Disability and Exposure to High Levels of Adverse Childhood Experiences: Effect on Health and Risk Behavior

Anna Austin, Harry Herrick, Scott Proescholdbell, Jacqueline Simmons

BACKGROUND Health disparities among persons with disabilities have been previously documented. However, there is little research specific to adverse childhood experiences (ACEs) in this population and how ACE exposure affects health outcomes in adulthood.

METHODS Data from the 2012 North Carolina Behavioral Risk Factor Surveillance System (BRFSS) survey were analyzed to compare the prevalence of ACEs between adults with and without disabilities and high ACE exposure (3–8 ACEs). Adjusted risk ratios of health risks and perceived poor health by disability status were calculated using predicted marginals.

RESULTS A higher percentage of persons with disabilities (36.5%) than those without disabilities (19.6%) reported high ACE exposure. Among those with high ACE exposure, persons with disabilities were more likely to report several ACE categories, particularly childhood sexual abuse. In adjusted analyses, persons with disabilities had an increased risk of smoking (relative risk [RR] = 1.29; 95% CI, 1.10–1.51), poor physical health (RR = 4.34; 95% CI, 3.08–6.11), poor mental health (RR = 4.69; 95% CI, 3.19–6.87), and doctor-diagnosed depression (RR = 2.16; 95% CI, 1.82–2.56) compared to persons without disabilities.

LIMITATIONS The definition of disability derived from the BRFSS survey does not allow for those with disabilities to be categorized according to physical disabilities versus mental or emotional disabilities. In addition, we were unable to determine the timing of ACE exposure in relation to disability onset.

CONCLUSIONS A better understanding of the life course associations between ACEs and disability and the impact of exposure to multiple types of childhood adversity on disability and health is needed to inform research and services specific to this vulnerable population.

National and state agency publications have stressed the need for a greater focus on the health of persons with disabilities. Emphasis has been placed on the need for improved access to health care services among persons with disabilities, as well as the need for increased surveillance and research specific to persons with disabilities, particularly with regard to how health exposures, risks, and outcomes differ compared to persons without disabilities [1-4].

Previous research has documented health disparities among persons with disabilities [5-8]. An analysis of 2010 US Behavioral Risk Factor Surveillance System (BRFSS) data found that adults with disabilities were at greater risk for adverse health behaviors and outcomes compared to persons without disabilities. After adjustment for demographic factors, adults with disabilities had higher odds of physical inactivity, obesity, smoking, binge drinking, fair or poor self-rated health, and several chronic conditions compared to those without disabilities [5].

To date, the topic of adverse childhood experiences (ACEs) among persons with disabilities has received relatively little attention in the research literature. ACEs include 8 categories of traumatic or stressful life events experienced before the age of 18 years. The 8 ACE categories are sexual abuse, physical abuse, emotional abuse, household adult mental illness, household substance abuse, domestic violence in the household, incarceration of a household member, and parental divorce or separation. A growing body of literature has demonstrated that these early experiences can have broad and long-lasting effects on mental and physical well-being. Studies have consistently demonstrated that, as the number of ACEs experienced increases, the risk of poor outcomes—such as smoking, obesity, depression, and ischemic heart disease in adulthood—also increases [9, 10].

Two recent studies have explored the association between ACEs and disability in adulthood [11, 12]. In a study of ACEs and disability among US adults, adult disability was shown to have the strongest association with exposure to sexual abuse during childhood (of the 8 categories of ACEs assessed). Those who reported having been touched sexually by an adult, having sexually touched an adult, or having been forced to have sex with an adult as a child were 3 times as likely to also report having disabilities compared to those who did not report these ACE exposures. In addition, with an increase in the number of ACEs an individual reported having experienced during childhood, the risk of disability in adulthood also increased [11].

In a second study of the same population, associations were demonstrated between disability, ACEs, and health risk.

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behaviors. Overall, persons with disabilities were found to have a higher prevalence of health risk behaviors compared to persons without disabilities. Moreover, persons with disabilities who reported 1 or more ACEs were found to have a higher prevalence of smoking and HIV risk behaviors than either persons with disabilities who reported no ACEs or persons without disabilities who reported 1 or more ACEs. These findings suggest that the cumulative effect of exposure to ACEs and the presence of a disability results in those with disabilities and ACEs having a particularly high prevalence of health risk behaviors [12]. However, in these studies the age of onset of disability was unknown. Therefore, the timing of disability onset in relation to the timing of ACE exposure was also unknown, and drawing conclusions about the temporal nature of demonstrated associations was not possible.

The purpose of the present study was to compare outcomes among persons with and without disabilities and exposure to multiple ACEs. The experience of multiple ACEs has been shown to increase the risk for poor outcomes in adulthood [9, 10]; thus we chose to focus only on respondents with high ACE exposure, defined as exposure to 3 or more ACEs. This targeted analysis allowed us to quantify the excess risk of poor outcomes among those with disabilities compared to those without disabilities among an already high-risk group. The definition of high ACE exposure complies with the standardized metric created by the Association of Maternal and Child Health Programs’ Life Course Metrics Project to assess ACEs among adults and the success of various maternal and child health programs [13]. We analyzed data from the 2012 North Carolina BRFSS survey to examine the prevalence and relative risk of health risks and perceived poor health by disability status among adults with high ACE exposure.

Methods

Data for this study were derived from the 2012 North Carolina BRFSS survey. Detailed information regarding the BRFSS survey can be found on the website of the North Carolina State Center for Health Statistics. Briefly, the BRFSS survey is a random-digit-dial telephone survey of the health and health practices of non-institutionalized resident adults aged 18 years and older. In 2012, the North Carolina BRFSS survey included both landline and cell phone interviews (N = 11,898). Inclusion of cell phones began in 2011 and has improved the representativeness of the survey, particularly for low-income and younger adults. The response rate for the 2012 survey was 40.4%, similar to response rates for other Southern states.

ACE Module

Data regarding ACEs were captured by the ACE module included as part of the 2012 North Carolina BRFSS survey (see Table 1). The ACE module consists of 11 questions that measure events experienced before the age of 18 years. Six questions capture household dysfunction, and 5 questions capture childhood abuse. Responses of “don’t know” or “refused” were coded as missing.

| TABLE 1. Behavioral Risk Factor Surveillance System Adverse Childhood Experiences Module |
|---------------------------------------------------------------|
| **Household dysfunction**                                     |
| Mentally ill household member                                 |
| 1. Did you live with anyone who was depressed, mentally ill, or suicidal? [Yes/No] |
| Substance abuse in household                                  |
| 2. Did you live with anyone who was a problem drinker or alcoholic? [Yes/No] |
| 3. Did you live with anyone who used illegal street drugs or who abused prescription medications? [Yes/No] |
| Incarcerated household member                                 |
| 4. Did you live with anyone who served time or was sentenced to serve time in a prison, jail, or other correctional facility? [Yes/No] |
| Parental separation/divorce                                   |
| 5. Were your parents separated or divorced? [Yes/No]          |
| Violence between adults in household                          |
| 6. How often did your parents or adults in your home ever slap, hit, kick, punch or beat each other up? [Never/Once/More than once] |
| **Childhood abuse**                                           |
| Physical abuse                                                |
| 7. How often did a parent or adult in your home ever hit, beat, kick, or physically hurt you in any way? Do not include spanking. [Never/Once/More than once] |
| Emotional abuse                                               |
| 8. How often did a parent or adult in your home ever swear at you, insult you, or put you down? [Never/Once/More than once] |
| Sexual abuse                                                  |
| 9. How often did anyone at least 5 years older than you or an adult touch you sexually? [Never/Once/More than once] |
| 10. How often did anyone at least 5 years older than you or an adult force you to have sex? [Never/Once/More than once] |
| 11. How often did anyone at least 5 years older than you or an adult try to make you touch them sexually? [Never/Once/More than once] |

ACE Score

The ACE score is a standardized score based on responses to the ACE module, and it measures cumulative exposure. To calculate this score, the 11 module questions were used to capture 8 ACE categories, as indicated in Table 1. Exposure to any single category counted as 1 point toward the score. The final score was the sum of the total number of points accumulated; scores ranged from 0–8. Respondents who reported zero ACEs were considered to have no ACE exposure; 1–2 ACEs were considered low ACE exposure; and 3–8 ACEs were considered high ACE exposure.

Measures

Disability was defined according to standard Centers for Disease Control and Prevention (CDC) guidelines for the BRFSS survey and the Healthy People 2010 measure of disability [14, 15]. Disability was assigned to respondents who answered yes to either of 2 questions: “Are you limited in any way in any activities because of physical, mental, or emo-
tional problems?” or “Do you now have any health problem that requires you to use special equipment such as a cane, a wheelchair, a special bed, or a special telephone?” [14]. The ACE score was calculated for those with and without disabilities, and only the highest-risk group, those with high ACE exposure, was retained in the final analysis.

Demographic characteristics of respondents included sex, race, age, education level, and employment. History of chronic conditions was defined as the presence of 2 or more chronic conditions including heart disease, current asthma, skin cancer, other cancer, chronic obstructive pulmonary disease, arthritis, depression, kidney disease, and diabetes.

Health risks included 6 self-report indicators: current smoking (having smoked at least 100 cigarettes and currently smoking on some days or every day [16]), binge drinking (5 or more drinks for males or 4 or more drinks for females on 1 or more occasion(s) in the past month [17]), heavy drinking (more than 2 drinks per day for males or more than 1 drink per day for females), obesity (body mass index ≥ 30 [18]), no exercise (no physical activity in the past 30 days), and HIV risk behaviors (intravenous drug use, having been treated for a sexually transmitted disease, having given or received money or drugs for sex, or having had anal sex without a condom in the past year).

Perceived poor health included 5 self-report indicators: 14 or more days of poor physical health in the past 30 days, 14 or more days of poor mental health in the past 30 days, 14 or more days with an activity limitation due to poor physical or mental health in the past 30 days [19], fair or poor overall health, and doctor-diagnosed depression.

Statistical Analysis

We calculated the prevalence of the ACE score by disability status. The prevalence and chi-square P-values of demographic characteristics among respondents with high ACE exposure were calculated by disability status. For each ACE module question, the prevalence and unadjusted risk ratio were calculated for those with disabilities compared to those without disabilities. For each indicator of health risk and perceived poor health, separate multivariate logistic models were constructed with disability status as the primary independent variable. Unadjusted and adjusted risk ratios were derived from the calculation of predicted marginals. Adjusted models included sex, age, and education level. Models for perceived poor health also adjusted for history of chronic conditions and being unable to work. All percentages shown are weighted percentages. Analyses were conducted in SUDAAN version 11.0.0 and SAS version 9.3.

Results

Distribution of ACE Score by Disability Status

The distribution of ACE scores by disability status for all 2012 North Carolina BRFSS respondents is presented in Figure 1. Among those with disabilities, more than one-third (36.5%) reported high ACE exposure compared to approximately one-fifth (19.6%) of those without disabilities. The final study sample consisted of 743 respondents with disabilities and high ACE exposure and 1,304 respondents without disabilities and high ACE exposure. Of those with disabilities and high ACE exposure, 468 individuals reported activity limitations because of physical, mental, or emotional problems; 48 reported use of special equipment; and 227 reported both activity limitations and use of special equipment.

Demographic Characteristics by Disability Status

Table 2 shows select demographic characteristics for those with and without disabilities and high ACE exposure (3–8 ACEs). Sex did not differ significantly by disability status. However, we did observe significant differences in race, age, education level, and employment. Specifically, whites,
individuals aged 45–54 years, those with less than a high school education, and those unable to work were more prevalent among those with disabilities.

ACE Module Questions by Disability Status

Table 3 shows the crude prevalence and risk ratios of each of the 11 ACE module questions by disability status. For questions regarding household dysfunction, those with disabilities were more likely to report household adult mental illness (RR = 1.30; 95% CI, 1.16–1.45) or alcohol abuse in the household (RR = 1.13; 95% CI, 1.04–1.22) compared to those without disabilities. For all 5 questions regarding childhood abuse, results indicated a significantly higher prevalence among those with disabilities compared to those without disabilities. With regard to sexual abuse, those with disabilities were more likely to report having been touched sexually by an adult (RR = 1.55; 95% CI, 1.32–1.83), having been forced to touch an adult sexually (RR = 1.68; 95% CI, 1.39–2.03), and having been forced to have sex with an adult (RR = 1.79; 95% CI, 1.41–2.27) compared to those without disabilities.

Health Risks and Perceived Poor Health by Disability Status

Among those with high ACE exposure, those with disabilities were at an increased risk for several health risks and for all indicators of perceived poor health compared to those without disabilities (see Table 4). After adjustment for sex, age, and education level, those with disabilities were significantly more likely to be current smokers (RR = 1.29; 95% CI, 1.10–1.51), to be obese (RR = 1.36; 95% CI, 1.16–1.59), to report no exercise in the past 30 days (RR = 1.63; 95% CI, 1.32–2.01), and to report HIV risk behaviors (RR = 1.56; 95% CI, 1.06–2.31). All associated risk ratios for indicators of perceived poor health—after adjustment for sex, age, race, education level, history of chronic conditions, and being unable to work—were significantly higher for those with disabilities. Respondents with disabilities were more than 4 times as likely to report 14 or more days of poor physical health (RR = 4.34; 95% CI, 3.08–6.11) or activity limitation (RR = 4.69; 95% CI, 3.19–6.87) than those without disabilities.

Discussion

In this study, high ACE exposure was more prevalent among those with disabilities (36.5%) than those without disabilities (19.6%). The prevalence of disability among adults in North Carolina is similar to that of other states and of the United States overall, and the finding of a higher prevalence of high ACE scores among those with disabilities compared to those without disabilities has been demonstrated in previous studies [5, 11, 14]. These findings indicate that childhood abuse, household dysfunction, and their effects on adult health are significant public health concerns among those with disabilities. Further, we found an increased risk of each measure of childhood sexual abuse—being forced to have sex with an adult, being touched sexually by an adult, and being forced to touch an adult sexually before age 18 years—among those with disabilities compared to those without disabilities. Associations between disability and childhood sexual abuse have been demonstrated in previous studies [20, 21]. However, such studies have focused on childhood sexual abuse among children with disabilities rather than on life course associations between childhood sexual abuse and disability.

As in previous studies, we were unable to determine the age of onset of disability, and therefore we were unable to determine the temporal association between childhood sexual abuse and disability. However, the 2000 North Carolina BRFSS survey included a question asking respondents the age at which their disability began. An examination of these data, in which disability was defined as activity limitations due to any impairment or health problem and/or the use of special equipment or help from others to get around, revealed that 20% of persons with disabilities had disability onset before the age of 20 years (results not shown). Thus, we can conservatively estimate that 10–15% of those

### Table 2

**Selected Characteristics of North Carolina Adults With High ACE Exposure (3–8 ACEs) by Disability Status**

| Characteristics | No disability | Disability |
|-----------------|--------------|------------|
|                 | N             | N (%)      | N             | N (%)      |
| **Sex**         |               |            |               |            |
| Male            | 458          | 42.3       | 250           | 39.5       |
| Female          | 846          | 57.7       | 493           | 60.5       |
| **Race**        |               |            |               |            |
| White           | 889          | 67.0       | 547           | 73.1       |
| Black           | 260          | 22.1       | 118           | 20.4       |
| Other           | 146          | 10.9       | 72            | 6.5        |
| **Age**         |               |            |               |            |
| 18–34 years     | 388          | 42.2       | 76            | 19.1       |
| 35–44 years     | 281          | 23.1       | 109           | 17.7       |
| 45–54 years     | 260          | 17.5       | 190           | 26.4       |
| 55–64 years     | 212          | 10.9       | 209           | 23.9       |
| 65 years and older | 159       | 6.3        | 156           | 12.8       |
| **Education**   |               |            |               |            |
| Less than high school | 152      | 17.9     | 130           | 26.3       |
| High school     | 336          | 28.5       | 221           | 24.4       |
| Post high school/some college | 391  | 33.4 | 248           | 34.7       |
| College         | 395          | 20.2       | 144           | 14.6       |
| **Employment**  |               |            |               |            |
| Employed        | 842          | 65.1       | 194           | 30.2       |
| Unemployed      | 152          | 13.6       | 86            | 14.0       |
| Unable to work  | 25           | 1.9        | 280           | 34.1       |
| Retired         | 144          | 6.4        | 135           | 12.5       |
| Other           | 138          | 13.0       | 46            | 9.2        |

Note. ACE, adverse childhood experiences. Chi-square tests were conducted to test associations between disability status (no disability versus disability) and each demographic characteristic.

*P < .05
**P < .001
***P < .0001

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with disabilities in the present study incurred their disability before the age of 20 years. Some respondents may therefore have experienced sexual abuse and other ACEs concurrently with their disability, rather than developing disability years after the ACEs occurred.

Among those with high ACE exposure, the risk of current smoking, no recent exercise, obesity, HIV risk behaviors, and all 5 indicators of perceived poor health was significantly higher for those with disabilities compared to those without disabilities, even after adjusting for potential confounders. Other studies of adults with disabilities have yielded similar results with regard to health risks and perceived poor health, but these studies have not taken into account the additional risk posed by childhood adversity [5, 6, 21-25]. Results from the present study demonstrated that the association between disability status and such outcomes remained even when focusing only on adults with high ACE exposure, which is a group already at increased risk for poor outcomes. Given the prevalence of high ACE exposure among persons with disabilities, future research should consider how exposure to ACEs and disability status may contribute independently and cumulatively to quality of life and progression of health among both children and adults with disabilities. Such knowledge will help to inform clinical practice and the development of more comprehensive programs that address the unique needs and history of this vulnerable population.

Limitations

The BRFSS survey includes adults who live in households with a landline or cellular telephone. Institutionalized individuals—including those living in nursing homes, prisons, or hospitals—are excluded, as are those who do not have a landline or cellular telephone. Such individuals may differ in terms of disability status and ACE exposure. Also, the BRFSS survey relies on the self-report of behaviors, conditions, and childhood experiences rather than on objective measurements, which may result in response biases. Specifically, the ACE module asks adult respondents to recall experiences that occurred prior to the age of 18 years, which may result in recall bias or error. However, research into potential biases of ACE questions has found that retrospective self-reports are likely to underestimate true ACE exposure, thus biasing results toward the null rather than overstating the effects of ACEs [27]. In addition, the test-retest reliability of responses to questions about ACEs and the ACE score has been found to be good [28].

The definition of disability derived from the BRFSS survey is broad and does not allow for those with disabilities to be

| ACE module questions                                           | No disability | Disability | Unadjusted risk ratios* (95% CI) |
|---------------------------------------------------------------|---------------|------------|----------------------------------|
| **Household dysfunction**                                     |               |            |                                  |
| Adult mental illness in household                             | 44.3          | 57.5       | 1.30 (1.16-1.45)                 |
| Adult alcohol abuse in household                              | 64.2          | 72.3       | 1.13 (1.04-1.22)                 |
| Adult drug abuse in household                                 | 34.5          | 37.5       | 1.08 (0.92-1.27)                 |
| Incarceration of household member                             | 28.3          | 24.6       | 0.87 (0.72-1.06)                 |
| Parental separation or divorce                                | 62.5          | 52.9       | 0.85 (0.76-0.94)                 |
| Adult domestic violence in household                          | 56.3          | 58.2       | 1.03 (0.94-1.14)                 |
| **Childhood abuse**                                           |               |            |                                  |
| Physical abuse                                                | 47.5          | 57.2       | 1.20 (1.08-1.34)                 |
| Verbal abuse                                                  | 70.0          | 77.9       | 1.11 (1.04-1.19)                 |
| Touched sexually by adult                                      | 25.0          | 38.9       | 1.55 (1.32-1.83)                 |
| Forced to touch adult sexually                                | 19.1          | 32.1       | 1.68 (1.39-2.03)                 |
| Forced to have sex with adult                                 | 13.2          | 23.7       | 1.79 (1.41-2.27)                 |

Note. ACE, adverse childhood experience; CI, confidence interval.

*Risk ratios calculated for disability versus no disability.
categorized by disability type (ie, physical disabilities versus mental or emotional disabilities). Finally, because the BRFSS survey is cross-sectional and does not ask for age of onset of disability, we were unable to draw causal conclusions or to determine the timing of disability onset in relation to ACE exposure.

Conclusion

Overall, the findings from this study demonstrate that persons with disabilities report high ACE exposure at a higher prevalence than persons without disabilities. In addition, among those with high ACE exposure, persons with disabilities were found to be at increased risk for certain health risks and perceived poor health, compared to persons without disabilities. A better understanding of how exposure to multiple types of childhood trauma affects disability and health in adulthood will help to inform strategies to improve the quality of life of persons with disabilities. Future studies would benefit from a life course perspective and information on the age of onset of disability, as the directionality of the association between disability and ACEs, particularly sexual abuse, remains unclear. Future studies would also benefit from the ability to distinguish between persons with physical disabilities and persons with mental or emotional disabilities, as ACE exposure and health outcomes may differ between these groups.

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**Table 4.**

| Health risk | No disability % | Disability % | Unadjusted risk ratios* (95% CI) | Adjusted risk ratios* (95% CI) |
|-------------|----------------|--------------|---------------------------------|-------------------------------|
| Current smoker | 30.7 | 38.2 | 1.24 (1.05-1.46) | 1.29 (1.10-1.51) |
| Heavy drinking | 8.3 | 5.7 | 0.68 (0.44-1.04) | 0.77 (0.49-1.20) |
| Binge drinking | 20.3 | 12.6 | 0.62 (0.46-0.84) | 0.87 (0.65-1.17) |
| Obesity | 30.8 | 44.1 | 1.43 (1.23-1.67) | 1.36 (1.16-1.59) |
| No recent exercise | 18.7 | 45.3 | 2.42 (2.03-2.88) | 1.63 (1.32-2.01) |
| HIV risk behaviors | 9.0 | 9.7 | 1.08 (0.70-1.65) | 1.56 (1.06-2.31) |

**Note.** ACE, adverse childhood experience; CI, confidence interval.

*Risk ratios calculated for disability versus no disability.

*Risk ratios adjusted for sex, age, and education.

*Risk ratios adjusted for sex, age, education, history of chronic conditions, and being unable to work.
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