

Table II. Number of adverse childhood experiences and risk of any biomedical or psychosocial problem

Number of adverse childhood experiences	Percent of total sample	Biomedical risks			Psychosocial risks		
		Percent of sample	OR [95% CI]	OR-adj* [95% CI]	Percent of sample	OR [95% CI]	aOR-adj* [95% CI]
0	47.3 (237)	44.4	1.0 (ref)	1.0 (ref)	39.0	1.0 (ref)	1.0 (ref)
1	21 (105)	17.5	.85 [.51-1.41]	.85 [.51-1.43]	22.5	1.60 [†] [1.01-2.55]	1.70 [†] [1.07-2.78]
2	12.0 (60)	11.9	1.08 [.59-1.98]	1.09 [.59-2.01]	12.6	1.53 [.86-2.70]	1.50 [.81-2.78]
3	6.8 (34)	6.9	1.11 [.51-2.40]	1.17 [.54-2.55]	5.6	1.01 [.48-2.12]	1.34 [.61-2.95]
>4 ^{§,¶}	13.0 (65)	19.4	2.12 [‡] [1.21-3.71]	2.18 [‡] [1.22-3.89]	20.3	4.27 [¶] [2.33-7.80]	4.46 [‡] [2.34-8.50]
Linear trend			F = 5.71 (df = 499), P = .017			F = 18.823 (df = 499), P < .001	

*Adjusted for maternal age and Canadian-born status.

[†]P < .05.

[‡]P < .01.

[§]Number (%) of women with 4 adverse childhood experiences: 31 (6.2), 5 adverse childhood experiences: 13 (2.6%) 6 adverse childhood experiences: 8 (1.6%) 7 adverse childhood experiences: 8 (1.6), 8 adverse childhood experiences: 2 (0.4), and 9 adverse childhood experiences: 3 (0.6).

[¶]P < .001.

Methods

This study was part of an ongoing longitudinal study (Kids, Families, Places study) that aimed to investigate genetic and environmental influences on children’s developmental health. Multiparous women were eligible if they gave birth in the cities of Toronto and Hamilton from 2006 to 2008 and had been contacted by the Healthy Babies Healthy Children public health program (run by Toronto and Hamilton, Ontario, Public Health Units). Inclusion criteria were (1) English-speaking mother; (2) a newborn weighing at least 1500 g; (3) 1 or more children less than 4 years old in the home; and (4) agreement to the collection of observational and biological data. When the children were 2 and 18 months of age, mothers in each family participated in a 2-hour home interview conducted by trained interviewers. The University of Toronto Research Ethics Board approved all procedures, including informed consent.

When infants were 2 months old, mothers were asked to answer a series of questions pertaining to family dysfunction and victimization before the age of 16 years (Table I; available at www.jpeds.com). Sexual and physical victimization was assessed using an adapted version of a self-report measure of childhood exposure to violence for adults (Childhood Experience of Violence Questionnaire),²⁰ which shows good reliability and validity.²¹ Scores ranging from 0 to 10 were summed, and the distribution of scores is shown in Table II. As in other studies on childhood adversity,² few individuals existed in the upper tail of the distribution; thus, scores of ≥4 were combined to reflect “4 or more” adverse childhood experiences.

An objective proxy for low current socioeconomic status was created by extracting census data on the current socioeconomic state of all families. Current neighborhood-level disadvantage was assessed as the proportion of families in the neighborhood with low income (below the poverty line) before tax. This variable was normally distributed and standardized, with a higher score indicating more disadvantage.

At infant age 2 months, mothers reported on prenatal and perinatal risk factors (Table III). A single item was used to assess the presence/absence (0 = absent; 1 = present) of each risk factor. A count of these biomedical risks was computed. The presence of 1 or more biomedical risks was reported by 32.0% of

Table III. Characteristics of study sample

Characteristics	n	Mean or %
Maternal age, y (mean, SD)	501	32.7 (4.9)
Educational attainment (mean, SD)	500	15.3 (2.7)
Marital status (%)		
Married or cohabitating	469	93.6
Single (never been married)	22	4.4
Divorced/separated/widowed	10	2.0
Ethnicity (%)		
White	283	56.5
Black	46	9.2
East Asian	60	12.0
South Asian	73	14.6
Other	39	7.7
Type of adverse childhood experience (%)		
Mother mental illness	91	18.8
Father mental illness	68	14.0
Mother drug/alcohol problem	20	4.0
Father drug/alcohol problem	59	11.8
Parent went to jail	15	3.0
Nonintact family	108	21.6
Experience sexual abuse	49	10.0
Experience physical abuse	96	19.6
Witness inter-parental verbal abuse	105	21.0
Witness inter-parental physical abuse	52	10.4
At least 1 adverse childhood experience	264	52.3
Biomedical risk (%)		
Diabetes during pregnancy	30	6.0
Hypertension during pregnancy	23	4.6
Thyroid problems during pregnancy	16	3.2
Loss of fetal movement during pregnancy	58	11.6
Injury to abdomen during pregnancy	7	1.4
Infant need for intensive care after birth	23	4.6
Infant need for oxygen/ventilation	20	4.0
Infant transfer to a specialized hospital	2	.40
Low birth weight (<2500 g)	18	3.6
Short gestation (<37 wk)	20	4.0
At least 1 risk	160	32.0
Psychosocial risk		
Single parent	32	6.4
Teenage mother	31	6.3
Low family income (<\$20 000)	45	9.5
Low maternal education (≤high school)	90	18.0
Maternal depression (clinical level ≥16)	83	16.8
Marital conflict (+1 SD above mean)	96	21.8
At least 1 risk	231	46.1
Child variables (18 mo, n = 397)		
Age in y (mean, SD)	397	1.60 (.16)
Female sex (%)	247	49.3
Physical health problems (scale 1-5)(mean SD)	381	1.56 (.82)
Emotional problems* (mean, SD)	388	-.15 (.67)

*This is a standardized composite score, hence, the negative mean.

the sample, while no individual reported 7-10 problems. As few individuals existed in the upper tail of the distribution, we combined 4-6 problems into a category of “4 or more” problems (1.4% of the sample). Thus, this variable represented a count of the number of biomedical risks on a scale from zero to “4 or more.”

At infant age 2 months, mothers reported on 6 psychosocial risk factors (Table III). Maternal depression was assessed using the Center for Epidemiologic Studies Depression Scale,²² a widely used self-report scale that assesses depression in nonclinical populations. Marital conflict was assessed using the Conflicts and Problem-Solving Scales.²¹ For each scale, the mean of the items was calculated and the cut-point for high marital conflict corresponded to +1 standard deviation above the mean. As with biomedical risk, a count of the number of psychosocial risks was computed, from 0 to “5 or more” problems (as no individuals endorsed problems in all 6 domains).

At 18 months of age, children’s emotional problems were assessed using scales adapted for use in the National Longitudinal Survey of Children and Youth.²³ Mothers and, if available, fathers (n = 246; 62% of sample), rated the frequency of 8 behaviors (eg, “seems unhappy, sad, or depressed”) on 3-point scales (never, sometimes, or often), that were averaged to create a composite score. Internal consistency was adequate (mothers $\alpha = .67$; fathers $\alpha = .73$). Maternal and paternal ratings were significantly correlated ($r = .30$), and scores were averaged for analyses.

At infant age 18 months, children’s physical health was assessed by having mothers respond to the following question: “In general, would you say this child’s health is (1) excellent, (2) very good, (3) good, (4) fair, or (5) poor. Similar ordinal measures of child health have been employed in other survey-based epidemiologic studies.²⁴

Covariates included maternal age (in years), Canadian-born status (ie, immigration status), child age (in months), and child sex (0 = male; 1 = female).

Statistical Analyses

Analyses were carried out using a combination of SPSS v 20 (SPSS Inc, Chicago, Illinois) and Mplus v 7.2 (Muthén and Muthén, Los Angeles, California).²⁵ Logistic regression was used to examine the relation of individual adverse childhood experience variables to the presence of any biomedical or psychosocial risk (ie, regardless of the type or number of problems in each domain). To determine whether more adverse childhood experiences increased the odds of having any type of biomedical or psychosocial problem, a preliminary set of logistic regressions were performed with the number of adverse childhood experiences predicting the presence of any biomedical and psychosocial risk. Next, Poisson regression was used to determine if there was a linear association between the number of adverse childhood experiences and cumulative biomedical and psychosocial risk (ie, as a count of risks rather than presence of any risk). Finally, whether mothers’ adverse childhood experiences were indirectly associated with their offspring’s physical and emotional health was evaluated at 18 months via 2 intermediary pathways: cumulative biomedical

and psychosocial risk. A path analysis was used to test the direct and indirect effects of mothers’ adverse childhood experiences on infant physical and emotional health via biomedical and psychosocial risks, both of which were treated as continuous. These intermediary pathways were modeled simultaneously, and within-time covariance terms were controlled to determine whether the effect of maternal adverse childhood experiences on infant outcomes operated specifically through biomedical or psychosocial risk (ie, all effects were unique). The path analysis was modeled with the MLR estimator that is robust to nonnormality.²⁶ The significance of the indirect paths was investigated using 5000 bootstrap samples with bias-corrected and accelerated CIs.^{27,28}

Results

Sociodemographic characteristics are presented in Table III. The mean age of women was 32.7 years (SD = 4.9 years). Over 90% of the sample was married or cohabitating, and approximately 56% of the sample was Caucasian. The bivariate associations between study variables can be found in Table IV (available at www.jpeds.com).

Individual vs Cumulative Adverse Childhood Experiences and Risk of Any Biomedical and Psychosocial Problem

Table V shows that some, but not all, individual adverse childhood experience items were associated with risk of any biomedical or psychosocial risk. Logistic regressions were conducted to determine whether there was a dose-response relationship between cumulative adverse childhood experiences and the presence/absence of any biomedical or psychosocial problem (ie, 1 or more risks compared with no risk; Table V). Indeed, results revealed that the presence of 4 or more risks was related to a greater than 2-fold increased risk for having 1 or more biomedical risk, and a nearly 5-fold increased risk of having 1 or more psychosocial problems, compared with those with no adverse childhood experiences. Although effects were only observed at 4+ adverse childhood experiences, there was a linear trend such that more adverse childhood experiences were associated with a higher risk of having 1 or more biomedical or psychosocial risks. Thus, there is a gradient effect such that the accumulation of adverse childhood experiences has a more pronounced effect on biomedical and psychosocial problems compared with single risk indicators alone.

Relation of Cumulative Adverse Childhood Experiences to Cumulative Biomedical and Psychosocial Risks

Using Poisson regression, the relation between the number of adverse childhood experiences and cumulative biomedical and psychosocial risk was examined (ie, as a count of risks). After controlling for mothers’ age and Canadian-born status, there was a significant association between the number of adverse childhood experiences and cumulative biomedical risk, B (SE) = .14 (.05), $\chi^2 = 9.19$, $P = .002$, as well as cumulative

Table V. Individual adverse childhood experience and risk of any biomedical or psychosocial problem

Adverse childhood experiences	Biomedical risk			Psychosocial risk		
	% (n)	OR [95% CI]	OR-adj* [95% CI]	% (n)	OR [95% CI]	OR-adj* [95% CI]
Mother mental illness						
Yes	38.5(35)	1.41 [.88-2.26]	1.44 [.89-2.34]	60.4(55)	2.10 [†] [1.32-3.34]	2.36 [†] [1.42-3.91]
No	30.7(121)	Ref	Ref	42.1(166)	Ref	Ref
Father mental illness						
Yes	41.2(28)	1.58 [‡] [.93-2.67]	1.64 [‡] [.96-2.80]	55.9(38)	1.62 [‡] [.97-2.71]	1.85 [‡] [1.06-3.22]
No	30.7(128)	Ref	Ref	43.9(183)	Ref	Ref
Mother drug/alcohol problem						
Yes	55.0(11)	2.73 [§] [1.11-6.74]	2.82 [§] [1.13-7.08]	75.0(15)	3.72 [§] [1.33-10.4]	3.85 [§] [1.30-11.4]
No	30.9(148)	Ref	Ref	44.7(214)	Ref	Ref
Father drug/alcohol problem						
Yes	33.9(20)	1.11 [.63-1.97]	1.12 [.62-2.00]	52.5(31)	1.35 [.79-2.33]	1.37 [.76-2.46]
No	31.6(139)	Ref	Ref	45.0(198)	Ref	Ref
Parent went to jail						
Yes	66.7(10)	4.47 [†] [1.50-13.3]	4.44 [†] [1.46-13.5]	86.7(13)	7.99 [†] [1.78-35.8]	5.95 [§] [1.25-28.3]
No	30.9(150)	Ref	Ref	44.9(218)	Ref	Ref
Nonintact family						
Yes	36.1(39)	1.27 [.81-1.98]	1.23 [.78-1.95]	53.7(58)	1.48 [‡] [.97-2.28]	1.14 [.72-1.82]
No	30.9(121)	Ref	Ref	43.9(172)	Ref	Ref
Experienced sexual abuse						
Yes	42.9(21)	1.67 [‡] [.92-3.05]	1.66 [§] [.89-3.09]	71.4(35)	3.26 [¶] [1.71-6.23]	2.65 [†] [1.33-5.28]
No	31.0(136)	Ref	Ref	43.4(191)	Ref	Ref
Experienced physical abuse						
Yes	45.8(44)	2.05 [†] [1.30-3.24]	2.04 [†] [1.29-3.22]	65.6(63)	2.72 [¶] [1.70-4.33]	2.97 [¶] [1.80-4.89]
No	29.2(115)	Ref	Ref	41.3(163)	Ref	Ref
Witnessed verbal abuse						
Yes	38.1(40)	1.41 [.90-2.21]	1.43 [.90-2.25]	56.2(59)	1.68 [§] [1.09-2.59]	1.81 [†] [1.13-2.89]
No	30.4(120)	Ref	Ref	11.8(171)	Ref	Ref
Witnessed physical abuse						
Yes	44.2(23)	1.80 [§] [1.01-3.23]	1.80 [§] [1.00-3.24]	63.5(33)	2.21 [§] [1.22-4.01]	2.30 [†] [1.23-4.30]
No	30.6(137)	Ref	Ref	44.0(197)	Ref	Ref

Ref, reference category.

Values in bold are significant.

*Adjusted for maternal age and Canadian-born status.

† $P < .01$.‡ $P < .10$.§ $P < .05$.¶ $P < .001$.

psychosocial risk, $B (SE) = .34 (.04)$, $\chi^2 = 46.7$, $P < .001$. Results were supported by a linear trend analysis, which showed that as the number of adverse childhood experiences increased, the number of biomedical risks increased, $F (499) = 9.31$, $P = .002$, and so did the number of psychosocial risks, $F (499) = 50.80$, $P < .001$.

Relation of Adverse Childhood Experiences to Offspring Physical and Emotional Health Through Cumulative Biomedical and Psychosocial Risk

Next, the relation between mothers' adverse childhood experiences and their offspring's physical and emotional health problems was evaluated through cumulative biomedical and psychosocial risk. **Figure 1** (available at www.jpeds.com) pres-

ents the association between cumulative biomedical and psychosocial risk and infant physical and emotional health (standardized scores).

The pathways linking maternal adverse childhood experiences to infant physical and emotional health were tested using path analysis while controlling for maternal age, Canadian-born status, and child age and sex. This model also included a measure of maternal childhood disadvantage alongside adverse childhood experiences, as well as current neighborhood poverty alongside biomedical and psychosocial risk, to improve confidence that the current results were not simply attributable to continuities in mothers' socioeconomic status. **Figure 2** shows the individual paths comprising this model. The significance of the indirect effects was tested using bootstrap-

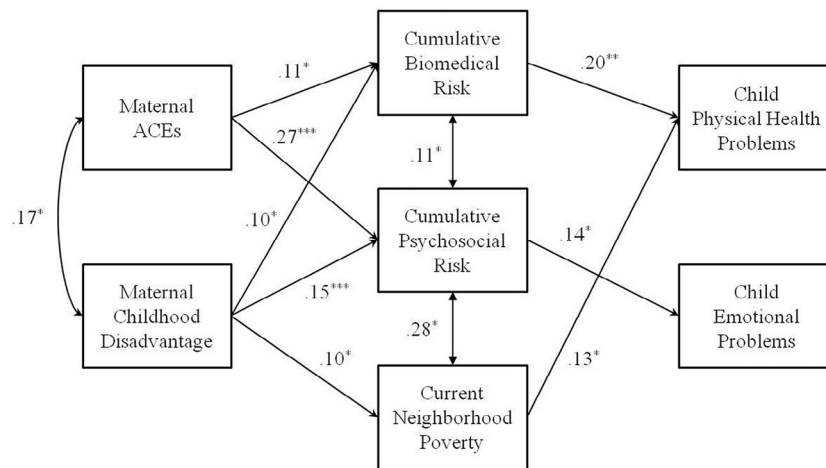


Figure 2. Path model showing the indirect effect of adverse childhood experiences on children’s physical and emotional health problems through cumulative biomedical and psychosocial risk. All concurrent associations as well as direct and indirect paths were modeled, but nonsignificant variables and covariate effects are not depicted here to avoid cluttering. Model fit was excellent: $\chi^2(6) = 1.12, P = .98$, Comparative Fit Index = 1.00, Tucker Lewis Index = 1.10, Root Mean Square Error of Approximation = .00. Variables are standardized coefficients. Indirect effects (a*b) are presented in text. † $P < .10$. * $P < .05$. ** $P < .01$. *** $P < .001$.

ping. An indirect effect is significant when the 95% CI does not include zero.²⁹ Results showed that more adverse childhood experiences were indirectly associated with more infant physical health problems through heightened cumulative biomedical risk, $\beta = .022, b = .018, 95\% \text{ CI } (.003, .046)$ but not through cumulative psychosocial risk, $\beta = -.003, b = .009, 95\% \text{ CI } (-.032, .025)$. The opposite trend emerged for emotional problems: higher adverse childhood experiences were indirectly associated with more infant emotional problems through heightened psychosocial risk, $\beta = .037, b = .025, 95\% \text{ CI } (.001, .056)$ but not through cumulative biomedical risk, $\beta = .008, b = .005, 95\% \text{ CI } (-.001, .021)$. Neither of the direct effects from adverse childhood experiences to physical or emotional health problems were significant ($P > .05$), and, thus, these effects operated exclusively through biomedical and psychosocial risk. Finally, maternal childhood disadvantage was associated with infant physical health problems via current neighborhood poverty, $\beta = .020, b = .036, 95\% \text{ CI } (.004, .107)$ and biomedical risk, $\beta = .014, b = .052, 95\% \text{ CI } (.010, .130)$, whereas the association with infant emotional problems operated through psychosocial risk, $\beta = .020, b = .102, 95\% \text{ CI } (.005, .114)$. Importantly, all indirect effects controlled for within-time covariances, meaning they are independent estimates.

Discussion

Maternal early life factors have long been considered important for understanding offspring health. One consistently cited antecedent risk of prenatal and perinatal complications is a history of abuse.³⁰ Theoretically, early adversity can influence later stress reactivity and/or exacerbate pre-existing stress or anxiety during pregnancy and the postpartum period. We determined that 4 or more maternal adverse childhood expe-

riences were related to a 2- and 5-fold increased risk of biomedical and psychosocial risk, respectively. These findings are consistent with previous research demonstrating that higher adverse childhood experiences are associated with preterm birth,³¹ an increased risk of fetal mortality,³² as well as offspring adjustment difficulties.³³

Identifying adverse childhood experiences as antecedent risks of biomedical complications has broad implications for pediatric and public health, notably because pre- and perinatal complications are 2 of the leading causes of neonatal morbidity and mortality.³⁴ Complications in pregnancy can lead to fetal growth restriction and preterm birth, which are in turn associated with adverse perinatal outcomes such as low birth weight and neonatal death.³⁵ Our findings support the incorporation of adversity measures into screening tools to identify women and their children who are at heightened risk of short- and long-term physical and emotional problems.

Studies examining associations between discrete abuse experiences and risk for pre- and perinatal complications have yielded inconsistent findings. For example, we found that sexual abuse as a discrete exposure was associated with biomedical complications in the pre/perinatal period, a finding consistent with Leeners.³⁶ However, in another study, no association was reported between these variables.³⁷ These findings may be explained by sample heterogeneity, or possibly, insufficient measurement of discrete variables using single item measures. It is also possible that inconsistencies are due to the use of discrete vs multiple co-occurring indicators of risk. We found a dose-response relationship between the number of adverse childhood experiences and cumulative biomedical and psychosocial risk. These findings echo evidence across literatures in clinical and developmental science supporting the notion that cumulative risk begets cumulative maladaptation.^{5,17,38}

Although previous research has demonstrated that maternal adversity is associated with poor offspring adaptation, a noticeable gap is an explication of mechanisms that explain the transmission of risk across generations. We examined whether biomedical risk served as a mechanism linking maternal adverse childhood experiences to offspring physical and emotional health at 18 months. We also examined psychosocial risk as a competing mechanism through which maternal adverse childhood experiences were related to children's physical and emotional health. Our study simultaneously tested alternative pathways through which maternal adversity is linked to offspring physical and emotional health. Maternal adverse childhood experiences were associated with more infant physical health problems through heightened biomedical, but not psychosocial, risk and with more infant emotional health difficulties through heightened psychosocial, but not biomedical, risk. These findings were not explained by continuities in maternal socioeconomic status and point to disparate mechanisms by which maternal adverse childhood experiences intensify the intergenerational risk of offspring maladaptation. Moreover, these results are consistent with a small but growing body of research on the intergenerational transfer of health risk. For example, Roberts et al³⁹ demonstrated that perinatal factors partially accounted for the link between maternal adversity and children's risk of developing autism. Here, we extend such results to include the physical and emotional well-being of children in the second year of life within a community sample.

Accumulating perturbations in biological regulatory mechanisms may instigate multiple vulnerabilities, and these associations may account for the link between family adversities and the health of children.³⁸ Indeed, unfavorable childhood experiences have been linked to adverse biological sequelae, including dysregulation of the hypothalamic-pituitary-adrenal axis, compromised immune system functioning, and enduring inflammatory and metabolic abnormalities (eg, biomarkers of hypertension and diabetes), all of which may have a bearing on in utero development and, in turn, postnatal physical health.^{39,40} Moreover, fetal exposure to stress may affect later physical and behavioral regulation through early bio-behavioral programming of stress reactivity, thus, engendering compromised neuroendocrine and immune functioning that amplifies risk for many health problems.¹ Further, the stability in socioeconomic conditions over time and across generations has led to the hypothesis that such intergenerational continuities are at least partially accounted for by deteriorated physical health.⁴¹ It should be noted that, although our findings have implications for understanding the mechanisms of morbidity across the lifespan, future research addressing other potential pathways of influence, such as epigenetic mechanisms, insufficient prenatal care, telomere length, and/or health behaviors during pregnancy (eg, smoking, illegal drug and medication use) is necessary to make informative decisions for prevention and intervention efforts.

The transfer of risk from parents to children has been demonstrated.³⁸ In the current study, we demonstrated an intergenerational cascade from maternal adverse childhood ex-

periences to infant emotional health problems, with psychosocial risk serving as a key mechanism of transmission, thereby demonstrating a propagation of disadvantage across generations. Thus, the burden of enduring early childhood adversity can exacerbate psychosocial stress in the postnatal period, which in turn has downstream consequences for the offspring's emotional health. When mothers are burdened by psychosocial stressors, they may be less attuned to the behavioral and affective needs of the infant, and/or may be psychologically or emotionally unavailable, which has clear consequences for their offspring's emerging capacity to understand and regulate affect.⁸ Moreover, when children lack the appropriate models for managing distress, they may be at greater risk for emotional dysregulation that underlies psychopathology in several domains.

Our results underscore the practice of not only recognizing, but also addressing concerns regarding individuals' struggles with early childhood adversity. In cases where this is not sufficient, referral-based intervention services should be provided. If the ultimate goal is to break continuities of risk across generations, the best line of attack in community and primary care settings is to address the needs of this vulnerable population. A fundamental mechanism to interrupt this cycle is to simultaneously address the mother's stress as well as her awareness of the potential negative impact on her child (and future pregnancies), and to proactively monitor and intervene with the infant at hand. If unaddressed, the toxic stress that leads to poorer prenatal, perinatal, and immediate postnatal psychosocial outcomes is unlikely to spontaneously remit, and has the potential to exert continued negative influences on maternal health, as well as her offspring's development and adaptation.

Several limitations should be noted. Retrospective reports of early experience are likely to be under- vs over-reported. Accuracy for memory of concrete events, such as parental incarceration, are comparatively stronger than subjective variables such as relationship quality with parents.⁴² Nonetheless, the majority of research on childhood adversity is collected via retrospective report, given the near impossibility of following individuals from infancy onward to document substantiated maltreated histories throughout development. An important caveat is that individuals' difficulty or resistance with recall of childhood events may lead to some misclassification, which can in turn bias results. Second, although agreement between parental self-report and criterion-standard medical record data is generally high for pre- and perinatal complications and events,⁴³⁻⁴⁵ future studies using more comprehensive information from obstetrical records could strengthen the findings reported herein. Third, because of the nature of our study design and data collection, limited inferences can be made regarding causality, despite the fact that adverse childhood experiences were, by definition, experienced in childhood and predated the biomedical and psychosocial risk variables. A final caveat is that although the neighborhood poverty measure was based on census data and both parents rated children's emotional problems in the current study, the remaining measures were based on maternal report.

This research contributes to a small but growing body of literature on the intergenerational impact of adverse childhood experiences, transmitted from mother to child, and points to the need to develop support services to break this cycle of risk. Healthcare providers are ideally positioned to play a pivotal role in facilitating access to support services for individuals struggling with the aftermath of adversity, which will hopefully redirect families on a pathway toward reduced psychosocial and physical health problem. Given our growing understanding of the deleterious role that adverse childhood experiences play in women's psychosocial and physical health, a key area for future research will be identifying protective factors that buffer mothers against these risks (eg, social support, coping mechanisms, etc), as these factors may be suitable targets for prevention and intervention efforts. ■

Submitted for publication Sep 13, 2016; last revision received Apr 3, 2017; accepted Apr 24, 2017

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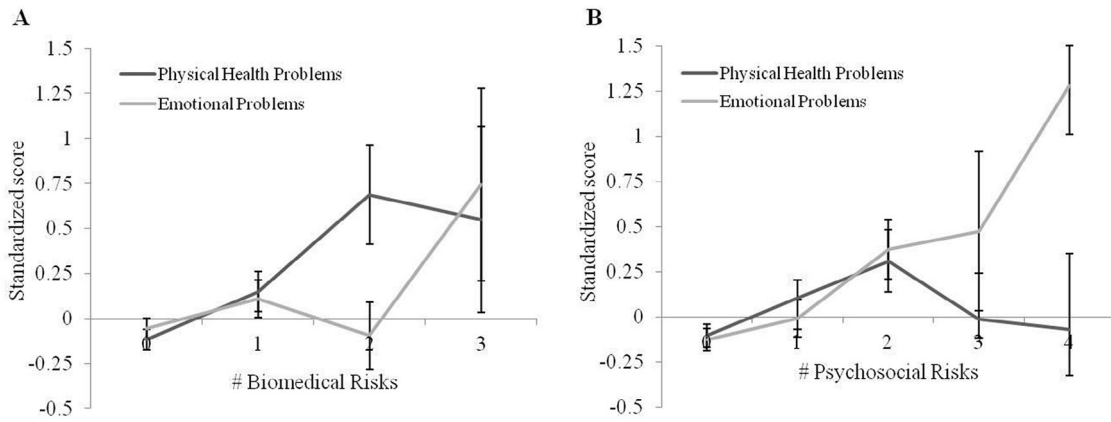


Figure 1. Relationship between **A**, cumulative biomedical risk and **B**, cumulative psychosocial risk and offspring's physical and emotional health problem.

Table I. Adverse childhood experience questions used in the current study

Before the age of 16 y:

1. As far as you know, did your mother ever have problems with her emotions or nerves?
2. As far as you know, did your father ever have problems with her emotions or nerves?
3. Did your mother ever have problems with the use of alcohol or drugs?
4. Did your father ever have problems with the use of alcohol or drugs?
5. Were your parents ever arrested or put in jail?
6. Did you live with both your biological parents in the same home?
7. Were you ever sexually assaulted or raped?
8. How many times did an adult caregiver kick, bite, punch, choke, burn you, or physically attack you in some way?
9. How many times did you see or hear any one of your parents/caregivers who raised you say hurtful or mean things to each other or to another adult in her home?
10. How many times did you see or hear any one of your parents/caregivers hit each other or another adult in your home?

Table IV. Bivariate correlations between study variables

Measures	1.	2.	3.	4.	5.
1. Adverse childhood experiences	—				
2. Biomedical risk	.14*	—			
3. Psychosocial risk	.30†	.17†	—		
4. Emotional problems	.05	.10‡	.23†	—	
5. General physical health	.02	.20†	.10‡	.08	—

* $P < .01$.

† $P < .001$.

‡ $P < .05$.