

Child maltreatment and the risk of antisocial behaviour: a population-based cohort study spanning 50 years

Abstract

Background: Child maltreatment is associated with an increased risk of antisocial behaviour; however, whether this risk persists and remains stable across the life-course is undetermined.

Objective: To examine associations between child maltreatment and antisocial behaviour across the life-course.

Participants and setting: The study used 50 years of longitudinal data from the 1958 British birth cohort (n=8088) measuring child neglect (prospectively) and abuse (retrospectively) and antisocial behaviour from childhood-to-adulthood.

Methods: Latent growth curve models analysed the longitudinal course of antisocial behaviour across childhood (7-16years) and adulthood (23-50years) as a function of child maltreatment. We used directed acyclic graphs to identify, and adjust for, potential confounders (biological, family, social).

Results: Child maltreatment was associated with higher levels of antisocial behaviour at all seven timepoints across the life-course (7-50years). Antisocial behaviour was elevated during childhood and adulthood in individuals who were maltreated, independently of confounding factors. Individuals who experienced multiple types of maltreatment were at the greatest risk of antisocial behaviour. Each additional maltreatment type was associated with an increased risk during both childhood (B=0.173; SE=0.024; $p<.001$) and adulthood (B=0.137; SE=0.014; $p<.001$). There was limited evidence that child maltreatment was associated with within-person rates of change, indicating that the increased risk of antisocial behaviour 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. Our results highlight the burden of child maltreatment and the importance of providing long-term support for individuals who experience child maltreatment.

Key words: Child maltreatment; antisocial behaviour; latent growth curve modelling; longitudinal data; 1958 British birth cohort.

Introduction

Child maltreatment is a major public health problem; encompassing any acts of commission (abuse) or omission (neglect) that results in harm or potential for harm (Gilbert et al., 2009). In the UK, 0.5% of children are placed under child protection every year and 5%-15% of individuals report experiences of maltreatment at some point during their childhood (Degli Esposti, Taylor, Humphreys, & Bowes, 2018; May-Chahal & Cawson, 2005). A child who has experienced maltreatment is 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 associated with child maltreatment, and recent evidence suggests that this risk may persist from childhood into mid-adulthood (Braga, Cunha, & Maia, 2018; Scott, Knapp, Henderson, & Maughan, 2001; Widom, 2017; Wilson, Stover, & Berkowitz, 2009). However, it remains unclear whether child maltreatment is associated with a persistent and stable risk of antisocial behaviour across the life-course.

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; Malvaso, Delfabbro, & Day, 2018; Paolucci, Genuis, & Violato, 2001; Wilson et al., 2009). This approach does not capture the longitudinal course of antisocial behaviour and is unable to investigate whether child maltreatment is associated with 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. Clinical observation and research have previously found that the effects of adverse childhood experiences can wax and wane across the life-course (Briere, 1992; Briere & Runtz, 1988; Holmes, 2013). This variability may be related to specific developmental stages due to social and biological changes, such as developing relationships with peers and puberty. Alternatively, it may reflect significant delayed effects

of child maltreatment on antisocial behaviour (i.e. ‘sleeper effects’), worsening with time, or natural recovery where deleterious effects alleviate with time (Widom, 2017). 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, or is persistent and stable; then there is a need for interventions to extend beyond the childhood period to include adulthood.

Longitudinal cohort studies are able to investigate whether child maltreatment is associated with within-person change (Farrington, 1991). Existing analyses of these studies have been shaped by life-course theories of antisocial behaviour. Moffitt’s developmental taxonomy theory is one of the most valuable and influential life-course theories of antisocial behaviour (American Psychiatry Association, 1994; Fairchild, van Goozen, Calder, & Goodyer, 2013). The developmental taxonomy theory explains the age-crime curve, the observation that antisocial behaviour peaks in mid-adolescence and then decreases throughout late adolescence, by arguing that there are distinct subgroups who show different patterns of within-person change (e.g. adolescence-limited and life-course persistent trajectories) (Moffitt, 1993). 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. Assuming that trajectories are categorically instead of continuously distributed, and that researchers manage to identify the correct number of classes, this approach helps to identify at-risk subgroups (Bauer, 2007; Bauer & Curran, 2003). However, it does not directly examine the association between child maltreatment and within-person change, and thus is unable to determine whether the risk of antisocial behaviour changes over time. Additional

analytical approaches are needed to identify at what points during the life-course interventions may be best targeted.

Several theories have been developed to explain the association between child maltreatment and antisocial behaviour. Social learning theories argue that children acquire antisocial behaviour by modelling and reinforcement contingencies learned from social interactions (Bandura, 1973, 1978; Dodge, Bates, & Pettit, 1990). Children who experience or observe maltreatment may go on to show antisocial behaviours since they have learned that violence and aggression can be used to gain rewards. Social learning theories conceptualise antisocial behaviour as a learned behaviour, offering a strong explanation for the environmentally-mediated link between physical abuse and violent acts (Jaffee, Caspi, Moffitt, & Taylor, 2004). However, these theories are less able to explain why some children who are maltreated do not show antisocial behaviour (Topitzes, Mersky, Dezen, & Reynolds, 2013), or account for the well-documented association between other types of maltreatment (e.g. neglect) and antisocial acts in general (Braga et al., 2018).

The developmental psychopathological perspective conceptualises child maltreatment as an environmental risk that interacts in a complex and dynamic way with other risk (e.g. chronic illness) and protective factors (e.g. social support) across the life-course (Bowes & Jaffee, 2013; MacKenzie, Kotch, & Lee, 2011; Masten & Wright, 1998). Although child maltreatment is a risk factor, depriving children of the average expectable environment, it is not necessary or sufficient to cause antisocial behaviour (Cicchetti & Toth, 2016). Instead, a maltreated child is vulnerable to antisocial behaviour as they are likely to develop a suite of maladaptive responses, including biological, emotional, cognitive, and interpersonal features, that reflect coping strategies or altered calibration to their maltreating environments (McCrory & Viding, 2015; Schimmenti, Di Carlo, Passanisi, & Caretti, 2015). This explains why some children who are maltreated do not show antisocial behaviour (Cicchetti & Toth, 2016;

Topitzes et al., 2013). It further explains why there is an association between child maltreatment and antisocial behaviour generally since each type of maltreatment acts as a risk factor. The developmental psychopathology perspective has many parallels with the idea of cumulative risk (also ‘polyvictimization’) – where the number of maltreatment types (i.e. risk factors) rather than a specific type (i.e. physical abuse) – confers the greatest risk of antisocial behaviour (Felitti et al., 1998; Finkelhor, Ormrod, & Turner, 2007; MacKenzie et al., 2011; Masten & Wright, 1998).

In this study, we add to the current literature by investigating whether child maltreatment is associated with a persistent and stable risk of antisocial behaviour from childhood through to mid-adulthood (7-50years). We 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, we aim to answer the following questions: 1) Is child maltreatment associated with a persistent risk of antisocial behaviour across the life-course? 2) Does the magnitude of this risk change with time or is it stable across the life-course? We also aim to examine whether specific types of maltreatment or the number of maltreatment types confers the greatest risk of antisocial behaviour across the life-course.

Method

Sample

This study is a secondary data analysis of the 1958 British birth cohort study. 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 16 years (y) ($n = 920$). 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 S1 available online). 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).

Measures

Child maltreatment

Prospective information on neglect was collected at 7 and 11y from structured interviews with the child's parent (typically mother) and from questionnaires completed by their teacher. In line with methodological recommendations for measuring neglect in this cohort study (Denholm, Power, Thomas, & Li, 2013), we selected and summed 11 indicators of neglect to derive a summed score (range: 0-11). We then created a binary variable, where participants scoring ≥ 3 on at least 6 indicators were classified as neglected. This measure of neglect was derived based on the best available measures collected at the time, while the cut-off threshold was informed by UK prevalence estimates for neglect (Denholm et al., 2013). The measure has since been externally validated in a series of published studies (Archer, Pinto Pereira, & Power, 2017; Geoffroy, Pinto Pereira, Li, & Power, 2016; Li, Pereira, & Power, 2019).

Retrospective information on experiences of parental maltreatment during childhood (0-16y) 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). Consistent with previous studies, we created three binary variables for emotional, physical, and sexual abuse (Archer et al., 2017; Geoffroy et al., 2016). For definitions and variables for measures of child maltreatment see Table S1 available online. All measures of child maltreatment related to experiences in which parents were the perpetrator. While there are other important types of victimisation against children and adolescents (e.g., peer victimisation), these were beyond the scope of this study which focused specifically on parental maltreatment.

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. Recent meta-analytical evidence found poor agreement between prospective and retrospective measures of child maltreatment (Baldwin, Reuben, Newbury, & Danese, 2019), we therefore conducted a sensitivity analysis to check whether combining the prospective measure of neglect with retrospective measures of emotional, physical and sexual abuse changed our findings. We found no substantial differences when excluding neglect (range: 0-3) or including neglect (range: 0-4) in the summed scores for number of maltreatment types. Both summed scores showing the same pattern of significant ($p < .05$) and non-significant ($p \geq .05$) associations with antisocial behaviour across the life-course. Thus, we only report the summed score including neglect here.

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, we 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, we 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, we created a composite measure for childhood antisocial behaviour (range: 0-6) and adulthood antisocial behaviour (range: 0-3) by summing their respective indicators. We 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, 2007). All antisocial behaviour scores were significantly associated with externalising behaviour and criminality ($p < .001$), with effect sizes ranging from small to large depending on temporal proximity (r range: 0.11-0.45). These additional measures of antisocial behaviour, externalising behaviour and criminality, were only collected at one time-point and therefore could not be included in our main analyses since latent growth curve modelling requires repeated measures over time.

Longitudinal measurement invariance of antisocial behaviour

We 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. We tested whether it was reasonable to assume that our

metrics for antisocial behaviour were broadly the same across childhood (7-16y) and, separately, across adulthood (23-50y). We 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. We also explored the practical significance of potential violations of longitudinal measurement invariance by comparing predicted probabilities for less versus more restrictive measurement models (Liu et al., 2017; Liu & West, 2018). These potential violations were trivial, further indicating that our measures of antisocial behaviour were reliable over time. Full details are presented in online supplementary material (https://osf.io/njctw/?view_only=6809adac4ed248249e928d594a931991).

Covariates

We used directed acyclic graphs (DAGs) to identify covariates to include in our adjusted models (see Figures S2-S5). DAGs are a useful tool in modern epidemiology which can inform decisions about the optimal analytic strategy for estimating causal effects (Hernán, Hernández-Díaz, Werler, & Mitchell, 2002). They are probabilistic graphical models that represent the associated network of interrelated variables and can be used to effectively identify key covariates for adjusting for confounding (Austin, Desrosiers, & Shanahan, 2019). In order to estimate the causal effect of child maltreatment on antisocial behaviour, confounding pathways or “backdoor pathways” need to be blocked and d-separation (directed separation) should be achieved; i.e., there is conditional independence between child maltreatment and antisocial behaviour (Pearl, 1995). When d-separation cannot be achieved – as in this study – DAGs help to illuminate potential sources of bias (Austin et al., 2019).

We populated our DAGs based on previous literature and theory on biological, family, and social factors that may confound the association between 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: socioeconomic 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.

Statistical Analyses

Prior to main analyses, we 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. We fitted unconditional LGCMs to the repeated measures of antisocial behaviour (model specifications are depicted in Figure 1). 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, we 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, we 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. We adjusted all conditional LGCMs for sex only, all covariates listed above (including sex), and then all covariates plus other types of child maltreatment to control for maltreatment co-occurrence. 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).

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 standardized root mean square residual (SRMR <0.05) (Preacher, Wichman, Briggs, & MacCallum, 2008). We 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, we plotted model-fitted estimates and corresponding 95% confidence intervals (CIs).

Missing data

The study sample was broadly representative of the surviving cohort (Atherton, Fuller, Shepherd, Strachan, & Power, 2008). To minimise data loss, we 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%) (Little & Rubin, 2014). 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, internalizing and externalizing 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; we therefore report results based on multiple imputation in the manuscript and results from complete case analyses in online supplementary material (https://osf.io/njctw/?view_only=6809adac4ed248249e928d594a931991).

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 1). The strength of correlations among types of child maltreatment were small to moderate, with emotional and physical abuse showing the strongest association (Table S2). The mean antisocial behaviour score decreased across childhood from 7y to 16y but was relatively stable across adulthood from 23y to 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 (Table 3). 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; e.g., at 7y each additional maltreatment type was associated with higher levels of antisocial behaviour (B: 0.17; 95% CI: 0.13 to 0.22; $p < .001$).

Figure 1 graphically represents unconditional LGCMs and corresponding parameter estimates are presented in Table 3 (see footnote). In the unconditional LGCMs, the mean level of antisocial behaviour at 7y for all individuals was 1.466 (SE: 0.014), which then decreased steeply and linearly across childhood from 7 to 16y (mean rate of change: -0.123; SE: 0.002). This translated to a relative reduction in child antisocial behaviour of 8.4% each year. For all individuals, the mean level of antisocial behaviour at 23y was 0.306 (SE: 0.006). Adult antisocial behaviour showed a shallow linear increase of less than 0.7% each year from 23 to 50y (mean rate of change: 0.002; SE: 0.000).

Model fit indices showed that all adjusted LCGMs for childhood antisocial behaviour, and all unadjusted and adjusted LCGMs for adulthood antisocial behaviour showed good model fit. Model fit for unadjusted LCGMs only showed reasonable fit, with one model fit

index indicating adequate fit (SRMRs all $<.05$). Model fit indices for LCGMs are shown in Table S3 (available online). Figure 2 and Table 3 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 ; $p<.001$). Although this association persisted across childhood, it significantly decreased over time as neglect was also associated 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. Across childhood, antisocial behaviour was therefore consistently 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 (see Table 3). As a result, all four types of child maltreatment were associated with an elevated and stable risk of antisocial behaviour across adulthood. Individuals who were neglected showed the smallest increase in antisocial behaviour compared to individuals who were not neglected ($B_3: 0.145$; SE: 0.026 ; $p<.001$), while individuals who were sexually abused showed the largest increase compared to individuals who were not sexually abused ($B_3: 0.357$; SE: 0.084 ; $p<.001$).

The number of maltreatment types was associated with higher levels of antisocial behaviour (see Figure S6 available online). Each additional type of child maltreatment corresponded to a significant increase in antisocial behaviour during childhood (B_0 : 0.173; SE: 0.024; $p < .001$) and adulthood (B_3 : 0.137; SE: 0.014; $p < .001$). These associations did not significantly change across childhood or adulthood.

Sex-adjusted models identified that each type of maltreatment was associated with higher levels of antisocial behaviour at 7y (Table 3). Although neglect continued to be associated with a steeper rate of change across childhood (β_1 : -0.016; SE: 0.006; $p = .010$), emotional and sexual abuse were no longer significantly associated with a shallower decrease in antisocial behaviour across childhood after adjusting for sex. Sex-adjusted models for adult antisocial behaviour showed the same associations as unadjusted models, where all types of maltreatment were associated with an elevated stable risk of antisocial behaviour across adulthood. Adjusting for all covariates, including sex, attenuated but minimally impacted associations between maltreatment and antisocial behaviour across childhood and adulthood. On the other hand, adjusting for all covariates plus other types of maltreatment impacted the significance of some associations. For example, the association between higher levels of adult antisocial behaviour and physical abuse and sexual abuse at 23y was no longer significant after adjusting for maltreatment co-occurrence (B_2 : 0.070; SE: 0.042; $p = .095$ and B_2 : 0.171; SE: 0.091; $p = .061$, respectively).

Discussion

We used a large, population-based cohort to investigate whether child maltreatment is associated with a persistent and 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 higher during childhood and 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.

Our longitudinal analysis of a nationally representative UK sample highlights the long-reaching impacts of child maltreatment. We 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. Our 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 et al., 2017; Kisely et al., 2018).

Unlike previous studies however, we 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. We found limited evidence to suggest that the risk of antisocial behaviour changed across the life-course, neither improving nor 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. In contrast, the majority of clinical interventions are designed to be delivered exclusively in childhood (eg, Nurse-Family Partnership, Child-Parent Psychotherapy) (MacMillan et al., 2009). While early intervention is critical, many individuals who are maltreated do not come to the attention of authorities until adulthood. Our results highlight the importance of tailored long-term support; extending clinical interventions beyond the childhood period to include adulthood.

We also identified sub-groups that were particularly at risk of antisocial behaviour. After controlling 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”), our results also identified neglect and emotional abuse as significant risk factors (Widom, 2017). This indicates that a simple social learning mechanism, where individuals model behaviours that they observe, may not fully explain the relationship between child maltreatment and antisocial behaviour (Bandura, 1973, 1978; Dodge et al., 1990). 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, we 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 findings on cumulative burden, which shows that the number of adverse experiences rather than the type is the main predictor of poor outcomes (Finkelhor et al., 2007; Hughes et al., 2017; Jonson-Reid, Kohl, & Drake, 2012; Masten & Wright, 1998).

Furthermore, child maltreatment has been linked with an increased risk of experiencing additional trauma throughout their lives, which in turn adds to its cumulative burden (Schimmenti, 2018). Together this evidence highlights the importance of recognising the equivalence of harms for all types of maltreatment, early intervention, and that shifting a focus to cumulative risk may be a more helpful approach for guiding public health and clinical intervention.

Despite our study having many strengths, there are also several limitations to consider. First, we 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, & Woodward, 2000; Widom, Raphael, & DuMont, 2004). Since we exclusively rely on retrospective self-report to measure emotional, physical and sexual abuse, our findings may be subject to measurement errors from recall bias, forgetting, the subjective interpretation of event(s), socially desirable responding, changing societal norms in parenting practices over the last 50 years, and confounding from current mood and mental health, and should be interpreted with caution (Hardt & Rutter, 2004).

In order to minimise such biases introduced by retrospective self-report, we excluded vague questions that are particularly prone to recall bias and subjective interpretative (e.g., “I was neglected”), and restricted our analyses to questions about specific childhood experiences (e.g., “I was physically abused by a parent – punched, kicked or hit or beaten with an object, or needed medical treatment”; Table S1). The validity of our retrospective measures of child maltreatment may have been further improved if the 1958 British birth cohort study had used

an investigator- based interview method, such as the Childhood Experiences of Care and Abuse (CECA), instead of a computer assisted self-interviewing questionnaire (Bifulco, Brown, & Harris, 1994). However, our prevalence estimates were comparable to other UK-wide studies measuring different types of maltreatment (Denholm et al., 2013; May-Chahal & Cawson, 2005). For instance, a national survey conducted by the National Society for the Prevention of Cruelty to Children in 1999 identified that 1% of children reported sexual abuse with contact by parents and less than 1% reported non-contact abuse with parents (May-Chahal & Cawson, 2005). This is consistent with our study's 1.4% estimate for parental sexual abuse (contact and non-contact). We note that this estimate appears lower than other study estimates for sexual abuse (1.4% vs. 5-15%) since our measure captures sexual abuse perpetrated by parents only, which is a subset of all cases of sexual abuse (Stoltenborgh, van IJzendoorn, Euser, & Bakermans-Kranenburg, 2011; US Department of Health and Human Services, 2006).

It is also important to note that our retrospective measures for emotional, physical, and sexual abuse share commonalities in informant and timing with our measures for antisocial behaviour across adulthood, especially at aged 42 and 50 years old. Consequently, the estimated associations between child maltreatment and adult antisocial behaviour may be inflated due to shared measurement error. Although neglect was measured using prospective parental- and teacher-report, this measure was also limited as we were unable to assess for neglect during adolescence (>11 years old). In addition, we found that our 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 be explained by the documented poor agreement between prospective and retrospective measures of child maltreatment – different measurement types identify largely different subgroups of

individuals (Baldwin et al., 2019). Although this means that caution should be taken when comparing our retrospective measures of abuse to our prospective measure of neglect, it does not mean that both measures are not capturing important information about adverse childhood experiences.

Second, because this study aimed to comprehensively examine change in antisocial behaviour across the life-course we 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”). These indicators capture the social and physical aggression dimensions of antisocial behaviour but fall short in adequately measuring the rule-breaking dimension (Burt & Donnellan, 2009). Thus, our measure of adult antisocial measure may also capture other types of psychopathology or personality traits, such as depression or negative emotionality, which may explain the why females showed slightly higher levels of adult antisocial behaviour than males. To address this concern, we tested the validity of these measures of antisocial behaviour and found they were highly correlated with externalising behaviour in childhood and criminality in adulthood. These measures of externalising behaviour and criminality were unable to be included in our main analyses since they were only collected at one timepoint. Although these results favour the interpretation that we are measuring key dimensions of antisocial behaviour across adulthood, they are unable to eliminate the possibility that we are also capturing related constructs, particularly negative emotionality (Burt & Donnellan, 2009).

We were 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, we 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 so that future research is able to soundly measure and model the longitudinal course of psychopathologies over time.

Third, a subset of the LGCMs were limited by statistical power, which should be considered when interpreting the findings. Although the majority of the LCGMs showed good model fit, the unadjusted models for childhood antisocial behaviour only showed reasonable fit. This poorer model fit was because antisocial behaviour did not follow a strictly linear decrease across childhood but was better modelled by curvilinear decrease, where there was a larger decrease between the ages 11 and 16y compared to 7 and 11y (see Table 1). We were unable to adequately model this curvilinear decrease as there were only three available time-points across childhood. These analyses were thus limited by statistical power. The LGCMs examining the associations between sexual abuse and antisocial behaviour were also limited by statistical power. Across imputed datasets, around 120 individuals indicated that they had experienced childhood sexual abuse. Consequently, these LGCMs may be underpowered to detect any significant associations between sexual abuse and childhood antisocial behaviour. This is somewhat implied by the fact that coefficients for sexual abuse and antisocial behaviour were associated with larger standard errors than any other type of maltreatment (see Figure 2 and Table 3).

Fourth, 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 our 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 et al., 2016). We 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, particularly because it is plausible that the missing data mechanism is missing not at random (MNAR). Since the validity of multiple imputation relies on a missing at random (MAR) assumption, missing data biases in this study may result in underestimating the relationship between child maltreatment and antisocial behaviour across the life course (Sterne et al., 2009). We note however that our reported associations for child maltreatment and *adult* antisocial behaviour are more likely to represent liberal estimates given the shared measurement bias (see above for full discussion).

Finally, even though we adjusted associations for several biological, family and social characteristics, our DAGs identified the potential of residual confounding from unmeasured factors, such as genetics (Jaffee et al., 2004). Our DAGs also underlined the fact that our retrospective measures of abuse may be related to our outcome, antisocial behaviour. Thus, the associations between child abuse (emotional, physical, sexual) and antisocial behaviour may be further confounded by reverse causation. As a result, our findings do not determine causality but point towards a probabilistic relationship between child maltreatment and antisocial behaviour across the life-course.

In conclusion, our results provide longitudinal evidence that child maltreatment is associated with a persistent and stable risk of antisocial behaviour across a 50-year period. To better understand the burden of maltreatment on individuals and societies it is important to not underestimate the long-reaching impacts of child maltreatment. To begin to reduce the burden of child maltreatment, clinicians and policymakers should aim to emphasise both early intervention and long-term support, including tailoring interventions for older adults who experienced maltreatment as a child.

References

- American Psychiatry Association. (1994). Diagnostic and statistical manual of mental disorders (DSM-IV). *American Psychiatry Association, Washington, DC.*
- Archer, G., Pinto Pereira, S., & Power, C. (2017). Child maltreatment as a predictor of adult physical functioning in a prospective British birth cohort. *BMJ Open*, *7*(10), e017900. <https://doi.org/10.1136/bmjopen-2017-017900>
- Assink, M., van der Put, C. E., Hoeve, M., de Vries, S. L. A., Stams, G. J. J. M., & Oort, F. J. (2015). Risk factors for persistent delinquent behavior among juveniles: A meta-analytic review. *Clinical Psychology Review*, *42*, 47–61. <https://doi.org/10.1016/j.cpr.2015.08.002>
- Atherton, K., Fuller, E., Shepherd, P., Strachan, D. P., & Power, C. (2008). Loss and representativeness in a biomedical survey at age 45 years: 1958 British birth cohort. *Journal of Epidemiology & Community Health*, *62*(3), 216–223. <https://doi.org/10.1136/jech.2006.058966>
- Austin, A. E., Desrosiers, T. A., & Shanahan, M. E. (2019). Directed acyclic graphs: An under-utilized tool for child maltreatment research. *Child Abuse & Neglect*, *91*, 78–87. <https://doi.org/10.1016/j.chiabu.2019.02.011>
- Baldwin, J. R., Reuben, A., Newbury, J. B., & Danese, A. (2019). Agreement Between Prospective and Retrospective Measures of Childhood Maltreatment: A Systematic Review and Meta-analysis. *JAMA Psychiatry*, *76*(6), 584–593. <https://doi.org/10.1001/jamapsychiatry.2019.0097>
- Bandura, A. (1973). *Aggression: A social learning analysis*. Oxford, England: Prentice-Hall.
- Bandura, A. (1978). Social learning theory of aggression. *Journal of Communication*, *28*(3), 12–29.

- Bauer, D. J. (2007). Observations on the use of growth mixture models in psychological research. *Multivariate Behavioral Research*, 42(4), 757–786.
- Bauer, D. J., & Curran, P. J. (2003). Distributional assumptions of growth mixture models: Implications for overextraction of latent trajectory classes. *Psychological Methods*, 8(3), 338.
- Bifulco, A., Brown, G. W., & Harris, T. O. (1994). Childhood Experience of Care and Abuse (CECA): A retrospective interview measure. *Journal of Child Psychology and Psychiatry*, 35(8), 1419–1435.
- Bowes, L., & Jaffee, S. R. (2013). Biology, genes, and resilience: Toward a multidisciplinary approach. *Trauma, Violence, & Abuse*, 14(3), 195–208.
<https://doi.org/10.1177/1524838013487807>
- Braga, T., Cunha, O., & Maia, Â. (2018). The enduring effect of maltreatment on antisocial behavior: A meta-analysis of longitudinal studies. *Aggression and Violent Behavior*, 40, 91–100. <https://doi.org/10.1016/j.avb.2018.04.003>
- Briere, J. (1992). Methodological issues in the study of sexual abuse effects. *Journal of Consulting and Clinical Psychology*, 60(2), 196.
- Briere, J., & Runtz, M. (1988). Symptomatology associated with childhood sexual victimization in a nonclinical adult sample. *Child Abuse & Neglect*, 12(1), 51–59.
- Burt, S. A. (2009). Are there meaningful etiological differences within antisocial behavior? Results of a meta-analysis. *Clinical Psychology Review*, 29(2), 163–178.
- Burt, S. A., & Donnellan, M. B. (2009). Development and validation of the Subtypes of Antisocial Behavior Questionnaire. *Aggressive Behavior: Official Journal of the International Society for Research on Aggression*, 35(5), 376–398.
- Cicchetti, D., & Toth, S. L. (2016). Child maltreatment and developmental psychopathology: A multilevel perspective. In *Developmental psychopathology: Maladaptation and*

- psychopathology, Vol. 3, 3rd ed* (pp. 457–512). Hoboken, NJ, US: John Wiley & Sons Inc.
- Clark, C. (2007). Childhood and adulthood psychological ill health as predictors of midlife affective and anxiety disorders: The 1958 British birth cohort. *Archives of General Psychiatry, 64*, 668–678.
- Colman, I., Kingsbury, M., Garad, Y., Zeng, Y., Naicker, K., Patten, S., ... Thompson, A. H. (2016). Consistency in adult reporting of adverse childhood experiences. *Psychological Medicine, 46*(03), 543–549.
<https://doi.org/10.1017/S0033291715002032>
- 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. <https://doi.org/10.1371/journal.pone.0201223>
- Denholm, R., Power, C., Thomas, C., & Li, L. (2013). Child maltreatment and household dysfunction in a British birth cohort. *Child Abuse Review, 22*(5), 340–353.
<https://doi.org/10.1002/car.2235>
- Dodge, K. A., Bates, J. E., & Pettit, G. S. (1990). Mechanisms in the cycle of violence. *Science, 250*(4988), 1678–1683. <https://doi.org/10.1126/science.2270481>
- Dong, M., Anda, R. F., Felitti, V. J., Dube, S. R., Williamson, D. F., Thompson, T. J., ... Giles, W. H. (2004). The interrelatedness of multiple forms of childhood abuse, neglect, and household dysfunction. *Child Abuse & Neglect, 28*(7), 771–784.
<https://doi.org/10.1016/j.chiabu.2004.01.008>
- Enders, C. K. (2010). *Applied missing data analysis*. New York: Guilford Press.
- Fairchild, G., van Goozen, S. H. M., Calder, A. J., & Goodyer, I. M. (2013). Research review: Evaluating and reformulating the developmental taxonomic theory of antisocial

- behaviour. *Journal of Child Psychology and Psychiatry*, 54(9), 924–940.
<https://doi.org/10.1111/jcpp.12102>
- Farrington, D. P. (1991). Longitudinal research strategies: Advantages, problems, and prospects. *Journal of the American Academy of Child & Adolescent Psychiatry*, 30(3), 369–374. <https://doi.org/10.1097/00004583-199105000-00003>
- Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., ... Marks, J. S. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *American Journal of Preventive Medicine*, 14(4), 245–258.
- Fergusson, D. M., Horwood, L. J., & Woodward, L. J. (2000). The stability of child abuse reports: A longitudinal study of the reporting behaviour of young adults. *Psychological Medicine*, 30(3), 529–544.
- Finkelhor, D., Ormrod, R. K., & Turner, H. A. (2007). Polyvictimization and trauma in a national longitudinal cohort. *Development and Psychopathology*, 19(01).
<https://doi.org/10.1017/S0954579407070083>
- Geoffroy, M.-C., Pinto Pereira, S., Li, L., & Power, C. (2016). Child neglect and maltreatment and childhood-to-adulthood cognition and mental health in a prospective birth cohort. *Journal of the American Academy of Child & Adolescent Psychiatry*, 55(1), 33–40. <https://doi.org/10.1016/j.jaac.2015.10.012>
- Gilbert, R., Widom, C. S., Browne, K., Fergusson, D., Webb, E., & Janson, S. (2009). Burden and consequences of child maltreatment in high-income countries. *Lancet*, 373(9657), 68–81. [https://doi.org/10.1016/S0140-6736\(08\)61706-7](https://doi.org/10.1016/S0140-6736(08)61706-7)
- Hardt, J., & Rutter, M. (2004). Validity of adult retrospective reports of adverse childhood experiences: Review of the evidence. *Journal of Child Psychology and Psychiatry*, 45(2), 260–273. <https://doi.org/10.1111/j.1469-7610.2004.00218.x>

- Hernán, M. A., Hernández-Díaz, S., Werler, M. M., & Mitchell, A. A. (2002). Causal knowledge as a prerequisite for confounding evaluation: An application to birth defects epidemiology. *American Journal of Epidemiology*, *155*(2), 176–184.
- Holmes, M. R. (2013). The sleeper effect of intimate partner violence exposure: Long-term consequences on young children's aggressive behavior. *Journal of Child Psychology and Psychiatry*, *54*(9), 986–995.
- Hughes, K., Bellis, M. A., Hardcastle, K. A., Sethi, D., Butchart, A., Mikton, C., ... Dunne, M. P. (2017). The effect of multiple adverse childhood experiences on health: A systematic review and meta-analysis. *Lancet Public Health*, *2*(8), e356–e366.
[https://doi.org/10.1016/S2468-2667\(17\)30118-4](https://doi.org/10.1016/S2468-2667(17)30118-4)
- Jaffee, S. R., Caspi, A., Moffitt, T. E., & Taylor, A. (2004). Physical maltreatment victim to antisocial child: Evidence of an environmentally mediated process. *Journal of Abnormal Psychology*, *113*(1), 44–55. <https://doi.org/10.1037/0021-843X.113.1.44>
- Jonson-Reid, M., Kohl, P. L., & Drake, B. (2012). Child and adult outcomes of chronic child maltreatment. *Pediatrics*, *129*(5), 839.
- Kisely, S., Abajobir, A. A., Mills, R., Strathearn, L., Clavarino, A., & Najman, J. M. (2018). Child maltreatment and mental health problems in adulthood: Birth cohort study. *British Journal of Psychiatry*, 1–6. <https://doi.org/10.1192/bjp.2018.207>
- Li, L., Pereira, S. M. P., & Power, C. (2019). Childhood maltreatment and biomarkers for cardiometabolic disease in mid-adulthood in a prospective British birth cohort: Associations and potential explanations. *BMJ Open*, *9*(3), e024079.
<https://doi.org/10.1136/bmjopen-2018-024079>
- Little, R. J., & Rubin, D. B. (2014). *Statistical analysis with missing data* (Vol. 333). John Wiley & Sons.

- Liu, Y., Millsap, R. E., West, S. G., Tein, J.-Y., Tanaka, R., & Grimm, K. J. (2017). Testing measurement invariance in longitudinal data with ordered-categorical measures. *Psychological Methods*, 22(3), 486–506. <https://doi.org/10.1037/met0000075>
- Liu, Y., & West, S. G. (2018). Longitudinal measurement non-invariance with ordered-categorical indicators: How are the parameters in second-order latent linear growth models affected? *Structural Equation Modeling: A Multidisciplinary Journal*, 0(0), 1–16. <https://doi.org/10.1080/10705511.2017.1419353>
- MacKenzie, M. J., Kotch, J. B., & Lee, L.-C. (2011). Toward a cumulative ecological risk model for the etiology of child maltreatment. *Children and Youth Services Review*, 33(9), 1638–1647. <https://doi.org/10.1016/j.childyouth.2011.04.018>
- MacMillan, H. L., Wathen, C. N., Barlow, J., Fergusson, D. M., Leventhal, J. M., & Taussig, H. N. (2009). Interventions to prevent child maltreatment and associated impairment. *The Lancet*, 373(9659), 250–266. [https://doi.org/10.1016/S0140-6736\(08\)61708-0](https://doi.org/10.1016/S0140-6736(08)61708-0)
- Malvaso, C. G., Delfabbro, P., & Day, A. (2018). The maltreatment–offending association: A systematic review of the methodological features of prospective and longitudinal studies. *Trauma, Violence, & Abuse*, 19(1), 20–34. <https://doi.org/10.1177/1524838015620820>
- Masten, A. S., & Wright, M. O. (1998). Cumulative risk and protection models of child maltreatment. *Journal of Aggression, Maltreatment & Trauma*, 2(1), 7–30. https://doi.org/10.1300/J146v02n01_02
- May-Chahal, C., & Cawson, P. (2005). Measuring child maltreatment in the United Kingdom: A study of the prevalence of child abuse and neglect. *Child Abuse & Neglect*, 29(9), 969–984. <https://doi.org/10.1016/j.chiabu.2004.05.009>

- McCrory, E. J., & Viding, E. (2015). The theory of latent vulnerability: Reconceptualizing the link between childhood maltreatment and psychiatric disorder. *Development and Psychopathology*, 27(2), 493–505. <https://doi.org/10.1017/S0954579415000115>
- Mehta, P. D., Neale, M. C., & Flay, B. R. (2004). Squeezing interval change from ordinal panel data: Latent growth curves with ordinal outcomes. *Psychological Methods*, 9(3), 301–333. <https://doi.org/10.1037/1082-989X.9.3.301>
- Moffitt, T. E. (1993). Adolescence-limited and life-course-persistent antisocial behavior: A developmental taxonomy. *Psychological Review*, 100, 674–701.
- Murray, J., & Farrington, D. P. (2010). Risk factors for conduct disorder and delinquency: Key findings from longitudinal studies. *Canadian Journal of Psychiatry*, 55(10), 633–642. <https://doi.org/10.1177/070674371005501003>
- Norman, R. E., Byambaa, M., De, R., Butchart, A., Scott, J., & Vos, T. (2012). The long-term health consequences of child physical abuse, emotional abuse, and neglect: A systematic review and meta-analysis. *PLoS Medicine*, 9(11), e1001349. <https://doi.org/10.1371/journal.pmed.1001349>
- Odgers, C. L., Moffitt, T. E., Broadbent, J. M., Dickson, N., Hancox, R. J., Harrington, H., ... Caspi, A. (2008). Female and male antisocial trajectories: From childhood origins to adult outcomes. *Development and Psychopathology*, 20(2), 673–716.
- Paolucci, E. O., Genuis, M. L., & Violato, C. (2001). A meta-analysis of the published research on the effects of child sexual abuse. *Journal of Psychology*, 135(1), 17–36.
- Pearl, J. (1995). Causal diagrams for empirical research. *Biometrika*, 82(4), 669–688.
- Preacher, K. J., Wichman, A. L., Briggs, N. E., & MacCallum, R. C. (2008). *Latent growth curve modeling*. USA: Sage.
- R Core Team. (2018). *R: A language and environment for statistical computing* (R Foundation for Statistical Computing). Retrieved from <https://www.R-project.org/>

- Rhemtulla, M., Brosseau-Liard, P. É., & Savalei, V. (2012). When can categorical variables be treated as continuous? A comparison of robust continuous and categorical SEM estimation methods under suboptimal conditions. *Psychological Methods, 17*(3), 354–373. <https://doi.org/10.1037/a0029315>
- Rosenman, S., & Rodgers, B. (2006). Childhood adversity and adult personality. *Australian and New Zealand Journal of Psychiatry, 40*(5), 482–490.
- Rosseel, Y. (2012). Lavaan: An R package for structural equation modeling and more. Version 0.5–12 (BETA). *Journal of Statistical Software, 48*(2), 1–36.
- Rutter, M., Tizard, J., & Whitmore, K. (1970a). *Education, health and behaviour*. Longman Publishing Group.
- Rutter, M., Tizard, J., & Whitmore, K. (1970b). Malaise inventory. *Education, Health and Behaviour, 339–340*.
- Schimmenti, A. (2018). The trauma factor: Examining the relationships among different types of trauma, dissociation, and psychopathology. *Journal of Trauma & Dissociation, 19*(5), 552–571.
- Schimmenti, A., Di Carlo, G., Passanisi, A., & Caretti, V. (2015). Abuse in childhood and psychopathic traits in a sample of violent offenders. *Psychological Trauma: Theory, Research, Practice, and Policy, 7*(4), 340.
- Scott, S., Knapp, M., Henderson, J., & Maughan, B. (2001). Financial cost of social exclusion: Follow up study of antisocial children into adulthood. *BMJ, 323*(7306), 191. <https://doi.org/10.1136/bmj.323.7306.191>
- Sterne, J. A. C., White, I. R., Carlin, J. B., Spratt, M., Royston, P., Kenward, M. G., ... Carpenter, J. R. (2009). Multiple imputation for missing data in epidemiological and clinical research: Potential and pitfalls. *BMJ, 338*, b2393. <https://doi.org/10.1136/bmj.b2393>

- Stoltenborgh, M., van IJzendoorn, M. H., Euser, E. M., & Bakermans-Kranenburg, M. J. (2011). A Global Perspective on Child Sexual Abuse: Meta-Analysis of Prevalence Around the World. *Child Maltreatment, 16*(2), 79–101.
<https://doi.org/10.1177/1077559511403920>
- Thornberry, T. P., Matsuda, M., Greenman, S. J., Augustyn, M. B., Henry, K. L., Smith, C. A., & Ireland, T. O. (2014). Adolescent risk factors for child maltreatment. *Child Abuse & Neglect, 38*(4), 706–722. <https://doi.org/10.1016/j.chiabu.2013.08.009>
- Topitzes, J., Mersky, J. P., Dezen, K. A., & Reynolds, A. J. (2013). Adult resilience among maltreated children: A prospective investigation of main effect and mediating models. *Children and Youth Services Review, 35*(6), 937–949.
<https://doi.org/10.1016/j.chilyouth.2013.03.004>
- US Department of Health and Human Services. (2006). *Child maltreatment* (pp. 1–194). Washington, DC: US Government Printing Office.
- Vachon, D. D., Krueger, R. F., Rogosch, F. A., & Cicchetti, D. (2015). Assessment of the harmful psychiatric and behavioral effects of different forms of child maltreatment. *JAMA Psychiatry, 72*(11), 1135–1142.
- van Buuren, S., & Groothuis-Oudshoorn, K. (2011). mice: Multivariate Imputation by Chained Equations in R. *Journal of Statistical Software, 45*(3).
<https://doi.org/10.18637/jss.v045.i03>
- Widom, C. S. (2017). Long-term impact of childhood abuse and neglect on crime and violence. *Clinical Psychology: Science and Practice, 24*(2), 186–202.
<https://doi.org/10.1111/cpsp.12194>
- Widom, C. S., Raphael, K. G., & DuMont, K. A. (2004). The case for prospective longitudinal studies in child maltreatment research: Commentary on Dube,

Williamson, Thompson, Felitti, and Anda (2004). *Child Abuse & Neglect*, 28(7), 715–722. <https://doi.org/10.1016/j.chiabu.2004.03.009>

Wilson, H. W., Stover, C. S., & Berkowitz, S. J. (2009). Research Review: The relationship between childhood violence exposure and juvenile antisocial behavior: a meta-analytic review. *Journal of Child Psychology and Psychiatry*, 50(7), 769–779. <https://doi.org/10.1111/j.1469-7610.2008.01974.x>

Captions

Figures

Figure 1. Initial levels and rates of change in antisocial behaviour across childhood (7-16y) and adulthood (23-50y).

Note: Observed mean values of ASB (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 ASB and are reported in Table 3. ASB = antisocial behaviour; y = years.

Figure 2. Mean difference in initial level and rate of change in antisocial behaviour across childhood (7-16y) and adulthood (23-50y), by child maltreatment.

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

Supplementary material

Table S1. Definitions and measures of child maltreatment in the 1958 British birth cohort.

Table S2. Bivariate correlations for types of child maltreatment.

Table S3. Model fit indices for latent growth curve models for antisocial behaviour.

Figure S1. Flow diagram of study sample.

Figure S2. Directed acyclic graph of variables operative in the effect of child neglect on antisocial behaviour across childhood (7-16y). *Note: After adjusting and 'blocking' for measured confounders, confounding remains from unmeasured factors (ie, open pathway), potentially overestimating the effect of child neglect. ASB = antisocial behaviour; y = years.*

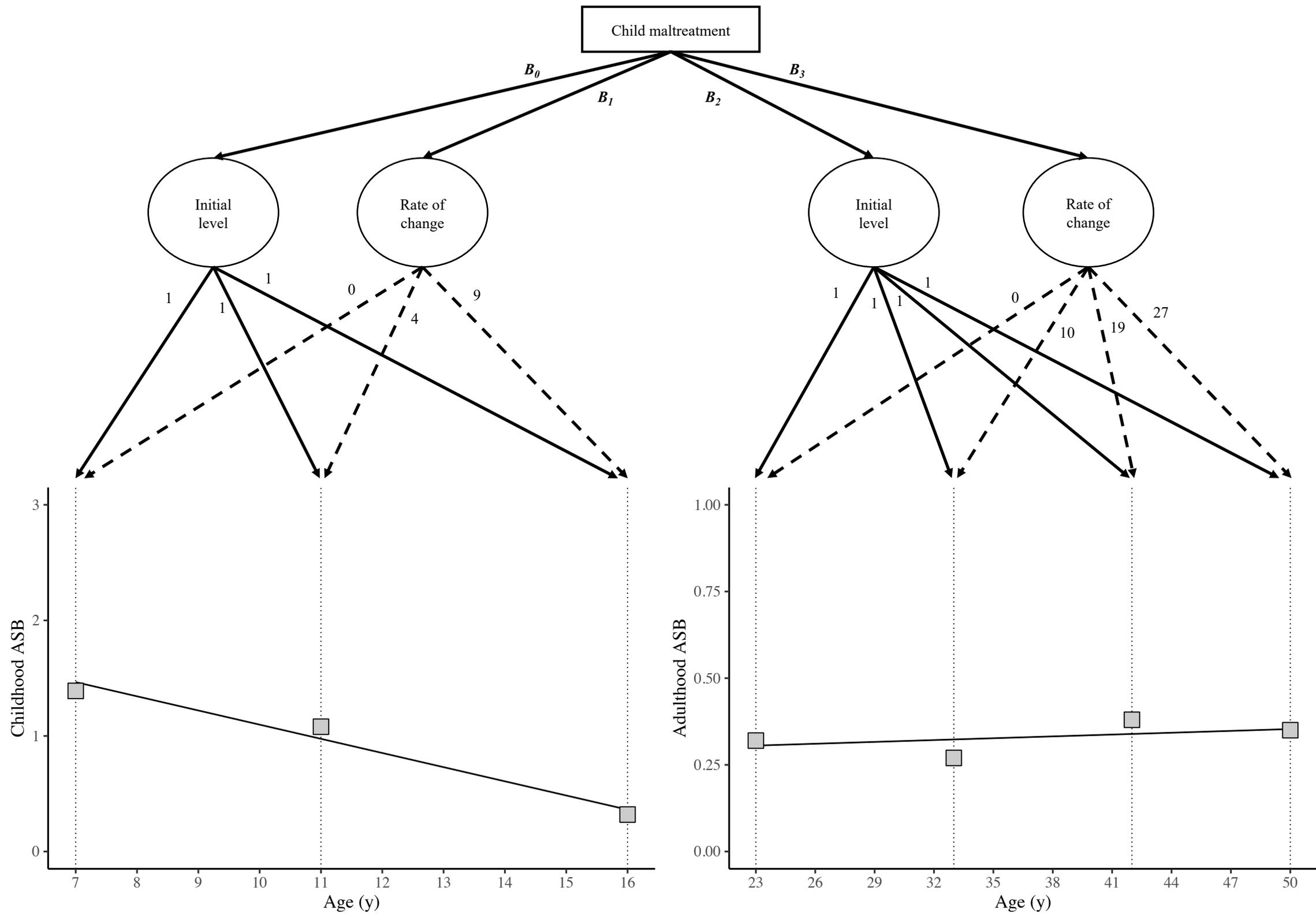
Figure S3. Directed acyclic graph of variables operative in the effect of child neglect on antisocial behaviour across adulthood (23-50y). *Note: After adjusting and 'blocking' for measured confounders, confounding remains from unmeasured factors (ie, open pathway), potentially overestimating the effect of child neglect. ASB = antisocial behaviour; y = years.*

Figure S4. Directed acyclic graph of variables operative in the effect of child abuse on antisocial behaviour across childhood (7-16y). *Note: After adjusting and 'blocking' for measured confounders, confounding remains from unmeasured factors and from the bi-directional relationship between self-report and ASB (ie, open pathways), potentially overestimating the effect of child abuse. ASB = antisocial behaviour; y = years.*

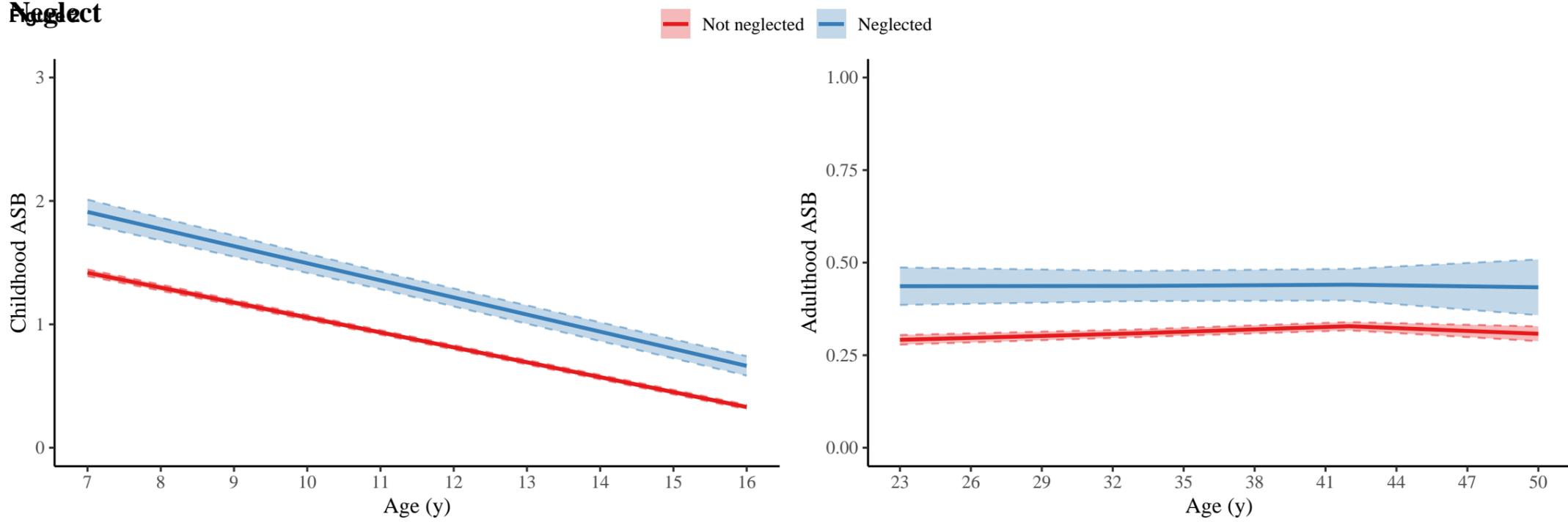
Figure S5. Directed acyclic graph of variables operative in the effect of child abuse on antisocial behaviour across childhood (7-16y). *Note: After adjusting and 'blocking' for measured confounders, confounding remains from unmeasured factors and from the bi-directional relationship between self-report and ASB (ie, open pathways), potentially overestimating the effect of child abuse. ASB = antisocial behaviour; y = years.*

Figure S6. Mean difference in initial levels and rates of change in antisocial behaviour across childhood (7-16y) and adulthood (23-50y), by number of maltreatment types. *Note: Maltreatment types include neglect, emotional, physical, sexual abuse. Measures of ASB are different for childhood (range: 0-6) and adulthood (range: 0-3). ASB = antisocial behaviour; y = years.*

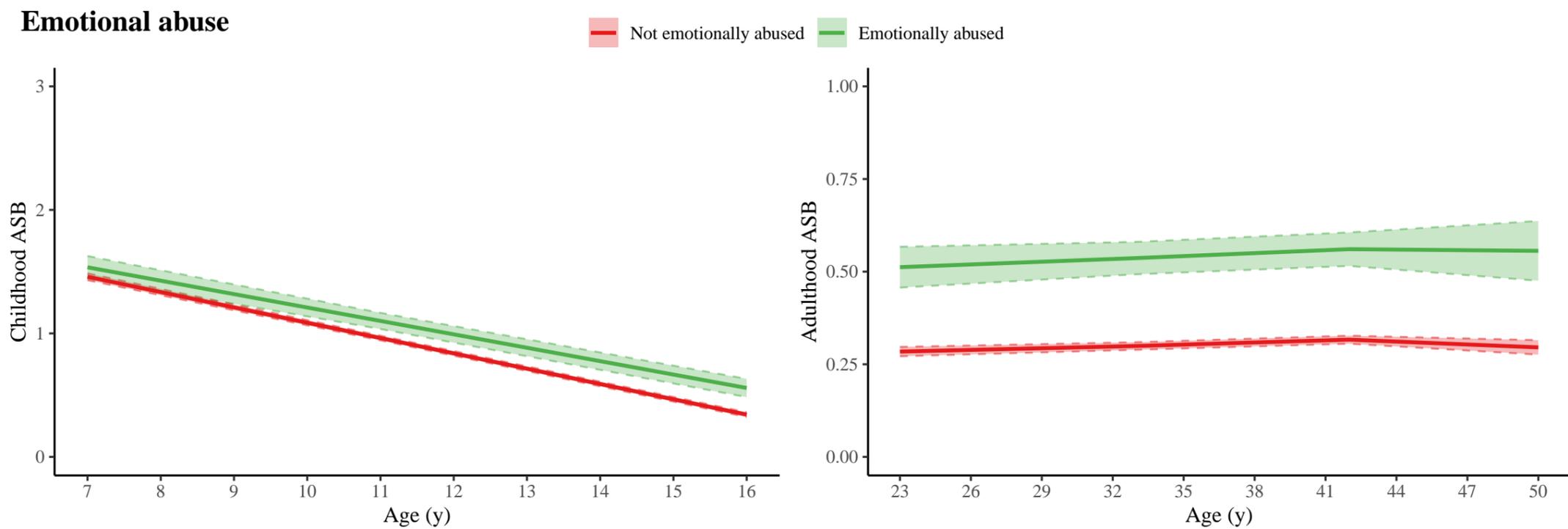
Figure 1



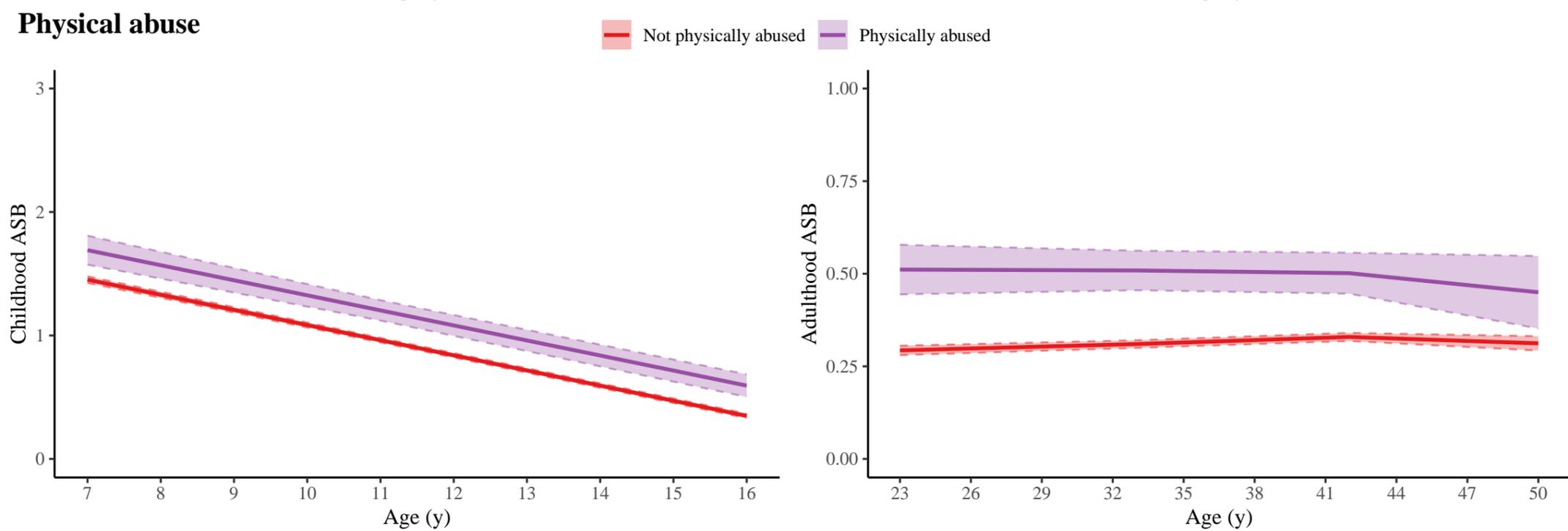
Neglect



Emotional abuse



Physical abuse



Sexual abuse

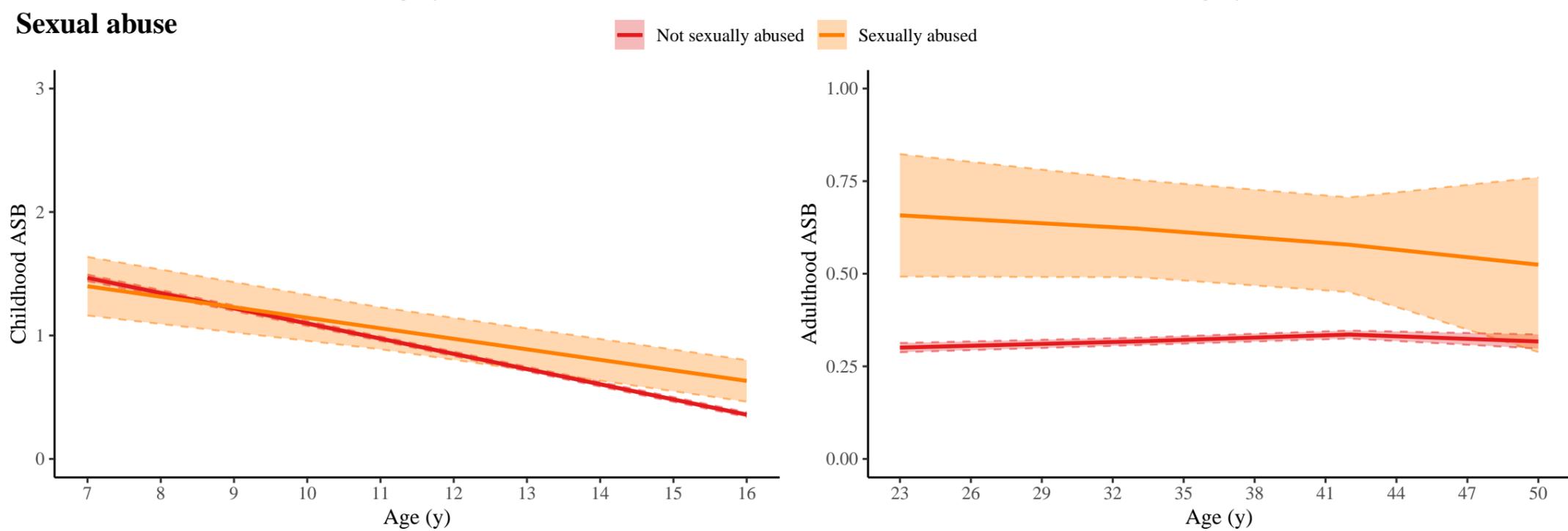


Table 1. Prevalence of child maltreatment and antisocial behaviour in the study sample

	Total (n = 8088)		Males (n = 3954)	Females (n = 5134)
	n	%	%	%
Type of child maltreatment (0-16y)				
Neglect	7368 ^a	9.47	4.87	4.60
Emotional abuse	7849	8.88	3.58	5.30
Physical abuse	8025	5.58	2.79	2.79
Sexual abuse	8055	1.35	0.20	1.15
No. of maltreatment types^b (0-16y)				
0	5817	81.91	82.59	81.25
1	958	13.49	13.37	13.60
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)

Note: Percentages (%) are given for categorical variables and means and standard deviations for continuous variables. Based on 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.

Table 2. Unadjusted associations between child maltreatment and antisocial behaviour from 7 to 50 years

	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)**
<i>Per additional maltreatment</i>	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)***

Note: All coefficients are unadjusted and unstandardized (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.

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

Table 3. Mean difference in initial level and rate of change in antisocial behaviour, by child maltreatment

	Childhood antisocial behaviour (7-16y) ^a							
	Unadjusted		Adjusted for sex only		Adjusted for covariates ^c		Adjusted for covariates ^c & other maltreatment types ^d	
	Initial level	Rate of change	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) ^{**}	0.479 (0.049) ^{***}	-0.016 (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) [*]	0.120 (0.045) ^{**}	0.011 (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)	0.237 (0.057) ^{***}	0.001 (0.007)	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) ^{**}	0.334 (0.083) ^{***}	-0.006 (0.004)	-0.085 (0.120)	0.026 (0.014)	-0.144 (0.121)	0.022 (0.014)
No. of maltreatment types^d								
0	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
1	0.292 (0.042) ^{***}	-0.006 (0.005)	0.294 (0.04) ^{***}	-0.007 (0.005)	0.212 (0.042) ^{***}	-0.005 (0.005)	..	..
2	0.281 (0.071) ^{***}	0.007 (0.009)	0.297 (0.068) ^{***}	0.006 (0.009)	0.199 (0.070) ^{**}	0.007 (0.009)	..	..
3-4	0.301 (0.137) [*]	0.014 (0.017)	0.390 (0.129) ^{**}	0.005 (0.017)	0.172 (0.132)	0.012 (0.018)	..	..
<i>Per additional maltreatment</i>	0.173 (0.024) ^{***}	0.001 (0.003)	0.186 (0.023) ^{***}	0.000 (0.003)	0.121 (0.024) ^{***}	0.001 (0.003)	..	..
Adulthood antisocial behaviour (23-50y)^b								
	Unadjusted		Adjusted for sex only		Adjusted for covariates ^c		Adjusted for covariates ^c & other maltreatment types ^d	
	Initial level	Rate of change	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)	0.147 (0.013) ^{***}	-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)	0.222 (0.012) ^{***}	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)	0.219 (0.012) ^{***}	-0.002 (0.001)	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)	0.334 (0.012) ^{***}	-0.006 (0.001)	0.277 (0.09) ^{**}	-0.006 (0.004)	0.171 (0.091)	-0.006 (0.004)
No. of maltreatment types^d								

	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
0	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
1	0.152 (0.021)***	0.000 (0.001)	0.151 (0.012)***	0.000 (0.001)	0.126 (0.023)***	0.001 (0.001)	..	..
2	0.263 (0.042)***	-0.001 (0.002)	0.263 (0.002)***	-0.001 (0.008)	0.228 (0.044)***	-0.001 (0.002)	..	..
3-4	0.400 (0.086)***	-0.005 (0.004)	0.388 (0.013)***	-0.006 (0.001)	0.321 (0.089)***	-0.004 (0.004)	..	..
<i>Per additional maltreatment</i>	0.137 (0.014)***	-0.001 (0.001)	0.135 (0.012)***	-0.001 (0.001)	0.115 (0.015)***	0.000 (0.001)	..	..

Note: All coefficients are unstandardized (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 for childhood and at 23y for adulthood. Rate of change (i.e. slope) represents linear change from 7-16y for childhood and 23-50y for adulthood.

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

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

^c *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.*

^d *Includes neglect, emotional, physical, sexual abuse.*

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

Supplementary Material - Table S1

[Click here to download Supplementary Material - online only: Table S1.docx](#)

Supplementary Material - Table S2

[Click here to download Supplementary Material - online only: Table S2.docx](#)

Supplementary Material - Table S3

[Click here to download Supplementary Material - online only: Table S3.docx](#)

Supplementary Material - Figure S1

[Click here to download Supplementary Material - online only: Figure S1.pdf](#)

Supplementary Material - Figure S2

[Click here to download Supplementary Material - online only: Figure S2 Revised.pdf](#)

Supplementary Material - Figure S3

[Click here to download Supplementary Material - online only: Figure S3 Revised.pdf](#)

Supplementary Material - Figure S4

[Click here to download Supplementary Material - online only: Figure S4 Revised.pdf](#)

Supplementary Material - Figure S5

[Click here to download Supplementary Material - online only: Figure S5 Revised.pdf](#)

Supplementary Material - Figure S6

[Click here to download Supplementary Material - online only: Figure S6.pdf](#)