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## The Effect of Adverse Childhood Experiences on the Health of Current Smokers: 2012 North Carolina Behavioral Risk Factor Surveillance System Survey

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### Abstract

**Objective:** Adverse childhood experiences (ACEs) are stressful or traumatic events experienced before age 18 such as physical abuse or witnessing domestic violence. Research has shown that nicotine addiction, as manifested in early initiation of smoking and heavy smoking, is strongly associated with an increase in the number of ACE exposures. The objective of this study was to measure the additional risk posed by ACE exposures on poor health outcomes among current smokers. A second objective was to highlight differences or similarities in the results of the state study on ACE, titled, “The Effect of Adverse Childhood Experiences on Health in Adulthood: 2012 North Carolina Behavioral Risk Factor Surveillance System Survey,” and the findings of this study.

**Methods:** This study uses data from the 2012 North Carolina BRFSS Survey. From the population of all smokers, 1,846 respondents met the definition for study members, i.e., current smokers who completed some or all of the 11 ACE module questions. Following the methodology of the state study, three ACE study groups were constructed: 1) those who reported no ACEs; 2) those who reported one to two ACEs and 3) those who reported three to eight ACEs. These study groups were then compared with regard to the prevalence and risk (adjusted odds ratios) of chronic disease, self-perceived poor health and health risk behaviors.

**Results:** Seventy-two percent of smokers reported at least one ACE. Both the prevalence and adjusted odds for HIV risk behavior, current asthma, chronic obstructive pulmonary disease (COPD), depression, disability and all four measures of perceived poor health, were significantly higher in the High ACE group (three or more ACEs), compared to the No ACE group. For the Low ACE group (one to two ACEs), only the prevalence and adjusted odds of HIV risk behavior was significantly higher as compared to the No ACE group.

**Conclusion:** A key finding of this study is that only among smokers in the High ACE group did the results show significant worsening of health, as compared to smokers in the Low ACE group or the No ACE group. By comparison, findings from the state study revealed that individuals in *both* the Low and High ACE groups had significant excess risk for chronic disease, perceived poor health and health risk behaviors.

## Introduction

Adverse childhood experiences (ACEs) are traumatic or stressful life events experienced before the age of 18. ACEs include sexual, physical and emotional abuse as well as various forms of household dysfunction (i.e., mental illness in the household and parental divorce or separation). In recent years, increasing attention has been given to ACEs as these early experiences have been found to have broad and long-lasting effects on mental and physical well-being. Evidence from several epidemiological studies has consistently demonstrated a relationship between ACEs and numerous health risk behaviors and health outcomes in adulthood.<sup>1</sup>

This special study focuses on adverse childhood experiences among current smokers and is designed to complement findings from the 2012 North Carolina ACE Report, referred to hereafter as the “statewide study” or “state study” ([SCHS Study No.167](#)).<sup>2</sup> Pertinent to this study, results from the state study show a significant graded relationship between the prevalence of current smoking and ACE status: the smoking rates were 13.4 percent for the no-exposure group, 20.4 percent for those with one to two ACEs, and 33.0 percent for those with three or more ACEs. The focus of this study is on this subpopulation of current smokers, including daily and non-daily smokers, identified from the North Carolina 2012 BRFSS (Behavioral Risk Factor Surveillance System) Survey. The purpose of this study is to describe and measure the effect of ACE exposure on North Carolina smokers with regard to health risk behaviors, perceived poor health and chronic disease conditions. A second purpose of this study is to highlight pertinent differences or similarities in trends between the statewide study and the findings of this study.

## Background

Adverse childhood experiences, or early life stressors, can have a profound and long-lasting effect on smoking behavior. Numerous studies have shown that ACEs increase the likelihood of smoking from early adolescence through adulthood. Key research findings have revealed that ACE-exposure has been associated with early initiation of smoking, ever smoking, current smoking and heavy smoking.<sup>1,3,4</sup> ACEs have also been found to contribute to smoking persistence, even among smokers diagnosed with smoking-related diseases, such as chronic bronchitis, which would contraindicate continuing smoking.<sup>3</sup> Further, as the number of ACE exposures increases, the risk of smoking also increases. Felitti and colleagues found that among those who experience four

or more ACE exposures, the risk of smoking increased four-fold.<sup>5</sup> Similarly, it has been shown that each category of ACE increases the risk of both lifetime smoking and current smoking.<sup>5</sup> Even childhood exposure to parental separation or divorce, which is a fairly common experience for children in American families, increases the likelihood of ever smoking.<sup>6</sup> Taken together, these findings suggest that ACE is highly associated with smoking, both early in life and later in adulthood.

Several different theories have been proposed to account for the excess rate of smoking among persons exposed to ACEs. Using data from the original ACE study sample, Anda and colleagues proposed that, because nicotine has been shown to have a measureable effect on mood regulation, any attempt to quit smoking would remove nicotine as a potential “pharmacological coping device” for dealing with negative emotional, biological or social discomfort, resulting from stress.<sup>1</sup> Since then, there have been other studies to support the “nicotine resource model” which proposes that tobacco smokers benefit from nicotine use as a stress reducer. In a longitudinal study of adolescents, researchers found that high nicotine-expectancy (perceived benefit of smoking) for relief from negative emotions predicted an increase in smoking and nicotine dependence over time, even after controlling for mood and nicotine dependence at baseline.<sup>7</sup> Additionally, among persons with clinical depression, the use of nicotine has been suggested to have anti-depressant properties, acting on two main neurotransmitters, serotonin and dopamine.<sup>8</sup> These and other studies offer support for nicotine as a resource for reducing stress.

Theories have likewise been proposed which offer alternative explanations for the relationship between smoking behavior and ACE exposure. Ansell and colleagues found evidence to support the “stress-vulnerability model of addiction” which states that cumulative lifetime stress results in decreased self-control, increased impulsivity and subsequent increase risk for addiction.<sup>9</sup> Based on a small, community sample, Ansell found that cumulative stress, such as childhood physical or sexual abuse or lifetime-traumatic events, such as seeing someone attacked with a weapon, was positively associated with self-reported impulsivity, and higher impulsivity scores were associated with a greater likelihood of being a current smoker. Alternatively, Parrot and Murphy provide a review of studies that show that the benefits of smoking are countermanded by mood deficits that develop during periods of nicotine withdrawal or abstinence.<sup>10</sup> These type of studies support the “nicotine deprivation” model which posits that, in between cigarettes, most smokers experience some

level of nicotine abstinence or depressed mood; and cumulatively, these mood deficits can increase everyday stress. From a sample of smokers who rated their moods immediately before and after smoking a cigarette, Parrot found that smoking was associated with repetitive, hourly vacillation of mood states, suggesting that nicotine use may be a *cause* of mood fluctuation.<sup>11</sup> Large prospective studies of adolescents smokers have shown that smokers have higher than expected rates of depression, anxiety and suicidal ideation.<sup>12</sup> Studies have also shown that successful smoking cessation leads to significant mood improvement and mood regulation. Cahssin and colleagues found significant and sustained mood gains in smokers who had quit smoking as much as six years after smoking cessation.<sup>13</sup>

## Methods

Data were derived from the 2012 North Carolina BRFSS survey. The BRFSS is an annual statewide telephone survey that assesses the health characteristics of non-institutionalized adults ages 18 years and older. In North Carolina, the 2012 BRFSS included both landline and cell phone interviews. In total, 11,898 adults participated in the 2012 North Carolina BRFSS survey, of which 10,383 (87.3%) responded to the ACE module. This study replicates the methodology outlined in the statewide BRFSS ACE study. The reader should refer to the state study for a more detailed discussion of the BRFSS Survey, the ACE Module questions, the ACE Score, the ACE study groups, and selection and definition of adverse health outcomes, i.e., the dependent variables under investigation.<sup>2</sup>

### *The Current Smoking Population*

The population of current smokers included respondents who reported smoking at least 100 cigarettes in their lifetime and also reported smoking either daily or occasionally. In all, 2,154 respondents met this definition. From this population of smokers, 1,846 respondents met the definition for study members, as current smokers who completed some or all of the ACE module questions. The final study sample represented about 86 percent of all eligible sample members.

### *The ACE Module*

The ACE module asks adults to recall experiences that occurred before the age of 18. The module is made up of 11 questions (see [Table 1](#) of state study) that assess

eight categories of adverse childhood experiences. These eight categories include three questions associated with childhood abuse and five questions associated with household dysfunction:

1. Physical abuse (childhood abuse)
2. Sexual abuse (childhood abuse)
3. Emotional abuse (childhood abuse)
4. A household member who was depressed, mentally ill, or suicidal (household dysfunction)
5. Alcohol or drug abuse in the household (household dysfunction)
6. An incarcerated household member (household dysfunction)
7. Violence between adults in the household (household dysfunction)
8. Parental divorce or separation (household dysfunction)

### *The ACE Score and ACE Study Groups*

The ACE score is the summation of YES responses (1,0) to at least one of the three sexual abuse questions (counted as a score of 1), to at least one of the two the substance abuse questions (counted as a score of 1) and a YES response to the remaining six questions. Thus, the ACE score has a possible range of 0 to 8.

The study groups were constructed in the same manner as the state study, by stratifying the ACE scores into three categories: 0 ACEs, one to two ACEs and three or more ACEs. Those with a score of 0 comprised the No ACE group; those with scores of one or two ACEs comprised the Low ACE group; and those with scores of three or more ACEs comprised the High ACE group. Out of all study members, 597 respondents were assigned to the No ACE group; 653 were assigned to the Low ACE group and 596 respondents were assigned to High ACE. The corresponding weighted percentages, represented by these group numbers, are 28.1 percent, 36 percent and 35.9 percent, respectively (Table 1).

### *Study Outcomes*

For this study, a total of 17 health indicators (outcomes) were selected and defined for analysis. These 17 indicators are categorized by three domains consisting of health risk behaviors, perceived poor health and doctor-diagnosed chronic conditions. Health risk behaviors included heavy drinking, binge drinking, obesity, the report of no exercise in past 30 days and report of at least one of four HIV risk behaviors, such as, used intravenous drugs in the past year.

Perceived poor health consisted of four indicators: 1) self-rated fair or poor health general health, 2) 14+ days in the past 30 days when physical health was not good, 3) 14+ days in the past 30 days when mental health was not good or 4) 14+ days in the past 30 days with an activity limitation due to poor physical or mental health.

The chronic diseases or conditions examined in this study were derived from CDC (Centers for Disease Control and Prevention) questions in the “Chronic Health Conditions” Core Section of the BRFSS Survey. The questions are formatted accordingly (e.g., Has a doctor or health professional ever told you had a stroke?). For the study, the mentioned diseases included current asthma, COPD, cardiovascular disease (heart attack, stroke or angina), diabetes, arthritis, depression, disability and cancer (other than skin cancer). Unlike the statewide study, we did not include kidney disease as the number of smokers with the disease was too small to yield reliable estimates.

### Analysis

Descriptive statistics were calculated for selected demographic characteristics of smokers by ACE study groups, as shown in Table 1. Included with the demographic profile, the prevalence of daily versus non-daily smoking was also calculated (Figure 1). Prevalence estimates were calculated for all (17) health indicators for all ACE study groups (Table 2). Difference-in rate tests (t-tests) were also calculated to test for statistically significant differences in rates between the High ACE group and the No ACE group, and between the Low ACE group and No ACE group. Resulting *p* values of less than 0.05 were considered statistically significant.

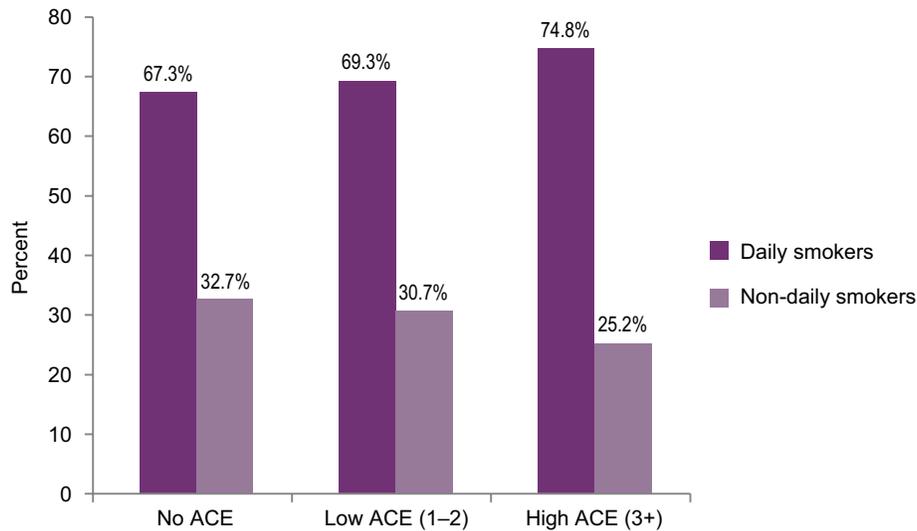
Odds ratios were used as a measure of risk for all study indicators, or adverse outcomes. Logistic regression was used to calculate the odds of the outcome occurring (e.g., heavy drinking) for the High and Low ACE groups compared to

**Table 1. Prevalence of Demographic Characteristics by ACE Study Groups: Current Smokers, 2012 N.C. BRFSS Survey**

Characteristics	No ACE		Low ACE (1–2)		High ACE (3+)	
	N*	%	N	%	N	%
<b>Sex</b>						
Males	267	53.3	307	57.4	220	43.5
Females	330	46.7	346	42.6	376	56.5
<b>Age</b>						
18–44	160	40.9	256	55.7	284	62.1
45–54	118	23.0	164	23.6	156	22.3
55–64	162	21.9	126	12.7	106	11.9
65+	155	14.2	101	8.1	49	3.6
<b>Race</b>						
White	421	71.4	444	65.1	409	67.9
Black	117	21.5	136	25.8	111	24.3
Other	55	7.1	70	9.1	73	7.8
<b>Education</b>						
Less than high school	86	17.0	119	24.7	115	29.9
High school	234	39.4	231	32.2	205	30.2
Post high school	168	31.2	191	32.6	194	32.1
College	107	12.4	112	10.5	82	7.8
<b>Marital status</b>						
Married	256	46.9	235	35.4	203	30.2
Divorce/separated	154	20.7	173	21.4	176	23.5
Widowed	84	7.7	66	6.0	32	2.6
Never married/partner	103	24.8	178	37.2	184	43.6
<b>Income</b>						
Less than \$15,000	98	18.3	123	19.3	155	27.6
\$15,000 to \$24,999	136	25.2	152	25.8	152	31.9
\$25,000 to \$34,999	78	13.0	92	15.9	59	10.9
\$35,000 to \$49,999	85	16.6	83	16.5	62	11.7
\$50,000+	118	26.9	126	22.5	99	17.9
<b>Employment</b>						
Employed	288	54.6	318	54.1	266	46.2
Unemployed	52	12.4	81	14.8	109	21.9
Unable to work	79	12.6	104	12.8	124	17.0
Retired	147	14.4	102	9.3	51	4.7
All other	30	6.1	44	9.1	46	10.3
<b>Housing status</b>						
Home owner	420	72.5	368	57.1	276	44.8
Renter	137	22.2	236	34.9	260	42.0
Other	40	5.3	49	7.9	60	13.3
<b>Total by group</b>	<b>597</b>	<b>28.1</b>	<b>653</b>	<b>36.0</b>	<b>596</b>	<b>35.9</b>

N\* = unweighted

**Figure 1.**  
**Prevalence of Daily and Non-daily Smoking**  
**by Adverse Childhood Experiences (ACE) Study Groups**



the odds occurring in the No ACE group (Table 2). These odds ratios were also adjusted for age and education which are associated with poor health, chronic disease and risk behaviors, such as binge drinking.<sup>15</sup> All percentages shown in this study are weighted percentages, designed to reflect the demographic characteristics of the non-institutionalized adult population in the state for 2012. All analyses were conducted with SAS-callable SUDAAN software (Release 11.0.0).

## Results

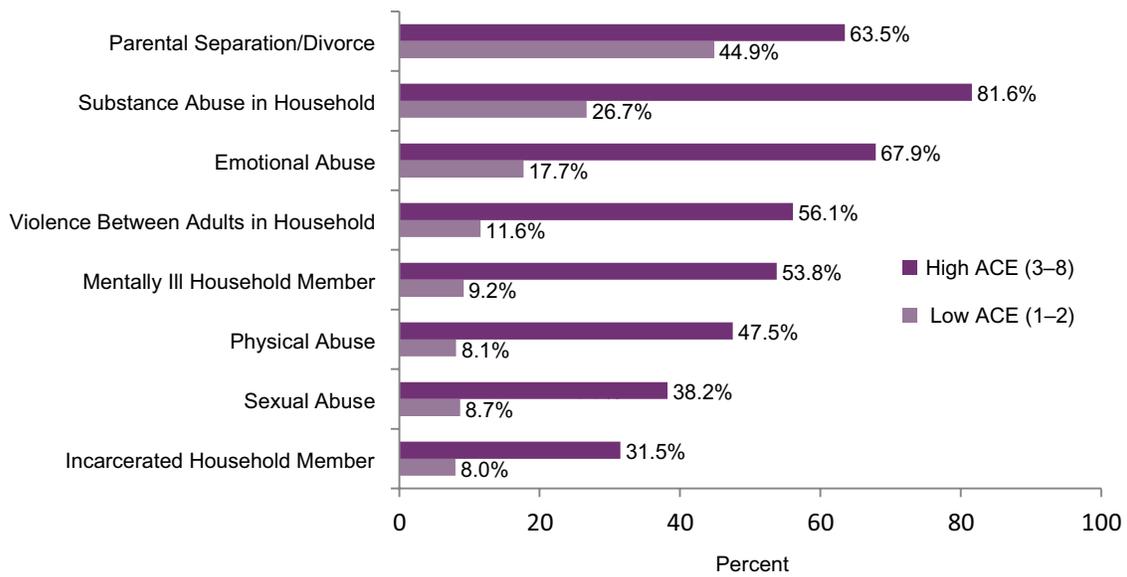
### Demographic Characteristics

In Table 1, the distribution of male and female smokers was equivalent for the No ACE and Low ACE groups; whereas, in the High ACE group there was approximately a 10 percentage point increase in the proportion of females. The age distribution among smokers varied considerably across study groups. The proportion of young adults, ages 18 to 44, increased in a stepwise fashion from 40.9 percent in the No ACE group to 55.7 percent and 62.1 percent in the Low ACE and High ACE groups, respectively. In the oldest age group, the results show a significant stepwise decline in the proportion of 65+ year olds from about 14 percent in the No ACE group to about 4 percent in the High ACE group.

With regard to race, the change in distribution for white smokers dropped by about 6 percentage points from the No ACE group to the Low ACE group. While for blacks, their percentage increased by 4.3 percentage points from No ACE to Low ACE. Many of these demographic trends cited above were also observed in the statewide study.

With regard to education, income and employment, differences between the state sample and the smoking sample were more noticeable. For example, among those with less than a high school education, the proportion of smokers (29.9%) in the High ACE group was significantly higher than the corresponding figure of 20.6 percent for the state (Table 2).<sup>2</sup> With regard to employment status, slightly more than two-in-ten (21.9%) smokers in the High ACE group reported being unemployed; for the state sample, slightly more than one-in-ten (13.7%) respondents in High ACE group reported being unemployed. Also, the percentage of those in the lowest income group (<\$15,000) across all ACE groups was about 8 percentage points higher in the smoking sample as compared to the state sample. Further, smokers were far less likely to report being married across all ACE groups, as compared to the percent married in the state ACE groups. Among smokers just in the High ACE group, home owners were substantially less likely to be represented in the smoking sample (44.8%) than in the statewide sample (60.0%).

**Figure 2.**  
**Prevalence of Individual Adverse Childhood Experiences (ACE) Categories among Current Smokers by ACE Study Groups**



### Daily Smokers

The prevalence of daily versus non-daily smoking by ACE study groups is shown in Figure 1. The results show that daily smoking was somewhat higher among smokers in the High ACE group, while the rates of daily smoking between the No ACE and Low ACE groups were fairly similar. When testing for differences in daily smoking rates, the rate among the High ACE group was statistically higher ( $p=0.03$ ) than the corresponding rate among the No ACE group, while there were no statistical differences in daily smoking rates between the High and Low ACE groups (results not shown).

### Prevalence of Individual ACE Categories

Overall, 72 percent of smokers reported at least one ACE event, while, for the state, 46 percent of non-smokers reported at least one ACE event.

Figure 2 shows the percent distribution for smokers with High and Low ACE scores for each of the eight categories that comprise the total ACE Score. Among smokers in the High ACE group, household substance abuse was the most commonly cited ACE exposure (81.6%). Among smokers in the Low ACE group, parental separation/divorce was most commonly cited (44.9%). The least-often cited ACE exposure for the High ACE group was

household incarceration (31.5%), which was about seven points below the percent reporting sexual abuse (38.2%). By comparison, for the Low ACE group, among the least-often cited indicators, there was no substantial difference in the reporting of household member incarceration (8.0%), sexual abuse (8.7%), physical abuse (8.1%) or living with a mentally ill household member (9.2%) — all rates were within the margin of error.

### Prevalence of Adverse Health Outcomes by ACE Study Groups

Table 2 shows the crude prevalence rates for ACE study groups by health risk behaviors, perceived poor health and chronic disease conditions. For the High ACE group, regarding health risk behaviors, the difference in rates between the No ACE group was not statistically significant for heavy drinking, obesity and lack of exercise. However, there was a substantial difference with regard to HIV risk behavior(s): the rate for the High ACE group was about 4.5 times higher than the rate for the No ACE group. Though not as pronounced, but still significant, the rate for heavy drinking was about 1.5 times higher for the High ACE group. With regard to the four measures of perceived poor health, the reported rates for the High ACE group were all significantly higher ( $p < 0.001$ ) than the corresponding rates for the Low ACE group. For chronic disease conditions,

most notably, the rate of depression (43.1%) was about 2.6 times higher than the rate of depression for the Low ACE group (16.3%). In addition, the rates of current asthma, COPD and disability were also statistically higher ( $p < 0.01$ ) for the High ACE group compared to the Low ACE group. Conversely, there was no statistical difference between these groups with respect to the prevalence of cardiovascular disease, diabetes, arthritis and cancer (other than skin cancer).

For the Low ACE group, the results indicate that, for all but one indicator, HIV risk, there was no significant difference between the corresponding rates found among the No ACE group (Table 2). This trend substantially departs from what was found in the statewide study; whereby, for 10 out of 19 indicators, the prevalence rates were significantly higher in the Low ACE group compared to the No ACE group (Table 3).

### Risk of Adverse Health Outcomes for Low and High ACE Groups

Table 3 shows the odds ratios and associated 95 percent confidence intervals for health risk behaviors, perceived poor health and chronic conditions. For both the Low and High ACE groups, the odds of engaging in HIV risk behavior(s) were significantly higher than the comparable odds for the Low ACE group (the referent group), as were the odds for 14 or more days of activity limitation (due to poor physical/mental health), and the odds of depression. For the High ACE group, the odds associated with every measure of perceived poor health were all highly statistically significant ( $p < 0.001$ ). Of the eight chronic conditions assessed, the adjusted odds ratios for all but diabetes were statistically significantly higher in the High ACE group.

## Discussion

A key finding to emerge from this study of smokers and ACE exposure is that, only among smokers in the High ACE group (three or more ACEs), did we see a significant

**Table 2. Prevalence of Adverse Health Outcomes by ACE Study Groups: Current Smokers, N.C. BRFSS 2012 Survey**

Health indicators	No ACE	Low ACE (1–2) <sup>1</sup>	High ACE (3+) <sup>2</sup>
	%	%	%
<b>Health risks</b>			
Heavy drinking	9.0	5.8	13.5
Binge drinking	21.5	24.7	31.2**
Obesity	23.1	25.2	28.7
No exercise (past 30 days)	25.3	26.1	29.5
HIV risk	3.3	8.7**	15.1***
<b>Perceived poor health</b>			
Fair or poor general health	20.7	22.2	33.6***
14+ days of poor physical health	13.5	14.6	21.9***
14+ days of poor mental health	13.4	16.3	33.7***
14+ days of activity limitation	13.3	18.8	26.3***
<b>Chronic conditions</b>			
Current asthma	6.1	6.5	12.6**
COPD <sup>a</sup>	8.9	9.4	14.8**
CVD <sup>a</sup>	9.0	10.2	10.2
Diabetes	10.0	8.9	9.5
Arthritis	25.4	25.7	29.4
Depressive disorder	16.3	21.2	43.1***
Disability	24.7	22.1	34.9**
Cancer (other than skin)	5.1	6.9	6.7

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .  
<sup>1</sup>P values associated with T-test for difference in rates between 0 ACE and 1–2 ACEs.  
<sup>2</sup>P values associated with T-test for difference in rates between 0 ACE and 3–8 ACEs.  
<sup>a</sup>Abbreviations: COPD — chronic obstructive pulmonary disease; CVD — cardiovascular disease.

worsening of health, compared to smokers with less or no exposure to ACE. Also, having three or more ACEs for smokers was found to have an independent effect on nearly all study indicators of perceived poor health and chronic disease, after controlling for education and age. These findings suggest that, in addition to the deleterious effects caused by smoking alone, having multiple ACE exposures (three or more) might further weaken the health of smokers.

Another key finding points to an excessively high burden of self-rated fair or poor health among smokers in the High ACE group (three or more). In this study, one in three smokers (33.6%) in the High ACE group rated their health as fair or poor. For smokers in the No and Low ACE groups, the rates were both similar (20.7% and 22.2%, respectively) and suggest that only about one-in-five of

**Table 3. Adjusted Odds Ratios for Low and High ACE Study Groups for Adverse Health Outcomes: Current Smokers, N.C. BRFSS 2012 Survey**

Health Indicators	Low ACE (1–2)	High ACE (3–8)
	aOR <sup>1</sup> (95% C.I.)	aOR <sup>2</sup> (95% C.I.)
<b>Health risks behaviors</b>		
Heavy drinking	0.58 (0.33, 1.01)	1.44 (0.88, 2.36)
Binge drinking	0.96 (0.65, 1.42)	1.27 (0.87, 1.84)
Obesity	1.13 (0.80, 1.59)	1.33 (0.94, 1.97)
No exercise (past 30 days)	1.14 (0.83, 1.57)	<b>1.38</b> (1.01, 1.90)
HIV risk	<b>2.24</b> (1.06, 4.77)	<b>3.83</b> (1.83, 8.01)
<b>Perceived poor health</b>		
Fair or poor general health	1.21 (0.85, 1.72)	<b>2.39</b> (1.66, 3.43)
14+ days of poor physical health	1.19 (0.79, 1.78)	<b>2.06</b> (1.37, 3.09)
14+ days of poor mental health	1.24 (0.82, 1.87)	<b>3.15</b> (2.13, 4.64)
14+ days of activity limitation	<b>1.79</b> (1.05, 3.04)	<b>2.94</b> (1.74, 4.98)
<b>Chronic disease conditions</b>		
Current asthma	1.09 (0.62, 1.90)	<b>2.21</b> (1.29, 3.77)
COPD <sup>a</sup>	1.36 (0.91, 2.01)	<b>2.61</b> (1.76, 3.87)
CVD <sup>a</sup>	1.50 (0.95, 2.36)	<b>1.72</b> (1.06, 2.78)
Diabetes	1.09 (0.68, 1.76)	1.27 (0.76, 2.11)
Arthritis	1.35 (0.98, 1.88)	<b>1.99</b> (1.46, 2.80)
Depressive disorder	<b>1.49</b> (1.03, 2.16)	<b>4.39</b> (3.05, 6.18)
Disability	1.05 (0.75, 1.47)	<b>2.37</b> (1.68, 3.33)
Cancer (other than skin)	1.69 (1.00, 2.87)	<b>1.83</b> (1.10, 3.04)

Bold indicates statistical significance ( $p < 0.05$ ).

<sup>1</sup>Odds ratios adjusted for age and education for Low ACE compared to No ACE (referent).

<sup>2</sup>Odds ratios adjusted for age and education for High ACE compared to No ACE (referent).

<sup>a</sup>Abbreviations: COPD — chronic obstructive pulmonary disease; CVD — cardiovascular disease.

smokers in these groups viewed their health as fair or poor. Studies have shown that self-rated poor health is a strong predictor of all-cause mortality. An early NHANES-I (National Health and Nutrition Examination Survey) study found that, over a 12 year period, self-rated fair or poor health was an independent predictor of mortality for middle-aged males, ages 25 to 74, controlling for physical exam status, disease status and other medical data.<sup>16</sup> A prospective study of Finnish adults, over the course of a 23 year period, found that after taking into account medical history, cardiovascular risk factors and education at follow-up, self-rated poor health remained a strong predictor of mortality.<sup>17</sup> Recently it was reported that self-

rated poor health was associated with an increased risk of lung cancer, even after controlling for smoking.<sup>18</sup> These research findings, coupled with our results, suggest that current smokers with three or more ACE exposures from childhood, who report being in fair or poor health, could also have a high risk of premature death.

For smokers in the High ACE group, an additional finding points to the high adjusted odds ratios for risky HIV behavior(s) (3.83) and for depression (4.39). For both of these risk conditions, the research on ACE exposure has shown a similar magnitude of risk among persons exposed to multiple ACE events.<sup>7</sup> As discussed in the statewide report, it is plausible that “. . . attempts to manage the stress of ACEs may result in the adoption of other health risk behaviors such as overeating, risky sexual behavior, illicit drug use, and alcohol abuse as coping mechanisms” (p. 11).<sup>2</sup> Finally, for all but one of the chronic conditions that we examined, the associated odds ratios for the High ACE group were statistically significant. For three of these conditions, COPD, arthritis and cancer, the research has revealed similarly high excess risk for these same chronic conditions.<sup>19,20,21</sup>

The fact that this same group of smokers also tends to be younger in age than their counterparts in the remaining groups is confounding. We found that for those in the High ACE group, the mean age was 44 years compared with 48 years for those in the Low ACE group, and 54 years for those in the No ACE group (results not shown). All three means were statistically independent. Prospective cohort studies are needed to address this co-occurring phenomenon of young age and excess chronic disease among ACE-exposed smokers.

## Conclusion

Overall, the findings from this study provide support for the theory that increased exposure to ACEs is associated with a subsequent increase in poor health outcomes among smokers. The crude prevalence rates for 10 out of 18 study outcomes were statistically significantly higher in the High

ACE group of smokers, compared to the Low and No ACE groups. The adjusted odds ratios for the study indicators of perceived poor health and chronic disease were almost all statistically higher in the High ACE group. We found that, after adjusting for age and education, the effect of having three or more ACE experiences as a smoker posed a significant risk for CVD, arthritis, disability and cancer; while at the same time, the corresponding crude prevalence rates for these chronic diseases were not significantly different. This finding suggests that when the effect that aging has on chronic disease is accounted for, there appears to be an excess risk for these chronic conditions among smokers in the High ACE group. We also found that the results of most study outcomes were similar for smokers in the No ACE group and Low ACE group, except for the elevated risks of HIV risk behaviors, activity limitation, and depression in the Low ACE group.

There are several limitations of this study. The first is the relatively small sample sizes — less than 600 respondents — for the No ACE and the High ACE study groups, upon which most of our conclusions were based. As shown in Table 3, the 95 percent confidence intervals for the associated odds of the High ACE group were, in some cases, quite large (see HIV risk) which indicate a high degree of variability in these estimates. A larger sample size would be needed to produce more stable or reliable estimates. Secondly, we were not able to assess smoking intensity from the survey, which is known to be a defining characteristic among ACE smokers. We did find that daily smoking was significantly higher in the High ACE group but this is only a crude measure of smoking intensity. BRFSS questions on time-to-first-cigarette in the morning or number of cigarettes smoked per day might enhance our understanding and analysis of ACE smokers. Thirdly, as with any telephone survey, health risks and chronic diseases are self-reported, which could result in an underestimate of both of these risk conditions. Both recall and social-desirability biases can occur in telephone surveys, particularly when the topic is sensitive, such as ACE exposure. Therefore, it is likely that results of this study underestimate the true burden of poor health and chronic disease among smokers in the High ACE group.

## Recommendations

One of the most important findings to emerge from this study was the excessively high burden of depression (43%) found among High ACE smokers. A second insight gained from the research is that current cigarette smokers with a history of multiple adverse childhood experiences (and

many with depression) may be most likely to subscribe to the belief that smoking reduces stress or “calms your nerves.” Given these factors, two cessation strategies emerge which might be helpful among the High ACE smoking population — or heavy smokers.

- **Assessment and treatment of depression in smoking cessation therapies**

For smoking cessation therapies to be most successful, particularly among ACE-exposed smokers, assessment and treatment of depression should also be considered in any smoking cessation plan.

- **Debunk the notion that smoking helps “calm your nerves”**

The need to debunk the notion that smoking helps “calm your nerves” may also be an effective quit-smoking message for smokers who believe in the benefit of nicotine to restore mood. As an example of this, Parrot and Murphy developed a leaflet which counters the stress-reducing suppositions of smoking.<sup>10</sup> The authors describe in their leaflet that there are no true calming effects derived from the use of nicotine, that smoking contributes to daily moodiness, that adolescents who take up smoking report more stress one year later than their non-smoking peers and that when adults quit smoking, overtime they feel less stress and both their physical health and psychological well-being improve.

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