Adverse Childhood Experiences: Separate and Cumulative Effects on Adolescent Health and Emotional Well-Being

While adverse childhood experiences (ACE) are linked to a host of health problems in adulthood, few studies examine more proximate effect of ACE on health and emotional well-being in adolescence. Using the 2011/12 National Survey of Children's Health, we assessed the separate and cumulative effects of ACE on the health and emotional well-being of US adolescents ages 12–17. We also investigated a moderating role of family functioning. Given exposure to one adverse experience, they were at greater risk of experiencing others. Economic hardship and experiencing discrimination increased the odds of poor adolescent health, while parental divorce and neighborhood violence increase the odds of adolescent emotional problems. Mental illness in the home increased the risk of both poor adolescent health and emotional problems. Family functioning moderated the negative impact of cumulative ACE on emotional well-being. Our findings have implications for policy and intervention before at-risk children reach adulthood.

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Adverse childhood experiences (ACE) have been consistently linked to a host of health problems in adulthood, such as depression and suicide,[1] alcohol and drug abuse,[2–3] premature all-cause mortality,[4] and chronic health problems.[5] By the time children have been exposed to four or more adverse experiences, the odds of having negative health outcomes in adulthood are up to 12 times that of children without such exposure.[6] Nevertheless, most studies on ACE exposure and health use retrospective reports from adults and their current well-being, rather than more immediate consequences during childhood and adolescence.[7] Few studies have examined the more proximate effects of ACE on health and well-being in adolescence. This is surprising given the importance of this life stage in human development,[8] and the potential for early intervention for children with ACE exposure.[1,9]

Research strongly suggests that parental violence, family disruption and neighborhood violence negatively affect children's development.[10–11] Contextual risk factors, however, do not occur in isolation. It may be the combination of risk factors that increases the risk of poor health among adolescents.[12–13] Recent research has found negative effects of cumulative ACE on an increased risk of illness among preschool children,[14] interpersonal and self-directed violence,[15] depression, substance abuse,[16] and teen pregnancy.[17] Indeed, the cumulative risk hypothesis suggests that it is the accumulation of risk factors, independent of particular risk factors, that increases the probability of problem behaviors and poor health in adolescence.[18]

Much of the research examining the link between ACE and children's health and well-being, however, is based on select, non-representative samples,[14–17] such that we do not fully understand the patterns and prevalence of ACE exposure among adolescents in the U.S. today, or how it may be associated with their health and emotional well-being. Our goal was to use nationally representative data to determine the separate and cumulative effects of adverse

childhood events on the health and emotional well-being of US adolescents ages 12 through 17. We focused on a global measure of health and a measure of emotional well-being to examine (1) how each *individual* ACE is associated with adolescent health and well-being relative to others; and (2) the *cumulative* effects of ACE on adolescent health and well-being.

Methods

We used publicly available data from the 2011/2012 National Survey of Children's Health (NSCH). Participants in the NSCH were selected from households with children under 18 in each of the 50 states and the District of Columbia. One child was randomly selected to be the subject of the interview. Interviewers asked a parent or guardian about the health and well-being of the child, including questions about the child's health status, family functioning and ACE exposure. Overall, the respondent was the mother for 69% of the sampled children, the father for 24%, and a guardian or other relative for the remainder of the sampled children.

A total of 95,677 NSCH interviews were completed by parents/caregivers of children. For our analysis we focused on adolescent's ages 12 to 17 years only—the age group most likely to have had the time to experience adverse childhood events. There were a total of 34,601 youth aged 12–17 years in the 2011 NSCH, with roughly 2% of the sample (N=827) missing values on key variables. We exclude those cases from analysis, resulting in a final sample size of 33,774.

Measures

Health and Well-Being. NSCH respondents reported the child's general health condition on a five point scale—"excellent", "very good", "good", "fair" or "poor." We collapsed the categories of "fair" and "poor" health into a dichotomous indicator of *poor health*. This measure is widely used in public health and epidemiological research due to its strong associations with other objective measures of health and well-being.[19] We captured adolescent *emotional problems*

by combining physician reports of children's diagnosis of depression, or anxiety, with caregivers' reports of the child's unhappiness. Adolescents were coded as having emotional problems if they have been diagnosed with depression, or anxiety, or if they are reported by their parent/caregiver to be unhappy, sad or depressed usually or always.

Adverse Childhood Experiences. The 2011/12 NSCH included questions about children's ACE exposure to capture psychosocial risk factors that affect children. The ACE factors are assessed through nine items indicating whether the child has experienced: (1) socioeconomic hardship; (2) divorce/separation of parent; (3) death of parent; (4) a parent serving time in jail; (5) witness to domestic violence; (6) victim of neighborhood violence; (7) lived with someone who was mentally ill or suicidal; (8) lived with someone with alcohol or drug problem; (9) discrimination or unfair treatment due to race or ethnicity. We constructed a cumulative measure by summing the total number of ACE.

Demographic, Economic and Family Characteristics. We included adolescent age, gender, and reported race/ethnicity (non-Hispanic white, non-Hispanic black, non-Hispanic other, and Hispanic). A ratio of income to household poverty provided by NSCH used four categories: household income at or below 100% of poverty, above 100% to 199%, 200% to 399%, and above 400% of the poverty level. Family structure comprised three categories: single-parent, two-parent, and other family structure.

Given that family functioning has been found to be a critical moderator on the effects of economic hardship on children's well-being,[20] we included a family functioning index. The NSCH collected multiple measures of family functioning, including frequency of family shared meals, two items on the parent-child relationship (*How well can you and sampled child share ideas or talk about things that really matter?* and *In general, how well do you feel you are*

coping with the day to day demands of parenthood?), and three items derived from the Parental Stress Index[21] and the Parental Attitudes about Childrearing Scale [22] (*During the past month, how often have you felt the sampled child is much harder to care for than most children his/her age? ~ have you felt he/she does things that really bother you a lot? ~ how often have you felt angry with him/her?*). Following previous research,[23] we derived a composite *family functioning index* based upon these six indicators using factor analysis. The estimated Kaiser-Meyer-Olkin values for the six items range from 0.71 to 0.81 well above 0.50 cut point that is required to support factor analysis.[24] We then created a family functioning index that has a mean of zero, a standard deviation of 0.847, a minimum value of –4.424, and a maximum value of 1.263. Higher index values indicate better family functioning.

We used multivariate logistic regression to examine the effects of individual ACE, the relative contributions each ACE, and cumulative ACE on adolescent health and emotional well-being. We also investigated interaction effects of family functioning and cumulative ACE on the dependent variables. All analyses include sampling weights provided by the NSCH. All variances and standard errors were adjusted to take into account the complex sampling design of the survey using Stata 12.0.

Results

Weighted percentages, means and standard errors for the independent and dependent variables are shown in Table 1. Approximately 3.5% of sampled adolescents were reported to have poor health, and roughly one out of eight (12.2%) experienced depression, anxiety, or frequent sadness. A majority (57%) of adolescents have experienced at least one adverse life event. Roughly two out of five (43.4%) have experienced no adverse events, 39.4% have experienced one or two events, and 17.2% have experienced three or more. The average

cumulative ACE score was 1.2. Adolescents were on average 14.5 years old and approximately half (50.8%) were male. The majority (56.9%) were non-Hispanic white, 14.0% were non-Hispanic black, 8.9% were identified as non-Hispanic other (Asian, Pacific Islanders, and multiple races), and 20.2% as Hispanic. Roughly 19% lived below the poverty line, and nearly one in five (19.5%) of adolescents lived with a single parent.

Table 2 presents weighted prevalence rates of ACE exposure along with relationships between individual adverse experiences. The first column shows the weighted percentage of adolescents exposed to each ACE. A quarter of adolescents experienced economic hardship very or somewhat often since birth, and 27% lived with a parent who divorced or separated after the child was born. Roughly one in seven (13.8%) U.S. adolescents were reported to have been a victim of or witness to violence in their neighborhood, one in ten (9.5%) witnessed domestic violence, and nearly 8% lived with a parent who served time in jail or prison since their birth. Fourteen percent were reported to have lived with someone who had a drug or alcohol problem, and 12% have lived with someone experiencing a mental illness. Five percent of adolescents have experienced the death of a parent.

The remaining columns of Table 2 labeled "%" show the weighted percentage distribution of exposure to a specific ACE, given exposure to another. For example, 29.5% of adolescents experiencing economic hardship also lived with a parent who has divorced or separated. Well over a third (36.3%) of adolescents who have been a victim of or witness to violence in their neighborhood also have witnessed domestic violence in their home, much higher than the sample's overall rate of 9.5%.

To understand how one adverse experience may predict having another, we regressed each individual ACE on one another while controlling for demographic, economic and family

characteristics. The resulting odds ratios are also presented in Table 2. For example, the odds of reporting exposure to domestic violence were 4.89 times greater among adolescents with a divorced parent than those whose parents have not divorced. The odds of exposure to drugs or alcohol problems in the home were 4.23 times higher for adolescents with a history of exposure to mental illness than those without.

To examine the relationship between ACE exposure and adolescents' physical and emotional health, we tested three models controlling for demographic, family and economic factors, shown in Tables 3 and 4. The first column (Table 3) shows bivariate relationships between each ACE and the odds of reported poor health when the other adverse experiences were not included in the model. Results indicate that economic hardship, mental illness in the home, and experiencing discrimination increased the odds of poor adolescent health. All demographic and economic covariates were in the expected direction, with minority, lower-income, and older youth displaying higher odds of reported poor health. As expected, high levels of family functioning were associated with lower odds of poor health. (Results not shown). In the second model (specific risk) once all the adverse experiences were added, the relationships between economic hardship, mental illness in the home, and discrimination were slightly attenuated but remained statistically significant. In the last model, to test the cumulative risk hypothesis, we included a continuous measure of total ACE exposure. Results suggest that odds of reported poor health among adolescents increased with each additional ACE reported. For example, each additional ACE increased the odds of reported poor health by 14% (odds ratio [OR] = 1.14; 95% CI 1.05, 1.23; $p<.01$).

Table 4 presents the results of a parallel analysis predicting reported emotional problems. The bivariate model indicates that, net of demographic, family and economic characteristics,

each ACE significantly increased the odds of reported anxiety, depression or frequent sadness. With all adverse events in the model, the odds of reported emotional problems remained significant for those whose parents had divorced, who were victims of or witness to neighborhood violence, or lived with someone with mental illness. In the cumulative ACE model, the odds of reported emotional problems increased with each reported ACE by 36% (odds ratio [OR=1.36; 95% CI 1.28; 1.42, p<.01). For both outcomes, we tested whether there was a nonlinear relationship between total ACE exposure and poor health or emotional problems and results were non-significant.

To explore the possible moderator effect of family functioning on the relationship between the ACE exposure and adolescent health and emotional well-being, we added interactions between the family functioning index and individual adverse events. We found no significant interactions in specific risk models predicting poor health or emotional well-being. We did, however, find that family functioning was a significant moderator of the relationship between the total ACE and adolescent emotional well-being. To better interpret the interaction we converted the odds ratios to predicted probabilities and present them in Figure 1. We fixed all covariates at their means, and assigned family functioning to the 25^{th} percentile (low family functioning), 50^{th} percentile (average family functioning), and the 75^{th} percentile (high family functioning). At higher levels of ACE exposure, higher levels of family functioning serve to reduce the probability of reported emotional problems among adolescents.

Discussion

Over half of U.S. youth have experienced at least one adverse life event by the time they reach adolescence, and that a considerable proportion have experienced three or more. We also found that given exposure to an adverse life experience, adolescents are at greater risk of

experiencing others. This suggests, given the economic and demographic factors associated with ACE exposure that certain groups may have compounded risks for experiencing adverse life events as well as the negative outcomes associated with them.

This study found an association between adverse childhood experiences and poor adolescent health and emotional well-being. Economic hardship, mental illness in the household, and racial or ethnic discrimination all increase the odds of reported poor health net of controls. Divorce, neighborhood violence and exposure to mental illness were significant predictors of emotional problems. In addition, this study finds evidence to support the cumulative risk hypothesis—each additional event increased the odds of poor health by 14% and 36% for problems associated with emotional health. This suggests that a child crossing the line from no adverse events to just one warrants concern.

Our results also draw attention to the specific risk of mental illness in the household for adolescents' well-being. While the magnitude of its effect was reduced with controls, children living in a home in which someone has mental health problems are especially at risk of physical and emotional health difficulties in adolescence. One-quarter of U.S. adults suffer from a diagnosable mental health disorder including depression and anxiety,[25] and recent evidence finds that parental mental health disorders are associated with children's poorer physical health and developmental outcomes.[26] Yet mental health issues such as depression are usually treatable and therefore any damage to children may be preventable.[27]

Whereas prior research has found consistent detrimental effects of discrimination on children's emotional and mental health,[28–29] we found only marginal evidence of this in the bivariate model. However, we note the specific contribution of racial or ethnic discrimination toward an increased probability of reported poor health among adolescents even after controlling

for exposure to all adverse childhood experiences studied here. Perceived discrimination has been linked to a host of mental and physical health problems among adults,[30] and it may be that discrimination creates a unique stress response influencing adolescent health. Given increasing racial and ethnic disparities in the health and well-being of children in the United States,[31–32] future research will need to more fully examine the link between perceived discrimination in childhood and health outcomes among adolescents.

The study has a key limitation. The data are cross sectional and thus we cannot establish a causal order between exposure to adverse events and adolescent health and well-being, nor can we establish the exact timing of adverse events. However, the NSCH is the only national sample of children in the United States in which to examine the prevalence of adverse childhood events, and provides us with important information on patterns and correlates of exposure as well as links to adolescent health and emotional well-being.

One implication of our findings is that research and services targeting adolescents with or at risk of ACE exposure should be careful not to limit their scope to individual adverse events. Moreover, the differences in both significance and magnitude of particular adverse events on physical and emotional well-being underscore the importance of considering multiple dimensions of well-being. The role of economic hardship, for example, might be understated in studies examining only emotional well-being; the role of parental divorce in those examining only physical health. Another implication is that social programs and intervention services may find initiatives directed toward improving family functioning, as this appears to be protective against the negative health outcomes examined here: adolescents in homes with high family functioning have approximately half the odds of poor physical and emotional health. Adolescent

well-being has enduring consequences, so identifying children with ACE exposure who also have lower-functioning family could also help identify those families at particular risk.

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TABLE 1- Sample Characteristics: Adolescent's Ages 12-17 National Study of Children's Health 2011/2012.

Characteristics	Sample (N= 33,774)
Health and Well Being %	
Poor Health	3.5
Emotional Problems	12.4
Adverse Childhood Experiences(ACE) %	
0	43.4
1 or 2	39.4
3 or more	17.2
Total ACE score, mean (SE)	1.2 (.02)
Male %	50.8
Age, mean (SE)	14.5 (.02)
Race/ethnicity %	
NH White	56.9
NH Black	14.0
NH Other	8.9
Hispanic (any race)	20.2
Poverty Level %	
At or below 100% poverty	19.1
Above 100% to at or below 199%	20.7
Above 200% to at or below 399%	29.0
Above or at 400% poverty level	31.3
Family Structure	
Two parent family	71.8
Single parent family	19.5
Other family	8.6

Estimates are weighted using NSCH weights, N is unweighted.

TABLE 2: Odds ratios for the risk of reporting other Adverse Childhood Experiences among adolescents with these expereInces.

Adverce Childhood Experience	Total Sample %	Weighted Percentages and Adjusted Odds Ratios of Reporting Other Adverce Childhood Experiences[1]																	
		Economic Hardship (n=7,017)		Parents Divorced (n= 8,331)		Death of Parent (n=1,643)		Jail/Prison (n=2,237)		Domestic Violence (n=2,780)		Victim/Witness to Neighborhood Violence (n=4,152)		Live with mentally ill person (n=4,038)		Live with drug/alcohol abuse (n=4,855)		Experienced discrimination (n=1,908)	
		%	OR	%	OR	%	OR	%	OR	%	OR	%	OR	%	OR	%	OR	%	OR
Experienced economic hardship very or somewhat often since child was born.	25.3		--	37.7	1.47 ***	36.7	1.10	46.8	1.67 ***	49.7	2.18 ***	45.8	1.99 ***	44.6	2.05 ***	43.4	1.65 ***	37.4	1.65 ***
Child lived with a parent who divorced or separated after child was born.	27.2	29.5	1.47 ***	--	--	37.0	0.74 *	57.0	4.06 ***	62.6	4.89 ***	46.9	2.44 ***	47.8	2.64 ***	57.2	4.39 ***	32.8	1.59 ***
Child lived with a parent who died.	5.0	4.3	1.09	5.6	0.71 *	--	--	9.8	1.70 **	8.1	1.52 **	7.8	1.23	7.5	1.54 **	8.2	1.63 ***	6.5	1.10
Child lived with a parent who served time in jail or prison after child was born.	7.7	12.6	1.65 ***	19.6	3.93 ***	22.1	1.71 +	--	--	34.3	6.86 ***	25.9	4.34 ***	22.3	3.12 ***	35.5	11.19 ***	13.8	1.28
Child saw or heard parents or other adutls slap, hit, kick, punch or beat each other up.	9.5	14.1	2.18 ***	22.9	4.83 ***	19.8	1.52 **	36.9	6.89 ***	--	--	36.3	6.80 ***	28.7	4.47 ***	36.5	7.75 ***	17.2	1.92 ***
Child was a victim or violence or witnessed any violence in his or her neighborhood.	13.8	15.4	1.97 ***	20.3	2.38 ***	22.2	1.24	32.7	4.35 ***	42.8	6.81 ***	--	--	29.8	3.93 ***	29.5	4.19 ***	30.5	2.67 ***
Child lived with someone who was mentally ill or suicidal, or severaly depressed for more than a couple of weeks.	11.6	14.9	2.05 ***	20.5	2.64 ***	21.2	1.56 **	27.8	3.19 ***	33.8	4.52 ***	29.6	3.97 ***	--	--	34.4	5.49 ***	17.7	1.65 ***
Child lived with someone who had a problem with drugs or alcohol.	14.1	18.0	1.66 ***	30.4	4.38 ***	28.8	1.65 ** +	54.7	11.35 ***	52.3	7.81 ***	36.0	4.23 ***	42.4	5.48 ***	--	--	19.5	1.50 **
Child was unfairly treated or judged because of his or her race or ethnic group.	6.8	5.9	1.65 ***	6.6	1.61 ***	8.6	1.09	8.1	1.27	9.4	1.87 ***	14.4	2.70 ***	8.3	1.65 ***	7.4	1.48 **	--	--

**p<.01, * p<.05, + p.10

1. Odds ratios based on logistic regression models of each Adverse Childhood Experience contolling for child age, gender, race/ethnicity, family functioning index, family structure and poverty to income ratio.

TABLE 3: LOGISTIC REGRESSION MODELS FOR ADVERSE CHILDHOOD EXPERIENCES (ACE) AS PREDICTORS OF POOR HEALTH

	Poor Health					
	Bivariate Model[a]		Specific Risk Model[b]		Cummulative ACE Model	
	OR	95% CI	OR	95% CI	OR	95% CI
Number of Adverse Events					1.14 **	(1.05 to 1.23)
Type of adverse event						
Experienced economic hardship very or somewhat often since child was born.	1.57 **	(1.14 to 2.15)	1.47 *	(1.05 to 2.05)		
Child lived with a parent who divorced or separated after child was born.	1.00	(0.72 to 1.36)	0.90	(0.64 to 1.25)		
Child lived with a parent who died.	1.44	(0.94 to 2.20)	1.38	(0.89 to 2.12)		
Child lived with a parent who served time in jail or prison after child was born.	1.03	(0.70 to 1.52)	0.97	(0.66 to 1.42)		
Child saw or heard parents or other adutls slap, hit, kick, punch or beat each other up.	1.14	(0.76 to 1.67)	0.91	(0.56 to 1.44)		
Child was a victim or violence or witnessed any violence in his or her neighborhood.	1.23	(0.88 to 1.71)	0.97	(0.67 to 1.39)		
Child lived with someone who was mentally ill or suicidal, or severaly depressed for more than a couple of weeks.	2.01 ***	(1.42 to 2.84)	1.97 **	(1.28 to 3.03)		
Child lived with someone who had a problem with drugs or alcohol.	1.16	(0.84 to 1.59)	1.01	(0.71 to 1.42)		
Child was unfairly treated or judged because of his or her race or ethnic group.	1.80 **	(1.16 to 2.76)	1.73 *	(1.11 to 2.68)		

*** p <.001; ** p<.01, ; * p <..05

All models control for age, gender, race/ethnicity, family structure, family functioning index and income to poverty level.

a. Model includes ACE measure plus controls

b. Model includes all ACE measures plus controls

c. Model includes total ACE score plus controls

TABLE 4: LOGISTIC REGRESSION MODELS FOR ADVERSE CHILDHOOD EXPERIENCES (ACE) AS PREDICTORS OF EMOTIONAL PROBLEMS

	Emotional Problems					
	Bivariate Model[a]		Specific Risk Model		Cummulative ACE Model	
	OR	95% CI	OR	95% CI	OR	95% CI
Number of Adverse Events					1.36 **	(1.28 to 1.42)
Type of adverse event						
Experienced economic hardship very or somewhat often since child was born.	1.40 **	(1.14 to 1.70)	1.20	(0.97 to 1.48)		
Child lived with a parent who divorced or separated after child was born.	1.72 ***	(1.42 to 2.06)	1.31 *	(1.06 to 1.61)		
Child lived with a parent who died.	1.37 *	(1.00 to 1.86)	1.24	(0.87 to 1.75)		
Child lived with a parent who served time in jail or prison after child was born.	1.87 ***	(1.42 to 2.45)	1.07	(0.78 to 1.44)		
Child saw or heard parents or other adutls slap, hit, kick, punch or beat each other up.	2.15 ***	(1.71 to 2.69)	1.22	(0.93 to 1.59)		
Child was a victim or violence or witnessed any violence in his or her neighborhood.	2.34 ***	(1.91 to 2.86)	1.60 ***	(1.26 to 2.00)		
Child lived with someone who was mentally ill or suicidal, or severaly depressed for more than a couple of weeks.	3.29 ***	(2.69 to 4.00)	2.71 ***	(2.16 to 3.40)		
Child lived with someone who had a problem with drugs or alcohol.	1.99 ***	(1.65 to 2.41)	1.11	(0.86 to 1.41)		
Child was unfairly treated or judged because of his or her race or ethnic group.	1.28	(0.95 to 1.70)	0.99	(0.72 to 1.33)		

*** p <.001; ** p<.01, ; * p <..05

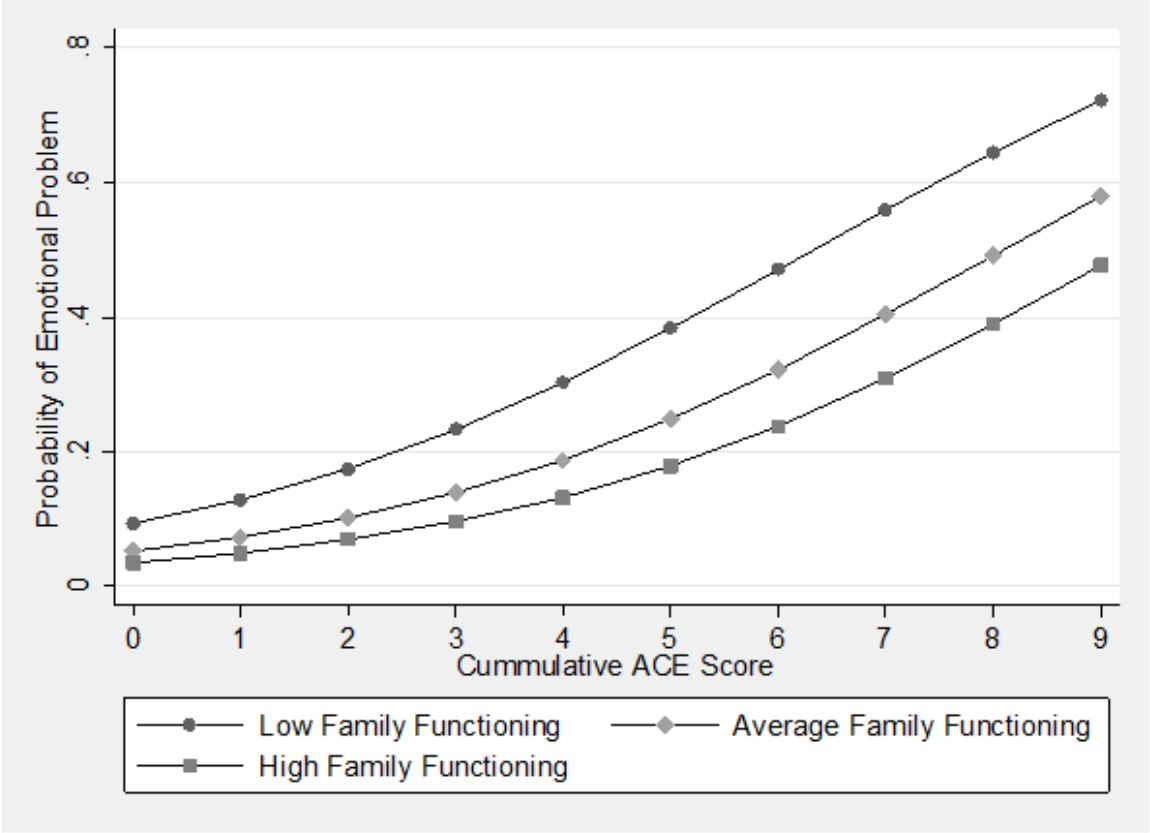
All models control for age, gender, race/ethnicity, family structure, family functioning index and income to poverty level.

a. Model includes ACE measure plus controls

b. Model includes all ACE measures plus controls

c. Model includes total ACE score plus controls

Figure 1: Predicted probabilities of emotional problems by level of family functioning and cummulative ACE score.



Note: Based on the cummulative risk model Table 4. All covariates set to the mean.