Original Investigation

Adverse Childhood Experiences and Child Health in Early Adolescence

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IMPORTANCE Child maltreatment and other adverse childhood experiences, especially when recent and ongoing, affect adolescent health. Efforts to intervene and prevent adverse childhood exposures should begin early in life but continue throughout childhood and adolescence.

OBJECTIVES To examine the relationship between previous adverse childhood experiences and somatic concerns and health problems in early adolescence, as well as the role of the timing of adverse exposures.

DESIGN Prospective analysis of the Longitudinal Studies of Child Abuse and Neglect interview and questionnaire data when target children were 4, 6, 8, 12, and 14 years old.

SETTING Children with reported or at risk for maltreatment in the South, East, Midwest, Northwest, and Southwest United States Longitudinal Studies of Child Abuse and Neglect sites.

PARTICIPANTS A total of 933 children who completed an interview at age 14 years, including health outcomes.

EXPOSURES Eight categories of adversity (psychological maltreatment, physical abuse, sexual abuse, neglect, caregiver's substance use/alcohol abuse, caregiver's depressive symptoms, caregiver treated violently, and criminal behavior in the household) experienced during the first 6 years of life, the second 6 years of life, the most recent 2 years, and overall adversity.

MAIN OUTCOMES AND MEASURES Child health problems including poor health, illness requiring a doctor, somatic concerns, and any health problem at age 14 years.

RESULTS More than 90% of the youth had experienced an adverse childhood event by age 14 years. There was a graded relationship between adverse childhood exposures and any health problem, while 2 and 3 or more adverse exposures were associated with somatic concerns. Recent adversity appeared to uniquely predict poor health, somatic concerns, and any health problem.

CONCLUSIONS AND RELEVANCE Childhood adversities, particularly recent adversities, already show an impact on health outcomes by early adolescence. Increased efforts to prevent and mitigate these experiences may improve the health outcome for adolescents and adults.

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The incidence of child maltreatment is higher in adolescents than in younger children, but it is less likely to be reported.[1] The Fourth National Incidence Survey of Child Abuse and Neglect found that about 21 of every 1000 adolescents aged 12 to 14 years were victims of child maltreatment compared with 8.5 of every 100 children aged 0 to 2 years.[2,3] Only about 8 of every 1000 children in this adolescent age group were actually reported to child protective services for maltreatment. Underreporting may be owing to assumptions that maltreatment is less harmful for adolescents than younger children.

Child maltreatment and other adverse childhood experiences (ACEs) have been linked to depressed mood, anxiety, posttraumatic stress disorder symptoms, risk-taking behavior, early pregnancy, eating disorders, weight problems, substance use, sexually transmitted disease treatment, suicide attempts, and mental health treatment in adolescents.[4-13] To our knowledge, few studies have examined the relationship between ACEs and adolescent physical health.[10,14]

Previous studies have provided evidence that exposure to ACEs is modestly related to health problems in younger children.[15,16] These associations appear to begin as early as age 6 years[15] and persist at age 12 years,[16] and they include somatic concerns as well as poor health.[17] Recent adversities, as opposed to more remote adversities, may have a stronger impact on health in children.[18]

Other studies have found a significant relationship between ACEs and health risk behaviors, health status, and disease among adults.[19-26] The Centers for Disease Control and Prevention (CDC)-Kaiser Permanente ACE studies found a strong dose-response relationship between ACEs and adult health problems including ischemic heart disease, cancer, chronic lung disease, skeletal fractures, and liver disease. The mechanism for the development of some disease appears to be related to unhealthy behaviors; adults who experienced ACEs were more likely to engage in risky health behaviors including alcohol and drug abuse, smoking, and physical inactivity.[21,27-29]

We sought to examine whether there is a dose-response relationship between ACEs and health problems in early adolescence. This study examined the relationship between both the overall exposure and the role of the timing of exposure of ACEs to health problems in early adolescence. We hypothesized that a higher number of ACEs would be associated with poor health and/or somatic concerns, that recent adversities would more strongly predict negative health outcomes, and that this relationship would be stronger than previously shown for younger children.

Methods

Participants and Study Design

Data collected by the Longitudinal Studies of Child Abuse and Neglect (LONGSCAN), a consortium of a coordinating center and 5 study sites, were analyzed.[30] The LONGSCAN sites are described in more detail in **Table 1**. The study sites represent different geographical regions with different levels of risk for maltreatment, but they share common measures of child and family function, exposure to maltreatment, and health status collected according to commonly shared age-specific protocols.[30]

Data on LONGSCAN participants who had completed an interview at age 14 years were analyzed. Of the 1354 children enrolled in the LONGSCAN studies at baseline (either age 4 or 6 years), 933 (68.9%) had completed an interview at age 14 years, including health outcomes. The decline in the number of participants from age 4 to 14 years was owing primarily to loss to follow-up, although there were 8 deaths. Comparison of demographic characteristics revealed no differences between those included in the analyses and those not included. The demographic description of the sample is presented in **Table 2**.

Human Subjects

Each participating study site, as well as the coordinating center, obtained independent approval from their local institutional review board. Caregivers provided informed consent, while youth provided assent for their participation.

Variables and Their Measurement

Using the CDC-Kaiser ACE studies[21] as a model, age-appropriate measures were selected from among the available instruments administered to the LONGSCAN sample. There was some variation of the time frame used in each question because some measures asked about events in the prior

Table 1. Description of LONGSCAN Samples

Site, No. of Children	Geographic Location	Risk Group	Comparison Group
East, 197	Urban	Either failure to thrive at <2 y of age or mother with prenatal drug use or HIV infected	Same pediatric clinic, adequate growth, and no special risk factors
South, 173	Urban, suburban, and rural	At-risk child reported to CPS by age 4 y	Matched control subjects not reported to CPS
Midwest, 176	Urban	Family reported to CPS and either 6 mo of family intervention or usual CPS intervention	Neighborhood control subjects
Northwest, 183	Urban and rural	Children with substantiated report to CPS before age 5 y and judged to be at moderate risk	Children with unsubstantiated report to CPS before age 5 y and judged to be at moderate risk
Southwest, 204	Urban	Children removed from families and placed in foster care	Children returned home by age 4 y

Abbreviations: CPS, child protective services; LONGSCAN, Longitudinal Studies of Child Abuse and Neglect.

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Table 2. Description of Sample and Youth Health Outcomes for 933 Children

Variable	No. (%)
Sex	
Male	457 (49.0)
Female	476 (51.0)
Race/ethnicity	
White	232 (24.9)
African American	528 (56.6)
Other	173 (18.5)
Site	
East	197 (21.1)
South	173 (18.5)
Midwest	176 (18.9)
Northwest	183 (19.6)
Southwest	204 (21.9)
Caregiver marital status[a]	
Never married	317 (34.0)
Married	354 (37.9)
Formerly married	258 (27.7)
Unknown	4 (0.4)
Family income, $[a]	
<20 000	372 (39.9)
≥20 000	521 (55.8)
Unknown	40 (4.3)
Health outcomes[a]	
Poor health	70 (7.5)
Somatic concerns	86 (9.2)
Illness	109 (11.7)
Any reported health problem	254 (27.2)

[a] Status at the time of the interview conducted when the child was 14 years of age.

year, while others asked about events in the prior 6 months. Analyses included data collected during assessment interviews at ages 4, 6, 8, 12, and 14 years. For several variables indicating adversity, different measures were used to assess the variable at different ages. To construct a risk profile, each predictor and outcome variable was dichotomized, unless otherwise specified.

Demographic Control Variables

Demographic variables were assessed at each age interview. Time-invariant demographic variables (child's race/ethnicity, sex, and study site) were collected at age 4 or 6 years. For time-varying variables (eg, caregiver's marital status and family income), data collected at the most recent point, the interview at age 14 years, were used in the block of control variables. To increase power, the child's race/ethnicity was categorized as white, African American, or other, while the caregiver's marital status was divided into married, never married, or formerly married. Family income was dichotomized into greater than $20 000 annually or at or less than $20 000 annually.

Adverse Exposures

Analogous to the ACEs used in the CDC-Kaiser ACE studies,[21] 4 categories of maltreatment (psychological maltreatment, physical abuse, sexual abuse, and neglect) and 4 measures of other household dysfunction (caregiver's substance use/alcohol abuse, caregiver's depressive symptoms, caregiver being treated violently, and criminal behavior in household) were identified as possible adverse experiences. An indicator for each of the measures of adversity was specified. The assessment periods were categorized as adversities occurring in the first 6 years of life (assessed at 4 and 6 years), occurring in the second 6 years of life (assessed at 8 and 12 years), or occurring recently (assessed at age 14 years). These 3 periods of potential adversity were also combined to produce an overall variable noting whether the adverse events had ever occurred.

Each site reviewed child protective service records for all lifetime reports of child maltreatment at least every 2 years. Based on prior research suggesting that distinguishing between allegations and substantiations is not useful,[31,32] each site coded all official reports of alleged child maltreatment using a modified[33] version of the Maltreatment Classification Scheme.[34] Reports were coded to allow reports to be linked to the period of the child's assessment used in our analysis. For each period, 4 general indicators of child maltreatment were created, each dichotomized, based on the coding of these allegations:

1. Physical abuse (any blows or injury to the body; violent handling, choking, burning, shaking, or nondescript injury);
2. Sexual abuse (any sexual exposure, exploitation, molestation, or penetration);
3. Psychological maltreatment (any threats to psychological safety and security, lack of acceptance and threats to self-esteem, or failure to allow age-appropriate autonomy); and
4. Neglect (any failure to provide for a child's physical needs, or lack of adequate supervision to ensure a child's safety).

Household Dysfunction

Caregiver's Substance Use

The CAGE, a commonly used screening measure of problem alcohol use, was administered to caregivers of children aged 4 years who reported having ever consumed alcoholic beverages (a caregiver who did not report such usage was coded as not abusing alcohol).[35] Any affirmative response was considered indicative of substance use by the parent when the child was age 4 years.

The Caregiver Substance Use measure, developed by LONGSCAN, was administered at ages 8, 12, and 14 years.[36] It asked a series of yes or no questions about the caregiver's use of common legal (tobacco and alcohol) and illegal (marijuana, cocaine, hallucinogens, heroin, and stimulants) substances. Any current use of illicit substances and/or current daily use of alcohol were coded as substance use present.

Caregiver's Depressive Symptoms

Caregivers' depressive symptoms were measured using 2 scales. The Center for Epidemiological Studies Depression Scale (CES-D),[37] which measures symptoms associated with depres-

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sion in the past week, was administered to caregivers of children at ages of 4, 6, 12, and 14 years. The CES-D has demonstrated good construct validity and reliability. A response score of 16 or greater on the CES-D is considered indicative of depressive symptoms. The Brief Symptom Inventory, administered at child's age 8 years, measures a broader range of psychological symptoms in the last week including depression.[38,39] Scores were interpreted by comparison to age-appropriate norms.

Caregiver Treated Violently

The partner-to-partner Conflict Tactics Scale[40] was administered to the primary maternal caregiver at child age 6, 8, 12, and 14 years to assess intimate partner violence between the caregiver and a partner that had occurred during the previous 3 months. The caregiver was coded as having been treated violently if he or she had been the victim of 1 or more of the following: kicking, biting, punching, hit with an object, being beaten up, threatened with a knife or gun, or the victim of a knife or a gun.

Criminal Behavior in the Household

Developed by LONGSCAN and administered to caregivers of children at ages 6, 8, 12, and 14 years, the Child Life Events measure[36] asks whether anyone in the child's household was jailed or imprisoned in the past year. Affirmative responses were coded as present for criminal behavior in the household.

Construction of the Adversity Index

Analogous to the methods used in the CDC-Kaiser ACE studies, the 8 dichotomous scores on the indices of childhood abuse and household dysfunction were summed to produce an overall Adversity Index, with scores ranging from 0 to 8.[21] Separate scores were calculated for adversity during the first 6 years of life (assessed using data collected at ages 4 and 6 years), during the second 6 years of life (ages 8 and 12 years), and in the most recent 2 years (age 14 years), as well as overall adversity (occurring at any age).

Assessment of Youth Health at Age 14 Years

Poor Health

The caregiver completed the Child Health Assessment and answered the question, "In general, would you say that [child]'s health is excellent, good, fair, or poor." Ratings of poor or fair were coded as poor health and ratings of good and excellent as good health.

Illness Requiring Medical Attention

The Child Life Events report asked the caregiver whether the youth had had a serious illness in the past year.[41] If the caregiver answered yes, he or she was asked whether the youth had seen a doctor for the illness. If an illness required medical attention, the answer was coded as present. The answers were dichotomized as yes or no; a "don't know/refused response" answer was coded as no.

Somatic Concerns

The caregiver completed the Child Behavior Checklist, a commonly used measure of child behavior to assess youth somatic concerns.[42] The Child Behavior Checklist includes several items assessing common physical concerns of uncertain origin including headaches, nausea, dizziness, tiredness, eye problems, aches, skin problems, stomach problems, vomiting, nightmares, and constipation.

Composite Health Outcomes

Children characterized by the caregiver as having poor health, illness requiring a doctor, or somatic concerns were classified as having any health problem.

Statistical Analysis

The analyses were conducted using Statistical Package for the Social Sciences version 15. Preliminary descriptive analyses were conducted for each of the control, predictor, and outcome variables. Missing data (less than 2% of cases) was eliminated in a casewise fashion. For each outcome variable, logistic regression was used to test the relationship of the Adversity Index score (categories 0, 1, 2, and ≥3 adversities) to the outcome, after entering the control variables (study site, child's sex, child's race/ethnicity, caregiver's marital status, and family income). Outcomes of interest included poor health, illness requiring a doctor, somatic concerns, and a composite indicator of poor health (any poor health). The analysis first examined the number of different adversities that had ever occurred, as a composite dichotomous variable, and then examined separately adversities occurring in the first 6 years of life, in the second 6 years of life, and within the previous 2 years (ages 13 and 14 years). Finally, a multivariate model was created that included control variables, and, as predictors, indicators of the number of ACEs occurring in each of these 3 periods.

Results

Youth Health

More than one-quarter of the youth (27.2%) had a health problem including reported poor health, illness requiring a doctor, or somatic concerns (Table 2).

Adverse Childhood Exposures

The prevalence, type, and timing of adverse exposures are shown in **Table 3**. The majority of the adolescents had been exposed to neglect and to caregiver depression (approximately 57% in each case), the most common adverse exposures. Only 8.7% of the children in the sample had never experienced any of the measured adversities during the first 14 years of life. Most had experienced 3 or more adversities during the first 14 years of life.

Association of Adverse Childhood Experiences With Health

There was an apparent graded relationship between adverse exposures and any heath problem, as shown in **Table 4**. In addition, 2 and 3 or more adverse exposures showed odds ratios of 8.91 and 9.25, respectively, with somatic concerns, while an increased number of adverse exposures trended toward a graded relationship with illness requiring a doctor.

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Table 3. Frequency of Adverse Childhood Exposures From the First 6 Years of Life Through Age 14 Years

	%			
	Age, y			
Adversity	0-6	6-12	13-14	Ever
Physical abuse	22.0	16.0	6.5	33.4
Sexual abuse	9.9	5.8	1.9	15.1
Psychological abuse	24.3	13.8	5.6	33.3
Neglect	50.5	21.9	6.1	57.3
Caregiver substance use	15.3	13.2	9.8	31.9
Caregiver depression	41.9	25.3	24.9	56.6
Caregiver treated violently	5.8	23.7	16.5	36.2
Criminal behavior in home	20.9	29.5	12.9	42.6
Total No. of occurrences				
0	20.5	32.8	50.2	8.7
1	26.4	24.9	28.2	16.3
2	22.6	20.2	13.4	17.8
≥3	30.5	22.2	8.3	57.2

Separating the effects of adverse exposures during the first 6 years of life, the second 6 years of life, and the most recent 2 years of life demonstrated some differential effects (**Table 5**). Greater adversities during the first 6 years of life were inconsistently associated with illness requiring a doctor, somatic concerns, and any health problem. There was little effect of adversities in the second 6 years of life. However, recent adversities had quite strong effects on poor child health, somatic concerns, and any health problem. There was a strong graded relationship between the number of adversities and any health problem. The odds ratio increased for both poor health and somatic concerns when there were 2 and 3 or more adversities.

Discussion

More than 90% of this sample of young adolescents had experienced some adversity during their 14 years of life, and more than a quarter had at least 1 health problem. Both overall exposure to adversity and concurrent exposure to adversity were associated with measures of poor health. There was a significant relationship between exposure to adversities and any health problem and increasing odds ratio for somatic concerns and illness requiring a doctor as the number of exposures increased.

This study shows some of the same apparent linear relationship between adversities and child outcomes that was demonstrated in the CDC-Kaiser ACE studies, although our study group was quite different from the CDC-Kaiser ACE group.[27,28,43-48] More than 90% of our study group had at least 1 adverse exposure compared with only half of the CDC-Kaiser ACE study participants.

Recent advances in neuroscience have provided a framework that begins to explain how childhood adversity may cause these negative health outcomes.[49,50] Exposure to violence and other childhood stress has been associated with a number of neurobiological and behavioral findings including smaller prefrontal cortex volume, impaired prefrontal cortex functioning, chronic activation of the hypothalamic-pituitary-adrenal axis, impaired responses to psychosocial stressors, and elevated inflammation levels.[51,52] Childhood exposure to violence has been linked to gene modifications.[53-55] Cumulative or chronic exposure to ACEs may lead to allostatic overload, causing neurobiological responses to become pathogenic rather than protective.[51,56] Excessive, prolonged, or frequent activation of the body's stress-response system may result in toxic stress for the child, leading to long-term health consequences.[49,50,56]

We found relatively strong effects of concurrent (ages 13-14 years) adversities on any health problem, somatic concerns, and caregiver's report of poor health. This is consistent with previous research that found the strongest effects for most recent adversities.[16] In a study examining how maltreatment affects certain adolescent behaviors, such as drug and alcohol use and delinquency, concurrent maltreatment of the adolescent was more significantly associated with adolescent behavior problems than maltreatment occurring earlier in childhood.[57] These findings suggest that recent ACEs have more negative consequences for the adolescent than has been previously appreciated. The effects of adolescent exposure to adversities are often overlooked but can be significant.[58]

The health consequences of adversities occurring during child ages 7 to 12 years were limited and this differed from the findings of our previous study of this sample. In that study of outcomes assessed at age 12 years, the sample's exposure to adversities in the second 6 years of life was associated with any health problem, child reports of poor health, somatic concerns, and illness requiring a doctor.[16] The limited effect found in the current study supports our hypothesis that the most recent adversities more strongly predict negative health outcomes than do adversities occurring at any particular developmental period.

We did find some evidence of an emerging effect of very early (ie, through age 6 years) adversity, which has also been seen in research examining psychosocial outcomes.[59] Other

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Table 4. Multivariate Analysis of Number of ACEs (Ever) and Adjusted Odds Ratios of Health Outcomes at Age 14 Years for 933 Children[a]

Health Outcome	Adjusted Odds Ratio (95% CI)
Poor health category	
0	1.00 [Reference]
1	1.85 (0.50-6.92)
2	2.66 (0.74-9.52)
≥3	1.55 (0.54-9.97)
Illness requiring doctor category	
0	1.00 [Reference]
1	3.12 (0.87-11.30)
2	3.40 (0.96-12.09)
≥3	3.68 (1.11-12.16)[b]
Somatic concerns category	
0	1.00 [Reference]
1	4.19 (0.50-34.90)
2	8.91 (1.15-68.83)[b]
≥3	9.25 (1.25-68.23)[b]
Any problem category	
0	1.00 [Reference]
1	3.09 (1.22-7.84)[b]
2	3.61 (1.44-9.02)[b]
≥3	3.91 (1.65-9.26)[b]

Abbreviation: ACEs, adverse childhood experiences.

[a] Adjusted for child's sex, child's race/ethnicity, caregiver's marital status, and family income.

[b] Significant at $P < .05$.

studies have demonstrated that the type of maltreatment or adversity experienced at particular developmental stages may play a role in determining particular outcomes.[57,60]

There are several cautions to be considered in interpreting these results. Because we examined ACEs similar to those used in the CDC-Kaiser studies, exposures to other adversities or risks were not included that may have some influence on child health. Also, because we used the CDC-Kaiser study as a model for our study, we did not examine the cumulative effects of adversities over time; rather, we simply examined whether particular adversities had occurred either over particular time frames or over the whole course of the period examined. For that same reason, we used simple logistic regression modeling for analysis. Future research might use more sophisticated approaches to modeling that allow for a more nuanced capturing of the degree to which exposure to adversities changes over time. Future research should include a more detailed assessment of health outcomes including the effects of earlier health problems as controls.

Because the study tools examining household dysfunction did not assess the whole period since the previous caregiver-child interview, the ACE exposure may have been even greater than the identified exposure. Finally, our reference group for analyses was the relatively small number of youth who had no exposure to adversities as assessed, and this is a challenge to generalizability.

In conclusion, childhood adversities, including child maltreatment, influence the young adolescent's health, illness, and somatic concerns beginning in childhood and continuing into adolescence. These findings suggest that greater efforts to mini-

Table 5. Multivariate Analysis of Number of ACEs during Age Period and Adjusted Odds Ratios of Health Outcomes for 933 Children[a]

Health Outcome	Odds Ratio (95% CI)		
	Early (age, 0-6 y)	Later (age, 6-12 y)	Concurrent (age, 13-14 y)
Poor health category			
0	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
1	1.31 (0.60-2.87)	1.18 (0.58-2.40)	1.87 (0.98-3.57)
2	0.94 (0.40-2.24)	0.92 (0.42-2.00)	2.59 (1.16-5.79)[b]
≥3	0.83 (0.35-1.93)	0.83 (0.35-1.93)	3.78 (1.59-8.97)[b]
Illness requiring doctor category			
0	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
1	1.64 (0.80-3.36)	1.12 (0.63-2.01)	1.24 (0.74-2.07)
2	1.59 (0.75-3.34)	1.14 (0.62-2.10)	1.47 (0.77-2.78)
≥3	2.21 (1.09-4.50)[b]	0.81 (0.42-1.59)	1.16 (0.52-2.61)
Somatic concerns category			
0	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
1	1.90 (0.81-4.47)	1.50 (0.74-3.02)	1.67 (0.92-3.03)
2	1.29 (0.52-3.24)	1.46 (0.71-3.01)	2.27 (1.13-4.59)[b]
≥3	2.12 (0.90-5.00)	1.08 (0.51-2.31)	3.47 (1.61-7.50)[b]
Any problem category			
0	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
1	1.66 (0.98-2.82)	1.06 (0.67-1.67)	1.71 (1.16-2.53)[b]
2	1.57 (0.90-2.74)	1.08 (0.67-1.73)	1.86 (1.12-3.07)[b]
≥3	1.91 (1.12-3.28)[b]	0.82 (0.50-1.37)	2.38 (1.32-4.31)[b]

Abbreviation: ACEs, adverse childhood experiences.

[a] Adjusted for child's sex, child's race/ethnicity, caregiver's marital status, and family income. All adversities were entered simultaneously; thus, reported effects for adversities from one time frame include control subjects for adversities from the other time frames.

[b] Significant at $P > .05$.

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mize or ameliorate childhood adversities, especially those occurring during adolescence, will have a demonstrable impact on the health of adolescents and adults. Further research should focus on developing prevention programs that improve and enhance parenting, as well as intervention programs to address adversity exposure.

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