



Children with developmental disabilities experience higher levels of adversity



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ABSTRACT

Objective: Individuals with developmental disabilities (DD) experience significant health disparities. An overlooked risk factor for health disparities in the DD population is adverse childhood experiences (ACEs). The purpose of this study was to generate population prevalence data about level of adverse experiences among children with DD in comparison to children without DD and the extent to which potential confounders may influence observed associations between adversity and child DD status.

Methods: Data from the 2011–12 National Survey of Child Health (NSCH) were analyzed to estimate prevalence of adversity among families of children with and without DD, age 3–17 years ($N = 62,428$; $DD = 2622$). Level of adversity was assessed via parent response to the Adverse Family Experiences questionnaire. Bivariate and multinomial logistic regressions were utilized to investigate the relationship between adverse family experiences (AFEs) and child DD status, adjusting for covariates.

Results: Child DD status was significantly and independently associated with higher probability of reporting 1–2 AFEs ($RRR = 1.28$, 95% CI 1.06, 1.5) and 3+ AFEs ($RRR = 1.60$, 95% CI 1.16, 2.21).

Conclusion: This study documents significant disparities in adversity among children with DD using a population-based sample. These adversities potentially compromise successful transition to adulthood and overall health outcomes.

What this paper adds

This study is one of the first to provide nationally representative prevalence data on level of adversity experienced by children with developmental disabilities. Our results indicate that children with DD experience disproportionate levels of family adversity in comparison to peers without disabilities. As such, our findings suggest that children with DD are a vulnerable minority group at disproportionate risk of specific psychosocial and material risks tied to adulthood health disparities. Our study offers compelling

Abbreviations: NSCH, national survey of children's health; DD, developmental disability

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evidence about the need to consider adverse childhood experiences when examining health comorbidities and related outcomes for individuals with DD.

1. Introduction

Adverse childhood experiences (ACEs) are traumatic experiences that include child maltreatment/neglect and other household stressors (witnessing family violence, experiencing the incarceration of a parent and growing up with substance abuse, mental illness or parental divorce/separation) (Felitti et al., 1998). From 1995–1997, ACE researchers examined ACEs among approximately 17,000 Kaiser Health members and concluded that the number of reported ACEs were associated with poor health outcomes in adulthood (Brown et al., 2009; Felitti et al., 1998). This finding has been instrumental in advancing scientific understanding of early childhood toxic stress and its impact across the life course (Garner et al., 2012). Numerous studies have since linked higher ACE scores to multiple public health priority outcomes, including hepatitis B, cardiovascular disease, lung disease, suicide and premature mortality (Brown et al., 2009; Felitti & Anda, 2010; Felitti et al., 1998). Studies using data from the 2009 and/or 2010 Behavioral Risk Factor Surveillance System survey to examine ACEs among individuals with disabilities found a strong graded relationship between childhood exposure to abuse and household dysfunction and self-reported disability in adulthood (Austin, Herrick, Proescholdbell, & Simmons, 2016; Rose & Miryam, 2013; Rose, Xie, & Stineman, 2014). This evidence suggests that probability of poor health outcomes increases substantially when individuals exceed a particular threshold of ACEs (e.g. 4 or more ACEs) (Felitti et al., 1998). The results of these and other landmark ACEs studies prompted health care providers to address the “new morbidities” of childhood adversity in pediatric primary care (Garner et al., 2012). In 2012, the American Academy of Pediatrics (AAP) issued a policy statement encouraging providers to screen for ACEs and employ evidence-based strategies to reduce toxic stress exposure in young children in the general population (Garner et al., 2012).

The initial ACEs studies relied upon retrospective report of adversity among primarily white, middle-aged adults (Brown et al., 2009; Felitti et al., 1998). Although these findings helped elucidate the complex relationship between childhood adversity and adult health, scholars recognized that recall bias and inattention to the adversities faced by diverse populations may have influenced the validity of the first wave of ACEs research (Cronholm et al., 2015; Finkelhor, Shattuck, Turner, & Hamby, 2013; Wade et al., 2016). In response, a number of studies employed modified ACE questionnaires to measure adversity exposure among children and diverse populations (Balistreri, 2015; Burke, Hellman, Scott, Weems, & Carrion, 2011; Lynch et al., 2016; Marie-Mitchell & O'Connor, 2013). The Adverse Family Experiences (AFE) questionnaire, a modified ACE questionnaire, incorporates contextual items about community violence exposure and racial/ethnic discrimination that are harmful to child well-being while omitting items pertaining to direct child maltreatment due to concerns about underreporting (Balistreri, 2015). Using the AFE questionnaire, Cronholm et al. (2015) documented that over 50% of US children (6–17 years) experienced at least one adversity with over 25% reporting two adversities. These findings, replicated in additional studies, suggest that adversity is a common experience among children in the general population, with significant implications for health and wellbeing, including developmental delays, obesity and behavioral challenges (Balistreri, 2015; Burke et al., 2011; Felitti et al., 1998; Lynch et al., 2016; Marie-Mitchell & O'Connor, 2013).

Studies of ACEs have largely overlooked children with developmental disabilities (DD); a population at high risk for health disparities (Berg, Shiu, Acharya, Stolbach, & Msall, 2016; Emerson & Hatton, 2007). Children with DD disproportionately experience family and community-level adversities (Berg et al., 2016; Glidden & Schoolcraft, 2003; Hartley et al., 2010; Hastings & Brown, 2002; Herring et al., 2006; Ingersoll, Meyer, & Becker, 2011; Jones et al., 2012; Puttler, Zucker, Fitzgerald, & Bingham, 1998; Roberts, Lyaal, Rich-Edwards, Ascherio, & Weisskopf, 2016; Rosen, Seng, Tolman, & Mallinger, 2007). However, available data pertains primarily to discrete stressors impacting children with specific diagnoses rather than cumulative adversities among children with DD, as a group. For example, prior research has linked childhood DD, such as intellectual disability and autism, to separate categories of ACEs, including child maltreatment, parental mental illness (depression, anxiety) and to a lesser extent, divorce and substance use (Berg et al., 2016; Hartley et al., 2010; Glidden & Schoolcraft, 2003; Herring et al., 2006; Puttler et al., 1998). Separate studies have also linked disability status, generally, to community-level risk factors considered to be adversities in modified ACE instruments, including the AFE questionnaire (e.g. exposure to community crime or violence and racial/ethnic discrimination) (Ali, Fazil, Bywaters, Wallace, & Singh, 2001; Harrell, 2012; Hughes et al., 2012; Sullivan, 2009). Evidence suggests that families of children with DD are more likely to reside in neighborhoods characterized by disadvantage; factors which exacerbate the fragility of families and elevate risk for adversity among children, including witnessing violence (Emerson, 2012; Msall, Avery, Msall, & Hogan, 2007). Moreover, recent studies suggest that low socioeconomic status (SES) may facilitate risk of ACEs exposure among individuals, generally (Nurius, Green, Logan-Greene, Longhi, & Song, 2016; Steele et al., 2016; Su et al., 2015). Little empirical research exists on perceived racism among children having DD, although there is growing recognition that racism, combined with the stigma of disability, may exert negative impacts upon the health and well-being of minority children having DD (Ali et al., 2001; Pachter & Coll, 2009).

To date, few studies have employed a cumulative ACE or AFE questionnaire to investigate adversities among children with DD, despite the fact that adversities often cluster together or co-occur in the lives of individuals (Felitti et al., 1998). Moreover, prior studies of adversity and child disability status typically involved non-representative or convenience samples (i.e. welfare recipients in Michigan professional nurses families of children with autism in MA and WI and other convenience samples making it difficult to generalize findings to the broader population of children with disabilities (Glidden & Schoolcraft, 2003; Hartley et al., 2010; Hastings & Brown, 2002; Roberts et al., 2016). Although a recent, population-based study documented significantly higher rates of adverse family experiences (AFEs) among US children with ASD, this analysis was limited to children with ASD; other developmental disabilities were not included (Berg et al., 2016).

Because adverse experiences may accrue disproportionately to families of children with DD, there is clear need for more information about prevalence and levels of adversity specific to this population, and its relationship to potential confounders, including poverty and residential disadvantage. The objective of our study is to generate new knowledge about the population prevalence of AFEs among US children with DD using the Adverse Family Experiences questionnaire. To achieve this objective, we tested the following hypotheses: 1) families of children with DD will report a higher level of AFEs than families of children without DD; 2) the relationship between childhood DD status and higher level of AFEs, for all levels, will remain significant after adjusting for the effects of confounding factors, including poverty and neighborhood disadvantage.

2. Methods

This study employed the 2011–2012 National Survey of Children's Health (NSCH), a nationally representative survey about child health and wellbeing conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention ([Child & Adolescent Health Measurement Initiative, 2016](#)). The design and methodology of the NSCH has been described extensively in the literature. 2011–2012, parent interview data was collected on 95,677 children nationwide. The completion rate for the survey was 54.1% and 41.2% for the landline and cell phone samples, respectively. Survey data was reweighted to be generalizable to the United States (US) population of non-institutionalized children ages 0–17 years and in each state. This study was limited to parents of children age 3–17 years ($N = 62,428$), given that age of diagnosis varies by DD and is typically ≥ 3 years of age for conditions such as autism spectrum disorder ([Boyle et al., 2011](#)).

2.1. Variables

2.1.1. Developmental disabilities (DD)

In the 2011–12 NSCH, parents reported whether a healthcare professional ever diagnosed their child with a medical condition. Parents were then prompted to respond (yes/no) to a list of common developmental disabilities.³⁰ For the purposes of this study, we adhered to the framework used by the Centers for Disease Control in the National Health Interview Surveys to measure developmental disabilities among non-institutionalized individuals in the general population; a conceptualization also documented in previously published epidemiological studies of childhood DD ([Boyle et al., 2011](#)).

As such, children with DD were identified as having ≥ 1 of the following conditions: autism spectrum disorder (ASD), intellectual disability, cerebral palsy, Tourette's syndrome, hearing impairment, vision impairment, speech impairment, epilepsy/seizure disorder, traumatic brain injury/concussion, and other developmental delays. Due to the uneven distribution of conditions, children with ≥ 1 DD were consolidated into one group: DD ($N = 2622$ population = 2,120,116). Children without DD who reported a physical health condition (asthma, diabetes, joint problems), mental health conditions (depression, anxiety), or learning/attention related disability (ADHD/learning disability) were excluded from this study (See Appendix A for the distribution of DD). We excluded children with *only* ADHD and/or learning disabilities given the frequent misclassification of trauma symptoms as learning or attention disorders ([Stolbach et al., 2013](#)). ADHD can be challenging to distinguish from PTSD as both disorders include physiological reactivity, heightened arousal, difficulty concentrating, and irritability ([Briscoe-Smith & Hinshaw, 2006](#); [Germán, Belamarich, & Oyeku, 2016](#); [Klein, Damiani-Taraba, Koster, Campbell, & Scholz, 2015](#); [Stolbach et al., 2013](#)). In addition, a recent population-based study of children with ADHD using the NSCH documented significantly higher rates of AFEs among this population; prompting questions about whether diagnoses of ADHD in this population could, at times, be a misclassification of trauma symptoms ([Germán et al., 2016](#)). ADHD, generally, may be one of the most common misdiagnosis among children ([Evans, Morrill, & Parente, 2010](#)). Finally, as documented in previous studies, substantial collinearity between learning disorders and pervasive developmental disabilities (PDD) suggested that many identified learning disorders may be a result of childhood PDD as opposed to co-morbidities ([Boyle et al., 2011](#)).

2.1.2. Adverse family experiences (AFEs)

The 2011–12 NSCH employed the Adverse Family Experiences questionnaire, an adaptation of the original ACE questionnaire. Five items from the original ACE questionnaire selected by the Child and Adolescent Health Measurement Initiative, in collaboration with the Maternal and Child Health Bureau and the National Center on Health Statistics for inclusion in the AFE questionnaire ([Felitti et al., 1998](#); [Child & Adolescent Health Measurement Initiative, 2016](#)). Four additional items, created by a Technical Expert Panel, captured additional, contextual aspects of adversity children may be exposed to and included the following: economic hardship, death of a parent, neighborhood violence, and discrimination based on race/ethnicity. Items pertaining to child maltreatment (neglect; physical, sexual and emotional abuse) were not included in the AFE questionnaire due to concerns that parent respondents would under report instances of maltreatment ([McKinney, Harris, & Caetano, 2009](#)). The AFE questionnaire, consisting of these nine items, was deemed valid by a technical review panel and has been utilized in multiple studies which resulted in clinically meaningful associations between composite AFE scores and childhood health challenges ([Bethell, Newacheck, Hawes, & Halfon, 2014](#); [Heerman, Krishnaswami, Barkin, & McPheeters, 2016](#); [Lynch et al., 2016](#); [Porche, Costello, & Rosen-Reynoso, 2016](#)).

The AFE questionnaire contains the following items: (1) How often has it been very hard to get by on family's income (1 = very often/somewhat often; 0 = not very often/never); (2) Child lived with a parent who got divorced or separated (Yes; No); (3) Child lived with a parent who died (Yes; No); (4) Child lived with parent who served time in jail or prison (Yes; No); (5) Child has witnessed domestic violence (Yes; No); (6) Child ever a victim/witness of neighborhood violence (Yes; No); (7) Child ever lived with anyone who was mentally ill or suicidal (Yes; No); (8) Child lived with anyone who had problems with alcohol or drugs (Yes; No) and (9)

Child was treated or judged unfairly based on race/ethnicity. Parent responses to each of the 9 items were recoded (0,1) and totaled to calculate AFE scores (0–9). Based upon the response distribution, children were categorized into 3 groups: (0) “low risk” or zero reported AFEs; (1) “moderate risk” or 1–2 reported AFEs; and (3) “high risk” or ≥ 3 reported AFEs. Previous research suggests a strong, graded relationship between ACE scores and probability of negative outcomes (Felitti et al., 1998). However, some studies indicate that the probability of poor outcomes increases substantially when exceeding a particular “threshold” of ACEs (Felitti et al., 1998). Although prior studies using adult retrospective report identified 4 or more ACEs as a potential clinical threshold, this categorization was not feasible given the distribution of AFEs across our population. To reduce statistical error, we merged children with 3 reported AFEs and those associated with 4 more AFEs into one group so that children with 3 or more AFEs corresponded to the top 10% of the population.

2.1.3. Covariates

Parental level of education, household income and residential instability are proxy measures frequently employed in research to estimate the effects of SES on exposure to developmental risk factors and related adversities (Boyle, Georgiades, Racine, & Mustard, 2007; Cronholm et al., 2015; Dong et al., 2005; Emerson & Spencer, 2015; Lantz, House, Mero, & Williams, 2005; Marie-Mitchell & O'Connor, 2013; Stein, Siegel, & Bauman, 2010).

For our study, family poverty level ($< 100\%$ FPL; $100\text{--}200\%$ FPL; $> 200\%$ FPL), parental education (HS or $< \text{HS}$; $> \text{HS}$), residential instability (≤ 3 moves vs. > 3 moves during focus child's lifetime) and additional demographic variables (child race, child gender, child age) were selected because they provide descriptive information about families of children with DD and were potentially associated with child DD status and/or experience of AFEs (Dong et al., 2005; Emerson & Spencer, 2015; Msall et al., 2007; Sullivan, 2009). The possibility exists that child DD status masks the role of socioeconomic factors on risk for adversity (Sobsey, 1994).

2.2. Data analysis

Statistical procedures in Stata 13 were employed to accommodate survey sampling and weighting schemes (StataCorp, 2013). Domain analysis was utilized to analyze the sub-sample representing the national population of families of children with DD, age 3–17 years. Missing values were generally $< 5\%$ across all selected variables except for poverty (9.4%). However, the missingness of poverty was not associated with children with DD. We created additional bivariate analysis to generate prevalence estimates on type and level of reported AFEs among families of children with and without DD. Effect sizes of the bivariate relationships were calculated with Cramer's V and Cohen's D based on the distributions of the variables. Multinomial logistic regression was used to quantify the relationship between child DD status and the probability of being in one of three AFEs outcome categories (0 AFEs; 1–2 AFEs; ≥ 3 AFE). We fitted two models, model 1 and 2, representing the unadjusted and adjusted model respectively. To investigate the robustness of study results we also conducted a series of sensitivity analyses, including selecting different model specifications, different link functions, and approaches to handling missing values.

This study received exemption from human subjects review by the Institutional Review Board given that all study procedures were based upon de-identified, publicly available data.

3. Results

Approximately 4.2% ($N = 2622$) of US children, age 3–17 years, had an identified DD (Table 1). The average age of children with DD was 8.9 years (95% CI 8.5, 9.3) with males comprising the majority of the sample (63.3%). The distribution of child race/ethnicity was as follows: 54.5% identified as White, 24.6% Hispanic; 11.1% Black; and 9.8% “other/multiracial”. Families of children with DD were characterized by higher rates of poverty ($< 100\%$; 26.3% (95% CI 21.9, 30.9) vs. 19.0% (95% CI 18.2, 9.8).

Children with DD were exposed to a higher level of cumulative AFEs compared to children without DD (Table 2). Approximately 40% of children with DD experienced at least one AFE with 14.6% experiencing between 3–9 AFEs. In contrast, 35.3% of children without DD experienced 1 AFE, with 10.2% experiencing ≥ 3 AFEs ($p < .01$). Bivariate analysis at the level of individual AFEs revealed that children with DD had significantly higher prevalence of several AFEs, including income insufficiency (30.3% vs. 22.8%; $p < .01$), household mental illness (10.8% vs. 7.3%; $p < .01$) and household substance use (13.4% vs. 9.9%; $p < .05$) (Table 2).

3.1. Moderate AFEs vs 0 AFEs

Using multinomial logistic regression, we estimated the association between child DD status and risk of moderate AFEs (1–2 AFEs). In the unadjusted model, child DD status (RRR = 1.33; 95% CI 1.10, 1.60) was associated with a 33% increase in relative risk of moderate AFEs (Table 3, Model 1). After adjusting for covariates, children having DD [Relative Risk Ratio (RRR = 1.28; 95% CI 1.06, 1.56)] were associated with a 28% increase in relative risk of moderate AFEs (Table 3, Model 2). Older child age (RRR = 1.03; 95% CI 1.02, 1.04), Black race/ethnicity (RRR = 1.52; 95% CI 1.30, 1.79) and housing mobility (RRR = 2.06; 95% CI 1.87, 2.26) were also independently associated with increased likelihood of moderate AFEs. In contrast, parental post-high school education ($> \text{HS}$; RRR = 0.79; 95% CI 0.71, 0.89), higher household income (100–200% FPL; RRR = 0.73; 95% CI 0.63, 0.85; $> 200\%$ FPL; RRR = 0.36; 95% CI 0.31, 0.41), were associated with a 21% 27% and 64% reduction in the likelihood of moderate AFEs, respectively.

Table 1

Descriptive and Bivariate Analysis between Child Developmental Disability Status and Key Variables in a Nationally Representative Sample of U.S. Families.

	Total Population	No Developmental Disability	Any Developmental Disability	P
Estimated Population Size	47,352,079	45,231,963	2,120,116	
Sample Size	62,428	59,806	2,622	
Adverse Family Experiences (AFEs)				< 0.01
0	54.0 (53.1, 54.9)	54.4 (53.5, 55.3)	45.9 (41.6, 50.1)	
1-2	35.5 (34.7, 36.4)	35.3 (34.4, 36.2)	39.6 (35.3, 43.8)	
3+	10.4 (9.9, 11.0)	10.2 (9.7, 10.8)	14.6 (11.3, 17.8)	
Child Characteristics				
Age	9.71 (9.63, 9.78)	9.74 (9.66, 9.82)	8.90 (8.53, 9.26)	< 0.01
Child Race/Ethnicity				0.74
Hispanic	24.6 (23.7, 25.6)	24.6 (23.7, 25.6)	24.6 (19.8, 29.4)	
White	52.5 (50.5, 53.4)	52.5 (51.5, 53.4)	54.5 (50.0, 59.0)	
Black	12.6 (12.0, 13.2)	12.7 (12.1, 13.3)	11.1 (8.5, 13.7)	
Others/Multiracial	10.2 (9.7, 10.8)	10.3 (9.7, 10.8)	9.8 (6.9, 12.6)	
Child Gender				< 0.01
Female	51.2 (50.3, 52.1)	51.9 (51.0, 52.9)	36.7 (32.7, 40.6)	
Family Characteristics				
Highest Parental Education				0.13
High School or lower	31.1 (30.1, 32.0)	30.9 (29.9, 31.9)	34.5 (29.8, 39.1)	
> High School	68.9 (68.0, 69.9)	69.1 (68.1, 70.1)	68.9 (68.0, 69.9)	
Poverty Level				< 0.01
< 100%	19.3 (18.5, 20.1)	19.0 (18.2, 19.8)	26.3 (21.9, 30.8)	
100% - 200%	22.0 (21.2, 22.9)	21.8 (21.0, 22.7)	25.9 (21.8, 30.1)	
> 200%	58.7 (57.7, 59.6)	59.2 (58.2, 60.2)	47.7 (43.3, 52.1)	
Housing Mobility				0.23
≥ 3 Moves	33.1 (32.2, 34.0)	33.0 (32.1, 33.9)	35.7 (31.2, 40.1)	

Table 2

Prevalence of Individual AFEs by Child Developmental Disability Status in a Nationally Representative Sample of U.S. Families.

AFEs	% of DD Population	% of Non-DD Population
Income insufficiency ^{**}	30.3%	22.8%
Parental divorce/separation	21.6%	20.3%
Parental death	2.9%	2.9%
Parental incarceration	8.1%	6.1%
Domestic violence [†]	8.8%	6.6%
Neighborhood violence [†]	9.6%	7.5%
Household mental illness ^{**}	10.8%	7.3%
Household alcohol/substance use [*]	13.4%	9.9%
Discrimination based on race/ethnicity	3.8%	4.1%

[†] < .10.

^{*} < .05.

^{**} < .01.

3.2. Risk of high AFEs relative to 0 AFEs

Similarly, we estimated the association between child DD status and risk of high (≥ 3) AFEs. In the unadjusted model, children with DD (RRR = 1.69; 95% CI 1.27, 2.24) were associated with a 69% increase in relative risk of 3 or more AFEs (Table 3, Model 1). After adjusting for covariates, child DD status (RRR = 1.60; 95% CI 1.16, 2.21) was significantly and independently correlated with a 60% increase in relative risk of high AFEs (Table 3, Model 2). Other child factors associated with high AFEs included older child age (RRR = 1.08; 95% CI 1.06, 1.09), White, Black, or “Other/Multiracial” race/ethnicity (RRR = 1.72; 95% CI 1.38, 2.16; RRR = 1.75; 95% CI 1.34, 2.30; RRR = 1.40; 95% CI 1.05, 1.85); respectively) and female gender (RRR = 1.19; 95% CI 1.04, 1.37). Residential mobility (≥ 3 moves; RRR = 4.99; 95% CI 4.32, 5.77) was associated with a five-fold increase in likelihood of high AFEs. In contrast, parental post-high school education (RRR = 0.83; 95% CI 0.70, 0.99), household income between 100%–200% FPL (RRR = 0.63; 95% CI 0.51, 0.77), and $> 200\%$ FPL (RRR = 0.20; 95% CI 0.16, 0.25), were associated with a 17%, 37%, and 80% reduction in relative risk of ≥ 3 AFEs, respectively. Additional sensitivity analyses revealed that our results were consistent across different analytical approaches, suggesting that our results were stable.

Table 3

Unadjusted and Adjusted Multinomial Regression Models with Moderate & High AFEs as Outcome Variables between Youths with and without Developmental Disability.

	Unadjusted Model		Adjusted Model	
	1 – 2 AFEs vs. 0 AFE	3 + AFEs vs. 0 AFE	1 – 2 AFEs vs. 0 AFE	3 + AFEs vs. 0 AFE
	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)
Developmental Disability				
Yes (vs. No)	1.33** (1.10, 1.60)	1.69* (1.27, 2.24)	1.28* (1.06, 1.56)	1.60** (1.16, 2.21)
Child Characteristics				
Age			1.03** (1.02, 1.04)	1.08** (1.06, 1.09)
Child Race/Ethnicity				
White (vs. Hispanic)			1.13† (0.99, 1.28)	1.72** (1.38, 2.16)
Black (vs. Hispanic)			1.52* (1.30, 1.79)	1.75** (1.34, 2.30)
Others/Multiracial (vs. Hispanic)			0.88 (0.74, 1.06)	1.40* (1.05, 1.85)
Child Gender				
Female (vs. Male)			1.04 (0.96, 1.13)	1.19* (1.04, 1.37)
Family Characteristics				
Parental Education				
> High School (vs. HS or lower)			0.79** (0.71, 0.89)	0.83* (0.70, 0.99)
Poverty Level				
100% - 200% (vs. < 100%)			0.73** (0.63, 0.85)	0.63** (0.51, 0.77)
> 200% (vs. < 100%)			0.36** (0.31, 0.41)	0.20** (0.16, 0.25)
Housing Mobility				
≥ 3 Moves (vs. < 3)			2.06** (1.87, 2.26)	4.99** (4.32, 5.77)

† < .10.

* < .05.

** < .01.

4. Discussion

This study is one of the first to provide nationally representative prevalence data on level of adversity experienced by children with DD. Our results indicate that children with DD are more likely to experience higher levels of AFEs regardless of income level, and residential status. This finding is consistent with previous, hospital-based and regional studies of adversity among children with DD and has important population health implications (Glidden & Schoolcraft, 2003; Hartley et al., 2010; Hastings & Brown, 2002; Herring et al., 2006; Ingersoll et al., 2011; Puttler et al., 1998; Roberts et al., 2016; Rosen et al., 2007). Items from the ACE and AFE questionnaires have been theoretically and empirically linked to deleterious physiological and developmental effects upon children because of their proximal influence upon development (Heerman et al., 2016; Bethell et al., 2014; Burke et al., 2011; Garner et al., 2012; Lynch et al., 2016; Porche et al., 2016). As such, our findings suggest that children with DD are a vulnerable minority group at disproportionate risk of specific psychosocial and material risks tied to adulthood health disparities (Felitti et al., 1998; Garner et al., 2012).

Our study did not find a significant association between childhood DD and experience of adversity in the community (community violence and racial discrimination). This contrasts with previous research linking youth with disabilities to greater community violence exposure and to a lesser extent, experienced racism (Ali et al., 2001; Harrell, 2012; Hughes et al., 2012; Sullivan, 2009). Our findings may reflect the youthful age of our sample population and subsequently fewer years of potential exposure to stressors (witnessing neighborhood violence, experiencing racism) outside the home. Another explanation is that parents may lack sufficient knowledge or awareness about children's experience of stressors outside of the immediate household resulting in underreporting or inaccurate data (Guterman & Cameron, 1997). Finally, the possibility exists that our findings reflect an actual trend; neighborhood violence exposure is, indeed, only marginally associated with the population of children with DD represented in our study. Notably, childhood DD was correlated with significant disparities in socioeconomic adversity. Over 1/2 of families of children with DD in our study lived at or below 200% of the federal poverty line in comparison to only 41% of families of children without DD. According to research on the stress “proliferation” effects of SES disadvantage, it would be expected that families of children with DD, who are disproportionately impacted by poverty, would experience greater AFEs (Thoits, 2010). This theory is supported by multiple findings on the inverse, linear relationship between family SES and reported experience of violence and adversity, as well as the well-documented relationship between financial hardship and parenting stress (Crouch, Hanson, Saunders, Kilpatrick, & Resnick, 2000; McLoyd, 1990).

Our study documented a significant reduction in relative risk of high AFEs with greater household income and parental education as well as a positive correlation between residential characteristics and heightened adversity; families who moved ≥ 3 times during the index child's lifetime were associated with a five-fold increase in relative risk of 3 or more AFEs (vs. zero AFEs). Further, children with DD were associated with a substantial increase in relative risk of high AFEs regardless of housing mobility and other indicators of family SES. While these correlations might be associated with the ACEs on top of the effects of DD in the general children

population, the etiology of higher levels of AFEs among children with DD remains unclear.

There is an indisputable body of evidence which documents an inverse, graded relationship between AFEs and negative health outcomes over the lifespan (Brown et al., 2009; Felitti et al., 1998). Our study offers compelling evidence about the need to consider AFEs when examining health comorbidities and related outcomes for individuals with DD. AFEs are risk factors which can be addressed, in part, through policy and practice (Garner et al., 2012). Routine screening for AFEs among families of children with DD could facilitate opportunities for prevention and early intervention. Enhanced screening programs of children with DD for AFEs could help identify those families who could benefit most from targeted supports, such as home visiting programs or substance abuse referrals, which could potentially reduce parental stress (Garner et al., 2012). Additionally, expansion of current housing and income assistance programs for families of children with DD could reduce income hardship, potentially averting experience of secondary adversities and health challenges related to poverty (Crouch et al., 2000; McLoyd, 1990; Stein et al., 2010). Finally, longitudinal research on the antecedents and sequelae of AFEs among families of children with DD could be used to develop strategies that promote resilience among vulnerable youth with DD over the life course.

The above findings should be interpreted in the context of several limitations. This study draws from cross-sectional, population-based data, which makes it challenging to infer causality (i.e. to distinguish whether the child DD or adversity came first). That said, our study was not intended to estimate the complex causal relationship between disability and AFEs. For our purposes, children with DD were conceptualized as a demographic subpopulation, and not an “outcome” of adversity. Our stated objective was to quantify the association between child DD status and AFEs and to measure the extent to which potential confounders might contribute to the reported relationship between DD and adversities. In addition, because data was based on parent self-report and recall, certain adversities, such as parental mental illness and domestic violence, may be underreported; therefore, our AFEs estimations may underestimate the full range of adversities experienced by US families. Furthermore, data pertaining to experiences of child maltreatment were not available. Finally, children from lower SES contexts may be underdiagnosed and under-represented among this sample, which would underestimate the strength of the relationship between DD and AFE. Although the issue of missing data was minor in our dataset, it is possible that some variables had non-ignorable missingness that required additional data to verify missing mechanisms. In response, we conducted additional analyses using different strategies to handle missing values. These different analyses yielded similar results and our study conclusions did not change.

5. Conclusion

Families of children with DD experience disproportionate levels of adversity. Beginning in early childhood, individuals with DD are more likely to experience significant adversities that may contribute to observed health disparities in adulthood. Given the significant and enduring impact of early childhood adversity on individuals and communities, it is crucial to assess the long-term impact of AFEs within this population and in the short term, to protect the safety of children with DD whose health challenges may be compounded by the cumulative physiological and psychosocial toll of early adversity.

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Conflict of interest

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Appendix A

Table A1

Table A1
Distribution of Diagnostic Conditions.

Disability/Diagnostic Condition	% of DD Population	% of Entire population, age 3-17 without PH/BMH conditions ^a
Autism Spectrum Disorder	10.8%	1.6%
Brain Injury/Concussion	.86%	.13%
Cerebral Palsy	.54%	.08%
Developmental Delay	19.3%	2.8%
Hearing Impairment	6.4%	.95%
Intellectual Disability	5%	.74%
Seizure Disorder/Epilepsy	3.2%	.47%
Speech/Language Disorder	28%	4.1%
Tourette's Syndrome	.99%	.15%
Vision Impairment	8.5%	1.3%

^a PH = physical health conditions; BMH = behavioral and mental health conditions.

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