Income Inequality and the Differential Effect of Adverse Childhood Experiences in US Children

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ABSTRACT

OBJECTIVE: Adverse childhood experiences (ACEs) can affect health and development across the life course. Despite a general understanding that adversity is associated with lower income, we know less about how ACEs manifest at different income levels and how these income-related patterns affect children's health and development.

METHODS: Data from the 2011 to 2012 National Survey of Children's Health were used to examine the prevalence of 9 ACEs in US children, across 4 levels of household income, and in relationship to 5 parent-reported measures of child health. Bivariate analyses and multivariable logistic regression models were used to examine the associations between number of ACEs and children's health outcomes on the basis of the 4 income groups.

RESULTS: When partitioned according to income strata, the proportion of children who experienced ACEs showed a steep income gradient, particularly for children who experienced ≥4 ACEs. The linear gradient across income groups was less pronounced for each specific ACE, with several ACEs (experience of divorce, drug and alcohol exposure, parental mental illness) showing high reported prevalence in all but the highest income group. Multivariate analysis showed a consistent income-related gradient for each of the health outcomes. However, higher income was not necessarily found to be a protective factor against ACEs.

CONCLUSIONS: ACEs are distributed across the income ladder and not just concentrated below the poverty level. This suggests that a more comprehensive policy strategy that includes targeted as well as universal interventions is warranted.

KEYWORDS: adverse childhood experiences; child health; childhood trauma; income inequality

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ADVERSE CHILDHOOD EXPERIENCES, or ACEs, has become a shorthand designation for a set of childhood traumatic events that have been empirically linked to adult health behaviors and leading causes of morbidity and mortality. A series of retrospective studies conducted over the past 20 years have shown a consistent and strong relationship between the cumulative number of ACEs and several common chronic medical and behavioral health conditions including cardiovascular disease, depression, and substance abuse.[1–5] This cumulative model of risk is consistent with evidence showing how multiple risks, experienced during childhood, result in a range of adverse child health and developmental outcomes.[6–11]

A growing and wide-ranging body of research on the neurobiology of stress and the developing role of allostatic load, has provided biologically plausible mechanisms to explain how different forms of social adversity can lead to stress-induced patterns of physiologic dysregulation across multiple systems including immune and inflammatory response patterns and metabolic pathways that are associated with a number of chronic health problems.[12–14] Life course health development research has also helped explain how time-specific biological conditioning during sensitive periods of development along with time-dependent cumulative exposures to adversity, can combine and interact to magnify the association of any one particular risk factor.[15] Recent analysis of the Abecedarian preschool intervention has also shown that children from low-income families who receive an educationally enhancing and risk-reducing intervention from age 3 to 5 years, can significantly decrease the prevalence of cardiovascular and metabolic disease risk factors by their mid-30s, indicating the potential of modifying risk-related health development trajectories by appropriately timed and targeted interventions.[16]

Building on the adult ACE study noted previously, more recent studies show that ACEs are prevalent among US children and that their associations with chronic illness status start early in life and can have a range of effects on

development during childhood, including engagement in school and other factors important to health across the life course.[17–19] Adversity is often associated with different levels of income. Because income and wealth inequality has become more pronounced in the United States over the past 30 years, dichotomous classifications of social adversity solely on the basis of the federal poverty level (FPL; ie, poor vs nonpoor) have been supplemented by assessments of inequality measured according to gradients in income. The shape and steepness of the income gradient indicates how exposures are distributed and can be useful in understanding their relative association.[20–22] Recent work by the World Health Organization Commission on Social Determinants of Health as well as the Robert Wood Johnson Foundation Commission to Build a Healthier America have highlighted how the distribution of health disparities and income inequality are inextricably linked and how important that causal link can be early in the life course.[23,24]

The National Survey of Children's Health (NSCH) provides a unique source of representative data to examine the prevalence of ACEs in US children and how ACEs are distributed across socioeconomic status measured according to different levels of household income. The 2011 to 2012 NSCH was designed to better measure ACEs[25] by adding a series of questions intended to represent measures that were similar to the ones used by Felitti et al in the original ACE study on adults.[1] In this analysis, we examined the patterning of ACEs according to household income and how that is associated with children's health and developmental outcomes.

METHODS

POPULATION AND DATA

The 2011 to 2012 NSCH was designed and sponsored by the federal Maternal and Child Health Bureau. Data were collected by the National Center for Health Statistics as a module of the State and Local Area Integrated Telephone Survey. The NSCH used a stratified random digit-dial sampling design to achieve a nationally representative sample of 95,677 parents of children 0 to 17 years of age. One child was randomly selected from each household and a detailed telephone interview was conducted with the parent or guardian who knew the most about the child's health and development. Interviews of approximately 30 minutes were conducted in English, Spanish, Mandarin, Cantonese, Korean, and Vietnamese. The interview completion rate for the survey, which is a measure of the response rate indicating the percentage of completed interviews among known households with a child younger than the age of 18 years, was 54.1% for the land line sample and 41.2% for the cell phone sample.

A total of 94,520 children had information available for at least 1 ACE measure. For analyses on the association of the number of ACEs with child health outcomes across income groups, the study sample was further restricted to individuals with no missing data on the outcome or the study covariates. Missing data on family income were multiply imputed by National Center for Health Statistics researchers and applied to our analysis.

To produce population-based estimates, data records were assigned a sampling weight. NSCH weights were designed to minimize bias by incorporating adjustments for various forms of survey nonresponse including raking so the sample matched population control totals on key demographic variables obtained from the American Community Survey. Further details on the design and operation of the survey are reported elsewhere.[26]

MEASURES

ACEs

The 2011 to 2012 NSCH included 9 items to capture ACEs. Parents reported if the child had ever had the following exposures: 1) financial hardship, 2) parental divorce/separation, 3) parental death, 4) parental imprisonment, 5) witness to domestic violence, 6) victim or witness of neighborhood violence, 7) lived with a mentally ill or suicidal person, 8) lived with someone with an alcohol or drug problem, and 9) treated unfairly because of race/ethnicity. These items were selected and tested for the NSCH on the basis of and adding to those used in the original adult ACE study, with modifications made through an extensive Technical Expert Panel process and review.[27] We created a cumulative ACEs score on the basis of the sum of these 9 items.

Family Income

Survey participants reported total combined household income during the calendar year before the survey. Income to household size measures were computed by the National Center for Health Statistics researchers and compared with the Department of Health and Human Services Federal Poverty Guidelines. The resulting income variable was then categorized into 4 levels: poor (<100% of the FPL), which included 22.5% of the population; low-income (100%–199% of the FPL), which included 21.6% of the population; middle-income (200%–399% of the FPL), which included 28.2% of the population; and high-income (≥400% of the FPL), which included 27.7% of the population.

Child Health

We selected 5 measures of child health for our analysis: 1) overall child health status (excellent/very good vs good/fair/poor) as reported by parents for children aged 0 to 17 years; 2) overall condition of teeth (excellent/very good vs good/fair/poor) as reported by parents for children aged 1 to 17 years; 3) body mass index at or above the 85th percentile classifying children (aged 10 and older) as overweight or obese on the basis of parent-reported height/weight; 4) asthma status (ages 0–17 years) identified by parent report that the child has a diagnosis from a health care professional and currently has the condition; and 5) parent report of whether the child has any emotional, developmental, or behavioral problems that require treatment or counselling (ages 0–17 years). An indicator of emotional, developmental, or behavioral problems was identified by a response of "yes" or if the parent reported

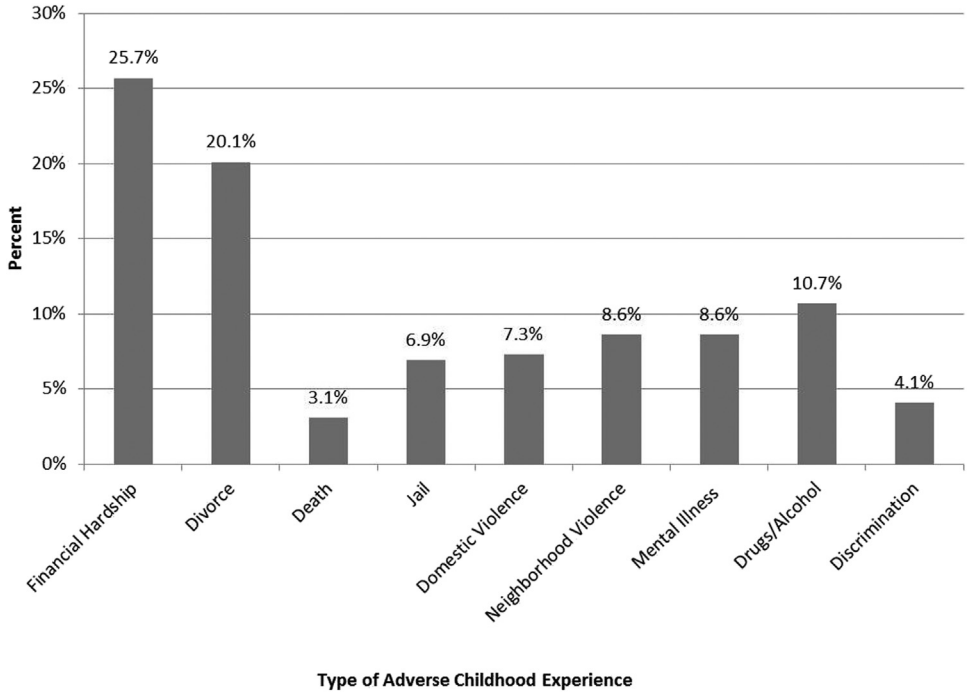

Figure 1. *Percent distribution of children with individual adverse childhood experiences, National Survey of Children's Health, 2011–2012.*

that the child currently has any of the following conditions: learning disability, attention deficit–hyperactivity disorder, depression, anxiety, behavior problem, autism, intellectual disability, developmental delay, speech problem, cerebral palsy, or Tourette syndrome.[27]

Analysis

All statistical analyses were performed using STATA (version 14.0; Stata Corp, College Station, Texas). All analyses accounted for the complex survey design with the Taylor series linearization method used to adjust the standard errors. The prevalence of each type of ACE is shown for the population of children overall. To examine income gradients in ACEs, cross-tabulations were calculated between family income and the overall number of ACEs (0, 1, 2, 3, or ≥4 reported ACEs) and also for each of the 9 individual ACEs. Wald tests of trend were used to examine the statistical significance of the income gradients in ACEs.

Bivariate analyses and multivariable logistic regression models were used to examine the associations between the number of ACEs and children's health outcomes. These analyses were conducted for children overall and then broken down for each of the 4 income groups. Adjusted logistic regression models included controls for children's race/ethnicity, gender, and age.

Results

Figure 1 shows how the prevalence of the specific ACEs measured in the NSCH are distributed across the US population of children aged 0 to 17 years. Whereas the experience of serious financial hardship (not equivalent to poverty) is reported for 25.7% of children and parental divorce for 20.1%, most of the other ACEs are experienced by <10% of children, with death of a parent and explicit racial or ethnic discrimination being reported in <5%.

Figure 2 provides a picture of how the experience of adversity in the United States is distributed across household income strata. First, the graph shows that most children in the lowest 2 income groups have at least 1 reported ACE. Children who live in families below the FPL were more than 3 times as likely to have ≥2 ACEs compared with those at or above 400% of the FPL (34.9% vs 9.7%, respectively). Those in low-income (28.7%) and middle-income families (20.9%) were more than 2 times as likely to experience ≥2 ACEs. For those who experienced the greatest exposure to adversity (≥4 ACEs), the gradient is even steeper. Children who live below the FPL are 5 times more likely to experience ≥4 ACES than those who live in families whose income is approximately 400% of the FPL. The distribution of ACEs suggests a significant drop off for children who live in families at or above 400% of the FPL. Nearly three-quarters of the children in the highest income group were free of any reported ACEs, compared to only one-third of children in the lowest income group.

Figure 3 shows the relationship between the income gradient and each specific category of adversity. As was the case for the cumulative prevalence of ACEs, there was an observable income gradient for each of the ACE categories. As might be expected, the experience of financial hardship shows a steep income gradient, yet 1 in 4 children in families above 200% of the FPL experience financial hardships. Another pattern that emerges is a clustering of ACEs across all of the lower (nonhigh) income categories. The experience of divorce was >20% for all but the highest income group, the experience of drug and alcohol exposures was >10% for all but the highest income

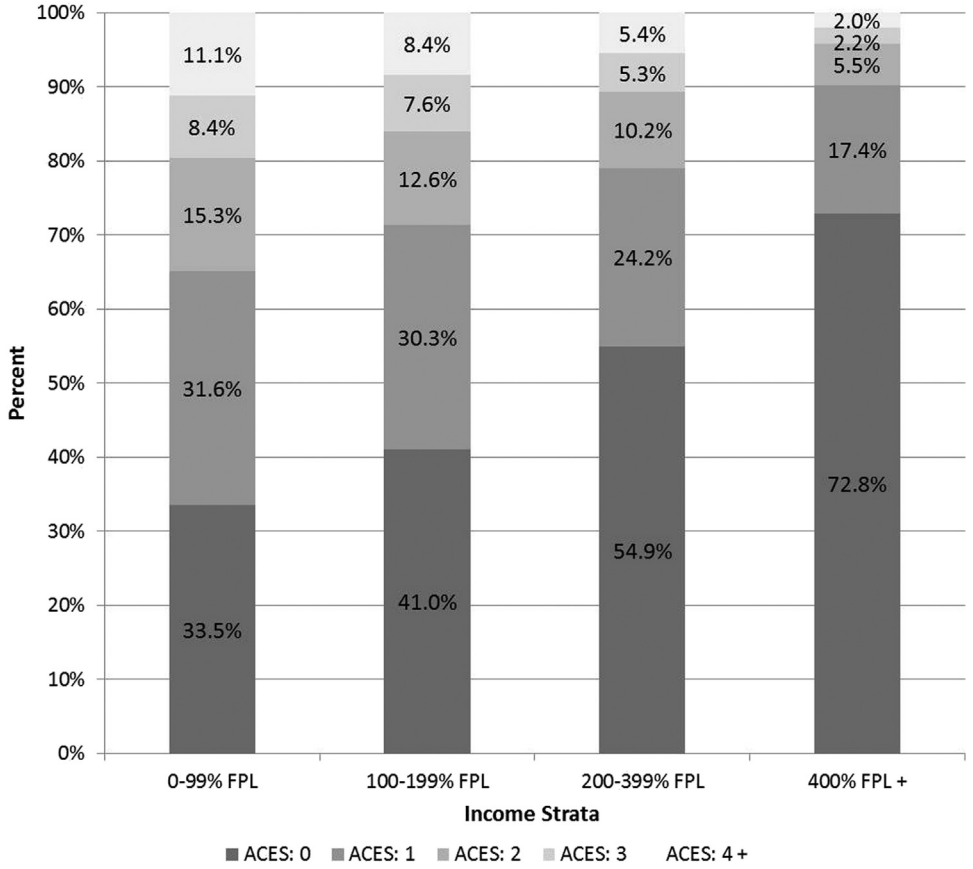

Figure 2. *Percent distribution of children with number of adverse childhood experiences (ACEs), according to income strata, National Survey of Children's Health, 2011–2012. FPL indicates federal poverty level.*

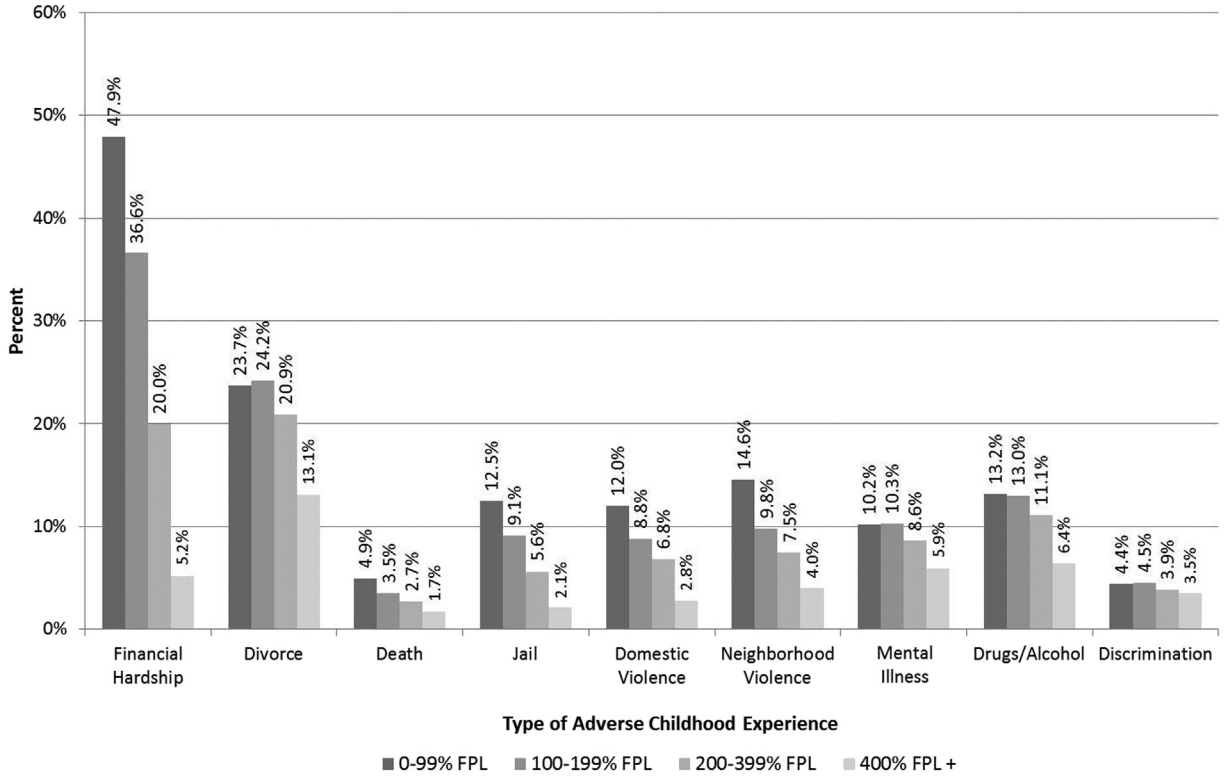

Figure 3. *Percentage of children in income strata affected by individual adverse childhood experiences, National Survey of Children's Health, 2011–2012. FPL indicates federal poverty level.*

group, and the experience of having a parent with a mental illness was >8% for all but the highest income group. The clustering of these specific ACEs in all but the highest income group as opposed to a linear pattern seems to indicate that specific types of household adversity are affecting a large proportion of families irrespective of their income, and that only the highest income group is likely to be relatively spared from what appears to be somewhat commonly distributed exposures.

The Table shows multivariable logistic regression analyses relating the number of ACEs to 5 health outcomes that represent physical, dental, emotional, behavioral, and developmental problems. Overall, there is a consistent income gradient for each of the health outcomes controlling for age, gender, and race/ethnicity. Reporting 1 ACE is associated with between a 25% and 84% increased odds of reporting 1 of these conditions, having 2 increases the odds anywhere from 48% to 160%, 3 increases the odds 53% to 251%, and ≥4 increases the odds 95% to 462%. Interestingly, the reported prevalence of emotional, behavioral, and developmental problems seems to be most influenced by a greater number of reported ACEs.

Across the different levels of income, there are several interesting findings. First, for the lowest income group (<100% of the FPL), having 1, 2, 3, or ≥4 ACEs is not necessarily associated with greater odds of poorer general health, poorer oral health, or being more overweight. The stepwise increase in the odds associated with each additional ACE was reported for asthma and emotional, developmental, and behavioral problems. At the high end of the income spectrum (>400% of the FPL), each additional reported adversity was associated with a stepwise increase in odds, except for asthma, for which the relationship was less consistent. Interestingly, having a larger number of ACEs seems to be more associated with the children in the higher income group than for the children in the lower income groups measured according to the spread between the odds ratios for 1 versus ≥4 reported ACEs. This would suggest that although ACEs are much less common in the highest income group, when they do occur, they can have a relatively greater influence on health outcomes.

DISCUSSION

This study showed that ACEs are aligned along an income gradient with those at the bottom of the gradient having a higher likelihood of experiencing adversity. By examining income gradients for ACEs, we showed how risks for ACEs occur at every level of the income hierarchy and not simply at below the threshold of poverty. Consistent with the income patterning of other health risks, moving up the gradient shows that those at the next level of income have higher levels of health and lower levels of adversity.

Previous analyses of the 2011 NSCH have shown that, similar to more localized studies, these nationally representative data show a high prevalence of ACEs as well as a strong relationship between ACEs and a range of child health and developmental outcomes.[17,25,28,29] Other research that used the NSCH also shows stable effects of ACEs on the prevalence of children's emotional, mental, or behavioral health conditions across income groups, although they still confirm higher rates of ACEs for poorer children overall.[30]

In this study, we showed a pronounced and linear income gradient for the cumulative influence of all ACEs. This association between income level and reported prevalence of ACEs was also shown in the multivariate analyses, controlling for children's race/ethnicity, gender, and age. However, the income patterning for specific types of adversity is more complex. Future analysis will need to tease out the relationship between the type and frequency of specific adversities and how they interact with each other depending on their co-occurrence. Whereas some ACEs are relatively common, like experiencing an economic hardship or parental divorce, others are less common (eg, parental death) and might have different meaning, salience, and effect in the life of a child. What is also interesting is that many families who live below the FPL did not report financial hardship, suggesting that poverty does not necessarily lead to the perception or reporting of financial hardship. In contradistinction, 20% of families who live between 200% and 399% of the FPL reported financial hardships, as did 5% of those who live at above 400% of the FPL. Because of growing rates of work and income instability in the United States, it is not surprising to see that higher income does not always immunize a family from financial hardships.[31] This is consistent with other research that showed that although hardships are strongly associated with income, there is variability in that relationship.[32]

Measuring health outcomes in relationship to income or education is a well accepted approach for understanding the influences of income inequality.[23,33,34] We have shown that income stratification is an important way of understanding how ACEs are distributed in the population of US children. Other studies have suggested how other risk and protective factors in early childhood are arrayed along an income gradient, and how gradients are associated with differences in a variety of health developmental outcomes such as vocabulary, literacy, and numeracy development, respiratory risks, psychopathology/mental illnesses, behavior/conduct problems, and others.[22,35–37] These results support a growing body of literature on how the patterns of income stratification arise, develop, and are reinforced, as well as engender differential exposures to health-damaging living conditions, and differential vulnerability to the consequences of these exposures.

Whereas the income gradient is linear and uniformly steep for some types of adversity, this pattern does not hold for all ACEs. For some ACEs, the prevalence clusters across several income groups, extends up the income scale and falls short of those in the highest category. This is consistent with other empirical data that show that as income gradients increase, the adversity tends to affect more and more families, as the rungs on the income ladders get farther apart.[38] What was also quite surprising is

Table. Association of the Number of ACEs with Children's Health, National Survey of Children's Health, 2011–2012

	Good/Fair/Poor Health (n = 93,179)		Good/Fair/Poor Condition of Teeth (n = 88,153)		Overweight (n = 42,901)		Asthma (n = 93,010)		Emotional, Developmental, Behavioral Problem (n = 93,098)	
Number of ACEs	%	AOR* (95% CI)	%	AOR* (95% CI)	%	AOR* (95% CI)	%	AOR* (95% CI)	%	AOR* (95% CI)
Overall										
No ACE reported	11.9†	Ref.	22.2†	Ref.	26.6†	Ref.	6.7†	Ref.	9.7†	Ref.
One ACE reported	19.0	1.60‡ (1.43–1.79)	32.7	1.57‡ (1.44–1.72)	31.5	1.25‡ (1.11–1.42)	9.5	1.34‡ (1.18–1.53)	17.2	1.84‡ (1.66–2.05)
Two ACEs reported	19.9	1.70‡ (1.47–1.96)	34.9	1.71‡ (1.53–1.93)	37.6	1.59‡ (1.37–1.85)	11.1	1.48‡ (1.27–1.73)	23.8	2.60‡ (2.29–2.95)
Three ACEs reported	19.8	1.75‡ (1.44–2.14)	36.6	1.91‡ (1.62–2.25)	35.8	1.53‡ (1.26–1.87)	13.8	1.88‡ (1.52–2.32)	30.3	3.51‡ (2.98–4.13)
≥ 4 ACEs reported	25.3	2.43‡ (2.05–2.87)	43.8	2.58‡ (2.24–2.97)	40.8	1.95‡ (1.64–2.32)	15.3	2.11‡ (1.78–2.51)	42.0	5.62‡ (4.90–6.45)
According to income group										
<100% FPL										
No ACE reported	31.5	Ref.	47.8	Ref.	44.5	Ref.	8.2†	Ref.	11.0†	Ref.
One ACE reported	30.6	1.03 (0.84–1.26)	45.7	0.97 (0.80–1.17)	44.4	1.05 (0.75–1.48)	10.0	1.14 (0.87–1.49)	17.1	1.50‡ (1.17–1.93)
Two ACEs reported	28.0	0.96 (0.76–1.23)	47.7	1.10 (0.88–1.37)	48.0	1.22 (0.84–1.78)	14.2	1.52‡ (1.12–2.06)	26.2	2.23‡ (1.70–2.94)
Three ACEs reported	27.3	0.97 (0.70–1.34)	47.4	1.11 (0.83–1.49)	45.8	1.13 (0.75–1.71)	16.6	1.75‡ (1.15–2.67)	34.6	3.08‡ (2.22–4.23)
≥ Four ACEs reported	34.3	1.29 (0.97–1.71)	52.4	1.26 (0.97–1.63)	44.1	1.16 (0.79–1.70)	18.5	2.06‡ (1.48–2.86)	45.3	4.35‡ (3.26–5.81)
100%–199% FPL										
No ACE reported	16.8†	Ref.	31.7†	Ref.	37.6	Ref.	5.8†	Ref.	7.9†	Ref.
One ACE reported	19.8	1.31‡ (1.03–1.66)	38.5	1.43‡ (1.18–1.74)	32.0	0.85 (0.63–1.14)	9.4	1.59‡ (1.15–2.19)	16.8	2.10‡ (1.64–2.68)
Two ACEs reported	23.1	1.63‡ (1.23–2.14)	36.8	1.29‡ (1.02–1.63)	42.3	1.33 (0.96–1.83)	10.7	1.69‡ (1.18–2.42)	26.4	3.35‡ (2.55–4.40)
Three ACEs reported	16.5	1.10 (0.76–1.60)	40.2	1.53‡ (1.12–2.10)	34.6	1.03 (0.70–1.53)	11.7	1.86‡ (1.24–2.78)	27.1	3.29‡ (2.41–4.49)
≥ Four ACEs reported	23.2	1.70‡ (1.25–2.30)	45.7	1.89‡ (1.43–2.49)	43.6	1.51‡ (1.07–2.14)	15.5	2.40‡ (1.64–3.53)	40.4	5.74‡ (4.34–7.60)
200%–399% FPL										
No ACE reported	8.0†	Ref.	17.8†	Ref.	25.0†	Ref.	7.0†	Ref.	9.7†	Ref.
One ACE reported	12.9	1.65‡ (1.29–2.10)	24.5	1.43‡ (1.21–1.70)	30.4	1.27‡ (1.03–1.58)	8.6	1.15 (0.91–1.46)	17.3	1.81‡ (1.49–2.20)
Two ACEs reported	12.0	1.44‡ (1.02–2.03)	26.2	1.50‡ (1.18–1.91)	32.1	1.35 (0.99–1.84)	8.4	1.01 (0.74–1.38)	19.5	1.94‡ (1.50–2.53)
Three ACEs reported	17.6	2.26‡ (1.42–3.59)	26.5	1.51‡ (1.08–2.13)	33.2	1.45‡ (1.00–2.10)	14.5	1.94‡ (1.28–2.94)	30.7	3.57‡ (2.47–5.16)
≥ Four ACEs reported	16.3	2.08‡ (1.48–2.93)	33.1	2.10‡ (1.58–2.78)	34.1	1.61‡ (1.17–2.21)	11.4	1.48‡ (1.04–2.10)	38.5	4.99‡ (3.81–6.53)
≥400% FPL										
No ACE reported	5.3†	Ref.	12.4†	Ref.	19.7†	Ref.	6.3†	Ref.	10.0†	Ref.
One ACE reported	9.6	1.85‡ (1.37–2.49)	18.3	1.57‡ (1.27–1.94)	23.0	1.22 (0.97–1.54)	10.2	1.40‡ (1.09–1.79)	17.5	1.59‡ (1.31–1.95)
Two ACEs reported	10.3	1.96‡ (1.37–2.81)	19.0	1.63‡ (1.21–2.21)	25.3	1.39‡ (1.03–1.87)	10.0	1.31 (0.93–1.86)	22.1	2.04‡ (1.55–2.68)
Three ACEs reported	11.2	2.21‡ (1.36–3.58)	19.8	1.77‡ (1.24–2.53)	23.6	1.40 (0.85–2.32)	9.3	1.21 (0.79–1.83)	24.5	2.26‡ (1.59–3.22)
≥ Four ACEs reported	16.8	3.45‡ (2.16–5.50)	27.6	2.69‡ (1.79–4.04)	37.5	2.59‡ (1.61–4.16)	11.2	1.51 (0.97–2.34)	41.9	5.22‡ (3.50–7.79)

ACE indicates adverse childhood experience; AOR, adjusted odds ratio; CI, confidence interval; Ref., reference; and FPL, federal poverty level.

*Logistic regression models controlled for child age, gender, and race/ethnicity.

†Wald test for bivariate association $P < .05$.

‡$P < .05$.

how common many of the adversities have become across the income strata. Mental illnesses, domestic violence, neighborhood violence, and drug and alcohol problems all showed relatively high prevalence, hovering near 10% across all but the highest income groupings and only decreasing to relatively low levels (<5%) in the highest income group. This would suggest that a large proportion of US families are experiencing adversities that can influence parenting, child rearing, and a range of child outcomes.

Our findings suggest that omitting the middle income strata in traditional analyses by dichotomizing social class into poor versus nonpoor would obscure the fact that a growing burden of adversity is weighing down on children living in families between 100% and 400% of the FPL. Furthermore, our analyses of the association of ACEs with health across income groups suggest that the negative influence of ACEs on a broad range of health and development outcomes is not only confined to children in poor families but rather extends up the income spectrum. It was found that although children in the highest income bracket are less likely to suffer from ACEs, when they do, the effect on their health status is actually greater, suggesting that higher income does not act as a protective factor against the influence of ACEs. This is important in considering the population-attributable risk of adversity and potential strategies for diminishing exposures, buffering effects, and treating the consequences. Many of our health and social care program are means-tested so that many families whose income is above the FPL, or some percentage thereof, are not eligible for potential services and supports.

Study findings suggest a need for policies and programs that not only target children in poor families, but also those in more middle-income groups. Focusing social and early intervention programs only on families below the FPL reflects an overarching strategy for addressing the marginal risks of the population as opposed to the median risk. Marginal risk strategies tend to identify individuals who are at the low end of a distribution and then intervene (ie, bring up the tail of the bell-shaped distribution curve). Median risk strategies tend to be more universal and address the entire population by focusing on shifting the entire curve in a positive direction. As our analysis has shown, ACEs are distributed along an income gradient, with those at the bottom end of the income distribution showing higher rates of exposures but with risk also extending up the income spectrum. In addition, the fact that many of the ACEs associated with family function (divorce, mental illnesses, and drug and alcohol use) are fairly evenly distributed across all but the highest income groups would also suggest that more universal interventions that target family functioning are called for, because growing levels of inequality place a larger proportion of families, and not just the poorest, at risk.

Primary prevention of ACEs will require policies that decrease social inequality or mitigate the effects of income status on the production of adversity. This will include labor market policies, educational policies, and family and social welfare policies with more attention to targeted and universal strategies. More can be done to decrease exposure to ACEs by focusing attention on the timing of ACEs in a child's life, the relationship of ACEs to social positioning, and the potential of other social policies and institutions to diminish exposures. Although there is a need for more universal programs, means-tested programs like Early Head Start, Maternal, Infant and Early Childhood Home Visiting can be targeted at the highest-risk groups during periods of heightened vulnerability during the first years of life.

In addition to targeted programs that focus on the lowest income populations with greatest risk of exposures, decreasing exposures and vulnerability for the growing number of low- and middle-income children will also require additional support to families with young children. Evidence-based family support programs like Family Foundations and Triple P could play an important role for all families. Like prenatal classes that are now widely used by middle- and upper-income families, programs like Family Foundations could be more universally available, and expected parts of new, more supportive, and widely available infrastructures of care could be designed to respond to child-rearing challenges that are increasingly taking their toll on a larger swath of American families.[39,40] Lessening the consequences of ACEs can also be addressed by better screening and care systems that are trauma-informed and designed to respond to the patterns of adversity in particular communities.[41–46] This is not just a job for pediatric offices, community health centers, child care centers, or family resource programs alone, but for an entire community.[47]

Our study adds to the sparse but growing literature on how income gradients are associated with the health and development of US children. Although this study used national data weighted to be representative of the US population of children, it has several limitations. First, the NSCH data are based on parent/guardian report, which introduces the possibility of reporting bias associated with experienced adversity or income. Also, ACEs are an important construct and capture some of the types of adversity that children experience, but the ACEs construct was developed >20 years ago for a retrospective epidemiological study of risks for obesity. Recent studies have shown the mechanisms that allow adversity to "get under the skin" and condition biological and behavioral regulatory systems.[48–50] There are now expanded ACEs checklists that assess a range of other risks associated with family chaos, stress reactivity, and allostatic dysregulation.[51–53] There is a growing literature on the importance of the timing of adversity during sensitive periods of health development, but the cross-sectional nature of the NSCH does not allow us to pinpoint the timing, duration, or interactions of specific exposures. In addition to understanding that timing matters, so does the context and existence of countervailing protective factors that can modify the role that ACEs have on specific health outcomes. For example, although loss of a parent can be traumatic, if it was family violence that resulted in the other parent's incarceration and the child's

separation from both parents, even the death of a parent might be a lot less traumatic if the parent died of a known illness over a period of time and there were extended family and other supports to lessen the effect.

CONCLUSION

As the World Health Organization Commission on Social Determinants of Health as well as the Robert Wood Johnson Foundation Commission to Build a Healthier America have shown, income gradient framing allows a more nuanced recognition of the role that inequality plays in generating health disparities. By examining the association of ACEs with specific outcomes across the entire income gradient, this study showed how many adversities associated with poorer health are distributed up the income ladder and not just concentrated below the poverty level. This suggests a different kind of policy discourse and different sets of policy solutions that are responsive to the population-attributable risk, not just the risk that is concentrated below the poverty level. Because of the significant and costly association of ACEs with child and lifelong health, and the fact that many of these adversities, if not completely preventable, can be significantly buffered, it is important to consider a more comprehensive policy strategy that includes targeted as well as universal family supports and interventions to decrease their prevalence and minimize their effects.[54]

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REFERENCES

1. Felitti VJ, Anda RF, Nordenberg D, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: the Adverse Childhood Experiences (ACE) Study. *Am J Prev Med*. 1998;14:245–258.
2. Dube SR, Anda RF, Felitti VJ, et al. Childhood abuse, household dysfunction and the risk of attempted suicide throughout the life span: findings from Adverse Childhood Experiences Study. *JAMA*. 2001;286:3089–3096.
3. Dube SR, Felitti VJ, Dong M, et al. The impact of adverse childhood experiences on health problems: evidence from four birth cohorts dating back to 1900. *Prev Med*. 2003;37:268–277.
4. Anda RF, Brown DW, Dube SR, et al. Adverse childhood experiences and chronic obstructive pulmonary disease in adults. *Am J Prev Med*. 2008;34:396–403.
5. Ford ES, Anda RF, Edwards VJ, et al. Adverse childhood experiences and smoking status in five states. *Prev Med*. 2011;53:188–193.
6. Sameroff A, Seifer R, Zax M, et al. Early indicators of developmental risk: Rochester Longitudinal Study. *Schizophr Bull*. 1987;13:383–394.
7. Liaw F, Brooks-Gunn J. Cumulative familial risks and low-birthweight children's cognitive and behavioral development. *J Clin Child Psychol*. 1994;23:360–372.
8. Gutman LM, Sameroff AJ, Cole R. Academic growth curve trajectories from 1st grade to 12th grade: effects of multiple social risk factors and preschool child factors. *Dev Psychol*. 2003;39:777–790.
9. Evans GW, English K. The environment of poverty: multiple stressor exposure, psychophysiological stress, and socioemotional health. *Child Dev*. 2002;73:1238–1248.
10. Evans GW. A multimethodological analysis of cumulative risk and allostatic load among rural children. *Dev Psychol*. 2003;39:924–933.
11. Stevens GD. Gradients in the health status and developmental risks of young children: the combined influences of multiple social risk factors. *Matern Child Health J*. 2006;10:187–199.
12. Seeman TE, McEwen BS, Rowe JW, et al. Allostatic load as a marker of cumulative biological risk: MacArthur studies of successful aging. *Proc Natl Acad Sci U S A*. 2001;98:4770–4775.
13. Evans GW, Kim P. Childhood poverty and health: cumulative risk exposure and stress dysregulation. *Psychol Sci*. 2007;18:953–957.
14. McEwen BS, Bowles NP, Gray JD, et al. Mechanisms of stress in the brain. *Nat Neurosci*. 2015;18:1353–1363.
15. Halfon N, Larson K, Lu M, et al. Lifecourse health development: past, present and future. *Matern Child Health J*. 2014;18:344–365.
16. Campbell F, Conti G, Heckman JJ, et al. Early childhood investments substantially boost adult health. *Science*. 2014;343:1478–1485.
17. Bethell CD, Newacheck P, Hawes E, et al. Adverse childhood experiences: assessing the impact on health and school engagement and the mitigating role of resilience. *Health Aff (Millwood)*. 2014;33:2106–2115.
18. Jimenez ME, Wade R, Lin Y, et al. Adverse experiences in early childhood and kindergarten outcomes. *Pediatrics*. 2016;137:1–9.
19. Guinosso SA, Johnson SB, Riley AW. Multiple adverse experiences and child cognitive development. *Pediatr Res*. 2016;79:220–226.
20. Marmot M. Social determinants of health inequalities. *Lancet*. 2005;365:1099–1104.
21. Starfield B, Robertson J, Riley AW. Social class gradients and health in childhood. *Ambul Pediatr*. 2002;2:238–246.
22. Larson K, Halfon N. Family Income Gradients in the Health and Health Care Access of US Children. *Matern Child Health J*. 2010;14:332–342.
23. *WHO Commission on Social Determinants of Health. Closing the Gap in a Generation: Health Equity Through Action on the Social Determinants of Health. Final Report of the Commission on Social Determinants of Health*. Geneva: World Health Organization; 2008.
24. RWJF Commission to Build a Healthier America. *Time to Act: Investing in the Health of Our Children and Communities*. Princeton, NJ: Robert Wood Johnson Foundation; 2014.
25. Child and Adolescent Health Measurement Initiative (CAHMI). Overview of adverse child and family experiences among US children. Available at: http://www.childhealthdata.org/docs/drc/aces-data-brief_version-1-0.pdf?Status=Master. Published 2013. Accessed March 15, 2016.
26. Data Resource Center for Child & Adolescent Health. Frequently asked questions about the NSCH. Available at: http://childhealthdata.org/learn/NSCH/FAQ. Accessed March 10, 2016.
27. Child and Adolescent Health Measurement Initiative (CAHMI). National Survey of Children's Health (NSCH). 2011-2012 NSCH: Child Health Indicator and Subgroups SAS Codebook, Version 1.0. Available at: http://childhealthdata.org/docs/nsch-docs/sas-codebook_-2011-2012-nsch-v1_05-10-13.pdf. Published May 2013. Accessed March 15, 2016.
28. Bethell CD, Newacheck PW, Fine A, et al. Optimizing health and health care systems for children with special health care needs using the life course perspective. *Matern Child Health J*. 2014;18:467–477.
29. Sacks V, Murphey D, Moore K. Child trends. Research brief. Adverse childhood experiences: national and state-level prevalence. Available at: http://www.childtrends.org/wp-content/uploads/2014/07/Brief-adverse-childhood-experiences_FINAL.pdf. Published July 2014. Accessed March 24, 2016.
30. Bethell CD, Gombojav N, Solloway M, et al. Adverse childhood experiences, resilience and mindfulness-based approaches: common denominator issues for children with emotional, mental or behavioral health problems. *Child Adolesc Psychiatr Clin N Am*. 2016;25:139–156.
31. Western B, Bloome D, Sosnaud B, et al. Economic insecurity and social stratification. *Annu Rev Sociol*. 2012;38:341–359.

32. Sullivan JX, Turner L, Danziger S. The relationship between income and material hardship. *J Policy Anal Manage*. 2008;27:63–81.
33. Marmot MG. Understanding social inequalities in health. *Perspect Biol Med*. 2003;46(suppl 3):S9–S23.
34. Bharmal N, Derose KP, Felician M, et al. *Understanding the Upstream Social Determinants of Health*. Santa Monica, CA: RAND Social Determinants of Health Interest Group, RAND Health; 2015.
35. Larson K, Russ SA, Nelson BB, et al. Cognitive ability at kindergarten entry and socioeconomic status. *Pediatrics*. 2015;135: e440–e448.
36. Pillas D, Marmot M, Naicker K, et al. Social inequalities in early childhood health and development: a European-wide systematic review. *Pediatr Res*. 2014;76:418–424.
37. Chen E, Martin AD, Matthews KA. Socioeconomic status and health: do gradients differ within childhood and adolescence? *Soc Sci Med*. 2006;62:2161–2170.
38. Wilkinson RG, Pickett KE. Income inequality and socioeconomic gradients in mortality. *Am J Public Health*. 2008;98:699–704.
39. Feinberg ME, Jones DE, Roettger ME, et al. Long-term follow-up of a randomized trial of family foundations: effects on children's emotional, behavioral, and school adjustment. *J Fam Psychol*. 2014;28:821.
40. Feinberg ME, Jones DE, Roettger ME, et al. Preventive effects on birth outcomes: buffering impact of maternal stress, depression, and anxiety. *Matern Child Health J*. 2016;20:56–65.
41. Oral R, Ramirez M, Coohey C, et al. Adverse childhood experiences and trauma informed care: the future of health care. *Pediatr Res*. 2016;79:227–233.
42. Nicholas EA. *Everychild Bright Beginnings Initiative: Transforming Care to Prevent and Address Toxic Stress and Trauma in Young Children and Families. 2015 AAP National Conference and Exhibition*. Elk Grove Village, IL: American Academy of Pediatrics; 2015.
43. Kerker BD, Zhang J, Nadeem E, et al. Adverse childhood experiences and mental health, chronic medical conditions, and development in young children. *Acad Pediatr*. 2015;15:510–517.
44. Szilagyi M, Kerker BD, Storfer-Isser A, et al. Factors associated with whether pediatricians inquire about parents' adverse childhood experiences. *Acad Pediatr*. 2016;16:668–675.
45. Kerker BD, Storfer-Isser A, Szilagyi M, et al. Do pediatricians ask about adverse childhood experiences in pediatric primary care? *Acad Pediatr*. 2016;16:154–160.
46. Garner AS, Forkey H, Szilagyi M. Translating developmental science to address childhood adversity. *Acad Pediatr*. 2015;15:493–502.
47. Forstadt L, Cooper S, Andrews SM. Changing medicine and building community: Maine's adverse childhood experiences momentum. *Perm J*. 2015;19:92.
48. Boyce T, Sokolowski MB, Robinson GE. Toward a new biology of social adversity. *Proc Natl Acad Sci U S A*. 2012;109(suppl 2): 17143–17148.
49. Hanson MA, Gluckman PD. Early developmental conditioning of later health and disease: physiology or pathophysiology? *Physiol Rev*. 2014;94:1027–1076.
50. Hertzman C. The Biological embedding of early experience and its effects on health in adulthood. *Ann N Y Acad Sci*. 1999;896:85–95.
51. Cronholm PF, Forke CM, Wade R, et al. Adverse childhood experiences: expanding the concept of adversity. *Am J Prev Med*. 2015; 49:354–361.
52. Finkelhor D, Shattuck A, Turner H, et al. Improving the adverse childhood experiences study scale. *JAMA Pediatr*. 2013;167:70–75.
53. Danese A, McEwen BS. Adverse childhood experiences, allostasis, allostatic load, and age-related disease. *Physiol Behav*. 2012;102: 29–39.
54. Szilagyi M, Halfon N. Pediatric adverse childhood experiences: implications for life course health trajectories. *Acad Pediatr*. 2015;15: 467–468.