

Abstract

Childhood maltreatment types (neglect and psychological, physical, or sexual abuse) are associated with many poor outcomes in adulthood. Yet, research mainly focuses on the cumulative adversity burden rather than specificities and commonalities of associations with adult outcomes and intervening pathways. To build understanding of life-course pathways to a range of outcomes, this overview summarises evidence from several original research studies using the 1958 British Birth Cohort on specific maltreatment types, child development trajectories, adult intermediaries and outcomes. About one-in-five participants were identified as neglected or abused in childhood (~10% were identified for neglect, 10% for psychological abuse, 6% for physical abuse and 1.4% for sexual abuse). Neglect was associated with key dimensions of development, for example, slower height growth, delayed maturation, faster BMI gain, and poorer emotional and cognitive development. Associated adulthood outcomes included harmful behaviours (notably smoking), poorer physical health (e.g. shorter height, excess BMI, poorer blood lipids and glucose, poor-rated health and physical functioning), worse mental health, lower socioeconomic circumstances (e.g. poorer living conditions) and elevated mortality in mid-adulthood. Childhood abuse associations were less widespread and were often only for specific types: most types were unrelated to childhood height and cognitive abilities, but all types were associated with poorer child emotional development, adult mental health, smoking, blood lipids and self-rated health. Additionally, physical abuse was associated with faster BMI gain, higher adult BMI, blood glucose, inflammation and mortality in mid-adulthood; sexual abuse with faster BMI gain, higher adult BMI, poor physical functioning at 50y and higher mortality in mid-adulthood. Adult health measures associated with neglect and abuse are key predictors of serious disease, disability and death. Therefore, neglect and abuse associations with these measures represent an important burden for individuals and society.

Introduction

Childhood maltreatment types such as neglect and psychological, physical, or sexual abuse, are associated with many poor outcomes in adult life, as shown in an extensive literature including several reviews (Baumeister, Akhtar, Ciufolini, Pariante, & Mondelli, 2016; Bunting et al., 2018; Danese & Tan, 2014; Gilbert et al., 2009; Jakubowski, Cundiff, & Matthews, 2018; Norman et al., 2012; Su, D'Arcy, Yuan, & Meng, 2019). Typically these reviews focus on a single outcome, such as obesity (Danese & Tan, 2014) or a group of markers for a particular outcome, for example inflammation (Baumeister et al., 2016; Jakubowski et al., 2018) or cardiometabolic disease (Baumeister et al., 2016; Jakubowski et al., 2018). Such reviews aim to provide estimates of risk from available studies, map the range of outcomes examined and/or identify gaps in evidence. Whilst some individual studies investigate potential intermediaries from child maltreatment to later outcomes, important gaps in knowledge remain, such as the life-course trajectories that lead to poor outcomes (i.e. underlying child-to-adult pathways). Moreover, knowledge on specific types of maltreatment is limited because different types are often considered together in relation to later outcomes. Examining types of maltreatment together using a cumulative score has been justified because they co-occur. However, cumulative scores assume that all types have comparable effects and common processes (and possible remedies) to outcome, rather than specific processes hypothesised as accompanying different types of child maltreatment, such as deprivation and trauma (Sheridan & McLaughlin, 2014). Given the scarcity of available evidence on the specificity of associations between different types of child maltreatment and long-term outcomes, further investigation is warranted (Baumeister et al., 2016; Bunting et al., 2018; Jakubowski et al., 2018).

Rather than examine life-course trajectories from specific child maltreatments in a new original study, we provide an overview of several existing studies on the association between maltreatment and later outcomes within a British cohort, the '1958 birth cohort'. With their rich information base, cohorts are currently the best study design available to track childhood exposures and pathways to adult outcomes (Power, Kuh, & Morton, 2013). This overview is novel because, to our knowledge, information for outcomes at different life-stages has not been brought together previously. Collation of this information is essential for building understanding of the child-to-adult pathways to later outcome.

We provide two perspectives, namely (i) a life-course perspective and (ii) a focus on specific types of maltreatment. Regarding the life-course perspective, we consider how developmental trajectories – physical, cognitive, emotional and social – of those exposed to maltreatment differ from others without such experiences. If developmental trajectories are unfavourable in ways known from the broader literature to have long-term effects, this informs on likely target pathways. For example, poor physical development (slow height growth and fast adiposity gain) are established risk factors for increased mortality and ill-health (Jousilahti, Tuomilehto, Vartiainen, Eriksson, & Puska, 2000; Power et al., 2013); if specific maltreatment types are associated with poor physical development (e.g. shorter height) and also with associated outcomes (such as cardiovascular disease) this would suggest that poor physical development may be on the pathway between child maltreatment and outcomes. Likewise, poor emotional and cognitive development are linked to future health, behaviour and economic detriments (Power et al., 2013) and could be considered as alternative developmental pathways from maltreatment to subsequent adult outcomes. As such, compromised physical, emotional and cognitive developmental trajectories could represent what epidemiologists refer to as 'biological embedding' of early experiences (Power et al., 2013), with unfavourable development associated with effects that place individuals at high risk for poor outcomes in their adult lives. Furthermore, the uptake and maintenance of harmful health-related behaviours during adolescence could link maltreatment with later health such as cardiometabolic or other disease outcomes. The original research papers included in this overview (listed in Table 1) span a range of physical, cognitive, emotional and social developmental trajectories that potentially inform on target pathways as well as several longer-term health and welfare outcomes.

These studies have established prevalence of different types of childhood maltreatment (study 1) and associations with:

- child development trajectories, including growth in height and BMI, and pubertal timing (studies 2 to 4), emotional and cognitive development throughout childhood and adolescence through to mid-adulthood (studies 5 and 6);
- adult socio-economic destinations (e.g. lacking assets, income-related support, financial insecurity, long-term sickness absence and inter- and intra-generational social mobility to mid-adulthood) (study 7);
- adult health behaviours, for example smoking (study 4);
- adult health, including markers for cardiometabolic disease and inflammation, cortisol levels, physical functioning, poor health (self-rated) and premature mortality (studies 8 to 13).

Regarding specific child maltreatments, our overview identifies associations for neglect and physical, psychological and sexual abuse in order to highlight whether associations with later outcome are distinct (i.e. independent) for the different maltreatment types. Inclusion of childhood neglect is important here because the literature is limited on its associated long-term outcomes (Bunting et al., 2018; Stoltenborgh, Bakermans-Kranenburg, & van IJzendoorn, 2013).

Data available allowed consideration of child maltreatment associations separate from other early life factors (e.g. low birthweight, socioeconomic disadvantage) known to be associated with numerous long-term outcomes. Whilst a primary purpose here is to highlight the potential of unfavourable developmental trajectories associated with maltreatment to affect later outcomes, a further advantage of considering earlier development (e.g. height growth, cognitive development etc) is to demonstrate the extent of more immediate effects of maltreatment that are likely to matter contemporaneously during childhood. Such knowledge contributes to a fuller delineation of outcomes at different life-stages which in turn is useful to establish the full harms/costs for individuals and society, and thereby, to inform decisions on priorities for prevention and intervention. However, it is beyond the scope of this overview to cover the extensive literature on child maltreatment and later outcomes. Hence, readers are referred to recent literature reviews (Baldwin, Reuben, Newbury, & Danese, 2019; Baumeister et al., 2016; Bunting et al., 2018; Danese & Tan, 2014; Gilbert et al., 2009; Jakubowski et al., 2018; Norman et al., 2012; Su et al., 2019) and to individual papers on the 1958 cohort (Table 1) on which the current overview is based.

Methods

Study sample

The 1958 birth cohort (also known as the National Child Development Study) is a continuing, multidisciplinary longitudinal study of all (~17,000) born in England, Scotland and Wales in one week in March, 1958 and ~900 immigrants enrolled in childhood (Power & Elliott, 2006). Social, economic and health data were collected throughout childhood (birth and ages 7, 11 and 16y) and adulthood (23, 33, 42, 45 and 50y) to age 55y in 2013, with further follow-up surveys planned. Respondents in mid-adulthood are broadly representative of the total surviving cohort (Atherton, Fuller, Shepherd, Strachan, & Power, 2008).

Data have been obtained from multiple sources, including parents, teachers and medical staff for the birth and childhood sweeps, and from the individual participants during adulthood, with a clinical assessment undertaken by nurses at 45y.

Ethical approval was obtained, for example, for the 50 y survey by the London Multi-Centre Research Ethics Committee (MREC) and for the 45 y clinical survey by the South East MREC, when written consents were obtained from study participants.

Glossary of measures

This overview capitalises on the fact that broadly similar methodologies were used across included studies. For example, the definitions for neglect and abuse were generally comparable and were based on information selected to correspond to conventional definitions (Table 2) (Gilbert et al., 2009; Norman et al., 2012).

Exposures: childhood maltreatment

As shown in Table 2, information was collected from multiple sources in childhood and was self-reported in adulthood. Main measures of neglect were obtained prospectively in childhood from parents and teachers, whereas childhood (to 16 y) abuse was reported retrospectively at 45 y (Table 2).

Neglect was identified at 7 y and 11 y from structured interviews with the child's mother (or father if the mother was unavailable), and from questionnaires completed by their teacher; the information recorded mostly reflects lack of stimulation (e.g. with reading). The eleven questionnaire/interview items listed in Table 2 were summed to create a neglect score (range 0-11); those scoring ≥ 3 were classified as neglected (9.6%), in keeping with other prevalence estimates in the UK (Gilbert et al., 2009; Radford et al., 2011).

Physical, psychological and sexual abuse to age 16 y was ascertained using a confidential Computer-Assisted Self Interviewing (CASI) questionnaire at age 45 y (Table 2). The questionnaire was originally from the PATH Through Life Project (Rosenman & Rodgers, 2004): items were derived from the Parental Bonding Instrument (Parker, 1979), the British National Survey of Health and Development (Rodgers, 1996) and US National Comorbidity Survey (Riso, Miyatake, & Thase, 2002).

Outcomes

A broad range of longitudinal data on outcomes and potential influences from early life to mid-adulthood have been examined to represent child development and adult physical/mental health and living standards (Table 1). Main child development outcome measures include child-to-adult height and adiposity measures (growth in height or Body Mass Index (BMI)), timing of puberty, child-to-adult emotional/mental health and cognitive abilities (Table 1). Adult outcomes include living standards, worklessness and social mobility, health behaviours, poor self-rated health, markers of cardiometabolic disease, inflammation, salivary cortisol, physical functioning and premature mortality in mid-adulthood. Brief details of outcomes are given in Table 1; descriptions of covariates and other (e.g. intermediary) factors are given in main tables or where appropriate, in the text below (with further details in respective publications). Importantly, all outcomes were obtained prospectively.

Potential mediators or markers of trajectory

Mediating factors vary as appropriate for the different outcomes considered. Some measures considered may themselves be mediators, while others are markers of a mediating process. They include adiposity (e.g. as indicated by BMI or waist-hip-ratio (WHR)), cardiometabolic markers, child-to-adult height trajectories, mental health, cognitive abilities, behavioural factors (e.g. smoking) and adult socio-economic position (SEP), usually assessed at a life-stage prior to the outcome.

Analytical approach

Unlike systematic reviews of multiple studies where there are established methods to summarise evidence, no such methodologies exist for an overview of findings for different outcomes within one particular population followed over time. Thus, in respect of our aim to focus on a life-course perspective, we organised the text and Tables (1 and 3) to highlight associations as a progression from

childhood developmental outcomes (e.g. height, emotional and cognitive status), that in turn may act as intermediaries for longer-term outcomes (e.g. cardiometabolic disease risk). To summarise key findings for specific maltreatments we indicate whether associations were not present, weak, moderate or strong similar to a previous review (Gilbert et al., 2009). The criteria used here to classify associations were based on Cohen's d for continuous outcomes (Cohen, 1988) and adapted from previously derived reference points for categorical outcomes for unadjusted associations (Chen, Cohen, & Chen, 2010) because associations summarised here are mostly adjusted for several potential confounding factors. Details of criteria used to classify associations are given in Table 3 (footnote).

In general, associations between childhood maltreatment(s) and outcome(s) include: (i) separate analysis for each type of maltreatment; (ii) adjustment for other early life factors (e.g. childhood SEP) previously shown to be associated with outcomes and also (because types of maltreatment co-occur) additional adjustments for the other maltreatments. These adjustments suggest whether there were independent and differential associations for specific types of maltreatment; (iii) consideration of several potential mediating factors in the associations of maltreatment with outcome, although factors selected varied for different outcomes; (iv) sensitivity analyses to confirm findings (e.g. using alternative analysis strategies). Statistical methods followed STROBE recommendations (von Elm et al., 2008) for example, testing whether associations differed by gender; differences where they were found are described in individual papers, although in general, few gender differences were observed. Analytic strategies were tailored to the particular study objectives; for full descriptions of methods, null findings, mediators examined and so forth readers are referred to the individual papers listed in Table 1.

Results

Most (78%) of the population in the 1958 birth cohort were not identified as having been maltreated during childhood, but about 10% were identified for neglect, 10% for psychological abuse, 6% for physical abuse and 1.4% for sexual abuse (study 12, Table 1). Many individuals (15%) were identified as experiencing one form of neglect or abuse and 7% experienced two or more forms (study 12, Table 1).

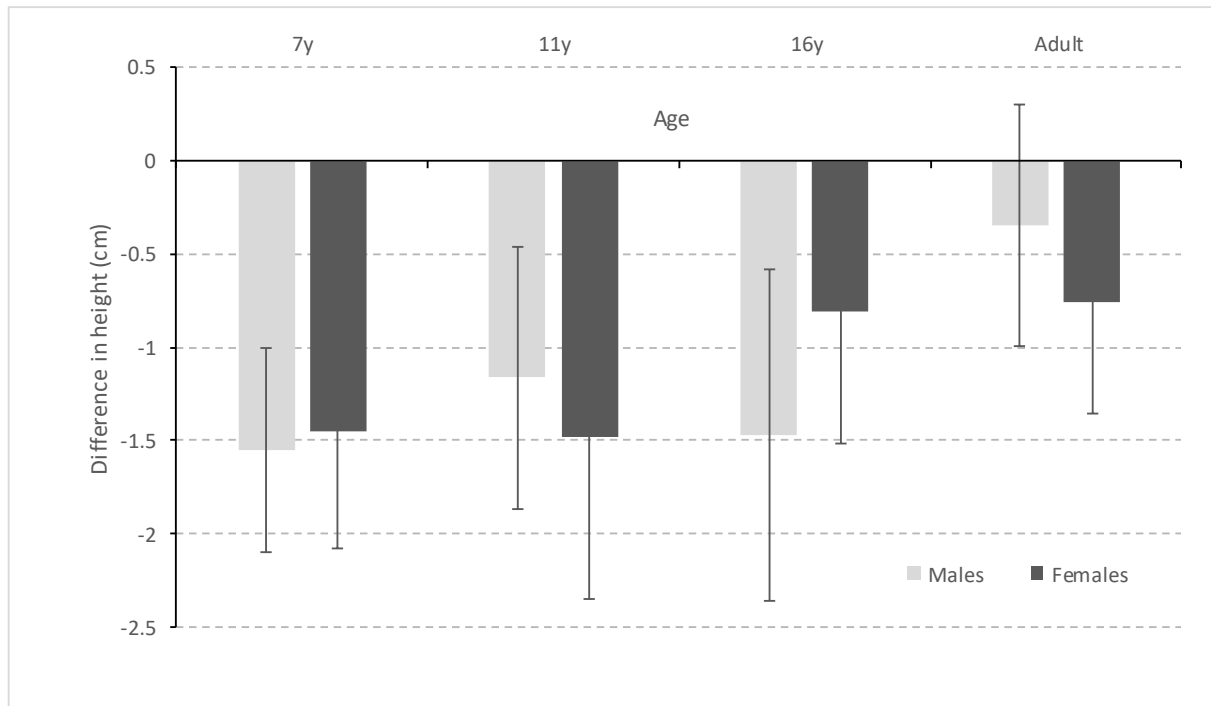
Associated developmental trajectories

Several studies were undertaken that, in general, suggest that child neglect and specific forms of abuse are associated with less favourable physical, emotional and cognitive development during childhood and adolescence than the non-maltreated.

Childhood neglect

In terms of physical development, child neglect was associated with shorter height throughout childhood and also in adulthood (Figure 1, based on study 2, Table 1). The association was stronger during childhood than in adulthood, suggesting greater child height deficits followed by some catch-up growth to adulthood. For the neglect group the estimated height deficit relative to others was up to 1.5 cm in childhood and less than 1 cm in adulthood. Slower maturation was seen also with some but not all markers of pubertal timing, with risk of delayed puberty onset elevated by 33% to 45% in neglected males (depending on pubertal indicator) and by 36% in females (study 3, Table 1). Neglect was not associated with higher mean BMI in childhood (Table 3) compared to the non-neglected, but after a faster rate of gain showed a small excess in BMI in mid-life (0.24 and 0.52 kg/m² for men and women respectively at age 50 y) (study 4, Table 1).

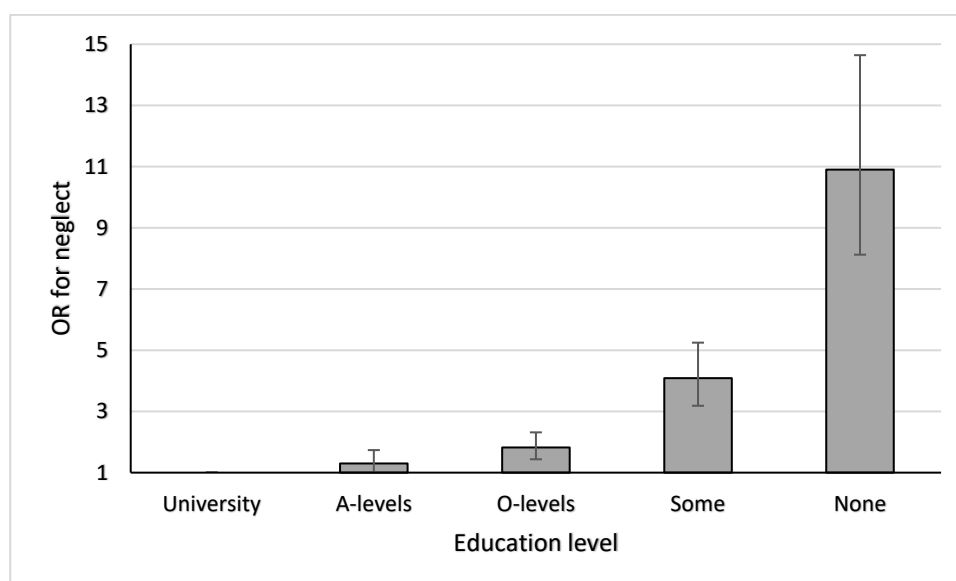
Figure 1: Deficit in average height associated with child neglect vs non-neglect at ages 7, 11 and 16y and in adulthood in the 1958 birth cohort study



Notes: the difference in height (cm) across ages between the most neglected at age 7y (3+ neglect items, ~10% of the sample) and the non-neglected (0 items, ~56%), estimated from linear models with adjustments for parental height, birthweight and several social factors. Source: study 2 (Table1)

In addition, neglect was associated with poorer emotional and cognitive development throughout childhood and adolescence compared to the non-neglected (Table 3). For the neglect group, emotional symptoms were higher by an estimated 8.4 symptoms at age 16 y, and by 5.7 symptoms at age 50 y (on child and adult scales as appropriate, range 0-100) (study 5, Table 1). Likewise, cognitive ability was estimated to be 10 points lower at 16 y and 2 points lower at 50 y (on child and adult scales, range 0-100). Furthermore, neglect was associated with lower qualifications by the end of formal education. As Figure 2 shows, child neglect was associated with 11-fold higher odds for no qualifications compared to university level (study 5, Table 1).

Figure 2: Child neglect associations (Odds ratios (ORs)) with qualification levels: comparing neglected* vs the non-neglected in the 1958 birth cohort study



Notes: Neglect categories were: non-neglected, score 1, 2 and 3+

*Neglect score 3+ on neglect scale, approximately 10% of the population (see study 5, Table 1 for details).

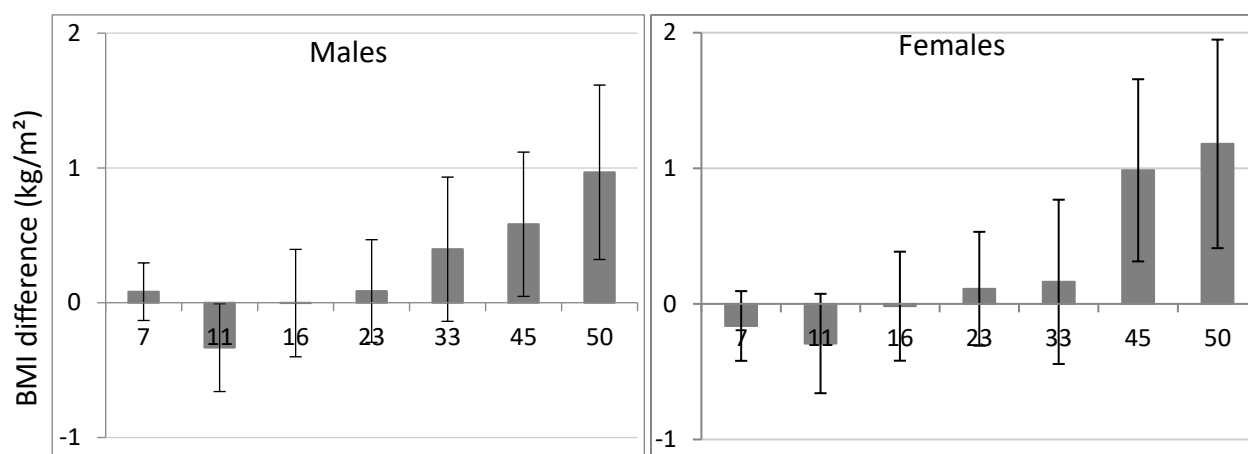
ORs and 95% confidence intervals were estimated from multinomial logistic regression analysis with neglect modelled as a categorical exposure variable with 4 levels (non-neglect, score 1, 2 and 3+). For illustrative purposes, the figure shows ORs for different qualification level vs university degree (the reference category) for neglect score 3+ compared to non-neglect. Analysis adjusts for gender, birth weight, maternal smoking during pregnancy, birth order, maternal age, father's class at birth, mother's/father's education, household amenities. Source: study 5 (Table1)

Childhood abuse

Psychological, physical and sexual abuse were all associated with poorer emotional status throughout childhood with most associations persisting to 50 y. On child or adult scales (range 0-100) as appropriate, emotional symptoms were 2.0 to 8.1 higher across ages 7 y to 16 y; and 4.9 to 8.3 higher at 50 y (study 5, Table 1). In another study, physical and sexual abuse was shown to be associated with poor mental health at different life-stages to age 45 y. Yet, associations for abuse and mental health in adolescence and young adulthood did not entirely explain the associations with later mental health at 45 y (i.e. suggesting that onset of poor mental health in mid-life could occur irrespective of status in adolescence or young adulthood (study 6, Table 1). In contrast to emotional health, abuse was mostly unrelated to child-to-adult cognitive abilities, although sexual abuse was associated with lower cognitive abilities (7-16 y) and qualifications (study 5, Table 1).

In terms of physical development, there were associations for physical abuse, and also in females, sexual abuse, with BMI child-to-adult trajectories (study 4, Tables 1 and 3). During childhood, BMI was lower or no different, on average, from the rest of the population, but by mid-adulthood (50 y) these abuse groups had an elevated BMI. Figure 3 shows this pattern across age for physical abuse. As Figure 3 suggests, study 4 (Table 1) showed a trend of faster rate of BMI gain from child to adulthood in these abuse groups. Faster BMI gain across the life-course was associated in turn with 34% to 67% higher odds of obesity at 50y for physical abuse and (in females) sexual abuse (study 4, Table 1). Unlike neglect, abuse was not associated with height, and was mostly unrelated to puberty onset, except for associations of sexual abuse with both early and late menarche (studies 2 and 3, Table 1).

Figure 3: Average BMI difference ages 7y to 50y for child physical abuse vs non-abuse; the 1958 birth cohort study



Notes: Average BMI difference (ages 7y to 50y) for child physical abuse vs non-abuse was estimated using linear regression analysis, unadjusted (physical abuse was the exposure of interest and BMI (kg/m^2) the outcome, at each age). For details see study 4 (Table 1)

In summary, different types of child maltreatment were associated with specific indicators of child development. The unfavourable developmental trajectories associated with child neglect and abuse are important in the immediate term, suggesting the ways in which the lives of individuals are affected whilst growing-up. They are also formative in relation to future health and wealth across the life-course. Thus, findings implicate specific potential pathways for neglect (i.e. factors associated with physical, emotional and cognitive development) and types of abuse (i.e. emotional development and in some instances, BMI trajectories) from childhood to adulthood. Further studies of the 1958 birth cohort therefore considered differing potential mediators (as reflected by the variations in developmental trajectories) for specific types of child maltreatment–adult outcome associations.

Adult living standards

Although child maltreatment, through cognitive and emotional developmental trajectories, might be expected to lead to poorer adult living standards, evidence from the broader literature is limited due to scarcity of long-term follow-up. Thus, we sought to identify whether specific childhood maltreatments were associated with adult living standards (e.g. lacking assets, income-related support, financial insecurity, long-term sickness absence) at 50 y and in addition, with inter- and intra-generational social mobility to mid-adulthood (study 7, Table 1), since improvement in occupational class has a notable influence on life chances. We also investigated the possible mediating influence of cognitive and emotional development. Results are summarised in Table 3.

Neglect and sexual abuse were associated with an approximate 50% lower odds of upward mobility (moving from a manual class at birth to a non-manual class at 50y) compared to non-neglected or sexually abused contemporaries. Likewise, for mobility within adulthood, neglect and sexual abuse were associated with a lower odds of upward mobility from 23 y to 50 y (by 39% to 53%). For downward mobility (non-manual to manual class) neglect was associated with more than twofold higher odds for mobility from family of origin and also for own occupational trajectories within adulthood (study 7, Table 1).

In relation to living standards in mid-life, child neglect and to some extent abuse, were associated with several important dimensions of adult socio-economic position; worklessness (not in employment, education or training (NEET); long-term sickness absence) and living standards (lacking assets, income-

related support, financial insecurity), thereby potentially reducing the prospects of a productive and healthy adulthood.

Notably, neglect was associated with worklessness in mid-life (50 y), including 43% to 69% higher odds of NEET and long-term sickness absence; similarly, there was a 68% higher odds of lack of assets (study 7, Table 1). As expected, analysis of these associations suggested a likely intermediary role for cognitive ability in adolescence, but less so for emotional status. Sexual abuse was associated with mid-life worklessness (80% higher odds of long-term sickness absence) and poor living standards (62% to 86% higher odds of lacking assets, receipt of income-related support, financial insecurity). Similarly, non-sexual abuse was associated with worklessness and poor living standards. Surprisingly, analysis of these associations suggested that neither cognitive ability nor emotional status in adolescence were important intermediary factors.

The burden of worklessness, unfavourable social mobility and living standards associated with neglect and (mostly sexual) abuse is important for the individuals affected over decades of their life-course and in terms of societal costs. Child-to-adult links from neglect and abuse to later socio-economic disadvantage, point to a likely detrimental impact on health contemporaneously in mid-life and subsequently into older age.

Adult health behaviours and health status

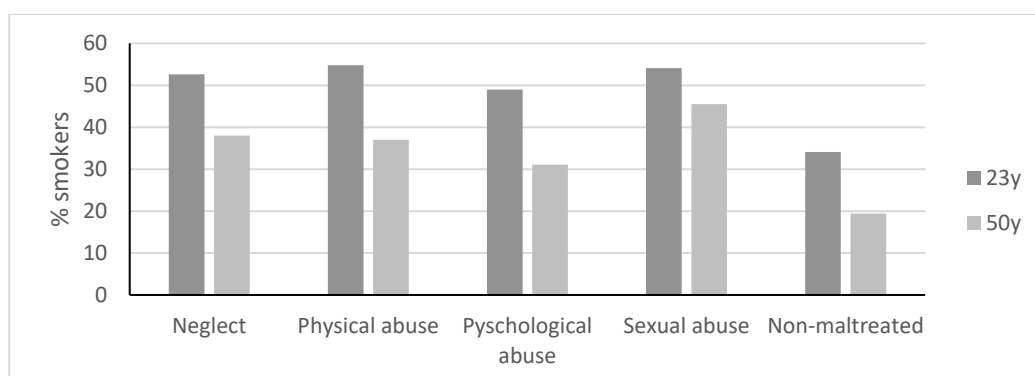
Knowledge is emerging only recently on the full impact of child neglect and abuse links with health over the long-term. Yet, from the developmental trajectories associated with neglect and, in some instances with abuse (see 'Associated developmental trajectories' section above) we would expect child maltreatment to be associated with health and behaviours over subsequent life-stages. This expectation is partly due to observations in the broader literature, for example, showing poor mental health and education level to be linked to hazardous health-behaviours, such as smoking. Here we report associations found in the 1958 cohort and provide a summary of results in Table 3.

Adult health behaviours

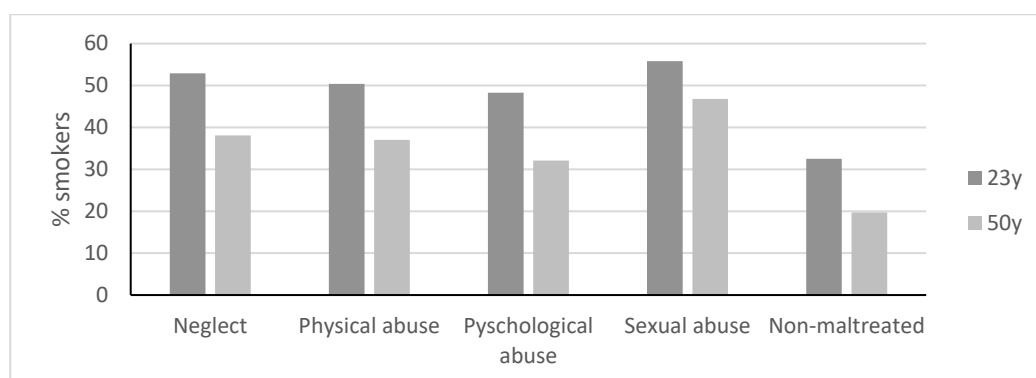
We examined if specific maltreatments were linked to health behaviours in early and mid-adulthood and found that child neglect and all forms of abuse were associated with higher rates of smoking at ages 23y and 50y than among the non-maltreated. As Figure 4 shows, neglect and abuse were associated with higher rates of smoking in young adulthood (48% to 56% vs 33% among the non-maltreated) and subsequently, at age 50y. All groups (i.e. neglect, abuse and non-maltreated) showed a trend of decline in the percentage of smokers with advancing age (23y to 50y), but in general the drop was less pronounced for the maltreated groups (study 4, Table 1).

Figure 4: Child neglect and abuse: prevalence (%) of daily smokers at ages 23y and 50y in the 1958 birth cohort study

Men



Women



Notes: daily smokers reported currently smoking ≥ 1 cigarettes a day; 'non-maltreated' are those with no experience of neglect or abuse. Simple unadjusted cross-tabulations were based on imputed data: see study 4 (Table 1)

Thus, evidence from this cohort suggests that there are strong associations of child neglect and all forms of abuse with smoking across decades of adulthood (Table 3). Smoking is known to be a key determinant of health and is therefore likely to make a major contribution to ill-health among these groups. Differences between neglect or abuse groups and the non-maltreated were less pronounced for heavy alcohol consumption and leisure-time physical inactivity in early and mid-adulthood (study 4, Tables 1 and 3).

Adult health and premature mortality

Regarding health, several adult outcomes have been investigated within the cohort, such as risk factors for cardiometabolic disease, inflammatory markers, cortisol levels, physical functioning, poor self-rated health and mortality in mid-adulthood. Because understanding whether particular developmental trajectories associated with specific maltreatments might implicate pathways to later health outcomes, we assessed mediation of associations, for example, by cognition, educational attainment, mental health, smoking or socio-economic position (as appropriate).

Childhood neglect was associated with 39% to 48% higher odds of poor self-rated health across several adult ages from 23y to 50y (study 12, Table 1). Associations between child neglect and poor health were confirmed with more objective measures, including poorer mean blood lipid and glucose concentrations in mid-life (45y), although associations were weak (study 8 and 9, Table 1). Suggested intermediary factors were: adult BMI, smoking and low social class (study 9, Table 1). Findings were expected because of neglect associations with these intermediary factors (mentioned above) and the wider body of research identifying adiposity, smoking and low social class as key determinants of health.

Also, childhood neglect was found to be associated with elevated inflammatory markers (C-reactive protein (CRP) and fibrinogen) at 45y, independent of other early life factors including childhood disadvantage: there was a strong association for CRP (higher by 23% on average) and moderate association for fibrinogen (higher by 3.53% on average) (study 10, Table 1). To investigate the potential intermediary role of adiposity in these associations we adjusted for adult BMI and WHR: associations attenuated, although remained (16.3% higher CRP; 2.78% higher mean fibrinogen); likewise, the association attenuated but remained after adjustment for adult socioeconomic position. Thus, our study provides some support for a likely intermediary role of adiposity and adult socioeconomic position. For cortisol levels at 45y, in women but not men, salivary cortisol measures 45mins post-awakening were lowered by 7.9% on average per unit increase in childhood neglect score (score range 0-3) and the morning decline in cortisol was less steep (study 11, Table 1). These findings suggest a flattened morning cortisol secretion pattern in mid-adult life, reflecting possible dysregulation of the hypothalamic

pituitary adrenal (HPA) axis and associated harmful effects on some health outcomes (Gardner et al., 2019).

At 50y, child neglect was associated with a 55% higher odds of poor physical functioning (limitation in the ability to perform physical tasks of daily living). The poorer educational qualifications associated with neglect, mentioned above, appeared to be an intermediary factor in its association with poor physical functioning (study 12, Table 1).

The risk of premature (i.e. ages 45y to 58y) mortality associated with child neglect was 45% higher than that for the non-neglected, independent of other early life factors including childhood disadvantage. Adult socioeconomic factors (social class and education) and health behaviours (primarily smoking) appeared to be important intermediaries of the child neglect – premature mortality association (study 13, Table 1).

Childhood abuse was also associated with increased odds of poor-rated health across several adult ages, ranging from higher odds at age 50y of 31% for physical abuse, 49% for psychological abuse, and 75% for sexual abuse (study 12, Table 1). With more objective outcomes, most forms of abuse were associated with poorer blood lipid levels in mid-life (45y) and also for physical abuse, with higher blood glucose levels (studies 8 and 9, Table 1). Associations were modest, for example, the odds of elevated LDL-c was 25% higher for physical abuse compared to non-physical abuse. Similarly, HbA_{1c} was raised by 2.5% (males) and HDL-c was lower on average by 0.06mmol/L (females) for those experiencing physical abuse. Associations for sexual abuse were similar to those for physical abuse but 95% CIs were wide. For psychological abuse the odds of elevated triglycerides was 21% higher and HDL-c was lower on average by 0.04mmol/L. Analysis of these associations suggested that adult BMI and smoking were likely intermediary factors (study 9, Table 1). Maltreatments were not associated with raised blood pressure. For childhood abuse and adult inflammation, we found a moderate association between physical abuse and CRP (higher by 16.3% on average), independent of other early life factors (study 10, Table 1). Study findings suggest that adiposity may be an important intermediary in the child abuse – adult inflammation relationship. For cortisol levels at 45y, no associations were observed for childhood abuse (study 11, Table 1).

Sexual abuse was strongly associated with poor physical functioning at 50y, with higher odds of more than twofold (Table 3), but key intermediary factors for the association were not identified. A moderately higher odds (49%) of poor physical functioning was observed for childhood psychological abuse (study 12, Table 1). Sexual abuse was also associated with over twice the risk of death in mid-adulthood independent of other early life factors but again, key intermediary factors were not identified. Whereas, physical abuse was associated with a 72% higher risk of premature mortality in mid-adulthood and health behaviours (mainly smoking) appeared to be a key intermediary factor (study 13, Table 1).

Discussion

In a large nationwide British population followed from birth to mid-life, one-in-five were identified as having experienced neglect or abuse (physical, psychological, sexual) in childhood. Within this population our research charts the life-course of child neglect and abuse groups compared to the non-affected population in terms of their (i) physical, cognitive and emotional development in childhood and adolescence, and (ii) adult wealth and health outcomes. A main focus was specific types of child maltreatment and associated outcomes. Synthesizing evidence from several original studies, main findings include the following. First, in respect of the life-course, all types of childhood maltreatment were associated with at least one unfavourable aspect of development during childhood that would be expected to lead to unfavourable outcomes in adulthood. Such expectations were observed, i.e. all

forms of maltreatment showed associations with at least one unfavourable outcome in mid-life. Many of these mid-adult outcome measures are key determinants of subsequent serious disease, disability and death, and are therefore important burdens for individuals and society, particularly in the context of ageing populations. Second, in respect of specific types of maltreatment, findings across several original studies showed that associations differed for a range of outcomes at different life-stages (Table 3). No type of maltreatment was associated with all outcomes, but neglect showed the most widespread associations in both child and adulthood.

Methodological strengths and limitations

The original studies summarized in this overview benefit from the rich longitudinal data contained in the 1958 birth cohort study. The cohort has several strengths in the measurement of child maltreatment, especially regarding the inclusion and prospective measurement of neglect which is often ignored in research on maltreatment (Stoltenborgh et al., 2013) (limitations of measures are acknowledged below). With a broad range of prospective and often repeatedly measured outcomes, the cohort permits a detailed investigation of diverse and multiple effects of maltreatment at different life-stages, contributing primary evidence to several reviews or meta-analyses (Baldwin et al., 2019; Baumeister et al., 2016; Bunting et al., 2018; Danese & Tan, 2014; Gilbert et al., 2009; Jakubowski et al., 2018; Norman et al., 2012; Su et al., 2019). The length of follow-up - over five decades of life - is a major strength of the 1958 cohort in the identification of associated outcomes over the long-term and in the task of understanding the developmental trajectories likely to influence later outcomes. In addition to the important outcomes examined, a wide range of potential confounding and intermediary factors were available. In terms of methodologies, we note the lack of established methods for such an overview of findings for different outcomes within a particular population. Accordingly, the structure of our overview was tailored to reflect its life-course focus on likely child-to-adult pathways from maltreatment to later outcome. It was also necessary to adapt criteria for classifying the strength of maltreatment-outcome associations. Whilst based on recommended or commonly used criteria (Chen et al., 2010; Cohen, 1988), cut-offs are somewhat arbitrary given that they should be dependent on the prevalence and clinical importance of different outcomes. Furthermore, we are unable to include a comparison of findings with other overviews given the absence of literature with a similar focus, whilst comparison for specific outcomes is precluded given the vast scale of the literature. In terms of comparability of findings across the original studies, comparability was evident in many respects, notably, all focused on specific types of maltreatment that were similar in their conceptualisation (rather than cumulative adversity scores) and analyses usually took account of all types of maltreatment simultaneously to distinguish specific effects. Also, the methods and approaches used in the included studies were broadly comparable, for example, in controlling for early life factors that usually occur before the maltreatment such as birth weight and socio-economic measures at birth and age 7y. Where appropriate additional covariates were included in instances where they were important for a particular outcome (e.g. parental height in analyses of an individual's height) and potential mediating factors were selected as relevant to outcomes. Thus, although similar, analyses were not identical. As with all observation studies, residual confounding cannot be excluded and causality cannot be inferred. However, similarity of findings, for example for inflammation in adulthood in the 1958 cohort and a US population (Pinto Pereira, Stein Merkin, Seeman, & Power, 2019) suggests that residual confounding does not account for observed associations. In terms of the robustness of findings in the original studies, several methodological issues are acknowledged, including for example, missing data, cohort attrition over time and sample representativeness. Fuller details and strategies employed to minimise bias from these issues are given in the original studies listed in Table 1 and related publications (Atherton et al., 2008). In addition, this overview is restricted to just one birth cohort and child maltreatment patterns of lifetime associations may differ by context, such as place and time. Notably, it has been argued that contextual factors affecting child development, such as family, peer group, school and community factors, may influence

both the incidence and developmental effects of maltreatment (Zielinski & Bradshaw, 2006). Thereby, the contexts in which children develop may account for some of the heterogeneity in outcomes associated with maltreatment (Zielinski & Bradshaw, 2006). Differences in estimated effects of maltreatment have been attributed as probably indicating differences in exposures and outcomes (Gilbert et al., 2009) across different populations, as well as variations in analyses.

Childhood maltreatment: prospective and retrospective measurement

Several considerations regarding our measures are noteworthy. Childhood neglect has the advantage of prospective ascertainment; focusing mostly on lack of stimulation via parental input it represents some but not all aspects of the conventional definition (i.e. covering failure to meet a child's basic physical, emotional, or educational needs, but not inadequate nutrition or shelter) (Gilbert et al., 2009). Construct validity is suggested by work reported here showing expected associations of child neglect with shorter child-to-adult stature and with lower premorbid cognitive abilities (for further details see studies 2 and 5, Table 1). Robustness and coherence of findings may be supported (or not) by comparing studies with different designs and limitations. Of relevance here is the consistency of our observational findings for child neglect with evidence from a different study design, namely an adoption study. Our finding that child neglect is associated with elevated risks of low qualification levels, not being in paid work and poor adult health are in accord with adoption study findings for high early life deprivation (in Romanian institutions) and subsequent low educational achievement, unemployment and mental health service use in young adulthood (Sonuga-Barke et al., 2017).

Abuse by a parent was reported in adulthood, and thus exclusion of abuse by others may lead to an underestimate of prevalence. Self-reports may be affected by recollection or mental health, and information is lacking on timing and duration of child maltreatment. Nonetheless, retrospective report is commonly used, for example as in the adverse childhood experiences study from the US (Anda et al., 1999; Anda et al., 2002; Dube et al., 2006), partly because of the lack of reliable alternative data ascertainment methods. In child maltreatment research it is acknowledged that all methods of ascertainment have limitations and there is no gold-standard (Gilbert et al., 2009). Regarding data validity in the 1958 cohort: i) importantly, reassurance for retrospective reports is provided by observations of expected associations (indicating construct validity), i.e. with prospectively measured family dysfunction/circumstances (Denholm, Power, Thomas, & Li, 2013b) and later mental health (Geoffroy, Pinto Pereira, Li, & Power, 2016). Also, as expected, the prospective and retrospective measures show co-occurrence of maltreatment types (Denholm et al., 2013b); ii) in general, prevalence estimates are within the ranges reported elsewhere (Gilbert et al., 2009; Radford et al., 2011); and iii) child abuse was reported at 45y blind to the knowledge of the scientific issues to be investigated.

Findings from the 1958 cohort provide insights into recent debates about retrospective and prospective reports of childhood maltreatment (Baldwin et al., 2019; Reuben et al., 2016; Shaffer, Huston, & Egeland, 2008). An important challenge in assessing the adequacy of retrospective report is the design of studies that attempt to shed light on this issue. One study design involves comparing early life and later measures of child maltreatment, but a common problem with this design is that measures or methods of data ascertainment often vary for different life stages, thereby affecting comparison. Whilst measures in the 1958 cohort also have this limitation, our findings nonetheless suggest that retrospective report of childhood abuse was associated with differing life-courses in some but not all respects, both before and after the timing of the adult report. Key to this observation is the fact that other early life factors (e.g. socio-economic position), covariates, intermediate factors and outcomes were measured prospectively.

To illustrate, all forms of abuse were associated with poorer emotional development as assessed by teachers for ages 7y to 16y (Geoffroy et al., 2016); all forms of abuse were associated with smoking at age 23y (>20y before adult reporting of abuse) (Power, Pinto Pereira, & Li, 2015); and, child sexual and

psychological abuse were associated with poor self-rated health also at 23y (Archer, Pinto Pereira, & Power, 2017). Sexual abuse was associated with lower cognitive abilities (7-16y), subsequent qualification level, and also with downward social mobility from family class background to own social class in adulthood (Geoffroy et al., 2016; Pinto Pereira, Li, & Power, 2017), suggesting that the educational and social trajectory of this group differs from others years before abuse was reported. Likewise regarding physical development: physical abuse, and in females sexual abuse, were associated with faster BMI gain from childhood to adulthood (Power et al., 2015). Health trajectories of abuse groups also differ after the timing of their report: for example, child psychological and sexual abuse were found to be associated with elevated odds of poor physical functioning 5y after the time at which abuse was reported (Archer et al., 2017).

Recognizing that retrospective recall of abuse in childhood is imperfect, findings from the 1958 cohort suggest that the lives of those reporting abuse retrospectively differ onwards from childhood in some key respects. Although there are alternative explanations for this important finding, a parsimonious interpretation is that retrospective reports have some validity, as suggested by findings by us and others showing that adult report of childhood abuse is associated with elevated mortality risk over 14 to 20 years following retrospective report (Chen, Turiano, Mroczek, & Miller, 2016; Rogers, Power, & Pinto Pereira, 2019).

Interpretation of childhood maltreatment types from a life-course perspective

Longitudinal studies such as the 1958 birth cohort can provide important insights into associations between childhood maltreatment and adult outcome(s), as the rich data available either contemporaneously or from earlier life stages allows account to be taken of potential confounding factors that have been prospectively recorded. Many crucial questions about childhood maltreatment and long-term outcome will continue to rely on observational data because appropriate randomised trials are unethical, impractical and 'natural experiments' are rare. Hence, increased attention to studies over the life-course is warranted. Our overview of one birth cohort brings together evidence on the sequelae of child maltreatment, particularly as relating to knowledge gaps on their extent, specificity and pathways involving child development and several adult outcomes. To our knowledge, this overview and many of the original studies on which it is based are the first to examine a wide range of outcomes over several decades of life. In particular, the series of studies based on the 1958 cohort provides a collection of evidence that is possibly unique (e.g. with inclusion of child neglect, range of outcomes, life-stages and long follow-up). Given the distinct characteristics of the data source, comparison with other studies was not always possible either for this overview or for the original studies. For example, previous studies had examined associations of child maltreatment and obesity, but none had examined BMI trajectories over more than four decades of life (Power et al., 2015). By collating evidence for a range of outcomes, this overview pertaining to contemporary adults suggests that child neglect and some forms of abuse generate profound and persisting disadvantage over decades in many health and wealth aspects of adult lives.

With respect to *specificity*, our research evaluates whether types of childhood maltreatment are relevant to particular outcomes, responding to recent calls for such knowledge (Baumeister et al., 2016; Bunting et al., 2018; Jakubowski et al., 2018). Bringing evidence together from several studies reveals that there are distinct patterns of associations with life-course outcomes. The observations for child neglect suggest widespread (although not universal) patterns of association with key dimensions of development and also with adult outcomes. Notably, child neglect was associated with poorer developmental trajectories from child to adulthood, including slower height growth, delayed puberty, faster BMI gain during childhood and adolescence than others, and with poorer emotional and cognitive development. Then in adulthood, neglect was associated with shorter height, excess BMI, lower qualifications, less favourable social mobility patterns and living conditions, smoking, poorer mental

health, blood lipid and glucose levels, and inflammatory markers in mid-life, poor-rated health and physical functioning at 50y and premature mortality in mid-adulthood. In contrast, observations for childhood abuse suggested that associations were specific to particular types of abuse and outcome. All forms of abuse were associated with poorer emotional development and, in adulthood, with poorer mental health, smoking, poor blood lipid levels and poor-rated health. In addition, physical and sexual abuse were associated with faster BMI gains, higher adult BMI and premature mortality. Physical abuse was also associated with poorer adult blood glucose levels and inflammation; while additionally, sexual abuse was associated with less favourable social mobility patterns, adult living conditions and poor physical functioning.

The adult health measures with which neglect and abuse are associated are key predictors of subsequent serious disease, disability and death. For example, poor-rated health predicts mortality (Idler & Benyamini, 1997), elevated blood lipid and glucose levels predict cardiovascular disease and diabetes (*Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III)*, 2001), and poor physical functioning in adulthood is strongly associated with inability to work, higher levels of dependency and mortality (Brock, Lemke, Branch, Evans, & Berkman, 1994; Cooper et al., 2010; Guralnik et al., 1994). These are important outcomes to consider in terms of the health burden for individuals and society, particularly in the context of ageing populations.

In regard to *trajectories and mechanistic pathways*, the tracking of growth, adiposity, cognitive and mental health trajectories informs our research on early and mid-adulthood outcomes as well as on future health and longevity. The value of understanding such trajectories is evident in considering particular findings. For example, physical abuse and, in women, sexual abuse were associated with faster BMI gains from child to adulthood. In turn, we would expect these types of maltreatment and not others to be associated with adiposity gain/obesity related outcomes such as poorer lipid/HbA_{1c} profiles and inflammation. This expectation of distinct patterns of association was borne out in subsequent studies, suggesting coherence in life-course progression from childhood to long-term outcome. Likewise, childhood neglect was associated with poorer cognitive and emotional development, qualification level and adult behaviour that in turn, would be expected to influence later outcomes in adulthood such as poor physical functioning, which again was observed in this population. To some extent these findings provide support for the argument that negative outcomes are mediated through continued social adversity (*Evidence-based early years intervention*, 2018). However, several of the long-term outcomes observed in our research were evident after taking account of adult socio-economic position, suggesting that other mechanisms may be involved. These mechanisms may involve embedding within neuropsychological, immune, neuroendocrine or epigenetic changes (*Evidence-based early years intervention*, 2018).

Implications for policy

Child neglect and abuse are not uncommon in today's children (Gilbert et al., 2009; Radford et al., 2011) hence, the research summarised here remains highly relevant to contemporary generations. Further overviews of specific childhood maltreatments and long-term outcomes are needed, as delineating the extent of such associations, as shown here, is important from the perspective of establishing the full harms for individuals and society. Of relevance to this delineation is whether unfavourable outcomes endure to later life-stages, incurring life-long costs, and whether multiple dimensions of life, such as health and wealth, are affected. Pertinent to the latter, is the finding highlighted here of childhood maltreatment impacts on adult socio-economic outcomes, as shown in a limited literature on this topic (Bunting et al., 2018). This is important given the economic implications: to illustrate, long-term absences from work are costs shared between individuals, employers, and the government. Thus,

knowledge on the full impact of child maltreatment informs decisions on priorities for prevention and intervention.

Inevitably when tracking individuals over time, the longer the period of follow-up the better informed we are about long-term outcomes, although a downside is that some childhood conditions (e.g. influences on obesity) may have changed. Importantly, evidence summarised here pertains to today's adults, and it suggests that child neglect and some forms of abuse generate profound and persisting disadvantage over decades in many health and wealth aspects of adult lives. Tracking a population over their lifetime provides valuable insights, particularly in respect of secondary prevention. From child neglect and abuse we observe associated impairments in developmental course during childhood and adolescence that in turn progressed to less healthy and productive adult lives. For example, physical abuse was associated with fast rate of BMI gain and subsequent elevations in adult blood glucose levels. This life-course progression provides a coherence that bolsters confidence in the research; it also has implications for when and where interventions may be most effective. Arguably, the child neglect and abuse associations with physical, emotional and cognitive development highlighted here denote childhood detriments that are important in their own right, in addition to their longer-term impacts, and suggests the need for early intervention. The latter may also offer the best chance to avert a lifetime cascade of subsequent harms. However, intervention strategies in adulthood may also yield benefits, if it is possible to forestall the accumulation with age of multiple risk factors that affect healthy ageing and longevity. An extensive literature demonstrates increased risk of cardiovascular disease with multiple factors that include short height, adiposity gain and obesity, smoking, lower educational qualifications and occupational class, and elevated blood lipid and glucose levels (Kuh & Ben Shlomo, 2004). Currently, for adults exposed to neglect and abuse in childhood, associations summarised here suggest an accumulation of multiple risk factors for chronic disease with increasing age. The child-to-adult links sometimes apply to specific types of childhood maltreatment. Specificity in associations from observational studies is often taken as providing firmer grounds that associations are causal. Specificity also informs where interventions may be beneficial. In this context, there was little evidence for abuse associations with height or cognitive development, but emotional development, subsequent mental health and adult smoking associations were common across all forms of abuse. Sexual abuse associations indicated a particularly damaging outlook across many facets of adult health and living standards. Pervasive associations for child neglect may point to alternative underlying explanations. Other research with a different study design (and associated strengths and limitations) provides some confirmation for such pervasive effects, for example, follow-up of severely deprived groups over an extended period of early-life demonstrates many deficits in young adulthood (Sonuga-Barke et al., 2017). The widespread harms associated with child neglect highlights the urgency for early interventions.

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Table 1. Child maltreatment studies from the 1958 birth cohort included in this overview.

Study number	Reference	Outcomes (overarching groups)	Main outcomes and age of measurement
1.	(Denholm et al., 2013b)	Household dysfunction	Parent report (at 7, 11 or 16y): domestic tension, parental separation/divorce by 16y, alcohol/drug dependency, relationship with parents (16y), parental mental health/ depression, contact with authority or in institutional care*. Several factors were self-reported in adulthood (33 or 45y): domestic tension, parental separation /divorce, alcohol /drug dependency, strict upbringing, physical punishment*.
2.	(Denholm, Power, & Li, 2013a)	Child-to-adult height trajectories (growth in height).	Measured heights (repeated at 7, 11, 16 and 33y)
3.	(Li, Denholm, & Power, 2014)	Timing of puberty	Ratings of pubertal stage by medical personnel using Tanner scales at 11y and 16y (indicators include: genitalia and pubic hair development, facial hair and voice change (males); age of menarche, stages of breast and pubic hair development (females).
4.	(Power et al., 2015)	Child-to-adult adiposity trajectories (growth/ gain in BMI) Adult health behaviours	BMI from measured heights and weights (repeated at 7, 11, 16, 23*, 33, 45, 50y*). At ages 23y and 50y: alcohol consumption*, leisure-time physical inactivity*, smoking*
5.	(Geoffroy et al., 2016)	Child-to-adult emotional/ mental health Child-to-adult cognitive abilities	Age appropriate measures at 7, 11, 16y: teacher ratings on the Bristol Social Adjustment Guide of behavioral problems at 7 and 11y (e.g., miserable, resentful/aggressive) and Rutter Scale at 16y (e.g. miserable/unhappy, disobedient). At 50y participants used the Mental Health Inventory (MHI-5) to record current depressive symptoms (e.g., low mood, nervousness). Maths, reading, and general intellectual ability tested at 7, 11, and 16y. Education level (qualifications) by 42y. Tests at 50y included immediate/delayed memory, verbal fluency and processing speed.
6.	(Clark, Caldwell, Power, & Stansfeld, 2010)	Mental health from adolescence to mid-adulthood	At 16y the teacher version of the Rutter Scales identified internalizing and externalizing symptoms. At 23y mental health was measured by the Malaise Inventory. At 45y mental health was any report of depressive episode, generalized anxiety disorder, social phobia, agoraphobia or panic in the past week (using the abbreviated Revised Clinical

			Interview Schedule administered by a trained research nurse).
Adult-hood			
7.	(Pinto Pereira et al., 2017)	Adult living standards and socio-economic position Worklessness Inter-generational social mobility Intra-generational social mobility	At 50y: lacking assets (home ownership), financial insecurity, receipt of income-related support, qualifications, manual social class At 50y: not in employment, education or training (NEET), long-term sickness absence (LTS) Social class at birth and young adulthood (23y) Social class at 23y and 50y
8.	(Thomas, Hypponen, & Power, 2008)	Adult type 2 diabetes risk and obesity	Elevated blood glucose (HbA _{1c}) at 45y~, oral anti-diabetes treatment at 45y, doctor diagnosis of Type 2 diabetes by 42y* general (BMI) and central (waist circumference) obesity and at 45y
9.	(Li, Pinto Pereira, & Power, 2019)	Adult markers of cardiometabolic disease	Blood pressure/ hypertension at 45y blood lipids (triglycerides, LDL-c, HDL-c) at 45y~ glucose metabolism (HbA _{1c}) at 45y~ metabolic syndrome at 45y~ general (BMI) and central (waist circumference) obesity at 45y
10.	(Pinto Pereira et al., 2019)	Markers of inflammation	C-reactive protein (CRP) at 45y~ fibrinogen at 45y~
11.	(Power, Thomas, Li, & Hertzman, 2012)	Adult cortisol levels	Salivary cortisol measured at 45y: 45mins post-awakening and 3hr later from which the morning decline was calculated.
12.	(Archer et al., 2017)	Adult self-rated health, physical functioning, mental health	Self-rated health at ages 23, 33, 42, 45, 50y physical functioning and mental health at 50y assessed using validated sub-scales of the Short-Form 36 (SF-36)*
13.	(Rogers et al., 2019)	Premature mortality	Death recorded mainly via the National Health Service Central Register: 45 to 58y

* self-reports

~ from blood sample taken at age 45y

HbA_{1c} = glycosylated haemoglobin

LDL-c: low-density lipoprotein cholesterol; HDL-c: high-density lipoprotein cholesterol

* SF-36 physical component summary (ability to perform the physical tasks of daily living, including lifting, carrying groceries, climbing stairs, bending, kneeling, stooping and walking moderate distances) and mental health (MHI-5) sub-scales.

Table 2. Definition of child maltreatment and representative variables from the 1958 British cohort

Type of maltreatment (age)	Definition ^a	1958 cohort variables	Prospective/retrospective assessment age (method ^d)
Neglect (7y & 11y)	Failure to meet a child's basic physical, emotional, medical/dental, or education need; failure to provide adequate nutrition, hygiene, or shelter; or failure to ensure a child's safety	<ul style="list-style-type: none"> - Child looks undernourished, scruffy or dirty[§] - Mother never, or hardly ever takes child out^c - Father never, or hardly ever takes child out^c - Mother shows little or no interest in child's educational progress - Father shows little or no interest in child's educational progress - Mother and Father never, or hardly ever read to, or reads with the child 	Prospective 7 & 11y (T) Prospective 7 & 11y (Pa) Prospective 7 & 11y (Pa) Prospective 7 & 11y (T) Prospective 7 & 11y (T) Prospective 7y (Pa)
Physical abuse (0-16y)	Intentional use of physical force or implements against a child that results in, or has the potential to result in, physical injury.	- I was physically abused by a parent – punched, kicked or hit or beaten with an object, or needed medical treatment [~]	Retrospective 45y (S)
Psychological abuse (0-16y)	Intentional behaviour that conveys to a child that s/he is worthless, flawed, unloved, unwanted, endangered, or valued only in meeting another's needs. ^b	<ul style="list-style-type: none"> - I was verbally abused by a parent (or parent-figure)[~] - I suffered humiliation, ridicule, bullying or mental cruelty from a parent (or parent-figure)[~] - Mother (or mother-figure) and father (or father-figure) were not at all affectionate 	Retrospective 45y (S) Retrospective 45y (S) Retrospective 45y (S)
Sexual abuse (0-16y)	Any completed or attempted sexual act, sexual contact, or non-contact sexual interaction with a child by a caregiver.	- I was sexually abused by a parent (or parent-figure) [~]	Retrospective 45y (S)

a: (Gilbert et al., 2009)

b: UK definition includes harmful (unintentional) parent-child interactions: 'the persistent emotional maltreatment of a child such as to cause severe and persistent adverse effects on the child's emotional development'. Department for Education (*Working together to safeguard children. A guide to interagency working to safeguard and promote the welfare of children*, 2015)

c: 'e.g. walks, outings, picnics, visits, shopping'

d: (S): self-report; (T): teacher-report; (Pa): parent-report

[~] yes /no response;

[§] item within the Bristol Social Adjustment Guide(Stott, 1963)

Table 3. Summary of findings on consequences of child maltreatment—evidence for an association in the 1958 British cohort

Outcome	Neglect	Sexual abuse	Physical abuse	Psychological abuse
Child development [study number]~				
mental/ emotional health[5]	moderate	moderate/strong	moderate	weak/moderate
cognition[5]	moderate	moderate	none	none
height[2]	moderate	none	none	none
pubertal timing[3]	moderate	none (M) inconsistent (F)	none	none (M) inconsistent (F)
adiposity(BMI)[4]	None	none	none	none
child-adult BMI gain[4]	weak	weak (F)	weak	none
Adulthood				
smoker at 23y[4]	strong	strong	strong	strong
smoker at 50y[4]	strong	strong	strong	strong
heavy drinker at 23y[4]	none	none	none	none
heavy drinker at 50y[4]	none	none	none	none
physically inactive at 23y[4]	weak	weak	weak	weak
physically inactive at 50y[4]	weak	weak	weak	weak
Height at 45y[2]	weak	none	none	none
general obesity at 45y[9]	weak	none	moderate	none
central obesity at 45y[9]	weak	none	moderate	none
hypertension at 45y[9]	none	none	none	none
HDL-c at 45y[9]	weak(F)	none*	weak(F)	weak
LDL-c at 45y[9]	none	none*	moderate	none
triglycerides at 45y[9]	weak	none*	None	moderate
glycosylated haemoglobin (HbA _{1c}) at 45y[9]	weak	moderate	moderate(M)	none
metabolic syndrome at 45y[9]	none	none*	none	none
C-reactive protein 45y[10]	strong	none	moderate	none
fibrinogen at 45y[10]	moderate	none	none	none
cognition at 50y[5]	weak	none	none	none
education level at age? [5]	strong	strong	moderate	none
LTS at 50y[7]	moderate	none*	moderate	moderate
NEET at 50y[7]	moderate	none*	none	none
lack of assets at 50y[7]	moderate	moderate	moderate	moderate
income-related support at 50y[7]	none	moderate	moderate	moderate
financial insecurity at 50y[7]	none	moderate	moderate	moderate
manual social class at 50y[7]	moderate	moderate	none	none
mental health* at 50y[12]	moderate	none	none	moderate
self-rated health at 50y[12]	moderate	moderate	moderate	moderate
physical functioning* at 50y[12]	moderate	strong	none	moderate
premature mortality (45y to 58y)[13]	moderate	strong	moderate	none

Footnotes: ~ study number given in Table 1; M= males; F=females

LTS and NEET (defined in Table 1) baseline = employed, in education or training.

* defined in Table 1

Associations between child maltreatment(s) and outcome(s): in general included adjustment for other early life factors (e.g. child SEP) shown previously to be associated with outcomes and, because types of maltreatment are correlated, adjustments for the other maltreatments were made where appropriate. Thus, associations summarised here mostly take account of other forms of neglect/abuse and other early life factors. Associations are consistent with the following criteria:

strong= OR_{adj} (RR_{adj} or HR_{adj}) > 2.0 i.e for binary, multinomial or survival outcomes; standardised mean difference (SMD) >0.5 i.e. for continuous outcomes;

moderate= OR_{adj} (RR_{adj} or HR_{adj}) 1.2-2.0 or SMD 0.2-0.5;

weak= OR_{adj} (RR_{adj} or HR_{adj}) < 1.2 or SMD <0.2;

none= no evidence of association using 95% confidence intervals; N for sexual abuse was small and study power was low to detect associations (*indicates where associations were moderate/strong but non-significant).

inconsistent=associations vary across different indicators.

Criteria are based on: (i) Cohen's d (standardized mean difference, SMD) for continuous outcomes (0.2, 0.5 and 0.8 are often cited as indicative of small, medium, and large effect sizes respectively)(Cohen, 1988); and (ii) for

categorical outcomes, the strength of an association is influenced by the prevalence of the outcome. For example, for an outcome with a 5% prevalence in the non-exposed group, OR reference points for a “weak”, “moderate”, and “strong” association (i.e. equivalent to a SMD of 0.2, 0.5 and 0.8) are 1.52, 2.74, and 4.72 respectively (Chen et al., 2010). An unadjusted OR of 4.72 is high and rarely seen in epidemiological studies. Note that because reference points are unadjusted, whereas associations in the 1958 cohort studies adjust for several potential confounding factors, we used lower cut-offs for adjusted OR, RR and HR as listed above.