Adverse Childhood Experiences: Translating Knowledge into Identification of Children at Risk for Poor Outcomes

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ABSTRACT

OBJECTIVE: To pilot test a tool to screen for adverse childhood experiences (ACE), and to explore the ability of this tool to distinguish early child outcomes among lower- and higher-risk children.

METHODS: This cross-sectional study used data collected of 102 children between the ages of 4 and 5 years presenting for well-child visits at an urban federally qualified health center. Logistic regression analyses adjusted for child sex, ethnicity, and birth weight were used to test the association between each dichotomized child outcome and risk exposure based on a 6-item (maltreatment suspected, domestic violence, substance use, mental illness, criminal behavior, single parent) and 7-item (plus maternal education) Child ACE tool.

RESULTS: Effect sizes were generally similar for the 6-item and 7-item Child ACE tools, with the exception of 2 subscales measuring development. The adjusted odds of behavior problems was higher for children with a higher compared to a lower 7-item Child ACE score (adjusted odds ratio [aOR] 3.12, 95% confidence interval [CI] 1.34–7.22), as was the odds of developmental delay (aOR 3.66, 95% CI 1.10–12.17), and injury visits (aOR 5.65, 95% CI 1.13–28.24), but lower for obesity (aOR 0.32, 95% CI 0.11–0.92).

CONCLUSIONS: Brief tools can be used to screen for ACE and identify specific early child outcomes associated with ACE. We suggest that follow-up studies test the incorporation of the 7-item Child ACE tool into practice and track rates of child behavior problems, developmental delays, and injuries.

KEYWORDS: chronic disease; prevention; social determinants; stress; well-child care

ACADEMIC PEDIATRICS 2013;13:14–19

WHAT'S NEW

We describe a new screening tool for adverse childhood experiences and the association of these experiences with brief measures of early child outcomes. This tool can provide needed information to guide the development of effective strategies for primary prevention through pediatric practice.

A ROBUST BODY of literature provides support for an association between early childhood experiences and adult outcomes. This literature includes animal studies of prenatal and postnatal conditions, psychological studies of early life stress, and epidemiologic studies of psychosocial risk factors.[1–6] Factors used to identify risk in the adverse childhood experiences (ACE) literature include child psychological abuse, child physical abuse, child sexual abuse, substance abuse in the household, mental illness in the household, domestic violence, incarceration of a household member, and parent marital status. The ACE literature shows that exposure to multiple risk factors during childhood is associated with higher rates of depression, tobacco use, alcoholism, illicit drug use, attempted suicide, sexually transmitted diseases, obesity, diabetes, ischemic heart disease, stroke, chronic obstructive pulmonary disease, and cancer.[7,8] Although the influence of ACE has been demonstrated across socioeconomic status, there is also a sizable literature linking low socioeconomic status to cardiovascular disease and other morbidities in adulthood.[9–16] As a whole, this research suggests that individual risk factors in childhood do not determine individual outcomes in adulthood, but that the accumulation of multiple risk factors in childhood greatly increases the odds of a range of poor outcomes.[17–19]

To a considerable extent, knowledge of the role played by early childhood risk exposures on adult outcomes has not been effectively translated into pediatric preventive care. There is little evidence that preventive care is tailored to the particular needs of children on the basis of family risk factors, as proposed by several authors and the Task Force on the Family.[20–22] At the same time, there is a dearth of evidence for the effectiveness of well-child care,[23] but ample evidence that the US health care system delivers poor health outcomes for children compared with other industrialized nations.[24]

The purpose of this study was to pilot test a tool to screen for ACE, and to explore the ability of this tool to distinguish early child outcomes among lower- and higher-risk children. Our goal was to demonstrate an association between ACE and specific early child outcomes using brief measures that could be feasible to use in clinical practice.

If reliable links between risk exposure and childhood-onset health and behavioral problems are demonstrated, then our results could provide needed information to guide an evidence-based approach to tailoring well-child care on the basis of identifying the target population (families with high-risk exposure) and measuring whether or not practice-based preventive interventions are effective in improving health and behavioral outcomes.

METHODS

DESIGN AND SUBJECTS

This cross-sectional study used data collected on 102 children between the ages of 4 and 5 years presenting for well-child visits at an urban federally qualified health center that served a low-income inner-city population. Medicaid provides health insurance coverage for 90% of the pediatric population at this health center. We considered a total of 171 children who presented to the clinic for a well-child visit in the last 6 months. Of these, we excluded 13 as a result of special health care that might alter any of the child outcomes examined (eg, congenital hypothyroidism, heart disease, chromosomal abnormality, kidney disease, sickle cell, mental retardation, autism), 2 as a result of language barrier, 3 as a result of lack of a female primary caretaker, and 4 because a sibling was already enrolled onto the study. We limited our sample to children with female primary caretakers because our sample was too small to stratify by caretaker gender, and the majority were female primary caretakers. These criteria resulted in a total of 149 eligible subjects, of whom 102 participated (68%). Participating children were African American (57%) or Hispanic/Latino (43%), which was reflective of the general pediatric population at this clinic.

PROCEDURE

Female primary caretakers (referred hereafter as mothers, but were in some cases other relatives with custody) were invited to participate in the study when they arrived for their child's visit or by telephone call after the visit. If interested, we arranged to meet the mother and child in a designated private area of the clinic. Some sessions were held in the early evening or on Saturdays in order to accommodate working mothers. Written informed consent was obtained, and then the mother was provided with questionnaires to complete in either English or Spanish, depending on her language preference. Most mothers (95%) completed these questionnaires without assistance in about 15–25 minutes, and 5 subjects (5%) needed assistance with reading the questions. Although the mother completed the questionnaires, the research assistant did 2 standardized tests with the child, which took about 10–15 minutes total. After the research encounter, a physician (AM) reviewed all encounters over the past year in the child's medical chart, as well as consults, emergency department visits, and laboratory data from the same time frame. This study was approved by the Research Subjects Review Board at the University of Rochester and by the research committee at the health center.

CHILD ACE MEASUREMENT

We created a 6-item Child ACE tool that was based on the 6 risk factors described in the ACE literature and associated with increased risk of poor adult outcomes. We also created a 7-item tool based on the addition of maternal education, which is a marker of childhood socioeconomic status and a strong predictor of adult outcomes. Table 1 summarizes the measures and criteria used to derive our 6-item and 7-item Child ACE scores. Each variable was dichotomized, and 1 point was added to the Child ACE score if criteria were met for high risk.

CHILD OUTCOMES MEASUREMENT

Several measures of child outcomes were considered, and where possible different data sources were utilized. Standardized instruments used included the Ages and Stages Questionnaire-III (ASQ)[30] and the Block Design and Vocabulary subscales of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI, version 3).[31] Mothers completed a child health questionnaire with questions about child health status, injuries, infections, behavior concerns, and asthma symptoms based on similar measures used in the literature.[32] Mothers also completed the Pediatric Symptom Checklist (PSC).[33,34] Medical charts were reviewed for body mass index (BMI) percentile at the most recent visit, for treatment for injury in the last year, for treatment using antibiotics in the last year, for prescription for a β-agonist inhaler in the last year, and for any documentation of developmental delay during the child's lifetime. The investigator (AM) was blind to the child's ACE score and maternal reports during medical chart review. Because of our interest in identifying clinical need, each variable was dichotomized to index poor outcome. Because of the high prevalence of overweight in this population, BMI percentile was dichotomized as obese (>95%) or not obese.

COVARIATES

We considered as potential covariates child sex, race/ethnicity (African American/Hispanic), and birth weight.

STATISTICAL ANALYSIS

Descriptive statistics were used to generate prevalence rates of child exposure to each risk factor. Logistic regression analyses adjusted for child sex, ethnicity, and birth weight were used to test the degree of association between each dichotomized child outcome and risk exposure on the basis of the 6-item and 7-item Child ACE tools. We dichotomized the Child ACE score to divide the sample into lower risk and higher risk. In other literature based on normal-risk community samples, a cutoff of 4 or more risk factors is typically used to index increased risk of poor child and adult outcomes.[7,32,35] Given that we had only one category for child maltreatment and that the sample was selected from a high-risk population, we used a cutoff of 3 risk factors. Each logistic regression equation calculated the odds ratio of having a child outcome in the higher-risk group (3+ measured risk factors) compared to the lower-risk group (0–2 measured

Table 1. Measures Contributing to the Child ACE Score (N = 102)

Variable	Measure	ACE Scoring	Prevalence, %
Maltreatment suspected	Maternal report of the child ever living away from home for over a month; medical record documentation of CPS inquiry or foster care placement	Positive response	24
Domestic violence	Maternal report being pushed, grabbed, slapped, had something thrown at her, kicked, bitten, hit with a fist, hit with something hard, or hit with a gun or knife in the past year[25]	Positive response	9
Substance use	Maternal CAGE[26]; household report of member with problem drinking or use of street drugs[27]	Positive response to any CAGE question or household report of substance use	11
Mental illness	Maternal EPDS[28]; household report of member with history of depression, mental illness or attempted suicide[29]	EPDS >13 or positive response to household report of mental illness	41
Criminal behavior	Maternal report of household member jailed or imprisoned[29]	Positive response	22
Single parent	Maternal report of marital status	Single	76
At least 1 of the above 6 risk factors			90
Maternal education	Maternal report of education	No high school degree or GED	57
At least 1 of the above 7 risk factors			94

ACE = adverse childhood experiences; CAGE = cut down, annoyed, guilty, eye-opener (standardized alcoholism screening test); CPS = child protective services; EPDS = Edinburgh postnatal depression screen; GED = general equivalency degree.

risk factors). We were not able to examine the Child ACE score as a linear variable because of the size of our sample. All analyses were performed by Statistical Analysis System software, version 9.2 (SAS, Cary, NC).

RESULTS

Among 171 children who presented to the clinic for a well-child visit between May 1 and December 1, 2010, we excluded 13 as a result of special health care needs that might alter any of the child outcomes examined (eg, congenital hypothyroidism, heart disease, chromosomal abnormality, kidney disease, sickle cell, mental retardation, autism), 2 as a result of language barrier, 3 as a result of lack of a female primary caretaker, and 4 because a sibling was already enrolled onto the study. These criteria resulted in a total of 149 eligible children, of whom 102 participated (68%). Among these participating children, half were male; 57% were African American and 43% Hispanic/Latino, which reflected the clinic population; 12% had a birth weight of <2500 g. The prevalence of each risk factor contributing to the Child ACE score is shown in Table 1. The most prevalent risk factors were single parent (76%), low maternal education (57%), and household mental illness (41%).

The prevalence of accumulated adverse exposures by sex, race/ethnicity, and birth weight is shown in Table 2. There were no statistically significant differences in lower versus higher ACE scores across covariates.

Results of the adjusted logistic regression analyses are shown in Table 3 for each outcome measure using the 6-item and 7-item Child ACE tool. Effect sizes are generally similar for the 6-item and 7-item Child ACE tools, with the exception of the 2 subscales from the WPPSI-III identifying developmental delay using the 7-item Child ACE tool only.

The effects of risk exposure on outcomes were generally consistent across different sources, where multiple sources were available. One exception was that risk exposure was statistically associated with medical records documenting injuries, but not maternal report. Another exception was that risk exposure strongly predicted developmental delay according to a brief observational measure (subscales of WPPSI-III), yet there was no link with developmental delay documented by the medical record or maternal report.

As detailed in Table 3 and illustrated in the Figure 1, the prevalence of behavior problems and developmental delay was 2 to 4 times greater in the higher-risk ACE group, and injury visits were 5 times more likely. By contrast, accumulated risk exposure was associated with lower BMI. Higher-risk children also had trends toward decreased likelihood of medically reported asthma and fewer problem visits over the past year.

DISCUSSION

This pilot study tested novel screening tools for child ACE. We evaluated both a 6-item and 7-item Child ACE

Table 2. Prevalence of Adverse Exposures by Covariates

Characteristic	n	6-item ACE Score		7-item ACE Score	
		0–2	3–6	0–2	3–7
Sex					
Male	50	68%	32%	54%	46%
Female	52	75%	25%	52%	48%
Race/ethnicity					
African American	58	71%	29%	46%	53%
Hispanic	44	73%	27%	61%	39%
Birth weight					
<2500 g	12	67%	33%	50%	50%
≥2500 g	90	72%	28%	53%	47%
All children	102	72%	28%	53%	47%

ACE = adverse childhood experiences.

Table 3. Association of Child ACE Score and Medical Outcomes†

Outcome	Measure	ACE (6 items)		ACE (7 items)	
		%	aOR (95% CI)	%	aOR (95% CI)
Behavior problems	PSC total >23				
	0–2 risk factors	10	1.00	9	1.00
	≥3 risk factors	28	3.64 (1.16–11.36)*	21	2.81 (0.86–9.13)
	Maternal concern about behavior, attention, or hyperactivity				
	0–2 risk factors	42	1.00	35	1.00
	≥3 risk factors	65	2.56 (1.02–6.40)*	64	3.12 (1.34–7.22)*
Developmental delay	WPPSI-III Vocabulary scaled score <7				
	0–2 risk factors	14	1.00	9	1.00
	≥3 risk factors	21	1.79 (0.56–5.69)	23	3.66 (1.10–12.17)*
	WPPSI-III Blocks scaled score <7				
	0–2 risk factors	19	1.00	13	1.00
	≥3 risk factors	31	2.27 (0.80–6.41)	33	4.21 (1.45–12.24)*
	Medical report developmental delay				
	0–2 risk factors	23	1.00	20	1.00
	≥3 risk factors	28	1.14 (0.42–3.15)	29	1.80 (0.69–4.68)
	ASQ total >1				
	0–2 risk factors	16	1.00	13	1.00
	≥3 risk factors	17	1.07 (0.33–3.39)	21	1.70 (0.58–4.50)
Injury	Medical report injury treated				
	0–2 risk factors	8	1.00	4	1.00
	≥3 risk factors	23	3.25 (0.87–12.05)	20	5.65 (1.13–28.24)*
	Maternal report injury treated in past year				
	0–2 risk factors	7	1.00	6	1.00
	≥3 risk factors	10	1.54 (0.34–7.06)	11	1.81 (0.40–8.31)
Health status	Maternal report health fair or poor compared to other children same age				
	0–2 risk factors	42	1.00	41	1.00
	≥3 risk factors	55	1.73 (0.72–4.16)	51	1.65 (0.73–3.73)
Weight status	Body mass index percentile >95%				
	0–2 risk factors	27	1.00	30	1.00
	≥3 risk factors	7	0.18 (0.04–0.84)*	12	0.32 (0.11–0.92)*
Asthma	Medical report asthma or prescription for inhaler				
	0–2 risk factors	18	1.00	20	1.00
	≥3 risk factors	7	0.33 (0.07–1.57)	8	0.33 (0.09–1.15)
	Maternal report breathing problems, wheezing, or wheezing at night				
	0–2 risk factors	26	1.00	30	1.00
	≥3 risk factors	21	0.75 (0.26–2.18)	19	0.62 (0.24–1.62)
Infections	Medical report antibiotic prescription in past year				
	0–2 risk factors	39	1.00	38	1.00
	≥3 risk factors	27	0.57 (0.20–1.60)	33	0.87 (0.36–2.11)
	Maternal report frequent infections in past year				
	0–2 risk factors	21	1.00	20	1.00
	≥3 risk factors	14	0.60 (0.18–2.02)	17	0.71 (0.25–2.01)
Utilization	≥3 problem visits in last year				
	0–2 risk factors	32	1.00	37	1.00
	≥3 risk factors	19	0.53 (0.17–1.62)	20	0.41 (0.15–1.07)

ACE = adverse childhood experiences; aOR = adjusted odds ratio; CI = confidence interval; PSC = Pediatric Symptom Checklist; WPPSI-III = Wechsler Preschool and Primary Scale of Intelligence, version 3; ASQ = Ages and Stages Questionnaire.
*P < .05.
†All logistic regression models are adjusted for child gender, race/ethnicity, and birth weight.

tool, and we found that the 7-item Child ACE tool had improved signal strength. We found that maternal education was an important risk factor to include in the child ACE screening in order to identify children most vulnerable to developmental delays. Both tools were constructed from a brief (∼5 minute) questionnaire and information about child protective service inquiries that is readily available in the medical chart. Thus, screening for child ACE can be feasible in pediatric practice.

Furthermore, we demonstrated that the Child ACE tool can be utilized to evaluate the early onset effects of accumulated risk factors. Our findings are consistent with previous research in identifying a strong relationship between ACE and child behavior problems.[4,36–39] Our findings are also consistent with prior studies demonstrating an association between ACE and developmental delays.[18,39,40] These results also support previous research connecting family-based stressors and substance use to risk for childhood injuries.[41,42] More broadly, ACE exposure was associated
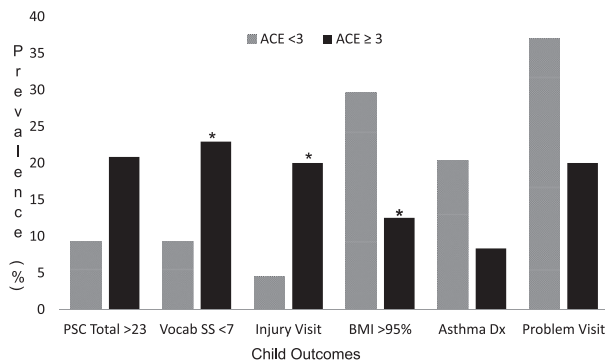
Figure 1. *Prevalence of selected outcomes by 7-item child ACE score. ACE indicates adverse childhood experiences; PSC, Pediatric Symptom Checklist; Vocab SS, vocabulary subscale; BMI, body mass index; and Dx, diagnosis. *P < .05.*

with a range of health and developmental outcomes in young children. Because the effects of risk exposure are evident early in development, there is an opportunity to identify and mitigate the effects of ACE exposure early in the life course.

A key strength of this study is the translation of the work on childhood risk exposures associated with poor adult outcomes into a model for primary prevention through pediatric practice. All of the items included in the 6-item and 7-item Child ACE tools are associated with poor adult outcomes, which means that these items can be used to identify the subpopulation of children at highest risk for poor outcomes over their life span. Given the competing demands for time in a primary care visit, we believe that priority should be given to use of a tool that not only identifies risk for poor outcomes in childhood, but also predicts chronic disease and disability in adulthood. Prioritization is particularly needed for higher-risk children, who are less likely to present for routine medical care, thereby decreasing the opportunities for prevention.[43] To facilitate time management, ACE screening could be done before the visit via e-mail or the Internet, or by using kiosks in the waiting room, as has been explored for other screening tools.[44] Incorporation of such a tool into use of an electronic health record would facilitate better characterization of the clinic population and would be an important step toward demonstrating needs of higher-risk patients and targets for preventive interventions.

Several of our results differ from previous research. For example, other studies have found ACE to be associated with poorer health status in preschool children.[32,35] Our results suggested a trend in this direction but did not reach statistical significance, either because of lack of power, lack of a no-risk comparison group, or unreliability of maternal report.

Also, we found that child obesity was actually less common in the higher ACE group. Studies of adolescents and adults have found obesity to be more common with increasing ACE.[7,39] A likely explanation is that high-risk families are more likely to have infants who are low birth weight and failure to thrive.[4,45] Studies also show that low-birth-weight infants are at increased risk of obesity

in adolescence and adulthood.[3] Thus, it is likely that the relationship between ACE and weight status changes over time, with ACE being associated with lower weight in young childhood and obesity by adulthood. This is a particularly important perspective to keep in mind when doing anticipatory guidance with young children. Screening for ACE may be a way to identify those healthy-weight children who are at greatest risk for obesity in adulthood.

An unexpected finding from this study was that the higher ACE group had nonsignificant trends toward lower rates of asthma and infections, which is contrary to other work in preschool children.[37] It is possible that lower utilization of health care services by the higher-risk group resulted in decreased rates of diagnosis, which may have been aggravated by lower maternal education and hence reduced recognition of symptoms. On the other hand, it is possible that young children are able to sustain an acute stress response to their high-risk environments, which puts them at lower risk for immune-mediated illnesses in the short term but higher risk over the life span. Links between stress exposure and immune system function are not yet well understood, but there is some evidence that increased stress exposure is associated with enhanced immune activation.[46] Including biomarkers of illness and stress in future studies of the effects of ACE on young children is an important next step for clinical research.

This study has several limitations. The 6-item and 7-item Child ACE tools were evaluated in a high-risk sample characterized by low-income nonwhite urban children. This allowed us to observe a high prevalence of ACE and poor health outcomes in a relatively small sample. However, the relatively small sample size and the lack of a low-risk comparison group may have limited the power to detect statistically significant differences, in addition to reducing the generalizability of our results. Further research should evaluate the 7-item Child ACE tool in a larger and more diverse pediatric sample. Also, the Child ACE tool should be evaluated among children with special health care needs, but testing for an association with child outcomes will likely require more extensive measures of child behaviors, developmental delays, potential medical outcomes, and a consideration of activities of daily living.

Our 7-item Child ACE tool provides a method to screen for child ACE, although validation is needed by studies with larger samples. Our study also identifies brief measures of early child outcomes associated with ACE. Prospective trials are needed to demonstrate that primary care interventions can reduce rates of child behavior problems, developmental delays, and injuries in higher-risk children. If child risk can be reliably identified by using a Child ACE tool and child outcomes consistently improved through primary care–based interventions, then there will be strong evidence to support the benefit of screening for child ACE in pediatric practice. Given that the 7-item Child ACE tool screened for ACE and identified specific early adverse childhood outcomes associated with ACE, this tool can provide the needed information to guide

the development of effective strategies for primary prevention through pediatric practice.

ACKNOWLEDGMENTS

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