HHS Public Access

Author manuscript

Biol Psychiatry Glob Open Sci. Author manuscript; available in PMC 2022 August 10.

Published in final edited form as:

Biol Psychiatry Glob Open Sci. 2022 July ; 2(3): 301–308. doi:10.1016/j.bpsgos.2022.04.003.

Childhood Maltreatment, Blood Lead Levels, and Crime and Violence: A Prospective Examination

Cathy Spatz Widom,

Departments of Psychology, John Jay College, City University of New York, New York, New York.

The Graduate Center, City University of New York, New York, New York.

Xuechen Li,

Departments of Psychology, John Jay College, City University of New York, New York, New York.

Anthony Carpi

Departments of Sciences, John Jay College, City University of New York, New York, New York.

Abstract

BACKGROUND: Research has shown that maltreated children are at increased risk for subsequent crime and violence and are more likely to reside in neighborhoods with a high likelihood of lead exposure. Other literature has reported associations between childhood lead exposure and antisocial and criminal behavior. Little is known about the relationships among childhood maltreatment, adult lead exposure, and crime and violence.

METHODS: As part of a prospective longitudinal study of the long-term consequences of childhood maltreatment, children with documented histories of abuse and neglect and demographically matched control children (ages 0–11 years) were followed into adulthood and interviewed. Participants included 556 individuals who had valid blood lead level (BLL) measures at a mean age of 41.2 years. Participants had a mean age of 50.5 (SD = 3.53) years at the time of the last criminal history check used to determine the number of arrests.

RESULTS: Childhood maltreatment predicted a higher number of arrests for any crime and any violence after the blood was collected but not higher BLLs in adulthood. There were significant paths from adult BLLs to arrests after the blood was collected, despite controlling for age, sex, race, and IQ and the inclusion of individual- and neighborhood-level socioeconomic status, and paths from neighborhood socioeconomic status to higher BLLs in models predicting any arrest and any violent arrest after the blood was collected.

CONCLUSIONS: These findings demonstrate how environmental toxins such as lead can affect outcomes in adulthood, including crime, and provide evidence that links neighborhood disadvantage to higher BLLs in adulthood.

Address correspondence to Cathy Spatz Widom, Ph.D., at cwidom@jjay.cuny.edu.

The authors report no biomedical financial interests or potential conflicts of interest.

Supplementary material cited in this article is available online at https://doi.org/10.1016/j.bpsgos.2022.04.003.

The cycle of violence hypothesis predicts that individuals who experience abuse or neglect in childhood are at risk for engaging in a higher rate of violence in adolescence and adulthood than nonmaltreated children (1). A substantial body of empirical research supports that association (2–8), and 2 earlier reviews of research on child maltreatment and violence in youth similarly concluded an association (9,10). One systematic review of methodological features of prospective and retrospective studies of the maltreatment-offending association pointed to the "large and convincing body of evidence, reported in multiple studies conducted in countries around the world, to support the suggestion that childhood maltreatment is associated with an increased risk of delinquent or criminal behavior in later life" (11). However, in a subsequent systematic review and meta-analysis of only prospective studies, Fitton *et al.* (12) concluded that "the risk of later violence perpetration was modestly increased in individuals with a history of childhood maltreatment." Both reviews called for further research to better understand the adverse consequences of child maltreatment, including mechanisms that might explain the cycle of violence.

A separate literature has reported on the effect of lead exposure on neuropsychological functioning across the life span (13,14). While children under the age of 10 are considered most susceptible to lead toxicity (15), adult lead exposure has also been associated with cognitive decline (16). There is mounting evidence that lead is associated with negative health outcomes even at levels substantially below thresholds previously considered safe (17–21). A number of studies have reported associations between exposure to lead in childhood and antisocial and criminal behavior (22–26). The adverse effects of lead are especially harmful in children and often only become apparent long after exposure (19,27–30). One meta-analysis of 19 studies, both longitudinal and cross-sectional, reported an association between lead exposure and conduct disorder (including aggressive and externalizing behaviors) (31).

Elevated blood lead levels (BLLs) have also been associated with increased criminal offending in adulthood (23,32), although at least one major longitudinal study reported only a weak association between BLLs and criminal offending (33). Sampson and Winter (32) followed over 200 infants from a birth cohort in Chicago and found that BLL at 3 years of age was linked to adolescent delinquent and antisocial behavior, but not to official arrests.

The existing literature has focused on the impact of BLLs in childhood, not adulthood. However, despite being prohibited, lead-based paint has remained in millions of housing units (34). Most current lead exposure comes from lead-contaminated house dust from lead paint left over from previous years or from soil brought into the home (35,36). Recent research indicates that maltreated children are at increased risk of residence in adulthood in households with higher levels of dust lead and in more disadvantaged neighborhoods (37).

The purpose of this paper was to examine whether lead exposure in adulthood may be one of the mechanisms in the cycle of violence that links child maltreatment to later crime and violence through its impact on maltreated children directly or indirectly through other outcomes associated with childhood abuse and neglect. Because exposure to lead has been linked to poverty at the individual and neighborhood levels (38–40), it is

possible that any associations among lead and behavioral outcomes may be confounded by low socioeconomic status (SES) (28,41). For this reason, we included indicators of neighborhood- and individual-level SES in models testing these relationships.

Using data from a prospective longitudinal study of the consequences of childhood abuse and neglect, we examined whether lead exposure plays a role in explaining the cycle of violence. In contrast to previous literature, in this study, BLLs were assessed in middle adulthood. Here, to maintain the correct temporal sequencing to determine whether BLLs predict criminal and violent criminal behavior, we examined arrests after the blood was collected and thus sought to determine whether elevated blood levels predict future crime. This approach is conservative because at the time of blood collection, these individuals were middle-aged (mean age 41 years), past the peak years for violent offending (42,43), and the time period included in the criminal records search was fairly short. In addition, lead exposure in this sample did not occur during sensitive periods of neurodevelopment.

METHODS AND MATERIALS

This work builds on previously published research and specifically on a paper on the relationship between childhood maltreatment and lead (37). The description of the methods of this study are similar to those published previously (44). Briefly, the data were collected as part of a large prospective cohort design study (45,46) in which abused and neglected children were matched with nonabused and non-neglected children and followed into adulthood. Because of the matching procedure, the participants are assumed to differ only in the risk factor, that is, having experienced childhood sexual or physical abuse or neglect. The assumption of equivalency for the groups is an approximation. The control group may also differ from the maltreated individuals on other variables nested with abuse or neglect, including socioeconomic status. For complete details of the study design and participant selection criteria, see (44).

The original sample of abused and neglected children (n = 908) represented all substantiated cases of childhood physical and sexual abuse and neglect processed from 1967 to 1971 in the county juvenile (family) or adult criminal courts of a Midwestern metropolitan area. Cases of abuse and neglect were restricted to children 11 years of age or younger at the time of the incident.

A critical element of the design involved the selection of a matched control group. Control children were matched with the sample on the basis of age, sex, race/ethnicity, and approximate family social class during the time period under study. Details of the matching procedure have been described previously (44).

In the initial archival phase of the study, we compared the abused and neglected children to the matched comparison group on juvenile and adult criminal arrest records (n = 1575) (2). A second phase involved locating and interviewing both groups during 1989 to 1995, approximately 22 years after the abuse or neglect (n = 1196). We conducted subsequent follow-up interviews in 2000 to 2002 (n = 896) and 2003 to 2005 (n = 807) that included a comprehensive health status interview, physical health measures, blood collection through

venipuncture, and other questionnaires and assessments. A chronology of the study is provided in Figure 1.

Demographic characteristics of the groups have been reported previously (44), and despite attrition associated with death, refusals, and our inability to locate individuals over the various waves of the study, the characteristics of the groups across the 4 phases of the study have remained about the same (Table 1). Selection bias could be a problem for longitudinal studies because they may have attrition over time. However, analysis indicates that this is not a significant problem in our study. Binary comparisons of key characteristics between participants in the third interview versus those who did not complete the third interview show no significant differences in child maltreatment status, race, and age. The only significant difference is that females were more likely to remain in the study than males (odds ratio = 1.65, 95% CI = 1.28–2.11).

The analytic sample for this study had a mean age of 41.2 years (SD = 3.5, range = 32.0–49.0 years) at time of blood collection and were 52.9% women and 59.2% White non-Hispanic. The sample was predominantly from the lower end of the socioeconomic spectrum: 60.0% completed high school, 54.9% held unskilled or semiskilled jobs, and only 13.7% held semiprofessional or professional jobs (47).

This sample included participants who had taken part in the third interview (n = 807) and who had valid BLL measures (n = 556). Table 2 shows that there were no significant differences between participants in this wave of the study who gave blood and those participants who did not. The small group of individuals who were incarcerated at the time were able to participate in this wave of the study but were not permitted by prison authorities to provide blood.

Procedures

As previously described (44), participants were interviewed in person in their homes or other quiet locations of their choice. Interviewers and participants were blinded to the purpose of the study and to the inclusion of an abuse and neglect group. Participants were told that they had been selected to participate as part of a large group of individuals who grew up in that area during the late 1960s and early 1970s. Institutional review board approval was obtained for each wave of this study, and individuals who participated signed a consent form acknowledging that they were participating voluntarily. For those with limited reading ability, the consent form was read aloud to the participant and, if necessary, explained verbally.

Measures

Child Maltreatment.—We assessed childhood physical and sexual abuse and neglect through review of official juvenile, family, and criminal court records of cases processed during 1967 to 1971. Physical abuse cases included injuries such as bruises, welts, burns, abrasions, lacerations, wounds, cuts, and bone and skull fractures. Sexual abuse cases included felony sexual assault, 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 and represented extreme failure to provide adequate food, clothing, shelter, and medical attention to children. Child maltreatment is operationalized here as a dichotomous variable indicating that the person had any physical or sexual abuse or neglect.

Blood Lead Levels.—Participants had a mean age of 41.2 years when blood was collected during 2003 to 2005 (interview 3). A licensed registered nurse performed a medical status examination in the participant's home or another quiet location of the participant's choice. Nurses collected 45 mL of blood for all medical screens and assays and observed universal precautions during all draws, using standard venipuncture procedures. Blood was wrapped and shipped overnight to University Hospital, Newark, New Jersey, where the University Hospital Pathology Laboratory conducted routine blood tests. After removing 116 people who did not give blood, the sample consisted of 556 people. Mean BLL in the sample was 3.30 (1.91) μg/dL (range = 1–18), and 9.89% of the sample had values above 5 μg/dL. BLL was treated as a continuous variable.

It is difficult to compare the BLLs assessed in adulthood with those reported in previous literature. Reports of mean BLLs vary widely, and most of the studies focus on child and/ or adolescent BLLs, where the range of mean BLLs is 3.9 to 18.6 μg/dL. In one study of adult lead exposure in former lead workers (16), the mean was 4.55 (SD = 2.69) μg/dL.

SES Indicators.—To assess neighborhood economic disadvantage (neighborhood SES), addresses from the 2000 to 2002 interviews were geocoded to a census tract and geomatched to 2000 census data (48). The sum of *z* scores of 3 items was used to assess economic disadvantage: 1) percentage of families below the poverty line, 2) percentage of families on public assistance, and 3) percentage of female-headed households. Higher *z* scores reflect greater neighborhood disadvantage.

Three indicators were used to assess individual SES: 1) income—the sample was divided into 2 groups (lower and higher) using a cut point at the poverty line in the United States in 2001 (using Health and Human Services poverty guidelines; for a family of 4, the household income threshold of poverty level is $17,650); 2) receipt of public assistance—whether the person was receiving food stamps or Medicaid; of the overall sample, 125 (18.6%) were receiving food stamps and 149 (22.1%) were receiving Medicaid; and 3) unemployment—participants were divided into those employed (including homemakers and those in school) and those not employed (including disabled persons).

Official Arrests.—Criminal histories were compiled from searches conducted during 1987 and 1988 (44), 1994 (3), and 2013 (49). We conducted an updated search of arrest records in 2013 using information from the Federal Bureau of Investigation's National Crime Information Center and from state law enforcement records for the Midwestern state where the records of childhood maltreatment were initially collected. This new information was combined with prior records to create a comprehensive criminal history record for each person. Participants had a mean age of 50.5 years (SD = 3.53) at the time of the last criminal history check. "Any arrest" includes all crime categories but excludes arrests for traffic violations. Arrests for violent crimes include murder and attempted murder, manslaughter

and involuntary manslaughter, reckless homicide, rape, sodomy, robbery and robbery with injury, assault, assault and battery, aggravated assault, and battery and battery with injury. We report the total number of arrests and violent arrests after blood had been collected. Because the majority of the interviews were completed in 2003, this time period was selected to allow us to determine whether BLLs predicted the number of subsequent arrests.

Control Variables.—Sex was coded 0 = male and 1 = female. To determine race and ethnicity, participants were shown a card with the names of racial and ethnic groups and asked to indicate which best described them. Race was coded 1 = White non-Hispanic and 0 = the remainder (this includes individuals who identified as Black [34%] and Hispanic [4%] and a very small number of Native American Indians and Hawaiian islanders). Age (in years) at the time of the blood lead exposure was assessed. IQ was also used as a control variable. The Quick Test (50) was used to assess IQ during the first interview at a mean age of 29 years. The Quick Test is recognized as a tool that screens for verbal-perceptual intelligence and as a valid and reliable assessment of specific cognitive abilities among a diverse array of samples (51,52).

Statistical Analysis

All analyses were conducted using the statistical software R (53). Statistical assumption checks were performed for all models (i.e., normality of data, normality of variance, collinearity), and there were no serious violations of normality. Bivariate t tests and χ^2 tests were used to investigate whether there were significant differences between the abused and neglected group and matched control participants. Structural equation models (SEMs) with zero-inflated negative binomial regressions were used instead of normal Poisson regressions to deal with overdispersion, where the variance of the outcome variable is greater than its mean, and to deal with the excessive number of zeros. Analyses controlled for sex, race, age, and IQ. Because of missing data, full information maximum likelihood, which uses information from all available data, was used to estimate the path coefficients. Standardized coefficients (β) and incident rate ratios (IRRs) are reported for all models. SEM analyses were not preregistered and were conducted after the initial analyses of bivariate correlations and χ^2 tests.

RESULTS

Table 3 shows the characteristics of the study sample. There are no significant differences between the control and maltreated groups in terms of basic demographic characteristics, including sex, age, and race. However, individual-level SES of the maltreated group was lower than the control group, with a higher percentage of maltreated adults reporting annual household income below $20,000 (36.0% vs. 18.9%, $p < .001$), reliance on public assistance (21.8% vs. 12%, $p < .001$), and unemployment (22.7% vs. 14.3%, $p < .001$). At the neighborhood level, maltreated adults were living in more disadvantaged neighborhoods, objectively defined by census data, than control subjects (census score = 0.91 vs. 0.25, $p = .002$). Maltreated adults also scored significantly lower on The Quick Test (IQ) than the control group (35.79 vs. 38.94, $p < .001$). At the bivariate level, there were no significant differences between the maltreated and control groups in terms of BLL.

Table 3 also shows that individuals with histories of childhood maltreatment had significantly more violent and nonviolent arrests in the time period after the blood was collected than individuals in the control group. On average, the maltreated group had 1.58 arrests compared with 0.84 arrests for the control group and 0.23 arrests for violent crimes compared with 0.08 arrests for violent crimes for the control group. Significantly more individuals with histories of child maltreatment than control subjects had any arrest after blood was collected (28.6% vs. 19.5%, respectively) and any arrest for a violent crime after blood was collected (10.7% vs. 5.2%, respectively).

Figure 2 illustrates the results from an SEM showing the relationships among childhood maltreatment, BLL, and arrests after blood collection, controlling for age, sex, race, and IQ and including individual-level and neighborhood-level indicators of SES as potential mediators in these relationships. Figure 2 shows that there were no significant total effects or direct effects for childhood maltreatment predicting the total number of arrests after blood collection. However, there was a significant path from BLLs to arrests after blood was collected (β = 0.478, SE = 0.158, IRR = 1.613 [95% CI = 1.183–2.199], $p = .003$), indicating that with 1 standard deviation increase in BLL, the number of arrests lifetime is 1.612 times larger (this is the exponential function of the coefficient, or exp [0.478]), holding other variables constant. There is also a significant path from neighborhood-level SES to BLL (β = 0.155, SE = 0.064, IRR = 1.168 [95% CI = 1.066–1.278], $p = .001$). The indirect path from neighborhood SES to BLL to arrests after 2002 is not significant. It is noteworthy that the path from childhood maltreatment to individual-level SES is significant (β = 0.163, SE = 0.041, IRR = 1.177 [95% CI = 1.085–1.276], $p < .001$), but not the path from childhood maltreatment to neighborhood-level SES, with all covariates in the model.

Figure 3 shows the results of the SEM of the relationships among childhood maltreatment, BLL, and violent arrests after blood collection. When controlling for age, sex, race, and IQ and the inclusion of the two SES indicators (neighborhood and individual) as potential mediators, the direct effect of childhood maltreatment on the number of violent arrests after blood collection was significant (β = 0.330, SE = 0.148, IRR = 1.391 [95% CI = 1.040–1.861], $p = .026$). This means that the maltreated group had 1.390 times more (exp [0.330]) arrests for violent crimes after blood collection than the control group. In contrast to the results for any arrests after blood collection, the path from BLL to violent crimes is not significant (β = 0.220, SE = 0.159, IRR = 1.246 [95% CI = 0.912–1.702], $p = .166$). However, there is a significant path from neighborhood SES to BLL in adulthood (β = 0.156, SE = 0.047, IRR = 1.169 [95% CI = 1.067–1.280], $p = .001$) and a significant path from childhood maltreatment to individual-level SES (β = 0.163, SE = 0.041, IRR = 1.177 [95% CI = 1.085–1.276], $p < .001$).

DISCUSSION

This research examined the associations among childhood maltreatment, BLLs, and criminal and violent criminal behavior after blood was collected. In simple bivariate analyses, the maltreated group had a larger number of arrests in general and arrests for violent crimes, and a larger percentage of previously maltreated individuals were arrested for any crime and any violent crime after blood was collected compared with control subjects. These new results

provide additional support for the cycle of violence, given that the relationship between childhood maltreatment and arrests for violent crimes after blood was collected remained significant, despite the introduction of controls for age, sex, race, and IQ and the inclusion of neighborhood- and individual-level SES. However, after these controls were introduced, the relationship between childhood abuse and neglect and the number of any arrests became not significant. In both models (Figures 2 and 3), we did not find a significant pathway between childhood maltreatment and arrests and violent arrests through BLL.

Previous research with children and adolescents has reported a relationship between BLL and antisocial and delinquent behavior (22–26,54). This new research provides evidence of a significant association between BLLs in adulthood and criminal behavior that occurred after blood was collected. We found these results even though these individuals were middle-aged, and middle-aged individuals are generally at reduced risk for committing crimes (43,44). A unique contribution of this paper is the evidence that BLLs in adulthood predict future criminal behavior. In contrast to the desistance from offending of most offenders in middle adulthood, it is very likely that the individuals in this study have committed crimes beforehand and continue to offend into middle adulthood and thus may represent a distinct group of offenders who should be studied in the future. In addition, this study's findings that show that higher BLLs in adulthood are associated with negative consequences are consistent with the work of Reuben *et al.* (55), who found that BLLs were associated with psychopathology and personality traits in adulthood.

In one of the few longitudinal studies, Beckley *et al.* (33) did not find an association between BLL and criminal offending, and these authors suggested that the results of earlier studies may have been confounded with social class. Our findings incorporate the contributions of neighborhood- and individual-level SES and reveal that higher BLLs in adulthood predicted arrests after blood was collected. These new findings show the important role that neighborhood SES plays in relation to BLLs in adulthood. We found significant paths from neighborhood-level SES to BLLs in both models (predicting any arrest and any violent arrest after blood collection). BLLs provide a measure of recent exposure to the metal (56). Lead has a half-life in blood of approximately 25 days and so is cleared from the blood in the absence of continuous exposure (15). Thus, while the marker measured here was acute in nature, the significant paths from indicators of neighborhood disadvantage suggest exposure to lead in adulthood and may be a function of living in disadvantaged neighborhoods with poorly maintained pipes, lead house paint, soils contaminated by road dust, or residue of smelting plants.

Strengths and Limitations

The design of this study has several advantages, including a clear and unambiguous definition of child maltreatment, use of documented cases of childhood maltreatment to minimize potential problems with reliance on retrospective self-reports, an appropriate demographically matched comparison group, a heterogeneous sample that includes men and women and Black and White individuals assessed in middle adulthood, and laboratory-assessed measures of BLLs.

At the same time, limitations need to be noted. One limitation of this study is our use of a single reference point for lead exposure. BLL was assessed in adulthood when the average age of our sample was 41. These findings do not address the question of whether the lead exposure was in childhood and chronic or acute in adulthood. BLLs are more reflective of acute exposure, whereas bone lead levels reflect exposure over time and may persist long after exposure has ended. Future research should consider how lead exposure can be assessed over an extended time period when examining its association with criminal behavior.

These results are based on a large sample of children who grew up in one Midwestern area during the late 1960s and early 1970s, and the findings may not be generalizable to children from other geographic regions or time periods. The sample is skewed toward the lower end of the SES spectrum, and thus, caution should be used in generalizing from these findings to maltreated children from middle- and upper-class families. Finally, because these cases came to the attention of the court at the time, these findings may not be generalizable to maltreated children whose cases did not come to the attention of the courts.

Conclusions

These findings reinforce previous literature on the cycle of violence showing that maltreated children are continuing to offend into adulthood, and this relationship persists despite controlling for IQ and social class. These findings add to the existing literature by demonstrating that environmental toxins such as lead can affect outcomes even in adulthood. This paper has focused on the relationships between BLLs and crime and violence. Given that prior literature has shown the impact of lead on cognitive functioning (5–8), future research should examine the role of adult lead exposure on cognitive functioning and health status more generally.

ACKNOWLEDGMENTS AND DISCLOSURES

This research was supported in part by the National Institute of Justice (Grant Nos. 86-IJ-CX-0033, 89-IJ-CX-0007, and 2011-WG-BX-0013 [to CSW]), National Institute of Mental Health (Grant Nos. MH49467 and MH58386 [to CSW]), Eunice Kennedy Shriver National Institute of Child Health and Human Development (Grant No. HD40774 [to CSW]), National Institute on Drug Abuse (Grant Nos. DA17842 and DA10060 [to CSW]), National Institute on Alcohol Abuse and Alcoholism (Grant Nos. AA09238 and AA11108 [to CSW]), National Institute on Aging (Grant No. AG058683 [to CSW]), and the Doris Duke Charitable Foundation (to CSW). The opinions, findings, and conclusions or recommendations expressed are those of the authors and do not necessarily reflect those of the U.S. Department of Justice.

We thank Max Osborn for assistance with the preparation of the final manuscript.

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YEARS			MEAN AGE
1967-1971	Court Substantiated Cases of Abuse and Neglect (N=908)	Matched Control (N=667)	6
1987-1988	Arrest Records Collected		26
1989	National Death Index Search		27
1989-1995	In-Person Interview 1 (1,196)		29
1994	Arrest Records		33
2000-2002	In-Person Interview 2 (896)		40
2003-2005	Medical Status Exam & Interview 3 (807)		41
2013	Arrest Records Collected		51

Figure 1.
Chronology of the study.

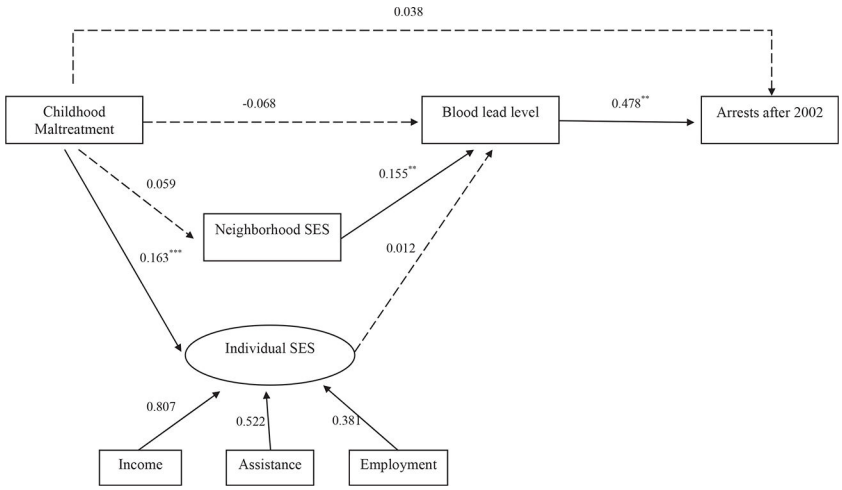

Figure 2.

Structural equation model showing pathways and coefficients from child maltreatment to arrests after 2002, through blood lead level and 2 indicators of socioeconomic status (SES), using zero-inflated negative binomial regressions. Analyses controlled for age, sex, race, and IQ. Coefficients represent a change in the log of expected arrest numbers with 1 unit change in the predictor variable. The total effect from child maltreatment to arrests after 2002 was not significant (β = 0.004, SE = 0.051, incidence rate ratio [IRR] = 1.004 [95% CI = 0.908–1.108], p = .944). This model revealed significant paths from blood lead level to arrests after 2002 (β = 0.478, SE = 0.158, IRR = 1.613 [95% CI = 1.183–2.199], p = .003), from neighborhood-level SES to blood lead level (β = 0.155, SE = 0.064, IRR = 1.168 [95% CI = 1.066–1.278], p = .001), and from child maltreatment to individual-level SES (β = 0.163, SE = 0.041, IRR = 1.177 [95% CI = 1.085–1.276], p < .001). **p < .01, ***p < .001.

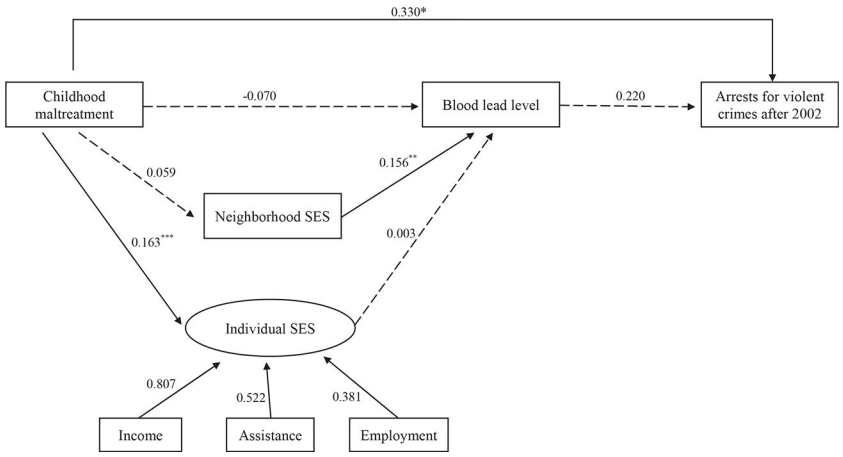

Figure 3.

Structural equation model showing pathways and coefficients from child maltreatment to arrests for violent crimes after 2002 through blood lead level and 2 indicators of socioeconomic status (SES), using zero-inflated negative binomial regressions. All analyses controlled for age, sex, race, and IQ. Coefficients represent a change in the log of expected arrest numbers with one unit change in the predictor variable. The direct effect of childhood maltreatment to arrests for violent crimes after 2002 was significant (β = 0.330, SE = 0.148, incidence rate ratio [IRR] = 1.391 [95% CI = 1.040–1.861], $p = .026$). The total effect of child maltreatment to arrests for violent crimes after 2002 approached significance (β = 0.109, SE = 0.058, IRR = 1.115 [95% CI = 0.994–1.250], $p = .063$). There were also significant paths from neighborhood-level SES to blood lead level (β = 0.156, SE = 0.047, IRR = 1.169 [95% CI = 1.067–1.280], $p = .001$) and from childhood maltreatment to individual-level SES (β = 0.163, SE = 0.041, IRR = 1.177 [95% CI = 1.085–1.276], $p < .001$). *$p < .05$, **$p < .01$, ***$p < .001$.

Table 1.

Characteristics of the Sample Over Four Waves

		Interviews		
	Records (*n* = 1575)	**1 (*n* = 1196)**	**2 (*n* = 896)**	**3 (*n* = 807)**
Dates	–	1989–1995	2000–2002	2003–2005
Characteristics				
Sex, female, %	50.7%	48.7%	51.0%	52.7%
Black, %	32.6%	34.9%	35.2%	37.3%
Hispanic, %	0.3%	3.8%	4.0%	4.0%
White, %	66.2%	62.9%	62.2%	60.4%
Abuse/neglect, %	57.7%	56.5%	55.8%	56.8%
Physical abuse, %	10.2%	9.2%	8.8%	9.7%
Neglect, %	44.3%	45.4%	45.3%	45.9%
Sexual abuse, %	9.7%	8.0%	7.6%	7.5%
Age at petition, years, mean (SD)	6.4 (3.3)	6.3 (3.3)	6.2 (3.3)	6.3 (3.3)
Age at interview, years, mean (SD)	–	29.2 (3.8)	39.5 (3.5)	41.2 (3.5)

Table 2.

Characteristics of Individuals Who Provided Blood Compared With Individuals in the Overall Interview 3 Sample

Characteristics	Interview 3, *n* = 807	Blood Lead Sample, *n* = 556	Test Statistic	*p* Value
Group, Maltreated, *n* (%)	458 (56.7%)	323 (58.1%)	$\chi^2_1 = 0.21$	.649
Sex, Female, *n* (%)	427 (52.9%)	315 (56.7%)	$\chi^2_1 = 1.77$	.184
Race, White, Non-Hispanic, *n* (%)	478 (59.2%)	337 (60.6%)	$\chi^2_1 = 0.22$	.636
Age at Interview 3, Years, Mean (SD)	41.2 (3.5)	41.2 (3.5)	$t_{1194} = 0.20$	.841

Table 3.

Sample Characteristics and Descriptive Statistics

Characteristics	Total, *n* = 807	Control, *n* = 349	Maltreatment, *n* = 458	Test Statistic	*p* Value
Sex, Female, *n* (%)	427 (52.9%)	178 (51.0%)	249 (54.4%)	$\chi^2_1 = 0.77$	.380
Race, White, Non-Hispanic, *n* (%)	478 (59.2%)	210 (60.2%)	268 (58.5%)	$\chi^2_1 = 0.16$	.688
Age at Interview 3, Years, Mean (SD)	41.20 (3.54)	41.11 (3.58)	41.27 (3.51)	$t_{741} = 0.67$	.505
Socioeconomic Status					
Household income <$20,000, *n* (%)	231 (28.6%)	66 (18.9%)	165 (36%)	$\chi^2_1 = 33.23$	<.001
Receiving public assistance, *n* (%)	142 (17.6%)	42 (12%)	100 (21.8%)	$\chi^2_1 = 13.25$	<.001
Unemployed, *n* (%)	154 (19.1%)	50 (14.3%)	104 (22.7%)	$\chi^2_1 = 9.15$	.002
Neighborhood-Level SES, Mean (SD)	0.62 (2.83)	0.25 (2.90)	0.91 (2.75)	$t_{668} = 3.14$	.002
The Quick Test Score (Raw), Mean (SD)	37.16 (6.08)	38.94 (5.63)	35.79 (6.07)	$t_{722} = 7.27$	<.001
Blood Lead Sample, *n*	556	233	323		
Blood Lead Level, µg/dL, Mean (SD)	3.30 (1.91)	3.36 (2.14)	3.27 (1.72)	$t_{432} = 0.55$	.584
Arrests After Blood Collection					
All arrests, No., mean (SD)	1.26 (4.13)	0.84 (2.79)	1.58 (4.90)	$t_{789} = 2.53$	.012
Violent arrests, No., mean (SD)	0.17 (0.71)	0.08 (0.40)	0.23 (0.87)	$t_{802} = 2.95$	.003
Arrested, *n* (%)	199 (24.7%)	68 (19.5%)	131 (28.6%)	$\chi^2_1 = 8.38$	.004
Arrested for violent crime, *n* (%)	67 (8.3%)	18 (5.2%)	49 (10.7%)	$\chi^2_1 = 7.28$	.007

Neighborhood-level SES is based on geocoded census tract data and reflects the sum of *z* scores of three items to assess economic disadvantage.

SES, socioeconomic status.

KEY RESOURCES TABLE

Resource Type	Specific Reagent or Resource	Source or Reference	Identifiers	Additional Information
Add additional rows as needed for each resource type	Include species and sex when applicable.	Include name of manufacturer, company, repository, individual, or research lab. Include PMID or DOI for references; use “this paper” if new.	Include catalog numbers, stock numbers, database IDs or accession numbers, and/or RRIDs. RRIDs are highly encouraged; search for RRIDs at https://scicrunch.org/resources.	Include any additional information or notes if necessary.
Antibody				
Bacterial or Viral Strain				
Biological Sample	Blood, humans, half male and half female	University Hospital, Newark, NJ		routine blood tests
Cell Line				
Chemical Compound or Drug				
Commercial Assay Or Kit				
Deposited Data; Public Database				
Genetic Reagent				
Organism/Strain				
Peptide, Recombinant Protein				
Recombinant DNA				
Sequence-Based Reagent				
Software; Algorithm				
Transfected Construct				
Other				