaded 95% confidence intervals. Y axes vary for different child maltreatment indicators. GLMs = generalised linear models; NSPCC = National Society for Prevention of Cruelty to Children (UK).

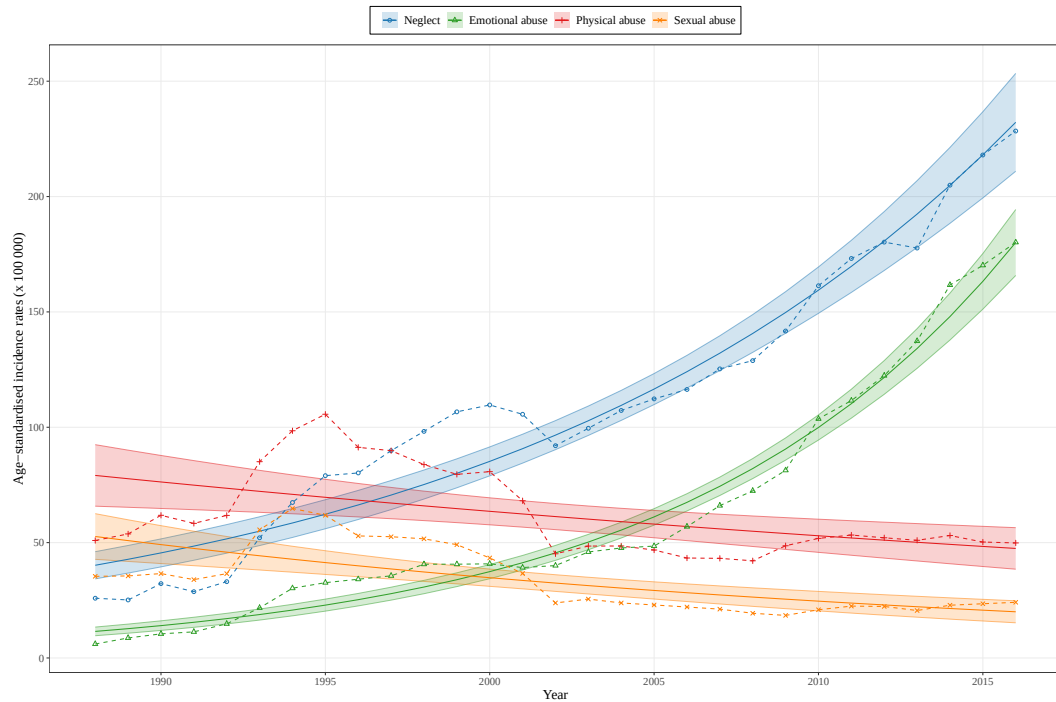


Figure C.7. Trends in annual incidence rates of child protection registrations by type of maltreatment (unadjusted GLMs).

Age-standardised incidence rates (x 100 000) of child protection registrations by type of maltreatment for all available years. Dotted lines show raw incidence rates whilst solid lines show unadjusted GLMs with shaded 95% confidence intervals. GLMs = generalised linear models.

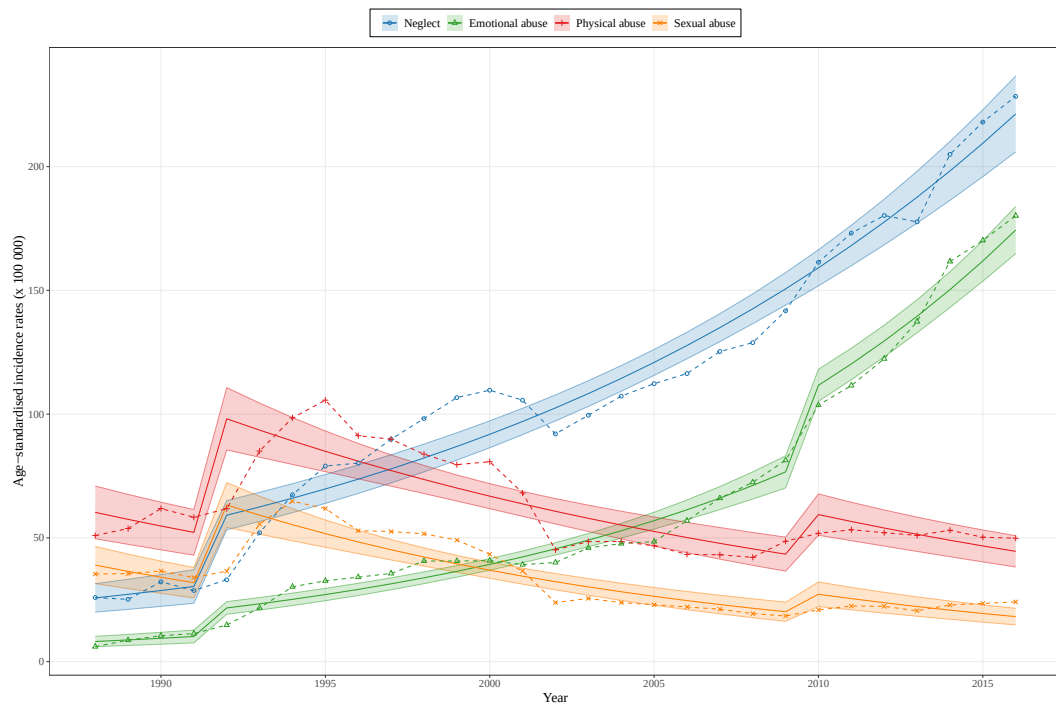


Figure C.8. Trends in annual incidence rates of child protection registrations by type of maltreatment (adjusted GLMs).

Age-standardised incidence rates (x 100 000) of child protection registrations by type of maltreatment for all available years. Dotted lines show raw incidence rates whilst solid lines show adjusted GLMs with shaded 95% confidence intervals. GLMs = generalised linear models.

**Appendix D Search terms & quality
assessment (Chapter 5)**

Tables

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Table D.1. Search strategy for Ovid (an electronic, searchable platform).

Key concepts	Study design	Child maltreatment	Antisocial behaviour
Searched in	Titles / abstracts / key words	Titles / abstracts / key words	Titles / abstracts / key words
Search terms	longitudinal* OR prospective* OR cohort OR “case-control” OR “case control” OR (follow* ADJ1 up) OR “follow-up” OR “repeated measures”	(child* ADJ4 maltreat*) OR (child* ADJ4 abuse*) OR (child* ADJ4 neglect*) OR (child* ADJ4 trauma*) OR (child* ADJ4 victim*) OR “battered child syndrome” OR (child* AJ3 adverse*) OR (child* ADJ5 depriv*)	“oppositional defiant disorder” OR conduct OR antisocial* OR dyssocial OR dissocial OR (callous* AND unemotional*) OR psychopath OR psychopathy OR psychopathic OR sociopath* OR (behavio* AND problem*) OR (disruptive AND behaving*) OR externalising OR externalizing OR “rule breaking” OR “rule-breaking” OR delinquen* OR offend* OR crime OR criminal* OR incarcerat* OR violent OR aggressive OR aggression

Notes. ADJ = Boolean operator that retrieves records containing terms within a specified number of words; AND = Boolean operator that retrieves only records that contains all search terms specified; OR = Boolean operator that retrieves records that contain any of the search terms specified.

Table D.2. Quality assessment of included studies.

Study	Selection & representativeness				Comparability			Outcome			Total stars (max. 9)
	Cases	Controls	Maltreatment measure	ASB at baseline	Gender, race, SES	Family factors	ASB measure	Length of follow-up	Attrition / response rate		
Bolger and Patterson (2001)	0	1	1	0	0	0	0	0	1	3	
P. Cohen et al. (2001)	1	1	1	0	1	0	1	1	1	7	
Cutajar et al. (2010)	0	1	1	0	1	0	1	1	1	6	
de Paul and Arruabar- rena (1995)	0	1	1	0	1	0	0	0	0	3	
Egeland et al. (2002)	0	1	1	0	0	0	1	1	0	4	
Famularo et al. (1992)	1	1	1	0	0	0	1	0	0	4	
Flynn et al. (2014)	0	1	1	0	0	0	0	1	0	3	
Godinet et al. (2014)	0	1	1	0	1	0	0	0	0	3	
Horwitz et al. (2001)	0	1	1	0	1	0	1	1	0	5	
Kaplan et al. (1998)	0	1	1	0	1	1	1	1	0	6	
Lansford et al. (2007)	1	1	0	1	1	1	1	1	0	7	
Lemmon (1999)	0	0	1	0	1	0	1	1	1	5	

Study	Selection & representativeness				Comparability			Outcome			Total stars (max. 9)
	Cases	Controls	Maltreatment measure	ASB at baseline	Gender, race, SES	Family factors	ASB measure	Length of follow-up	Attrition / response rate		
Ligezinska et al. (1996)	0	0	1	0	1	1	0	0	0	3	
Mills et al. (2013)	1	1	1	0	1	1	0	0	0	5	
Salzinger et al. (2007)	0	1	1	0	1	0	0	1	1	5	
Siegel and Williams (2003)	0	1	1	0	1	0	1	1	1	6	
Stouthamer- Loeber et al. (2001)	0	0	1	0	1	0	1	1	1	5	
Stouthamer- Loeber et al. (2002)	0	0	1	0	1	0	0	0	1	3	
Swanston et al. (2003)	0	1	1	0	1	1	1	1	0	6	
Thornberry et al. (2001)	1	1	1	0	1	1	0	1	0	6	
Toth and Cicchetti (1996)	0	0	1	0	0	0	0	0	0	1	
Trickett et al. (1991)	0	1	1	0	1	0	0	0	0	3	
Zingraff et al. (1994)	0	1	1	0	1	1	1	1	0	6	

Notes. Quality assessment tool is an adapted version of Newcastle–Ottawa Scale for case-control and cohort studies (Wells et al., 2000). Quality assessment is based on the outcome data extracted, not necessarily the overall study quality. ASB = antisocial behaviour; SES = socio-economic status.

Appendix E Longitudinal measurement invariance (Chapter 6)

Tables

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Methods

Longitudinal measurement invariance is the idea that a repeatedly measured variable carries the same meaning and the same scale (i.e. metric) across all time points. Models of change assume longitudinal measurement invariance, where changes across time are attributed to actual changes in the outcome of interest rather than changes to the metric. I explicitly tested this assumption by applying longitudinal confirmatory factor analysis (CFA) to three ordered-categorical indicators for antisocial behaviour in childhood (7, 11, 16y) and to three binary indicators for antisocial behaviour in adulthood (23, 33, 42, 50y; see Figure E.1). I sequentially specified and compared four hierarchical models: (1) configural invariance model, testing whether the same general pattern of factor loadings is consistent across time; (2) loading invariance model, constraining all factor loadings to be identical across time; (3) threshold invariance model, further constraining thresholds going from one response category to the next to be equal across time for each indicator; and (4) unique factor invariance, further constraining all unique factor variances and covariances to be equal across time (Liu et al., 2017; Liu & West, 2018; Mehta, Neale, & Flay, 2004). I adapted these models for adulthood as binary indicators only have one threshold. Because this one threshold is held constant in order to identify configural and loading invariance models, I was not able to test threshold invariance for adulthood (Millsap & Yun-Tein, 2004). All CFA models and specifications are described in Table E.1.

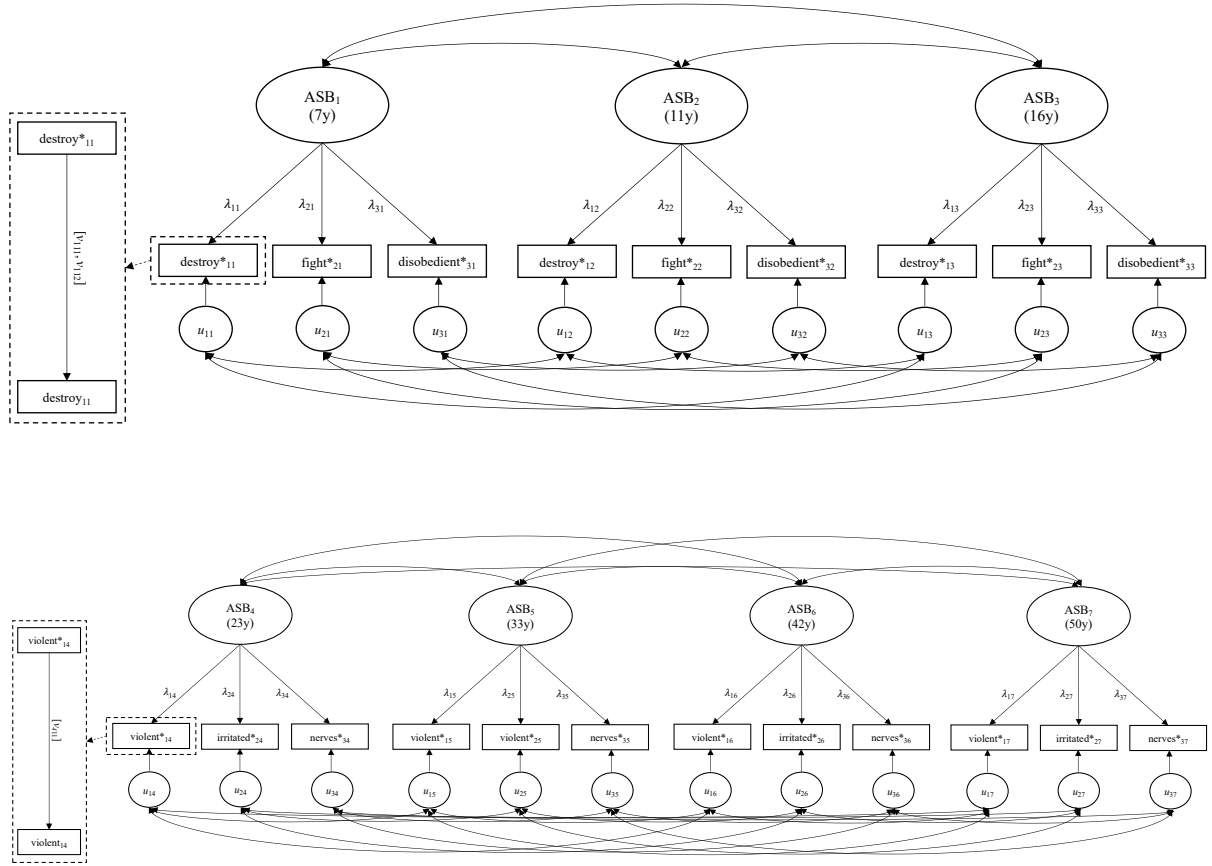


Figure E.1. Longitudinal confirmatory factor analysis testing measurement invariance of antisocial behaviour across three time-points for childhood (7, 11, 16y; *top panel*) and four time-points for adulthood (23, 33, 42, 50y; *bottom panel*).

Antisocial behaviour (ASB) represents latent common factors, λ represents factor loadings, and μ represents unique factors. The observed ordered-categorical indicators for childhood antisocial behaviour are destroy, fight, and disobedient, and the observed binary indicators for adulthood antisocial behaviour are violent rage, irritated, and nerves. Asterisk (*) indicators represent the continuous latent responses and τ represents the threshold parameters that slice the continuous latent response into the observed discrete values (i.e. response categories) for each indicator. To capture the data's longitudinal structure, common factors and unique factors are allowed to correlate across time (Liu et al., 2017).

Table E.1. Models for testing longitudinal measurement invariance with continuous, ordered-categorical and binary indicators.

Model	Additional constraints	Factor loadings	Factor means	Factor intercepts	Factor thresholds	Unique factor variances
Continuous indicators						
1. Configural invariance	Same general pattern of factor loadings is consistent across time	*	Fixed	*	n/a	*
2. Weak invariance	Factor loadings are equal across time	Fixed	Fixed	*	n/a	*
3. Strong invariance	Factor intercepts are equal across time	Fixed	Fixed	Fixed	n/a	*
4. Strict invariance	Unique factor variances (and non-zero within-wave covariances) are equal across time	Fixed	Fixed	Fixed	n/a	Fixed
Ordered-categorical indicators						
1. Configural invariance	Same general pattern of factor loadings is consistent across time	*	*	Fixed	*	*
2. Loading invariance	Factor loadings are equal across time	Fixed	*	Fixed	*	*
3. Threshold invariance	Factor thresholds going from one response category to the next are equal across time	Fixed	*	Fixed	Fixed	*
4. Unique factor invariance	Unique factor variances (and non-zero within-wave covariances) are equal across time	Fixed	*	Fixed	Fixed	Fixed

Appendix E. Longitudinal measurement invariance (Chapter 6)

Binary indicators						
1. Adapted configural invariance	Same general pattern of factor loadings is consistent across time and factor thresholds going from one response category to the next are equal across time	*	*	Fixed	Fixed	*
2. Adapted loading invariance	Factor loadings are equal across time	Fixed	*	Fixed	Fixed	*
3. Unique factor invariance	Unique factor variances (and non-zero within-wave covariances) are equal across time	Fixed	*	Fixed	Fixed	Fixed

Notes. The asterisk (*) indicates that the parameter is freely estimated (Edossa, Schroeders, Weinert, & Artelt, 2018). The table does not include additional constraints to the marker variable required for model identification (Liu & West, 2018).

The above approach parallels testing longitudinal measurement invariance for continuous indicators (configural vs. weak; weak vs. strong; strong vs. strict invariance). However, unlike continuous indicators, ordered-categorical indicators require adequate unique factor invariance model fit to establish measurement invariance (Liu et al., 2017; Liu & West, 2018). This more stringent criterion (strict rather than strong invariance) is difficult to meet and often results in measurement invariance violations. I gauged the practical significance of measurement invariance violations by comparing differences in model-predicted probabilities of choosing specific response categories. Model differences of ≥ 0.05 indicated a significant effect.

The weighted least squares mean and variance-adjusted (WLSMV) estimator with theta parameterization was used for all CFA models as WLSMV has been shown to be superior to maximum likelihood for categorical data (Beauducel & Herzberg, 2006). Theta parameterization was used because it considers unique variances as model parameters and therefore constraints may be directly placed on unique variances (Muthén & Asparouhov, 2002). Latent common factors do not have an inherent scale (i.e. unit of measurement). In order to identify scales

for latent common factors, I adopted the marker variable approach, where the loading of an observed variable was constrained to 1, giving latent common factors that scale. Model fit was evaluated using comparative fit index (CFI), root mean square error of approximation (RMSEA), where values of $CFI \geq 0.95$ and $RMSEA \leq .06$ indicated acceptable model fit (Hu & Bentler, 1999). When comparing nested models, inferior model fit was determined using $\Delta CFI \geq -.010$, supplemented by $\Delta RMSEA \geq -.015$ (Chen, 2007; Cheung & Rensvold, 2002). Because χ^2 goodness-of-fit and difference tests are overly sensitive to large sample sizes, I used CFI as the primary criterion (Sass, Schmitt, & Marsh, 2014; Steenkamp & Baumgartner, 1998). A corrected CFI was also calculated by specifying a more appropriate null model for ordered-categorical indicators (Liu et al., 2017; Wu & Estabrook, 2016).

Results

Tests supported longitudinal measurement invariance for childhood and adulthood anti-social behaviour (Table E.2). CFI and RMSEA values indicated adequate model fit for the configural, loading invariance, and threshold invariance models for childhood antisocial behaviour. The adapted configural and loading invariance models for adulthood antisocial behaviour also showed adequate fit. However, adequate model fit for unique factor invariance was undetermined. This was because there was significant model deterioration when adding unique factor invariance constraints to the threshold invariance model for childhood antisocial behaviour, and significant model deterioration when adding unique factor invariance constraints to the loading invariance model for adulthood antisocial behaviour. Sensitivity analyses examined the practical significance of these potential violations by comparing model-predicted probabilities of choosing a response category. Discrepancies in predicted probabilities for childhood antisocial behaviour are presented in Table E.3, which compares threshold invariance to unique factor invariance, and Table E.4 for adulthood antisocial behaviour, which compares adapted loading invariance to unique factor invariance. Neither sensitivity analyses found discrepancies greater than .05 in absolute value indicating that the practical significance of any violations of longitudinal measurement invariance were trivial.

Table E.2. Model fit indices for testing longitudinal measurement invariance for childhood and adulthood antisocial behaviour.

Model	χ^2 goodness-of-fit			CFI (de-fault)	CFI (cor-rected)	RMSEA	χ^2 difference test		
	Value	df	p				Value	df	p
Childhood antisocial behaviour (7–16y)									
1. Configural	33.558	15	0.004	0.997	0.998	0.012	n/a	n/a	n/a
2. Loading invariance	67.543	19	<.001	0.991	0.996	0.018	9.309	4	<.001
3. Threshold invariance	152.158	23	<.001	0.976	0.989	0.026	26.173	4	<.001
4. Unique factor invariance	524.044	29	<.001	0.909	0.957	0.046	51.929	6	<.001
Adulthood antisocial behaviour (23–50y)									
1. Adapted configural	53.118	27	0.002	0.997	0.998	0.011	n/a	n/a	n/a
2. Adapted loading invariance	284.879	33	<.001	0.975	0.977	0.031	35.059	6	<.001
3. Unique factor invariance	549.461	42	<.001	0.949	0.953	0.039	20.576	9	<.001

Notes. Values represent scaled model fit indices, including a Satorra–Bentler adjustment for χ^2 difference test, and are based on pooled analyses of 20 imputed datasets (n = 8088). CFI (corrected) is the corrected CFI value calculated using a more restricted null model that constrains all thresholds to be invariant across measurement occasions. For model specifications see Table E.1. CFI = comparative fit index; df = degrees of freedom; RMSEA = root mean square error of approximation; y = years; n/a = not applicable.

Table E.3. Discrepancies in predicted probabilities based on threshold invariance versus unique factor invariance models for childhood antisocial behaviour.

Indicator of childhood antisocial behaviour	Response category		
	<i>Never</i>	<i>Sometimes</i>	<i>Frequently</i>
Aged 7y			
Destroys/destroys belongings	0.008	-0.005	-0.003
Fights children	0.001	-0.006	0.004
Is disobedient	0.000	-0.010	0.010
Aged 11y			
Destroys/destroys belongings	-0.009	0.006	0.003
Fights children	0.015	-0.012	-0.002
Is disobedient	0.000	-0.002	0.003
Aged 16y			
Destroys/destroys belongings	-0.001	0.001	-0.001
Fights children	-0.022	0.023	-0.001
Is disobedient	-0.004	0.016	-0.012

Notes. Values greater than .05 in absolute value indicate significance discrepancies between threshold invariance versus unique factor invariance models for childhood antisocial behaviour (see Table E.1 & E.2). Missing data handled via pairwise deletion (n = 7935); y = years.

Table E.4. Discrepancies in predicted probabilities based on an adapted loading invariance versus unique factor invariance model for adulthood antisocial behaviour.

Indicator of adulthood antisocial behaviour	Response category	
	<i>No</i>	<i>Yes</i>
Aged 23y		
Often gets in a violent rage	0.009	-0.009
Often annoyed/irritated	-0.002	0.002
Things often get on your nerves	-0.011	0.011
Aged 33y		
Often gets in a violent rage	0.005	-0.005
Often annoyed/irritated	-0.003	0.003
Things often get on your nerves	-0.003	0.003
Aged 42y		
Often gets in a violent rage	-0.005	0.005
Often annoyed/irritated	0.008	-0.008
Things often get on your nerves	-0.001	0.001
Aged 50y		
Often gets in a violent rage	-0.019	0.019
Often annoyed/irritated	-0.004	0.004
Things often get on your nerves	0.012	-0.012

Notes. Values greater than .05 in absolute value indicate significance discrepancies between adapted loading invariance versus unique factor invariance models for adulthood antisocial behaviour (see Table E.1 & E.2). Missing data handled via pairwise deletion (n = 8088); y = years.

Appendix F Results based on complete case analyses (Chapter 6)

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Table F.1. Mean difference in antisocial behaviour from 7 to 50 years, by child maltreatment (complete case analysis).

	Childhood antisocial behaviour ^a					Adulthood antisocial behaviour ^b				
	7y	11y	16y	23y	33y	42y	50y			
Type of child maltreatment										
Neglect	0.46 (0.37 to 0.54)	0.44 (0.36 to 0.52)	0.31 (0.25 to 0.37)	0.14 (0.09 to 0.19)	0.14 (0.09 to 0.18)	0.06 (0.01 to 0.11)	0.12 (0.07 to 0.17)			
Emotional abuse	0.09 (-0.01 to 0.18)	0.10 (0.01 to 0.18)	0.20 (0.14 to 0.26)	0.20 (0.15 to 0.25)	0.25 (0.21 to 0.30)	0.26 (0.21 to 0.31)	0.22 (0.17 to 0.27)			
Physical abuse	0.22 (0.11 to 0.33)	0.29 (0.19 to 0.39)	0.23 (0.16 to 0.31)	0.18 (0.11 to 0.24)	0.23 (0.17 to 0.28)	0.20 (0.13 to 0.26)	0.12 (0.05 to 0.18)			
Sexual abuse	-0.03 (-0.25 to 0.20)	-0.01 (-0.22 to 0.20)	0.25 (0.09 to 0.40)	0.28 (0.16 to 0.41)	0.36 (0.25 to 0.47)	0.21 (0.09 to 0.33)	0.16 (0.04 to 0.28)			
No. of maltreatment types^c										
0	Ref	Ref	Ref	Ref	Ref	Ref	Ref			
1	0.25 (0.17 to 0.32)	0.26 (0.19 to 0.33)	0.23 (0.18 to 0.28)	0.15 (0.11 to 0.19)	0.15 (0.11 to 0.18)	0.13 (0.09 to 0.18)	0.16 (0.11 to 0.20)			
2	0.27 (0.13 to 0.41)	0.35 (0.22 to 0.48)	0.34 (0.25 to 0.43)	0.22 (0.14 to 0.30)	0.31 (0.24 to 0.38)	0.21 (0.13 to 0.29)	0.22 (0.14 to 0.29)			
3-4	0.26 (0.00 to 0.52)	0.21 (-0.02 to 0.44)	0.40 (0.23 to 0.57)	0.38 (0.24 to 0.53)	0.42 (0.28 to 0.55)	0.37 (0.23 to 0.52)	0.24 (0.10 to 0.38)			
<i>Per additional maltreatment</i>	0.16 (0.11 to 0.21)	0.17 (0.13 to 0.22)	0.18 (0.15 to 0.21)	0.13 (0.10 to 0.15)	0.15 (0.12 to 0.17)	0.12 (0.09 to 0.15)	0.12 (0.09 to 0.14)			

Notes. All coefficients are unadjusted and unstandardised (B (95% confidence interval)) and are based on complete cases (n range: 4426–8045). Coefficients for childhood (7–16y) and adulthood (23–50y) antisocial behaviour are not directly comparable.

^a Range 0–6, where higher scores indicate higher levels of antisocial behaviour.

^b Range 0–3, where higher scores indicate higher levels of antisocial behaviour.

^c Includes neglect, emotional, physical, sexual abuse.

Table F.2. Mean difference in initial level and rate of change in childhood antisocial behaviour, by child maltreatment (complete case analysis).

	Childhood antisocial behaviour (7–16y) ^a					
	Unadjusted			Adjusted for covariates ^b		
	Initial level	Rate of change	Initial level	Rate of change	Initial level	Rate of change
Type of child maltreatment						
Neglect	0.546 (0.060)***	-0.029 (0.007)***	0.416 (0.067)***	-0.024 (0.009)**	0.403 (0.069)***	-0.022 (0.009)*
Emotional abuse	0.063 (0.056)	0.011 (0.007)	0.027 (0.059)	0.012 (0.008)	-0.013 (0.068)	0.015 (0.009)
Physical abuse	0.257 (0.073)***	-0.002 (0.009)	0.154 (0.075)*	0.000 (0.009)	0.123 (0.091)	-0.010 (0.012)
Sexual abuse	-0.325 (0.156)*	0.069 (0.016)***	-0.304 (0.158)	0.061 (0.018)***	-0.328 (0.159)*	0.059 (0.019)**
No. of maltreatment types^c						
0	Ref	Ref	Ref	Ref	Ref	Ref
1	0.306 (0.049)***	-0.012 (0.006)*	0.231 (0.053)***	-0.009 (0.006)	n/a	n/a
2	0.230 (0.087)**	0.009 (0.012)	0.120 (0.095)	0.015 (0.014)	n/a	n/a
3–4	0.270 (0.198)	0.008 (0.022)	0.176 (0.217)	0.000 (0.026)	n/a	n/a
<i>Per additional maltreatment</i>	0.177 (0.031)***	-0.002 (0.004)	0.122 (0.033)***	0.000 (0.004)	n/a	n/a

Notes. All coefficients are unstandardised (*B* (standard error)) and are based on complete cases (n range: 4426–8045). Initial level (i.e. intercept) represents the level of antisocial behaviour at 7y and rate of change (i.e. slope) represents linear change from 7–16y.

^a Mean (standard error) for childhood antisocial behaviour (7–16y): initial level = 1.466 (0.014); rate of change = -0.123 (0.002).

^b Includes: sex; birth weight (adjusted for sex and gestational age); maternal age at birth; maternal smoking after 4 months of pregnancy; parent divorce/separation/desertion by 7y; parent death by 7y; family contact with mental health services by 11y; family contact with crime by 11y; socioeconomic position at birth; household crowding at 7y; and housing tenure at 7y.

^c Includes neglect, emotional, physical, sexual abuse.

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table F.3. Mean difference in initial level and rate of change in adulthood antisocial behaviour, by child maltreatment (complete case analysis).

Adulthood antisocial behaviour (23–50y) ^a						
Unadjusted			Adjusted for covariates ^b		Adjusted for covariates ^b & other maltreatment types ^c	
	Initial level	Rate of change	Initial level	Rate of change	Initial level	Rate of change
Type of child maltreatment						
Neglect	0.156 (0.031) ^{***}	-0.002 (0.001)	0.118 (0.036) ^{***}	-0.002 (0.002)	0.113 (0.037) ^{**}	-0.002 (0.002)
Emotional abuse	0.208 (0.032) ^{***}	0.002 (0.002)	0.161 (0.038) ^{***}	0.003 (0.002)	0.125 (0.045) ^{**}	0.004 (0.002)
Physical abuse	0.205 (0.039) ^{***}	-0.002 (0.002)	0.165 (0.044) ^{***}	-0.001 (0.002)	0.099 (0.054)	-0.002 (0.003)
Sexual abuse	0.344 (0.103) ^{***}	-0.006 (0.004)	0.277 (0.124) [*]	-0.005 (0.006)	0.170 (0.131)	-0.004 (0.006)
No. of maltreatment types ^c						
0	Ref	Ref	Ref	Ref	Ref	Ref
1	0.168 (0.026) ^{***}	-0.001 (0.001)	0.154 (0.030) ^{***}	-0.001 (0.001)	n/a	n/a
2	0.213 (0.049) ^{***}	0.001 (0.003)	0.146 (0.055) ^{**}	0.004 (0.003)	n/a	n/a
3–4	0.527 (0.142) ^{***}	-0.007 (0.007)	0.431 (0.148) ^{**}	-0.006 (0.008)	n/a	n/a
Per additional maltreatment	0.142 (0.017) ^{***}	-0.001 (0.001)	0.117 (0.019) ^{***}	0.000 (0.001)	n/a	n/a

Notes. All coefficients are unstandardised (B (standard error)) and are based on complete cases (n range: 4426–8045). Initial level (i.e. intercept) represents the level of antisocial behaviour at 23y, and rate of change (i.e. slope) represents linear change from 23–50y.

^a Mean (standard error) for adulthood antisocial behaviour (23–50y): initial level = 0.306 (0.006); rate of change = 0.002 (0.000).

^b Includes: sex; birth weight (adjusted for sex and gestational age); maternal age at birth; maternal smoking after 4 months of pregnancy; parent divorce/separation/desertion by 7y; parent death by 7y; family contact with mental health services by 11y; family contact with crime by 11y; socioeconomic position at birth; household crowding at 7y; and housing tenure at 7y.

^c Includes neglect, emotional, physical, sexual abuse.

* $p < .05$; ** $p < .01$; *** $p < .001$.

Appendix G Model fit indices & graphs for latent growth curve models (Chapter 6)

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Table G.1. Model fit indices for latent growth curve models for childhood antisocial behaviour.

Latent growth curve model	χ^2 goodness-of-fit			CFI	RMSEA	SRMR
	Value	df	p			
Unconditional	183.03	1	<.001	0.844	0.192	0.049
Conditional						
Type of child maltreatment						
Neglect	154.610	2	<.001	0.879	0.125	0.039
Emotional abuse	156.422	2	<.001	0.868	0.127	0.039
Physical abuse	156.867	2	<.001	0.871	0.126	0.040
Sexual abuse	172.329	2	<.001	0.865	0.132	0.039
No. of maltreatment types						
1	154.743	2	<.001	0.875	0.129	0.039
2	131.586	2	<.001	0.845	0.126	0.041
3–4	118.651	2	<.001	0.861	0.121	0.039
Per additional maltreatment	144.286	2	<.001	0.877	0.122	0.040

Notes. Values represent scaled model fit indices for unconditional and conditional latent growth curve models (unadjusted) based on complete case analyses (n range: 4920–6232). CFI = comparative fit index; df = degrees of freedom; RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = standardised root mean square residual.

Table G.2. Model fit indices for latent growth curve models for adulthood antisocial behaviour.

Latent growth curve model	χ^2 goodness-of-fit			CFI	RMSEA	SRMR
	Value	df	p			
Unconditional	134.501	5	<.001	0.93	0.064	0.041
Conditional						
Type of child maltreatment						
Neglect	144.062	7	<.001	0.932	0.058	0.036
Emotional abuse	145.219	7	<.001	0.930	0.057	0.036
Physical abuse	145.362	7	<.001	0.932	0.057	0.036
Sexual abuse	131.063	7	<.001	0.930	0.053	0.035
No. of maltreatment types						
1	143.208	7	<.001	0.924	0.060	0.037
2	126.340	7	<.001	0.914	0.060	0.039
3–4	122.978	7	<.001	0.898	0.060	0.041
Per additional maltreatment	137.464	7	<.001	0.931	0.058	0.036

Notes. Values represent scaled model fit indices for unconditional and conditional latent growth curve models (unadjusted) based on complete case analyses (n range: 4920–6232). CFI = comparative fit index; df = degrees of freedom; RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = standardised root mean square residual.

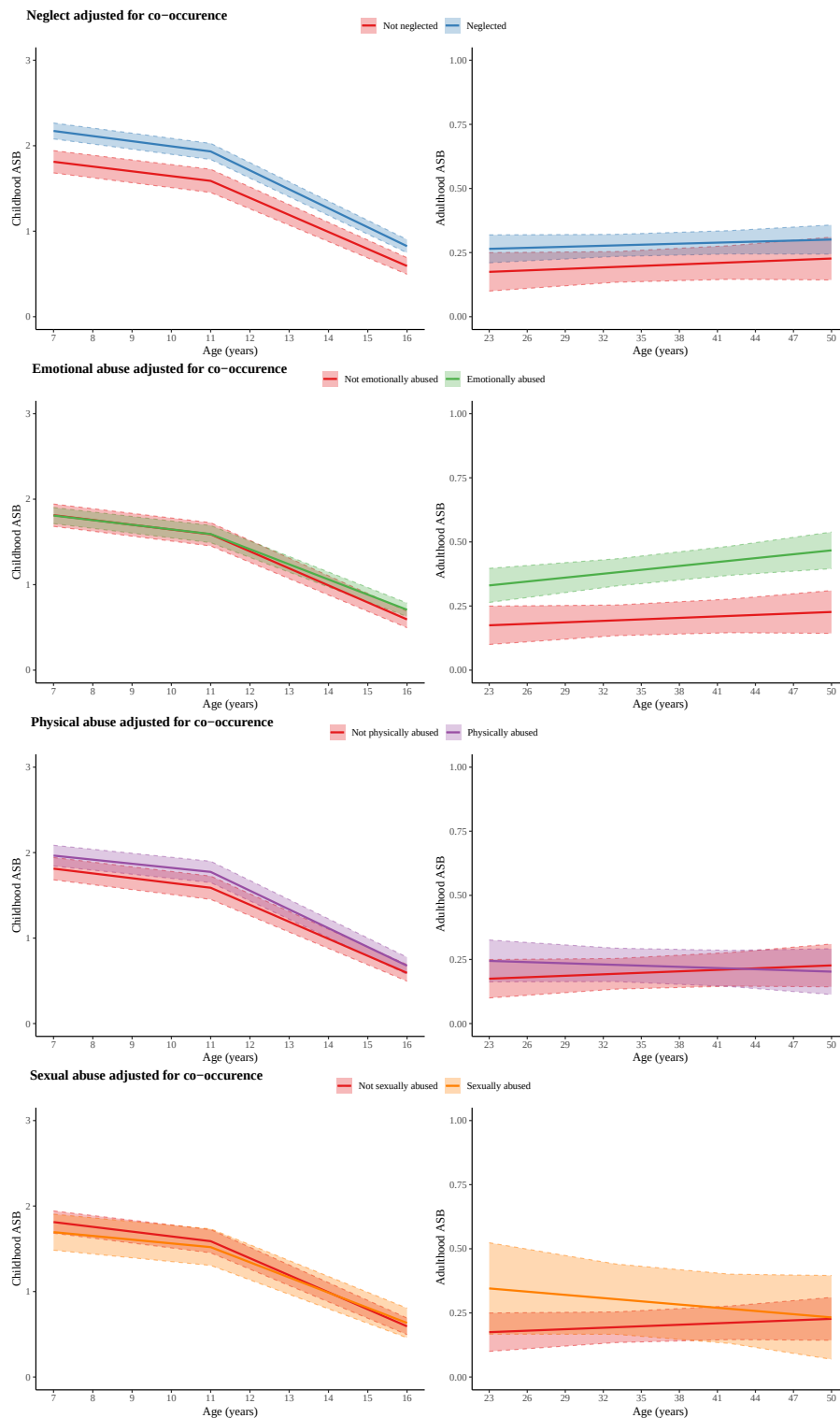


Figure G.1. Mean difference in initial level and rate of change in antisocial behaviour across childhood (7–16y) and adulthood (23–50y), by child maltreatment when adjusting for covariates and other maltreatment types.

Covariates include: sex; birth weight (adjusted for sex and gestational age); maternal age at birth; maternal smoking after 4 months of pregnancy; parent divorce/separation/desertion by 7y; parent death by 7y; family contact with mental health services by 11y; family contact with crime by 11y; socioeconomic position at birth; household crowding at 7y; and housing tenure at 7y. Maltreatment types include: neglect, emotional, physical, sexual abuse. Measures of antisocial behaviour are different for childhood (range: 0–6) and adulthood (range: 0–3). ASB = antisocial behaviour; y = years.

