

Cumulative Adversity in Childhood and Emergent Risk Factors for Long-Term Health

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Objective To examine whether and when effects of cumulative adversity in the first 7 years of life are evident in relation to 3 childhood markers of risk for poor adult physical health.

Study design The study data are from an English birth cohort. Parental reports of 8 social risk factors were obtained during the child's first 7 years, and scores were created to reflect cumulative adversity at 4 developmental periods. At age 7 and 11 years, weight, height, and blood pressure (BP) were measured by clinic staff, and caregivers reported behavior problems. Linear regression was used to estimate associations of cumulative adversity with each outcome (n = 4361) and changes in these outcomes between 7 and 11 years (n = 3348).

Results At age 7 years, mean adversity and chronic exposure to high adversity were associated with elevated body mass index (BMI) and internalizing and externalizing symptoms ($P < .05$), but not elevated BP. Adversity in all developmental periods was associated with elevated numbers of internalizing and externalizing symptoms ($P < .0001$), but associations were less robust for BMI. Adversity did not predict change in BMI or BP between age 7 and 11 years, however, it predicted increases in internalizing and externalizing symptoms ($P < .0001$).

Conclusion Cumulative adversity was associated with BMI and behavior problems at age 7 years, and our data indicate that timing and chronicity of exposure to adversity differentially influence diverse indicators of long-term health risk commonly measured in childhood. This research suggests the hypothesis that interventions to address adversity could reduce the development of multiple chronic disease risk factors and limit their effects on health. (*J Pediatr* 2014;164:631-8).

Recent advances have increased our understanding of the enduring influence of childhood experiences for long-term physical health.¹ National policy statements suggest an urgent need to develop strategies to address social determinants of early risk factors for adult chronic diseases,^{2,3} including higher body mass index (BMI),⁴ high blood pressure (BP),⁵ and behavior problems⁶ in childhood. Evidence suggests that these conditions are associated with the accumulation of social stressors in youth,⁷⁻⁹ and the impact of cumulative adversity in childhood on physical¹⁰ or psychological^{11,12} outcomes may vary depending on the developmental stage of exposure. Gaining greater insight into which childhood physical and behavior health conditions emerge early in the life course in response to social adversity is critical to enable earlier determination of who is at risk and to provide additional tools for evaluating interventions.

The goal of the present study was to examine the relationship of cumulative adversity occurring in the first 7 years of life with 3 childhood markers of risk for poor adult physical health. Our first aim was to examine the potential influence of cumulative exposure to adversity between birth and age 7 years on 3 early markers of risk for poor health in adulthood that can be relatively easily assessed by pediatricians—specifically, elevated BMI, BP, and behavior problems—with consideration of sensitive periods for the effects of exposure, mean level of risk exposure, and chronicity of high-risk exposure over time. Our second aim was to test whether cumulative adversity predicted greater increases in these risk factors 4 years later, at age 11 years. We considered risk indicators at age 11 years to examine the potentially sustained influence of cumulative adversity on physical health and behavior before entering the pubertal transition. We hypothesized that cumulative adversity occurring before age 7 years would be associated with elevated BMI, BP, and behavioral symptoms at age 7 years (baseline), as well as with continued increases in these risk factors between 7 and 11 years of age. We tested for interactions by sex, given that some related studies have reported sex differences in associations between adversity and child health outcomes.¹³ We used additive cumulative risk measures throughout our analyses, because this approach is parsimonious, allows for inclusion of relatively uncommon exposures, and does not make assumptions about the relative strength of each risk factor.¹⁴

ALSPAC	Avon Longitudinal Study of Parents and Children
BMI	Body mass index
BP	Blood pressure
CCEI	Crown-Crisp Experiential Index
DBP	Diastolic blood pressure
SBP	Systolic blood pressure

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Methods

Study participants were members of the Avon Longitudinal Study of Parents and Children (ALSPAC), a prospective investigation of children born to mothers living in Avon County with estimated delivery dates between April 1991 and December 1992.¹⁵ The ALSPAC was designed to study how biological, social, and environmental factors influence pregnancy outcomes and child development. Approximately 85% of eligible pregnant women agreed to participate (n = 14 541), and 13 988 children who were alive at age 12 months were enrolled. During the pregnancy and at regular intervals postpartum, researchers mailed questionnaires to parents and participants were invited to clinics for assessment, as described previously.¹⁶ Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the local Research Ethics Committee.

This analysis uses data from children who attended clinics at age 7 and 11 years and who provided completed data on survey items that asked about social risk factors during the first 7 years of life. All surviving children with correct contact information and parental permission for ongoing study participation were invited to each clinic visit. Our analyses were restricted to individuals with complete data on the required variables. A total of 4361 children had complete survey data on social risk factors and valid outcomes for age 7 year study outcomes, and 3348 children had complete data on social risk factors and age 11 year study outcomes. As documented elsewhere,^{16,17} children lost from the cohort were more likely to be from families with lower incomes and education, to have higher BMIs and behavior problems at age 7 years, and to experience more social adversity (Table I; available at www.jpeds.com).

Social Risk Factors

We examined 8 social risk factors (described below) that have been used to assess childhood adversity in the ALSPAC study¹⁸⁻²⁰ and other cohorts^{21,22} and were assessed using mail surveys on at least 4 occasions before age 7 years. This facilitated the creation of 4 identical cumulative adversity scores in each of 4 developmental periods (0-1.5 years, >1.5-3 years, >3-5 years, and >5-7 years), a mean cumulative adversity score, and a measure to reflect chronicity of exposure to cumulative adversity. The developmental periods were informed by previous developmental timing research that examined exposures in 1- to 3-year intervals^{12,13}; the specific age ranges were determined based on the availability of repeated survey items before age 7 years. Here we describe measurement of each risk factor and creation of the cumulative adversity scores.

Maternal Psychopathology. Maternal psychopathology was assessed at child age 8 months, 2 years, 3 years, 4 years, 5 years, and 6 years. Consistent with previous research in the ALSPAC study,¹⁸ an indicator variable for maternal psychopathology was assigned if at least 1 of the following

criteria was present: self-reported suicide attempt, Crown-Crisp Experiential Index (CCEI) depression score >9,²³ CCEI anxiety score >10, or Edinburgh Postnatal Depression Scale score >12.²⁴ Notably, a CCEI depression score was not available for the age 5-7 year period.

One Adult in the Household. At child age 8 months, 2 years, 3 years, 4 years, and 7 years, mothers were asked to report the number of adults (aged >18 years) living in the household. An indicator variable was created for children residing in households with only 1 adult.

Legal Problems. At child age 8 months, 2 years, 3 years, 4 years, 5 years, and 6 years, mothers and fathers were asked to respond to the statement "You were in trouble with the law" (since the last interview) with a "yes/no" response. An indicator variable was assigned if either parent affirmed this statement.

Child Taken into Care. At child age 1.5, 2.5, 3.5, 5, 6, and 7 years, mothers completed a stressful event inventory that asked whether their child was ever taken into care since the last interview, referring to either institutional foster care or with relatives. An indicator variable was assigned if this item was endorsed.

Physical Injury. As part of the stressful events inventory (see above), mothers were asked whether their child had been physically hurt since the last interview. If this item was endorsed, an indicator variable was assigned.

Sexual Abuse. As part of the stressful events inventory (see above), mothers were asked whether their child had been sexually abused since the last interview. If mothers endorsed this item, an indicator variable was assigned.

Financial Strain. At child age 8 months, 2 years, 3 years, 5 years, and 7 years, mothers were asked about whether they had difficulty in affording food, clothing, heat, housing, and items for their child since the last interview. Items were rated on a scale of 0-3. Following previous research using this sample, financial strain was defined as the top 10% of scores.¹⁸

Neighborhood Disadvantage. Measures of neighborhood disadvantage were collected during pregnancy and at child age 2, 3, 5, and 7 years. The measure during pregnancy asked mothers to report on the extent to which their neighborhood was lively, friendly, noisy, clean, and polluted/dirty (rated on a scale of 1-3, with higher values reflecting greater disadvantage). Using the same rating system, the assessments at 2, 3, 5, and 7 years asked mothers to report on a similar set of neighborhood characteristics: noise from other homes, noise from the street, litter, dog dirt, vandalism, worry about burglary, worry about mugging, and disturbances from youth. Consistent with our coding of financial strain, an indicator variable was assigned to the top 10% of scores.

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