*Psychological Medicine*

**cambridge.org/psm**

# Do documented records and retrospective reports of childhood maltreatment similarly predict chronic inflammation?

Max Osborn[1,2] and Cathy Spatz Widom[1,2]

[1]John Jay College of Criminal Justice, New York City, New York, USA and [2]Graduate Center, City University of New York, New York City, New York, USA

## Original Article

**Cite this article:** Osborn M, Widom CS (2020). Do documented records and retrospective reports of childhood maltreatment similarly predict chronic inflammation? *Psychological Medicine* **50**, 2406–2415. https://doi.org/10.1017/S0033291719002575

Received: 14 March 2019
Revised: 17 July 2019
Accepted: 30 August 2019
First published online: 23 September 2019

**Key words:**
Child maltreatment; chronic inflammation; C-reactive protein; documented reports; retrospective reports

**Author for correspondence:**
Cathy Spatz Widom,
E-mail: cwidom@jjay.cuny.edu

## Abstract

**Background.** Childhood adversities have been associated with chronic inflammation and risk for cardiovascular disease. With some exceptions, existing knowledge of this relationship is based on retrospective self-reports, potentially subject to recall bias or memory problems. We seek to determine whether childhood maltreatment is associated with higher C-reactive protein (CRP) later in life and whether individuals with official and retrospective self-reports of maltreatment and men and women show similar increases in risk.

**Methods.** Data are from in-person interviews in 2009–2010 with 443 offspring (mean age = 23.4) of parents in a longitudinal study of the consequences of childhood maltreatment. Official reports of maltreatment were abstracted from 2011–2013 Child Protective Services records. Eleven measures were used to assess self-reported maltreatment retrospectively. Seventeen percent of offspring had official reports, whereas self-reported prevalence rates ranged from 5.4% to 64.8%. CRP was assessed through blood spot samples. Regression models were used to estimate the effect of maltreatment on inflammation, adjusting for age, sex, race, parent occupational status, current depression, smoking, and heavy drinking.

**Results.** Individuals with official reports of child maltreatment and, specifically, physical abuse, had significantly higher levels of CRP than non-maltreated individuals. Maltreated females showed elevated CRP, independent of control variables, whereas no significant association was observed in males. Retrospective self-report measures of child maltreatment did not predict elevated CRP.

**Conclusions.** Individuals with documented histories of childhood maltreatment are at increased risk for chronic inflammation and may benefit from targeted interventions. The results strengthen inferences about the effects of childhood maltreatment on inflammation in females.

## Introduction

C-reactive protein (CRP) is an acute-phase protein synthesized by the liver in response to physical and psychosocial stressors (Du Clos and Mold, 2004), where levels peak during acute infection but subside quickly once the stimulus is removed (Pepys and Hirschfield, 2003). Consistently high levels of CRP are regarded as indicating chronic inflammation and CRP has been found to predict risk for cardiovascular disease, the leading underlying cause of death in the United States (Mozaffarian *et al.*, 2016). CRP is unaffected by eating and does not appear to be subject to diurnal or seasonal variation (Meier-Ewert *et al.*, 2001; Frohlich *et al.*, 2002; Pepys and Hirschfield, 2003). Elevated CRP levels have been linked to experiences of childhood adversities, stress, and trauma (Taylor *et al.*, 2006; Danese *et al.*, 2007; Pollitt *et al.*, 2007; Danese *et al.*, 2008; Danese *et al.*, 2009; Broyles *et al.*, 2012; Coelho *et al.*, 2014; Cicchetti *et al.*, 2015; Baumeister *et al.*, 2016; Baldwin *et al.*, 2018). These relationships have been demonstrated in the short-term (Heim, 2017), throughout adolescence (Copeland *et al.*, 2014), and into adulthood (Danese *et al.*, 2007), although these studies have predominantly used a broad definition of childhood adversities, rather than focusing on specific stressors (Fagundes *et al.*, 2013; Dowd *et al.*, 2014).

However, child maltreatment and its subtypes have been shown to have distinct effects on health outcomes (Chartier *et al.*, 2010; Widom *et al.*, 2012). In one study, individuals with a documented history of childhood physical abuse were at increased risk for higher levels of CRP than non-maltreated individuals 30 years later (Widom *et al.*, 2012). Elevated CRP levels have been linked not only to the presence of childhood maltreatment, but to its severity (Aas *et al.*, 2017). There also appears to be a stronger relationship between childhood adversity and CRP in females than males (Baldwin *et al.*, 2018), and while race differences in CRP levels have been reported (Ford *et al.*, 2003; Ford *et al.*, 2004; Khera *et al.*, 2005; Lande *et al.*, 2008), it is difficult to determine whether there are also race differences in the relationship between early life stress

© Cambridge University Press 2019

CAMBRIDGE UNIVERSITY PRESS

Article last updated 23 February 2022.

and CRP because the existing literature is based primarily on all White or majority-White samples (Danese *et al*., 2008; Danese *et al*., 2011; van Ockenburg *et al*., 2015; Lin *et al*., 2016).

With some exceptions (Danese *et al*., 2007; Danese *et al*., 2008; Danese *et al*., 2011; Widom *et al*., 2012; Copeland *et al*., 2014; Baldwin *et al*., 2018), the existing literature is based primarily on retrospective self-reports of childhood histories, rather than documented cases or prospective data. A recent meta-analysis found poor agreement between prospective and retrospective measures of maltreatment; more than half of individuals with prospective observations of maltreatment failed to report it retrospectively, and more than half of individuals who did report maltreatment had no corresponding documentation (Baldwin *et al*., 2019). This lack of concordance raises questions about potential biases (Henry *et al*., 1994; Offer *et al*., 2000) that may be due to deterioration in recall ability or to changes in individuals' understandings of maltreatment over time (Baldwin *et al*., 2019; Widom, 2019). Baldwin *et al*. (2019) provide an excellent discussion of multiple possibilities for memory biases that can result in under- and over-reporting, including forgetting, cognitive avoidance strategies, or cognitive appraisal.

The current study extends and expands on existing knowledge in two important ways: by comparing results based on official reports (prospective) and retrospective self-reports of childhood abuse and neglect and by distinguishing the consequences of childhood physical abuse, sexual abuse, and neglect. We expect that childhood maltreatment (and all three subtypes) will predict higher levels of CRP than for non-maltreated individuals. Furthermore, we expect that the relationship between retrospective self-reports of child maltreatment and inflammation will be stronger than the relationship between official reports and inflammation for two reasons. First, some research has shown that recall accuracy is influenced by current experiences (e.g. Widom *et al*., 2005). Thus, individuals experiencing physical and mental health problems in adulthood may be more apt to provide negative accounts of their pasts, thus artificially inflating the association between childhood maltreatment and negative outcomes later on. In addition, retrospective reports of maltreatment are more strongly linked to mental health problems than prospective measures (e.g. Reuben *et al*., 2016; Newbury *et al*., 2018). The second reason is based on the concern that reliance on official reports of child maltreatment underestimates the extent of the problem (Hardt and Rutter, 2004). Finally, based on prior literature, we expect that the relationship between child maltreatment and CRP will be stronger for women than men, although we examine, but do not make predictions about, race differences.

## Methods

### Study sample

This research uses data from the offspring of participants in a longitudinal study focusing on the long-term consequences of childhood maltreatment, where a large group of children with documented cases of childhood abuse and neglect ($n = 908$) and a matched control group ($n = 667$) were followed into adulthood and assessed. Maltreated participants were identified via county court records from a Midwestern city during the years 1967–1971. Controls were matched on the basis of age, sex, race, and approximate family social class. A detailed description of the study design and sample selection criteria has been previously reported (Widom, 1989; Widom *et al*., 2015*b*). Initial interviews were conducted during 1989–1995, with follow-up interviews in 2000–2002, 2003–2005, and 2009–2010. Although there was attrition associated with death, refusals, and our inability to locate individuals over the various waves of the study, the composition of the sample at all time points has remained about the same. The maltreatment group represented 56–58% at each time period; White, non-Hispanics were 62–66%; and males were 48–51% of the samples. There were no significant differences across the samples on these variables or in mean age across the phases of the main study.

During 2009–2010, 649 of the original participants from both groups (abuse/neglect and controls) and 697 of their offspring were interviewed using computer-assisted personal interviewing. The current analyses use data from the offspring group only.

In all waves of the study, participants and interviewers were blind to the purpose of the study. Because of the nature of the larger study, the expectation was that the offspring would be at high risk for child maltreatment (Widom *et al*., 2015*b*). Offspring were told that they were selected because someone in their family had participated in previous rounds of the study and that the purpose of the current study was to understand factors that shape how people change as they develop throughout the life course. Participants were assured that their responses would be kept confidential, unless they indicated that a minor was being harmed or in danger, in which case the appropriate authorities would be notified (per mandatory reporting laws). All procedures were approved by relevant Institutional Review Boards, depending on the wave of the study, and participants indicated their voluntary participation in the study and signed consent forms. As compensation, 12–17-year-old offspring received $50 and offspring 18 and over received $75.

The sample for the current analysis ($N = 443$) does not reflect the total offspring sample of 697. There were a number of reasons for the exclusion: (1) offspring under the age of 12 ($n = 42$) did not have blood drawn because of IRB concerns; (2) some offspring who were interviewed ($n = 157$) declined to have blood drawn; (3) offspring with CRP levels exceeding 10 mg/L ($n = 34$) were excluded, as this is considered evidence of acute inflammation, infections, or pathology (Pearson *et al*., 2003; McDade *et al*., 2004; Fuligni *et al*., 2009); and (4) individuals who self-identified as other than Black or White ($n = 38$) were excluded because this group was too small for meaningful analysis. There were no significant differences between offspring with and without available CRP data in terms of age ($p = 0.25$), sex ($p = 0.98$), race ($p = 0.62$), parent occupational level ($p = 0.32$), current depression ($p = 0.37$), smoking ($p = 0.17$), drinking ($p = 0.83$), and whether any CPS charges had been filed ($p = 0.42$).

The current sample includes 443 offspring of both original groups (abuse/neglect and controls), ages 12 and older, who self-identified their race as either White or Black. The resulting sample was mean age 23.4 years (S.D. = 5.23), 48.5% female ($n = 215$); 40.9% ($n = 181$) identified as Black and 59.1% ($n = 262$) as White.

### Measures

There is no single 'gold standard' to ascertain whether child abuse or neglect has occurred. Rather, each of the traditional methods used to assess child maltreatment (official records, self-reports, and observations) has limitations as well as strengths. For this reason, information was collected from multiple sources, including official reports from Child Protective Services (CPS) agency records and offspring retrospective self-reports.

https://doi.org/10.1017/S0033291719002575 Published online by Cambridge University Press

### Official reports of child maltreatment

Official reports of child maltreatment were based on searches of CPS records for the names of all offspring and their parents (Widom *et al.*, 2015*b*). These searches were conducted in 2011–2013 in the Midwestern state that was the site of the original study, where the majority of parents still resided. CPS records included information on overall and specific charges for physical abuse, sexual abuse, and neglect. Physical abuse cases included injuries such as bruises, welts, burns, abrasions, lacerations, wounds, cuts, and bone and skull fractures. Sexual abuse charges varied from felony sexual assault to fondling or touching, sodomy, incest, and rape. Neglect cases reflected a judgment that the parents' deficiencies in childcare were beyond those found acceptable by community and professional standards at the time. These cases represented extreme failure to provide adequate food, clothing, shelter, and medical attention to children. Any (overall) maltreatment was defined as the presence of at least one CPS charge. Of the sample, 76 (17.2%) offspring had an official CPS report for at least one type of child maltreatment.

Multiple commonly used and validated self-report measures were used to assess participants' maltreatment histories retrospectively. Depending on the measure, self-reports of physical abuse ranged from 17.2% to 64.8% of the sample, self-reports of sexual abuse ranged from 5.4% to 14.4%, and self-reports of neglect ranged from 28.2% to 53.7% (for a more detailed description of the measures, see Widom *et al.* (2015*a*)). Of the sample, 88.3% ($n = 391$) said yes to at least one of the self-report measures. Because the percent of the sample that retrospectively self-reported any childhood maltreatment was so high, we do not include the 'any self-reported maltreatment variable' in further analyses since there is insufficient variation in the exposure.

### Self-reports of physical abuse

Self-reports of physical abuse were assessed with questions from Longitudinal Studies in Child Abuse and Neglect (LONGSCAN) (Runyan *et al.*, 1998), Adolescent Health Wave IV (ADD Health) Pretest 'Mistreatment by Adults' measure (Harris, 2011), and the Lifetime Trauma and Victimization History (LTVH; Widom *et al.*, 2005). LONGSCAN is a multisite consortium investigating the predictors and outcomes of maltreatment. Separate questions taken from the LONGSCAN protocol were asked for the time periods 'before age 12' and 'from 12 up to 18' to assess for physical and sexual abuse. There were 18 physical abuse items, including 'hit you with something really dangerous, like a baseball bat or shovel,' 'hit you with something less dangerous, like a hairbrush or belt,' and 'kicked or punched you.' ADD Health is a nationally representative sample of adolescents followed from youth (ages 7–12) to ages 24–32. At wave 4, youth were asked 'How often did a parent or other adult caregiver hit you with a fist, kick you, or throw you down on the floor, into a wall, or down stairs?' The LTVH was developed as a structured in-person interview measure to assess for seven categories of traumatic and victimization experiences. The two physical abuse LTVH questions used asked participants 'Were you ever struck, kicked, beaten, punches, slapped around, or otherwise physically harmed as a child' and 'Were you ever physically abused as a child?'

### Self-reports of sexual abuse

Self-reports of sexual abuse were assessed with items from LONGSCAN, ADD Health, and LTVH. Twelve items were included in the LONGSCAN sexual abuse module, including 'made you look at something sexual, like pictures or a movie,' 'spied on you or tried to look at you without your clothes on when didn't want to,' and 'touched your private parts or bottom in some way.' In ADD Health, for the assessment of sexual abuse, participants were asked 'How often did a parent or other adult caregiver touch you in a sexual way, force you to touch him or her in a sexual way, or force you to have sexual relations?' All questions refer to the period up until the respondent's 18th birthday. In the LTVH, the sexual abuse questions were 'Were you ever forced or coerced into unwanted sexual activity,' 'Did someone ever attempt to force you into unwanted sexual activity,' and 'Did someone ever touch your private parts or make you touch theirs against your wishes?'

### Self-reports of neglect

Self-reports of neglect were assessed with items from the Conflict Tactics Scale (CTS; Straus *et al.*, 1998), ADD Health, and Childhood Experiences Questionnaire (CEQ; Widom *et al.*, 2015*b*). The CTS neglect questions asked about the period in the participant's life up to age 18. Questions included a child not getting the food s/he needed, not being taken to a doctor or hospital when s/he needed to go, and a parent getting drunk or high on drugs and being unable to take care of the child. ADD Health neglect was assessed with one question: 'How often did a parent or other adult caregiver say things that really hurt your feelings or made you feel like you were not wanted or loved?' Questions refer to the period up to the respondent's 18th birthday. The CEQ was designed as a self-report measure of childhood neglect and included 14 items addressing the child's physical, educational, and emotional needs. Items are generally framed in a positive direction, e.g. 'Was there always something for you to eat when you were hungry?'

### C-reactive protein

A blood spot filter paper sampling method was used to measure CRP levels (McDade *et al.*, 2004). The blood spot method used here was developed to permit immunological measures of psychosocial stress in community and field samples (Worthman and Stallings, 1997). Validation studies have demonstrated that high-sensitivity CRP concentrations are relatively stable within individuals across time, supporting the use of a single CRP measure to indicate chronic levels of systemic inflammation (Macy *et al.*, 1997; Ockene *et al.*, 2001). Requirements for sample collection, storage, and transportation are minimal. Participants' fingers were cleaned with alcohol and then pricked with sterile, disposable micro-lancets widely available for diabetic use (Microtainer, Franklin Lakes, NJ). Up to 5 drops of capillary whole blood were collected on standardized filter paper (no. 903; Schleicher and Schuell) commonly used for neonatal screening. Samples were dried overnight at room temperature and shipped to the Emory University laboratory for analysis. CRP was assayed using established blood spot sensitivity and specificity ELISA (enzyme-linked immunosorbent assay) methods (McDade *et al.*, 2000, 2004). Dried blood sampling has been incorporated into several population-based surveys (McDade *et al.*, 2007). Prior validation of assay performance indicates that the dried blood sample CRP method yields results that are comparable to gold-standard serum-based clinical methods (McDade *et al.*, 2004).

### Control variables

In addition to age, sex, race, parent occupational level, heavy drinking, smoking, and depression were included as control variables. The parent occupational level was included as an approximate

https://doi.org/10.1017/S0033291719002575 Published online by Cambridge University Press

indicator of socioeconomic status (Hollingshead, 1975). As alcohol intake has been shown to impact the CRP level (Imhof *et al.*, 2001), heavy drinking was used as a control and coded as positive if the participant reported consuming an average of over 60 drinks per month in the past year (Nikulina and Widom, 2013). Cigarette smoking, another lifestyle factor linked to higher CRP (Mendall *et al.*, 1996; Rohde *et al.*, 1999), was based on participants' responses to questions about whether they had ever been frequent smokers, i.e. daily for 30 days or more. A mean parent occupational level in the current sample was 3.5 (S.D. = 1.7) on the Hollingshead (between semi-skilled and skilled), 5.6% of the sample were heavy drinkers, and 45.6% frequent smokers. Current depression symptoms were also included as one of the control variables based on the previous literature that suggests that depression may impact the strength of the relationship between childhood maltreatment and CRP levels (Danese *et al.*, 2009, 2011). Participants age 12–17 completed the Children's Depression Inventory, Short Version (CDI-S; Kovacs, 2003), and those 18 and older completed the Center for Epidemiological Studies – Depression Scale, a 20-item scale developed for use with the general population (CES-D; Radloff, 1977). Scores on these measures were converted into dichotomous indicators of whether each individual reported depressive symptomatology. Although there is no standard published cutoff score for the CDI-S, a *T*-score of over 65 was used to indicate current depression. For the CES-D, a cutoff score of 16 has been established to define a clinically significant level of depression (Weissman *et al.*, 1977; Radloff, 1991). Almost one-fifth (19.9%) of the sample met or exceeded the cutoff for clinically significant depression.

### Statistical analysis

All analyses were conducted using SPSS 24.0. The threshold for statistical significance was set at $p < 0.05$. Since distribution of CRP serum levels was highly skewed, these data were first log-transformed and the resulting values were used as the dependent variable for all analyses. Multivariate linear regression analyses were performed to examine the extent to which official reports of childhood maltreatment, as well as specific maltreatment subtypes (physical abuse, sexual abuse, and neglect) predicted CRP levels. Given the literature on sex and race differences, separate regression analyses were then conducted, with the sample split first by sex (male *v.* female) and then by race (Black *v.* White). Next, regression analyses were repeated to determine whether the retrospective self-report measures of childhood maltreatment predicted the CRP level.

## Results

### Prevalence of child maltreatment and agreement between official and self-report measures

Table 1 presents descriptive statistics for the prevalence of maltreatment (official reports and self-reports) and CRP scores. Because one of the goals of this paper is to compare results using both strategies for ascertainment of childhood maltreatment, one question is the extent to which the two types of measures agree. Table 2 shows the extent of agreement (Cohen's Kappa) between the self-report measures and official reports of child maltreatment by type of maltreatment (physical abuse, sexual abuse or neglect). The Kappas are quite low, with the highest being 0.13 for the agreement between the ADD Health sexual abuse items and official report of sexual abuse. Inter-correlations among self-report measures can be found in online Supplementary Table S1.

### Official reports of child maltreatment and CRP levels

Table 3 shows that individuals in the overall sample with official reports of childhood maltreatment and physical abuse specifically had significantly higher CRP levels than individuals without those records, despite the introduction of all control variables. Results for individuals with official reports of sexual abuse and neglect did not reach conventional levels of significance. In all models, being female and older significantly predicted higher CRP levels. Race was not a significant predictor of the CRP level.

In separate sex specific regressions (online Supplementary Table S2), females with official reports of childhood maltreatment had significantly higher CRP levels compared to non-maltreated females [$\beta = 0.15$, CI (0.03–0.46)], whereas for males there was no association between child maltreatment and CRP. In regressions for Blacks and Whites separately, there were no significant associations between official reports of childhood maltreatment and CRP levels for either Blacks or Whites, although there was a non-significant trend for Whites. We did not conduct sex or race specific analyses for specific subtypes of maltreatment because of small sample sizes.

### Self-reports of child maltreatment and CRP levels

Surprisingly, none of the 11 self-report measures of childhood maltreatment predicted significantly elevated levels of CRP (see Tables 4 and 5). It is noteworthy that the only self-report measure to reach significance was the ADD Health physical abuse measure, but the coefficient ($\beta = -0.09$, $p = 0.05$) was negative, indicating that a self-report of physical abuse was associated with lower levels of CRP. Race was not a significant predictor of CRP level.

## Discussion

This is the first study to examine whether childhood maltreatment predicts higher levels of CRP using two approaches to operationalizing these specific adverse childhood experiences. Individuals with official reports of childhood abuse and neglect in general and physical abuse specifically had significantly higher CRP, compared to those without these histories, although sexual abuse and neglect showed a trend in the same direction.

Surprisingly, none of the 11 retrospective self-reports of childhood maltreatment were associated with higher levels of CRP, despite our expectations that the relationship to CRP would be stronger in individuals who retrospectively report childhood maltreatment compared to individuals with documented cases of maltreatment. These results are also unexpected given that the assessments represented well-known and frequently used self-report measures of child maltreatment that have been validated and found informative in other contexts. The finding that children with official reports of maltreatment are at risk for higher levels of CRP than non-maltreated children later in life is not surprising, as the preponderance of the previous literature has shown positive associations between early life stress and the CRP level. What is surprising is that we did not find self-reports of maltreatment to be associated with higher levels of CRP, although some recent studies have also failed to find such a relationship (Carpenter *et al.*, 2012; van Ockenburg *et al.*, 2015).

https://doi.org/10.1017/S0033291719002575 Published online by Cambridge University Press

**Table 1.** Descriptive statistics for the prevalence of maltreatment (official reports and self-reports) and CRP scores

| | Total sample ($N = 697$) | | CRP sample ($N = 443$) | | CRP mg/L | |
|---|---|---|---|---|---|---|
| | *N* | % | *N* | % | Maltreatment *M* (s.d.) | No maltreatment *M* (s.d.) |
| Official report | | | | | | |
| Any maltreatment | 112 | 16.1 | 26 | 17.2 | 3.05 (2.81) | 2.04 (2.29) |
| Any physical abuse | 17 | 2.4 | 12 | 2.7 | 2.47 (1.40) | 2.09 (2.36) |
| Any sexual abuse | 17 | 2.4 | 13 | 2.9 | 2.63 (2.06) | 2.08 (2.34) |
| Any neglect | 104 | 14.9 | 69 | 15.6 | 2.72 (2.83) | 2.06 (2.26) |
| Retrospective self-report | | | | | | |
| Physical abuse (LS 0–11) | 416 | 59.7 | 287 | 64.8 | 2.10 (2.37) | 2.11 (2.29) |
| Physical abuse (LS 12–17) | 296 | 42.5 | 212 | 47.9 | 2.17 (2.45) | 2.03 (2.23) |
| Physical abuse (ADD Health) | 123 | 17.6 | 81 | 18.3 | 2.07 (2.44) | 2.10 (2.32) |
| Physical abuse (LTVH) | 123 | 17.6 | 76 | 17.2 | 2.28 (2.50) | 2.06 (2.30) |
| Sexual abuse (LS 0–11) | 98 | 14.1 | 63 | 14.2 | 2.25 (2.43) | 2.07 (2.32) |
| Sexual abuse (LS 12–17) | 70 | 10.0 | 47 | 10.6 | 1.82 (1.96) | 2.13 (2.38) |
| Sexual abuse (ADD Health) | 42 | 6.0 | 24 | 5.4 | 2.25 (2.33) | 2.09 (2.35) |
| Sexual abuse (LTVH) | 86 | 12.3 | 64 | 14.4 | 1.97 (2.11) | 2.07 (2.32) |
| Neglect (CTS) | 360 | 51.6 | 238 | 53.7 | 2.09 (2.30) | 2.06 (2.35) |
| Neglect (ADD Health) | 343 | 49.2 | 220 | 49.7 | 2.13 (2.37) | 2.09 (2.32) |
| Neglect (CEQ) | 205 | 29.4 | 125 | 28.2 | 2.23 (2.31) | 1.99 (2.29) |

CRP, C-reactive protein; LS, LONGSCAN; 0–11, during ages 0–11; 12–17, during ages 12–17; ADD Health, National Longitudinal Study of Adolescent to Adult Health; LTVH, Lifetime Trauma and Victimization History; CTS, Conflict Tactics Scale; CEQ, Childhood Experiences Questionnaire.

**Table 2.** Agreement between maltreatment based on retrospective self-report with official report of maltreatment

| Source of maltreatment report | | Cohen's Kappa |
|---|---|---|
| Any self-reported child maltreatment | Any official reports of maltreatment | 0.01 |
| Self-reported physical abuse, LONGSCAN, age 0–11 | Official report of physical abuse | 0.02 |
| Self-reported physical abuse, LONGSCAN, age 12–17 | Official report of physical abuse | 0.03 |
| Self-reported physical abuse, ADD Health | Official report of physical abuse | 0.11 |
| Self-reported physical abuse, LTVH | Official report of physical abuse | 0.02 |
| Self-reported sexual abuse, LONGSCAN, age 0–11 | Official report of sexual abuse | 0.09 |
| Self-reported sexual abuse, LONGSCAN, age 12–17 | Official report of sexual abuse | 0.06 |
| Self-reported, sexual abuse, ADD Health | Official report of sexual abuse | 0.13 |
| Self-reported sexual abuse, LTVH | Official report of sexual abuse | 0.11 |
| Self-reported neglect, CTS | Official report of neglect | −0.01 |
| Self-reported neglect, ADD Health | Official report of neglect | −0.06 |
| Self-reported neglect, CEQ | Official report of neglect | −0.07 |

LONGSCAN, 0–11 refers to the time period from ages 0 to 11; LONGSCAN 12–17 refers to ages 12 to 17; ADD Health, National Longitudinal Study of Adolescent to Adult Health; LTVH, Lifetime Trauma and Victimization History; CTS, Conflict Tactics Scale; CEQ, Childhood Experiences Questionnaire.

However, the lack of agreement between our retrospective self-report findings and our findings based on official reports of child maltreatment is consistent with the results of the recently published review and meta-analysis by Baldwin *et al.*, (2019). There are several possible explanations for these unexpected findings. One possible explanation is that the maltreatment experiences these individuals retrospectively reported may not have been as severe as those for individuals with official reports, since cases reported to CPS are likely to be more severe than cases that do not come to the attention of the authorities (Groeneveld and Giovannoni, 1977). This explanation would be consistent with previous literature suggesting that both the frequency and severity of stressors plays a role in the CRP level (Danese *et al.*, 2009; Fuligni *et al.*, 2009; Lin *et al.*, 2016).

https://doi.org/10.1017/S0033291719002575 Published online by Cambridge University Press

**Table 3.** Official Child Protective Services Reports predict CRP level

| | *B* | S.E. | *β* | 95% CI |
|---|---|---|---|---|
| Any child maltreatment | 0.15* | 0.08 | 0.09 | (0.00–0.30) |
| Age | 0.03*** | 0.01 | 0.26 | (0.02–0.04) |
| Sex (female) | 0.21*** | 0.06 | 0.17 | (0.10–0.32) |
| Race (White) | −0.04 | 0.06 | −0.03 | (−0.16 to 0.08) |
| Parent occupational status | −0.03 | 0.02 | −0.08 | (−0.06 to 0.00) |
| Heavy alcohol use | 0.15 | 0.13 | 0.05 | (−0.10 to 0.39) |
| Depression | 0.02 | 0.06 | 0.07 | (−0.03 to 0.21) |
| Frequent smoking | 0.09 | 0.06 | 0.07 | (−0.03 to 0.21) |
| Any physical abuse | 0.39* | 0.18 | 0.10 | (0.04–0.73) |
| Age | 0.03*** | 0.01 | 0.26 | (0.02–0.04) |
| Sex (female) | 0.20*** | 0.06 | 0.16 | (0.09–0.32) |
| Race (White) | −0.03 | 0.06 | −0.03 | (−0.15 to 0.09) |
| Parent occupational status | −0.03 | 0.02 | −0.09 | (−0.06 to 0.00) |
| Heavy alcohol use | 0.13 | 0.13 | 0.05 | (−0.11 to 0.38) |
| Depression | −0.00 | 0.07 | −0.00 | (−0.14 to 0.14) |
| Frequent smoking | 0.10 | 0.06 | 0.08 | (−0.02 to 0.22) |
| Any sexual abuse | 0.29† | 0.17 | 0.08 | (−0.05 to 0.62) |
| Age | 0.03*** | 0.01 | 0.26 | (0.02–0.04) |
| Sex (female) | 0.21*** | 0.06 | 0.17 | (0.10–0.32) |
| Race (White) | −0.02 | 0.06 | −0.02 | (−0.14 to 0.10) |
| Parent occupational status | −0.03 | 0.02 | −0.09 | (−0.06 to 0.00) |
| Heavy alcohol use | 0.13 | 0.13 | 0.05 | (−0.12 to 0.38) |
| Depression | 0.01 | 0.07 | 0.01 | (−0.13 to 0.15) |
| Frequent smoking | 0.10 | 0.06 | 0.08 | (−0.02 to 0.22) |
| Any neglect | 0.14† | 0.08 | 0.08 | (−0.01 to 0.29) |
| Age | 0.03*** | 0.01 | 0.25 | (0.02–0.04) |
| Sex (female) | 0.21*** | 0.06 | 0.17 | (0.10–0.32) |
| Race (White) | −0.04 | 0.06 | −0.03 | (−0.16 to 0.09) |
| Parent occupational status | −0.03 | 0.02 | −0.09 | (−0.06 to 0.00) |
| Heavy alcohol use | 0.14 | 0.13 | 0.06 | (−0.10 to 0.39) |
| Current depression | 0.02 | 0.07 | 0.01 | (−0.13 to 0.16) |
| Frequent smoking | 0.09 | 0.06 | 0.07 | (−0.03 to 0.22) |

*B*, unstandardized coefficient; S.E., standard error of *B*; *β* = standardized coefficient; CI, confidence interval.
†$p < 0.10$, *$p \leqslant 0.05$, **$p \leqslant 0.01$, ***$p \leqslant 0.001$.

A second possibility is that the process of undergoing a CPS investigation may have exacerbated stress levels in individuals with official reports, given the risk of separation from family members, placements in unfamiliar environments, and negative emotional experiences associated with disclosing maltreatment (Ghetti *et al.*, 2002). One study of childhood sexual abuse victims found that the number of investigatory interviews a child participated in was positively correlated with the level of trauma symptomatology (Henry, 1997).

While previous literature indicates that chronic or severe stress increases a person's risk for higher CRP and subsequent cardiovascular disease, many maltreated individuals avoid these outcomes, indicating that negative consequences are not inevitable. For example, in the Adverse Childhood Experiences Study, although childhood adversity was linked positively with risk for ischemic heart disease (IHD), individuals with the highest levels of adversity had an IHD prevalence of 20% (Dong *et al.*, 2004).

Although our findings regarding self-reported maltreatment were surprising, other results were consistent with the existing literature showing age and sex differences in the CRP level. Being female was associated with higher CRP levels in all models (Khera *et al.*, 2005; Lakoski *et al.*, 2006). These findings are also consistent with a recent paper explicitly testing sex-specific effects of early life stress on inflammation (Baldwin *et al.*, 2018) where the association between childhood adversity and inflammation

https://doi.org/10.1017/S0033291719002575 Published online by Cambridge University Press

**Table 4.** Retrospective self-reports of physical and sexual abuse do not predict CRP level

| | Self-reported physical abuse | | | | Self-reported sexual abuse | | | |
|---|---|---|---|---|---|---|---|---|
| | *B* | S.E. | *β* | 95% CI | *B* | S.E. | *β* | 95% CI |
| LONGSCAN (0–11) | −0.08 | 0.06 | −0.06 | (−0.20 to 0.04) | −0.08 | 0.09 | −0.05 | (−0.25 to 0.09) |
| Age | 0.03*** | 0.01 | 0.26 | (0.02–0.04) | 0.03*** | 0.01 | 0.26 | (0.02–0.04) |
| Sex (female) | 0.20*** | 0.06 | 0.16 | (0.09–0.32) | 0.22*** | 0.06 | 0.18 | (0.11–0.34) |
| Race (White) | −0.02 | 0.06 | −0.01 | (−0.14 to 0.10) | −0.03 | 0.06 | −0.03 | (−0.15 to 0.09) |
| Parent occupational status | −0.03 | 0.02 | −0.09 | (−0.06 to 0.00) | −0.03 | 0.02 | −0.09 | (−0.06 to 0.00) |
| Heavy alcohol use | 0.13 | 0.13 | 0.05 | (−0.12 to 0.38) | 0.12 | 0.13 | 0.05 | (−0.13 to 0.37) |
| Depression | 0.03 | 0.07 | 0.02 | (−0.12 to 0.17) | 0.03 | 0.07 | 0.02 | (−0.12 to 0.17) |
| Frequent smoking | 0.11 | 0.06 | 0.08 | (−0.02 to 0.23) | 0.10 | 0.06 | 0.08 | (−0.02 to 0.22) |
| LONGSCAN (12–17) | −0.07 | 0.06 | −0.05 | (−0.18 to 0.05) | −0.15 | 0.10 | −0.08 | (−0.32 to 0.03) |
| Age | 0.03*** | 0.01 | 0.25 | (0.02–0.04) | 0.03*** | 0.01 | 0.26 | (0.02–0.04) |
| Sex (female) | 0.21*** | 0.06 | 0.17 | (0.10–0.32) | 0.23*** | 0.06 | 0.18 | (0.11–0.34) |
| Race (White) | −0.02 | 0.06 | −0.02 | (−0.14 to 0.10) | −0.03 | 0.06 | −0.02 | (−0.15 to 0.09) |
| Parent occupational status | −0.03* | 0.02 | −0.09 | (−0.07 to 0.00) | −0.03* | 0.02 | −0.09 | (−0.07 to −0.00) |
| Heavy alcohol use | 0.13 | 0.13 | 0.05 | (−0.12 to 0.38) | 0.12 | 0.13 | 0.04 | (−0.13 to 0.37) |
| Depression | 0.04 | 0.07 | 0.02 | (−0.11 to 0.18) | 0.04 | 0.07 | 0.02 | (−0.11 to 0.18) |
| Frequent smoking | 0.11 | 0.06 | 0.09 | (−0.02 to 0.23) | 0.10 | 0.06 | 0.08 | (−0.02 to 0.22) |
| ADD Health | −0.15* | 0.08 | −0.09 | (−0.30 to 0.00) | −0.09 | 0.13 | −0.03 | (−0.34 to 0.17) |
| Age | 0.03*** | 0.01 | 0.26 | (0.02–0.04) | 0.03*** | 0.01 | 0.25 | (0.02–0.04) |
| Sex (female) | 0.21*** | 0.06 | 0.17 | (0.10–0.32) | 0.22*** | 0.06 | 0.17 | (0.10–0.33) |
| Race (White) | −0.04 | 0.06 | −0.03 | (−0.16 to 0.08) | −0.03 | 0.06 | −0.02 | (−0.15 to 0.09) |
| Parent occupational status | −0.03* | 0.02 | −0.10 | (−0.07 to 0.00) | −0.03 | 0.02 | −0.09 | (−0.07 to 0.00) |
| Heavy alcohol use | 0.13 | 0.13 | 0.05 | (−0.12 to 0.38) | 0.12 | 0.13 | 0.05 | (−0.13 to 0.37) |
| Depression | 0.05 | 0.07 | 0.03 | (−0.10 to 0.19) | 0.03 | 0.07 | 0.02 | (−0.18 to 0.17) |
| Frequent smoking | 0.11 | 0.06 | 0.08 | (−0.02 to 0.23) | 0.10 | 0.06 | 0.08 | (−0.02 to 0.23) |
| LTVH | −0.03 | 0.08 | −0.02 | (−0.18 to 0.13) | −0.16 | 0.09 | −0.09 | (−0.32 to 0.01) |
| Age | 0.03*** | 0.01 | 0.25 | (0.02–0.04) | 0.03*** | 0.01 | 0.26 | (0.02–0.04) |
| Sex (female) | 0.21*** | 0.06 | 0.17 | (0.10–0.32) | 0.24*** | 0.06 | 0.19 | (0.12–0.36) |
| Race (White) | −0.03 | 0.06 | −0.02 | (−0.15 to 0.09) | −0.03 | 0.06 | −0.03 | (−0.16 to 0.09) |
| Parent occupational status | −0.03* | 0.02 | −0.01 | (−0.07 to 0.00) | −0.03 | 0.02 | −0.09 | (−0.07 to 0.00) |
| Heavy alcohol use | 0.13 | 0.13 | 0.05 | (−0.12 to 0.38) | 0.12 | 0.13 | 0.05 | (−0.13 to 0.37) |
| Depression | 0.02 | 0.07 | 0.01 | (−0.23 to 0.17) | 0.04 | 0.07 | 0.02 | (−0.11 to 0.18) |
| Frequent smoking | 0.10 | 0.06 | 0.08 | (−0.02 to 0.23) | 0.10 | 0.06 | 0.08 | (−0.02 to 0.23) |

*B*, unstandardized coefficient; S.E., standard error of *B*; *β*, standardized coefficient; CI, confidence interval; LONGSCAN, LS 0–11 refers to the time period from ages 0 to 11; 12–17 refers to ages 12 to 17; ADD Health, National Longitudinal Study of Adolescent to Adult Health; LTVH, Lifetime Trauma and Victimization History instrument.
*$p \leqslant 0.05$, **$p \leqslant 0.01$, ***$p \leqslant 0.001$.

was driven by a significant association in females. We did not find significant race differences. Given the prior literature reporting higher CRP levels for Blacks and Hispanics in general (Ford *et al.*, 2004; Khera *et al.*, 2005), it is possible that these findings reflect a ceiling effect.

Despite numerous strengths, certain caveats need to be noted. Because this sample is predominantly from the lower end of the socioeconomic spectrum, these findings cannot be generalized to cases of abuse and neglect that might occur in middle or upper class families. Inflammation was only measured at one time point and, thus, we are not able to determine when the changes in inflammation occurred. The current study omitted certain physical health variables that may impact CRP levels [e.g. body mass index (Aas *et al.*, 2017), cardiorespiratory fitness (Isasi *et al.*, 2003; Kasapis and Thompson, 2005), and use of oral contraceptives (Frohlich *et al.*, 1999; van Ockenburg *et al.*, 2015)]. Finally, we were also not able to examine the impact of multiple types of victimization, or victimization at multiple times during

https://doi.org/10.1017/S0033291719002575 Published online by Cambridge University Press

**Table 5.** Retrospective self-reports of neglect do not predict CRP level

| | *B* | S.E. | *β* | 95% CI |
|---|---|---|---|---|
| Conflict tactics scale | −0.02 | 0.06 | −0.02 | (−0.14 to 0.10) |
| Age | 0.03*** | 0.01 | 0.25 | (0.02–0.04) |
| Sex (female) | 0.21*** | 0.06 | 0.17 | (0.10–0.32) |
| Race (White) | −0.03 | 0.06 | −0.02 | (−0.15 to 0.10) |
| Parent occupational status | −0.03 | 0.12 | −0.09 | (−0.07 to 0.00) |
| Heavy alcohol use | 0.12 | 0.13 | 0.05 | (−0.13 to 0.38) |
| Depression | 0.02 | 0.07 | 0.01 | (−0.12 to 0.17) |
| Frequent smoking | 0.10 | 0.06 | 0.08 | (−0.02 to 0.23) |
| ADD Health | −0.05 | 0.06 | −0.04 | (−0.17 to 0.07) |
| Age | 0.03*** | 0.01 | 0.25 | (0.02–0.04) |
| Sex (female) | 0.21*** | 0.06 | 0.17 | (0.10–0.33) |
| Race (White) | −0.03 | 0.06 | −0.03 | (−0.15 to 0.09) |
| Parent occupational status | −0.03* | 0.12 | −0.09 | (−0.07 to 0.00) |
| Heavy alcohol use | 0.13 | 0.13 | 0.05 | (−0.12 to 0.37) |
| Depression | 0.03 | 0.08 | 0.02 | (−0.11 to 0.18) |
| Frequent smoking | 0.10 | 0.06 | 0.08 | (−0.03 to 0.22) |
| Childhood Experiences Questionnaire | 0.03 | 0.07 | 0.03 | (−0.10 to 0.17) |
| Age | 0.03*** | 0.01 | 0.25 | (0.02–0.04) |
| Sex (female) | 0.21*** | 0.06 | 0.17 | (0.09–0.33) |
| Race (White) | −0.03 | 0.07 | −0.03 | (−0.16 to 0.09) |
| Parent occupational status | −0.03 | 0.02 | −0.09 | (−0.07 to 0.00) |
| Heavy alcohol use | 0.12 | 0.13 | 0.05 | (−0.14 to 0.38) |
| Depression | 0.01 | 0.08 | 0.01 | (−0.15 to 0.16) |
| Frequent smoking | 0.10 | 0.07 | 0.08 | (−0.04 to 0.23) |

*B*, unstandardized coefficient; S.E., standard error of *B*; *β*, standardized coefficient; CI, confidence interval; ADD Health, National Longitudinal Study of Adolescent to Adult Health.
*$p \leqslant 0.05$, **$p \leqslant 0.01$, ***$p \leqslant 0.001$.

childhood and adolescence (Baldwin *et al.*, 2016, 2018; de Punder *et al.*, 2017).

## Conclusions and implications

Young people with official reports of childhood maltreatment had higher levels of CRP and physically abused children and maltreated girls are particularly susceptible to chronic inflammation. Although these findings need replication, they have clear clinical relevance. These results strengthen inferences about the effects of childhood maltreatment on inflammation in females. Assessing inflammatory markers, such as CRP, in children may be important in preventing long-term risk for cardiovascular disease. Physicians who work with maltreated children, and especially girls, may want to consider preventive interventions targeted at lifestyle factors and encouraging positive forms of coping strategies and possibly prescribe anti-inflammatory medication.

These new findings are also relevant to the recent calls for primary care providers to screen adolescents for adverse childhood experiences (Heller *et al.*, 2017). Screening for child maltreatment is a complex undertaking both scientifically and clinically. Our findings suggest that even validated self-report measures may not accurately distinguish the subset of individuals at risk for CRP elevation and cardiovascular risk. Finkelhor (2017) has suggested that screening for these adverse childhood experiences may be premature, arguing that clinically efficient tools for such screening are currently lacking. Other scholars have noted a lack of specificity with regard to identifying individuals at greatest risk for future health problems and a lack of consensus as to which types of adversity are the most important predictors of higher CRP and cardiovascular risk (Pardee *et al.*, 2017). While our results and those of others (Danese *et al.*, 2007, 2008) confirm a relationship between childhood maltreatment and risk for chronic inflammation, these new findings suggest that caution is needed before screening for adverse childhood experiences with self-report inventories is implemented on a large-scale basis.

**Supplementary material.** The supplementary material for this article can be found at https://doi.org/10.1017/S0033291719002575.

**Author contributions.** Dr Widom conceptualized and designed the study and all phases of the larger project, collected the data, and contributed to all phases in the preparation and writing of the manuscript. Ms. Osborn carried out the analyses and drafted the initial manuscript. Both authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

**Financial support.** All phases of this study were supported in part by grants (PI: Widom) from the National Institute of Mental Health (MH49467 and MH58386), National Institute of Justice (86-IJ-CX-0033 and 89-IJ-CX-0007), Eunice Kennedy Shriver National Institute of Child Health and Human Development (HD40774), National Institute on Drug Abuse (DA17842 and DA10060), National Institute on Alcohol Abuse and Alcoholism (AA09238 and AA11108) and the Doris Duke Charitable Foundation. Points of view are those of the authors and do not necessarily represent the position of the United States Department of Justice.

**Conflict of interest.** None.

**Ethical standards.** The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

## References

**Aas M, Dieset I, Hope S, Hoseth E, Morch R, Reponen E, Steen NE, Laskemoen JF, Ueland T, Aukrust P, Agartz I, Andreassen OA and Melle I** (2017) Childhood maltreatment severity is associated with elevated C-reactive protein and body mass index in adults with schizophrenia and bipolar diagnoses. *Brain, Behavior, and Immunity* **65**, 324–349.

**Baldwin J, Arseneault L and Danese A** (2016) Childhood violence victimisation predicts elevated inflammation levels in young women independent of latent genetic influences. *Psychoneuroendocrinology* **71**, 18.

**Baldwin JR, Arseneault L, Caspi A, Fisher HL, Moffitt TE, Odgers CL, Pariante C, Ambler A, Dove R, Kepa A, Matthews T, Menard A, Sugden K, Williams B and Danese A** (2018) Childhood victimization and inflammation in young adulthood: a genetically sensitive cohort study. *Brain, Behavior, and Immunity* **67**, 211–217.

**Baldwin JR, Reuben A, Newbury JB and Danese A** (2019) Agreement between prospective and retrospective measures of childhood victimization: a systematic review and meta-analysis. *JAMA Psychiatry* **76**, 584–593.

**Baumeister D, Akhtar R, Ciufolini S, Pariante CM and Mondelli V** (2016) Childhood trauma and adulthood inflammation: a meta-analysis of peripheral C-reactive protein, interleukin-6 and tumour necrosis factor-α. *Molecular Psychiatry* **21**, 642–649.

**Broyles ST, Staiano AE, Drazba KT, Gupta AK, Sothern M and Katzmarzyk PT** (2012) Elevated C-reactive protein in children from risky neighborhoods: evidence for a stress pathway linking neighborhoods and inflammation in children. *PLOS One* **7**, e45419.

**Carpenter LL, Gawuga CE, Tyrka AR and Price LH** (2012) C-reactive protein, early life stress, and wellbeing in healthy adults. *Acta Psychiatrica Scandinavica* **126**, 402–410.

**Chartier MJ, Walker JR and Naimark B** (2010) Separate and cumulative effects of adverse childhood experiences in predicting adult health and health care utilization. *Child Abuse and Neglect* **34**, 454–464.

**Cicchetti D, Handley ED and Rogosch FA** (2015) Child maltreatment, inflammation, and internalizing symptoms: investigating the roles of C-reactive protein, gene variation and neuroendocrine regulation. *Development and Psychopathology* **27**, 553–566.

**Coelho R, Viola TW, Walss-Bass C, Brietzke E and Grassi-Oliveira R** (2014) Childhood maltreatment and inflammatory markers: a systematic review. *Acta Psychiatrica Scandinavica* **129**, 180–192.

**Copeland WE, Wolke D, Lereya ST, Shanahan L, Worthman C and Costello EJ** (2014) Childhood bullying involvement predicts low-grade systemic inflammation into adulthood. *Proceedings of the National Academy of Sciences of the United States of America* **111**, 7570–7575.

**Danese A, Pariante CM, Caspi A, Taylor A and Poulton R** (2007) Childhood maltreatment predicts adult inflammation in a life-course study. *Proceedings of the National Academy of Sciences of the United States of America* **104**, 1319–1324.

**Danese A, Moffitt TE, Pariante CM, Ambler A, Poulton R and Caspi A** (2008) Elevated inflammation levels in depressed adults with a history of childhood maltreatment. *Archives of General Psychiatry* **65**, 409–415.

**Danese A, Moffitt TE, Harrington H, Milne BJ, Polanczyk G, Pariante CM, Poulton R and Caspi A** (2009) Adverse childhood experiences and adult risk factors for age-related disease: Depression, inflammation, and clustering of metabolic risk markers. *Archives of Pediatrics and Adolescent Medicine* **163**, 1135–1143.

**Danese A, Caspi A, Williams B, Ambler A, Sugden K, Mika J, Werts H, Freeman J, Pariante CM, Moffitt TE and Arseneault L** (2011) Biological embedding of stress through inflammation processes in childhood. *Molecular Psychiatry* **16**, 244–246.

**De Punder K, Overfeld J, Dorr P, Dittrich K, Winter SM, Kubiak N, Karaboycheva G and Heim C** (2017) Maltreatment is associated with elevated C-reactive protein levels in 3 to 5 year-old children. *Brain, Behavior, and Immunity* **66**, e17–e18.

**Dong MX, Giles WH, Felitti VJ, Dube SR, Williams JE, Chapman DP and Anda RF** (2004) Insights into causal pathways for ischemic heart disease: adverse childhood experiences study. *Circulation* **110**, 1761–1766.

**Dowd JB, Palermo T, Chyu L, Adam E and Mcdade TW** (2014) Race/ethnic and socioeconomic differences in stress and immune function in The National Longitudinal Study of Adolescent Health. *Social Science and Medicine* **115**, 49–55.

**Du Clos TW and Mold C** (2004) C-reactive protein: an activator of innate immunity and a modulator of adaptive immunity. *Immunologic Research* **30**, 261–277.

**Fagundes CP, Glaser R, Malarkey WB and Kiecolt-Glaser JK** (2013) Childhood adversity and herpesvirus latency in breast cancer survivors. *Health Psychology* **32**, 337–344.

**Finkelhor D** (2017) Screening for adverse childhood experiences (ACEs): Cautions and suggestions. *Child Abuse and Neglect* **85**, 174–179.

**Ford ES, Giles WH, Myers GL, Rifai N, Ridker PM and Mannino DM** (2003) C-reactive protein concentration distribution among US children and young adults: Findings from the National Health and Nutrition Examination Survey, 1999–2000. *Clinical Chemistry* **49**, 1353–1357.

**Ford ES, Giles WH, Mokdad AH and Myers GL** (2004) Distribution and correlates of C-reactive protein concentrations among adult US women. *Clinical Chemistry* **50**, 574–581.

**Frohlich M, Doring A, Imhof A, Hutchinson WL, Pepys MB and Koenig W** (1999) Oral contraceptive use is associated with a systemic acute phase response. *Fibrinolysis & Proteolysis* **13**, 239–244.

**Frohlich M, Sund M, Thorand B, Hutchinson WL, Pepys MB and Koenig W** (2002) Lack of seasonal variation in C-reactive protein. *Clinical Chemistry* **48**, 575–577.

**Fuligni AJ, Telzer EH, Bower J, Cole SW, Kiang L and Irwin MR** (2009) A preliminary study of daily interpersonal stress and C-reactive protein levels among adolescents from Latin American and European backgrounds. *Psychosomatic Medicine* **71**, 329–333.

**Ghetti S, Alexander KW and Goodman GS** (2002) Legal involvement in child sexual abuse cases: Consequences and interventions. *International Journal of Law and Psychiatry* **25**, 235–251.

**Groeneveld LP and Giovannoni JM** (1977) Disposition of child abuse and neglect cases. *Social Work Research and Abstracts* **13**, 24–30.

**Hardt J and Rutter M** (2004) Validity of adult retrospective reports of adverse childhood experiences: Review of the evidence. *Journal of Child Psychology and Psychiatry and Allied Disciplines* **45**, 260–273.

**Harris KM** (2011) *Design Features of Add Health*. Chapel Hill, NC: Carolina Population Center, University of North Carolina at Chapel Hill.

**Heim C** (2017) Immediate biological embedding of maltreatment in children: Berlin Longitudinal Children Study (BerlinLCS). *Psychoneuroendocrinology* **83**, 7.

**Heller E, Essex A and Teigen A** (2017) *State Strategies for Preventing Child and Adolescent Injuries and Violence*. Washington, DC: National Conference of State Legislatures.

**Henry J** (1997) System intervention trauma to child sexual abuse victims following disclosure. *Journal of Interpersonal Violence* **12**, 499–512.

**Henry B, Moffitt TE, Caspi A, Langley J and Silva PA** (1994) On the "remembrance of things past": a longitudinal evaluation of the retrospective method. *Psychological Assessment* **6**, 92–101.

**Hollingshead AB** (1975) *Four-Factor Index of Social Status*. New Haven, CT: Yale University.

https://doi.org/10.1017/S0033291719002575 Published online by Cambridge University Press

**Imhof A, Froehlich M, Brenner H, Boeing H, Pepys MB and Koenig W** (2001) Effect of alcohol consumption on systemic markers of inflammation. *Lancet* **357**, 763–767.

**Isasi CR, Deckelbaum RJ, Tracy RP, Starc TJ, Berglund L and Shea S** (2003) Physical fitness and C-reactive protein level in children and young adults: the Columbia University BioMarkers Study. *Pediatrics* **111**, 332–338.

**Kasapis C and Thompson PD** (2005) The effects of physical activity on serum C-reactive protein and inflammatory markers. *Journal of the American College of Cardiology* **45**, 1563–1569.

**Khera A, Mcguire DK, Murphy SA, Stanek HG, Das SR, Vongpatanasin W, Wians FH, Grundy SM and De Lemos JA** (2005) Race and gender differences in C-reactive protein levels. *Journal of the American College of Cardiology* **46**, 464–469.

**Kovacs M** (2003). *Children's Depression Inventory: Technical Manual Update*. Toronto, ON: Multi-Health Systems.

**Lakoski SG, Cushman M, Criqui M, Rundek T, Blumenthal RS, D'agostino RB and Herrington DM** (2006) Gender and C-reactive protein: Data from the Multiethnic Study of Atherosclerosis (MESA) cohort. *American Heart Journal* **152**, 593–598.

**Lande MB, Pearson TA, Vermilion RP, Auinger P and Fernandez ID** (2008) Elevated blood pressure, race/ethnicity, and C-reactive protein in children and adolescents. *Pediatrics* **122**, 1252–1257.

**Lin JE, Neylan TC, Epel E and O'donovan A** (2016) Associations of childhood adversity and adulthood trauma with C-reactive protein: a cross-sectional population-based study. *Brain, Behavior, and Immunity* **53**, 105–112.

**Macy EM, Hayes TE and Tracy RP** (1997) Variability in the measurement of C-reactive protein in healthy subjects: implications for reference intervals and epidemiological applications. *Clinical Chemistry* **43**, 52–58.

**Mcdade TW, Stallings JF, Angold A, Costello EJ, Burleson M, Cacioppo JT, Glaser R and Worthman CM** (2000) Epstein-Barr virus antibodies in whole blood spots: a minimally invasive method for assessing an aspect of cell-mediated immunity. *Psychosomatic Medicine* **62**, 560–568.

**Mcdade TW, Burhop J and Dohnal J** (2004) High-sensitivity enzyme immunoassay for C-reactive protein in dried blood spots. *Clinical Chemistry* **50**, 652–654.

**Mcdade TW, Williams S and Snodgrass JJ** (2007) What a drop can do: dried blood spots as a minimally invasive method for integrating biomarkers into population-based research. *Demography* **44**, 899–925.

**Meier-Ewert HK, Ridker PM, Rifai N, Price N, Dinges DF and Mullington JM** (2001) Absence of diurnal variation of C-reactive protein levels in healthy human subjects. *Clinical Chemistry* **47**, 426–430.

**Mendall MA, Patel P, Ballam L, Strachan DP and Northfield TC** (1996) C reactive protein and its relation to cardiovascular risk factors: a population based cross sectional study. *BMJ* **312**, 1061–1065.

**Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, Das SR, De Ferranti S, Despres JP, Fullerton HJ, Howard VJ, Huffman MD, Isasi CR, Jimenez MC, Judd SE, Kissela BM, Lichtman JH, Lisabeth LD, Liu S, Mackey RH, Magid DJ, Mcguire DK, Mohler ER, Moy CS, Muntner P, Mussolino ME, Nasir K, Neumar RW, Nichol G, Palaniappan L, Pandey DK, Reeves MJ, Rodriguez CJ, Rosamond W, Sorlie PD, Stein J, Towfighi A, Turan TN, Virani SS, Woo D, Yeh RW, Turner MB and American Heart Association Statistics Committee and Stroke Statistics Subcommitteee** (2016) Heart disease and stroke statistics-2016 update: a report from the American Heart Association. *Circulation* **133**, e38–e360.

**Newbury JB, Arseneault L, Moffitt TE, Caspi A, Danese A, Baldwin JR and Fisher HL** (2018) Measuring childhood maltreatment to predict early-adult psychopathology: comparison of prospective informant-reports and retrospective self-reports. *Journal of Psychiatric Research* **96**, 57–64.

**Nikulina V and Widom CS** (2013) Child maltreatment and executive functioning in middle adulthood: a prospective examination. *Neuropsychology* **27**, 417–427.

**Ockene IS, Matthews CE, Rifai N, Ridker PM and Reed GMSE** (2001) Variability and classification accuracy of serial high-sensitivity C-reactive protein measurements in healthy adults. *Clinical Chemistry* **47**, 444–450.

**Offer D, Kaiz M, Howard KI and Bennett ES** (2000) The altering of reported experiences. *Journal of the American Academy of Child and Adolescent Psychiatry* **39**, 735–742.

**Pardee M, Kuzma E, Dahlem CWY, Boucher N and Darling-Fisher CS** (2017) Current state of screening high-ACE youth and emerging adults in primary care. *Journal of the American Association of Nurse Practitioners* **29**, 716–724.

**Pearson TA, Mensah GA, Alexander RW, Anderson JL, Cannon ROR, Criqui M, Fadl YY, Fortmann SP, Hong Y, Myers GL, Rifai N, Smith SC, Taubert K, Tracy RP, Vinicor F and Centers for Disease Control and Prevention and American Heart Association** (2003) Markers of inflammation and cardiovascular disease: application to clinical and public health practice: a statement for healthcare professionals from the centers for disease control and prevention and the American Heart Association. *Circulation* **107**, 499–511.

**Pepys MB and Hirschfield GM** (2003) C-reactive protein: a critical update. *Journal of Clinical Investigation* **111**, 1805–1812.

**Pollitt RA, Kaufman JS, Rose KM, Diez-Roux AV, Zeng D and Heiss G** (2007) Early-life and adult socioeconomic status and inflammatory risk markers in adulthood. *European Journal of Epidemiology* **22**, 55–66.

**Radloff LS** (1991) The use of the Center for Epidemiologic Studies Depression Scale in adolescents and young adults. *Journal of Youth and Adolescence* **20**, 149–166.

**Radloff LS** (1977) The CES-D Scale: a self-report depression scale for research in the general population. *Applied Psychological Measurement* **1**, 385–401.

**Reuben A, Moffitt TE, Caspi A, Belsky DW, Harrington H, Schroeder F, Hogan S, Ramrakha S, Poulton R and Danese A** (2016) Lest we forget: comparing retrospective and prospective assessments of adverse childhood experiences in the prediction of adult health. *Journal of Child Psychology and Psychiatry* **57**, 1103–1112.

**Rohde LEP, Hennekens CH and Ridker PM** (1999) Survey of C-reactive protein and cardiovascular risk factors in apparently healthy men. *The American Journal of Cardiology* **84**, 1018–1022.

**Runyan DK, Curtis PA, Hunter WM, Black MM, Kotch JB, Bangdiwala S, Dubowitz H, English D, Everson MD and Landsverk J** (1998) LONGSCAN: a consortium for longitudinal studies of maltreatment and the life course of children. *Aggression and Violent Behavior* **3**, 275–285.

**Straus MA, Hamby SL, Finkelhor D, Moore DW and Runyan D** (1998) Identification of child maltreatment with the Parent-Child Conflict Tactics Scales: Development and psychometric data for a national sample of American parents. *Child Abuse and Neglect* **22**, 249–270.

**Taylor SE, Lehman BJ, Kiefe CI and Seeman TE** (2006) Relationship of early life stress and psychological functioning to adult C-reactive protein in the coronary artery risk development in young adults study. *Biological Psychiatry* **60**, 819–824.

**Van Ockenburg SL, Tak LM, Bakker SJL, Gans ROB, De Jonge P and Rosmalen JGM** (2015) Effects of adverse life events on heart rate variability, cortisol, and C-reactive protein. *Acta Psychiatrica Scandinavica* **131**, 40–50.

**Weissman MM, Sholomskas D, Pottenger M, Prusoff BA and Locke BZ** (1977) Assessing depressive symptoms in five psychiatric populations: a validation study. *American Journal of Epidemiology* **106**, 203–214.

**Widom CS** (1989) Child abuse, neglect and adult behavior: Research design and findings on criminality, violence, and child abuse. *American Journal of Orthopsychiatry* **59**, 355–367.

**Widom CS** (2019) Are retrospective self-reports accurate representations or existential recollections? *JAMA Psychiatry* **76**, 567–568.

**Widom CS, Dutton MA, Czaja SJ and Dumont KA** (2005) Development and validation of a new instrument to assess lifetime trauma and victimization history. *Journal of Traumatic Stress* **18**, 519–531.

**Widom CS, Czaja SJ, Bentley T and Johnson MS** (2012) A prospective investigation of physical health outcomes in abused and neglected children: New findings from a 30-year follow-up. *American Journal of Public Health* **102**, 1135–1144.

**Widom CS, Czaja S and Dumont KA** (2015*a*) Intergenerational transmission of child abuse and neglect: Real or detection bias? [Supplementary Materials]. *Science* **347**, 1–22.

**Widom CS, Czaja SJ and Dumont KA** (2015*b*) Intergenerational transmission of child abuse and neglect: Real or detection bias? *Science* **347**, 1480–1485.

**Worthman CM and Stallings JF** (1997) Hormone measures in finger-prick blood spot samples: New field methods for reproductive endocrinology. *American Journal of Physical Anthropology* **104**, 1–21.

https://doi.org/10.1017/S0033291719002575 Published online by Cambridge University Press