Long Term Physical Health Consequences of Adverse Childhood Experiences

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ABSTRACT

This study examined associations between adverse childhood experiences and adult physical health using data from 52,250 US adults aged 18-64 from the 2009-2012 Behavioral Risk Factor Surveillance System (BRFSS). We found that experiencing childhood physical, verbal, or sexual abuse, witnessing parental domestic violence, experiencing parental divorce, and living with someone who was depressed, abused drugs or alcohol, or who had been incarcerated were associated with one or more of the following health outcomes: self-rated health, diabetes, heart attack, heart disease, and functional limitations. Adult socioeconomic status and health behaviors significantly mediated several of these associations. The results of this study highlight the importance of family-based adverse childhood experience on adult health outcomes and suggest that adult SES and stress-related coping behaviors may be crucial links between trauma in the childhood home and adult health.

INTRODUCTION

A substantial literature addresses the associations between adverse childhood experiences (ACEs) in the family environment and physical and mental well-being in adulthood (For a systematic review of this literature, see Norman et al. 2012). Children who are exposed to emotional, physical, or sexual abuse and other types of household dysfunction are at greater risk of several negative health outcomes in adulthood, including poor self-rated health, chronic diseases, functional limitations, premature mortality, and poor mental health (Amato 1991; Bauldry et al. 2012; Bonomi et al. 2008; Felitti et al. 1998; Hager and Runtz 2012; Stack 1990). Given that adverse experiences early in life lay a critical foundation for long-term health trajectories, the social and economic consequence of ACEs are potentially far-reaching. ACEs result in significant economic costs in the form of lost employment productivity and tax revenue and increased spending on safety net programs and health care services (Tang et al. 2006; Zielinksi 2009). ACEs are also associated with reduced adaptability and increased social isolation (Elliott et al. 2005), reduced self-esteem (Oates 1984), and increased rates of dissociation and anger hostility (Teicher et al. 2006). Yet we still know little about the complex pathways between ACEs and poor adult health outcomes, and how these pathways may very across different adverse conditions and health outcomes.

The family is one of the most important contexts for human development. If the origins of adult disease and health disparities are found in disruptions that occur in the family environment during the early years of life (Shonkoff et al. 2009), understanding the relationships between ACEs in the family environment and physical well-being among those individuals once they become adults is crucial to developing strategies to confront health disparities early on. Accordingly, the objectives of the present study are to 1) examine whether there are significant

associations between nine specific ACEs (physical abuse; sexual abuse; verbal abuse; witnessing parental domestic violence; experiencing parental divorce; living with anyone who was depressed, mentally ill, or suicidal; living with anyone who was a problem drinker or alcoholic; living with anyone who abused drugs; or living with anyone who was incarcerated, and three specific types of adult health outcomes (self-rated health, chronic diseases, and the presence of functional limitations); 2) determine whether adult socioeconomic status (SES) and/or poor mental health and stress-related coping behaviors serve as potential pathways linking ACEs with adult health; and 3) determine whether these potential mechanisms linking adversities during childhood to adult health vary for different adversities and different health outcomes.

BACKGROUND

Understanding the Link between Adverse Childhood Experiences and Adult Health

Insofar as ACEs contribute to the development of risk factors for poor health, then exposure to these adverse conditions should be recognized as a social determinant of health (Greenfield 2010). Individuals are particularly vulnerable to environmental exposures during stages of rapid development, like infancy and early childhood (Kelly-Irving et al. 2013). Previous research has found that childhood abuse, witnessing parental domestic violence, parental divorce during childhood, and living with anyone who was depressed, abused substances, or was imprisoned are associated increased odds of experiencing several chronic diseases and disorders in adulthood (Felitti et al. 1998; Goodwin et al. 2003; Roettger and Boardman 2012; Schafer and Ferraro 2012; Springer et al. 2007; Springer 2009). While important, these studies have either examined one adverse experience at a time or summed them to create a cumulative ACE index, limiting our ability to understand which particular adverse

conditions are associated with each specific health outcome. Furthermore, much of the extant literature on abuse has focused on the relationship between childhood sexual and physical abuse and adult health (Bonomi et al. 2008; Briere and Elliott 2004; Spaccarelli 1994; Springer et al. 2007; Springer 2009), but verbal abuse occurs far more frequently in US households. In a large national sample, 63% of American parents reported one or more instance of verbal aggression, including swearing and insulting their child (Vissing et al. 1991). Furthermore, a large percentage of children in the US witness the perpetration of violence by one parent against another (Osofsky 2003), experience parental divorce (Amato 2010), and live with someone who was imprisoned (Wakefield and Wildeman 2013), and the relationships between these common ACEs and adult physical health remain largely unexamined.

Although some researchers have argued that early risk factors have a permanent and enduring effect on individual life trajectories (Dannefer 2003; Ferraro and Kelley-Moore 2003), others have suggested the potential of countervailing mechanisms to reduce the effects of early disadvantage on health (Ferraro and Kelley-Moore 2003). Identifying and targeting the potential links between adverse childhood circumstances and adult health may help to reduce one potential cause of health disparities throughout the life course.

Mechanisms Linking Adverse Childhood Experiences to Poor Health in Adulthood

The life course perspective is the dominant theoretical framework for understanding how conditions in childhood affect individuals throughout their lives. From this perspective, advantage and disadvantage are transmitted from parents to children through multiple pathways, and these early childhood experiences can affect adult health through cumulative social and economic damage over time (Elder 1998; Hayward and Gorman 2004) and through the

"biological embedding of adversities during sensitive developmental periods" (Shonhoff et al. 2009, 2252). Childhood is a particularly salient stage of development, and thus, adverse events during childhood have the potential to influence developmental pathways and shape the character and content of later life (Bauldry et al. 2012; Macmillan 2001). ACEs in the family environment may shape exposure to direct and indirect health risks, including disruption of neuroendocrine and immune functioning due to chronic arousal of the body's physiologic response to stress (Danese and McEwen 2012; Heim et al. 2002; Shonkoff et al. 2009), depression, PTSD, and negative health attitudes and beliefs (Kendall-Tackett 2002), and economic tenuousness, stressful home environments, and poor health behavior choices in adulthood (Repetti et al. 2002), consequently leading to health disparities over the life course. There are also several sociological pathways related to decision-making and the accumulation of human capital that may explain the relationship between ACEs and poor adult health. The development of personal and psychological resources that guide decision-making and the accumulation of various human, social, and cultural capitals that can shape future health occur during childhood (Caspi 1987; Clausen 1991; Edler 1994; Macmillan 2001).

The present research attempts to examine these consequences by using a large, diverse sample of US adults to examine two specific pathways that may link nine different adverse childhood experiences and three specific adult health outcomes. Specifically, ACEs may be associated with negative health outcomes in adulthood through adult SES and/or stress and coping strategies that involve unhealthy lifestyle behaviors. Although these proposed pathways are not exhaustive of all potential mechanisms, they provide two useful starting points for understanding the links between ACEs and adult health.

Socioeconomic Status

We know a great deal about how childhood SES impacts adult health. Children who grow up in low SES households have worse self-rated health, higher chronic disease and mortality rates, and more functional limitations in adulthood compared to those who grew up in higher SES households (Bauldry et al. 2012; Hayward and Gorman 2004; Poulton et al. 2002). In addition, Laaksonen et al. (2005) found that adult SES is associated with health independently of childhood economic difficulties. Few empirical studies, however, examine adult SES as a potential pathway linking ACEs to adult health, and those that do tend to focus on one type of adverse experience (usually physical or sexual abuse). There is some theoretical and empirical support for the idea that ACEs may be associated with adult SES, *net of the effects* of childhood SES. Children who grow up in unhealthy, unstable, or dangerous environments may be at greater risk of what Merton (1938) referred to as ritualism and retreatism. Retreatism involves rejecting goals and societal norms, and ritualism involves conforming to social norms related to legitimate means of attaining goals but lowering expectations, aspirations, and ambitions toward achieving those goals. Expanding on Merton, Agnew (1999) suggests that exposure to negative stimuli, like physical abuse or witnessing parental violence in the home, increases the likelihood of rejection of conventional goals. Both ritualism and retreatism are associated with reduced effort to achieve success, resulting in lower educational attainment, lower likelihood of employment, and less income (Covey et al. 2013).

There is empirical evidence of negative educational and socioeconomic consequences of abuse in childhood. Abused children have been found to have lower IQ scores (Sadeh et al 1994), worse school achievement (Eckenrode et al. 1993; Straus and Gelles 1989), diminished educational aspirations and effort (Macmillan 2000), and lower educational attainment (Widom

1989). These educational deficits are then likely to result in worse employment prospects, lower income, and less human capital in adulthood (Macmillan 2000). Childhood exposure to abuse has been found to be associated with dissociation, limbic irritability, depression, and anger-hostility (Teicher et al. 2006), all of which may make it more difficult to attain higher education and maintain employment. Exposure to abuse or adult depression or substance abuse in the home, for example, may produce negative models for interpersonal communication, which could then be incorporated as a behavioral response in adult settings, such as college and the workplace. In addition, these negative behavioral models may translate into involvement with the criminal justice system (Fagan et al. 1987; Hagan and McCarthy 1997; Widom 1989), which can diminish future educational and employment prospects.

Research demonstrates that children who grow up in unhealthy, unsafe, or unstable environments are more likely to be economically disadvantaged as adults, *despite parental SES*. In a prospective cohort study using court-substantiated cases of childhood physical and sexual abuse, Currie and Widom (2010) found that adults with documented histories of childhood abuse and/or neglect had lower levels of education, employment, and earnings and fewer assets as adults compared with matched control children. Using longitudinal data and controlling for parental family structure and childhood SES, Covey et al. (2013) found significant associations between childhood physical abuse and witnessing adult domestic violence and adult income and net worth. Together, these economic disadvantages that are more prevalent among adults who experienced adverse conditions in childhood may then equate to worse health outcomes.

Adult SES is an established fundamental cause of health disparities because SES embodies a diverse collection of resources, such as money, knowledge, prestige, power, and important social connections that protect health (Adler et al. 1994; Link and Phelan 1995). SES

differences exist for premature mortality (Idler and Benyamini 1997) and for almost every known disease and condition (Illsley and Baker 1991), including self-rated health (Laaksonen et al. 2005; Lantz et al. 2005), chronic conditions (House 1990; Winkleby et al. 1992) and disability (Hemingway et al. 1997; Lantz et al. 2005; Schoeni et al. 2005). Economic resources may buffer negative experiences in childhood once individuals reach adult status (Lin and Ensel 1989). Adults with higher SES should have greater access to financial resources, knowledge, and social networks that can protect against negative health conditions that may be linked to their adverse childhood experiences.

Unhealthy Lifestyle Behaviors

Previous research suggests that survivors of ACEs experience greater perceived stress as adults compared with adults who did not experience adverse events as a child (Bell and Belicki 1998; Briere and Elliott 2003; Hyman et al. 2007). As a result, these individuals may have developed adaptive coping strategies that are harmful to their health (Spaccarelli 1994). Adults with ACEs may attempt to manage psychological problems, like stress, through avoidance-focused coping mechanisms that may be adaptive means of coping with the trauma of the ACE but may be detrimental to health in the long term. Coping strategies like smoking, alcohol consumption, over-eating, and engaging in risky behaviors can temporarily alleviate distress, shame, and helplessness (Briere 2002) but can lead to serious health problems over time. Meanwhile, healthier coping mechanisms, like exercise, may be underutilized as adaptive strategies to deal with the stress and other psychological problems from childhood. A number of unhealthy lifestyle choices have been linked to growing up in adverse household conditions. Researchers have found higher rates of adult smoking, drug abuse, physical inactivity, poor diet,

alcoholism, and risky sexual behaviors among individuals who experienced childhood maltreatment or household dysfunction (Dube et al. 2003; Felitti et al. 1998; Ford et al. 2011; Kendall-Tackett et al. 2000). Ultimately, individuals' self-regulatory processes may be important intervening variables through which ACEs contribute to poor adult health.

The Present Study

This study advances the literature on the relationship between ACEs and adult health in several ways. First, while previous studies have been restricted to specific US states or community based samples, we use a large sample of US adults who provided retrospective information about their childhood experiences and current health status. Second, previous research that has examined relationships between ACEs and adult health has often failed to control for health care access, risking potential confounding of physical health factors with access to care. By controlling for health insurance status we reduce this risk. Third, although we know a great deal about the relationships between childhood physical and sexual abuse and adult health, we know far less about the ways in which adult health is associated with childhood verbal abuse – a far more common and potentially more enduring ACE - as well as other types of adverse experiences like parental divorce, witnessing parental domestic violence, and residing with adults who abuse drugs or alcohol or who have been imprisoned. Our research examines all of these associations while simultaneously controlling for each of the other ACEs in order to isolate the independent relationship of each ACE with adult health without risking the confounding that may occur when only examining one adverse condition at a time. Fourth, we use three distinct measures of health to explore whether ACEs differentially predict different adult health outcomes. Finally, we test two plausible pathways that may link ACEs to health,

including adult SES, which is often neglected in studies examining relationships between ACEs and adult health despite it being an established fundamental cause of health disparities (Link and Phelan 1995).

METHODS

Data

We use data from the 2009-2012 Behavioral Risk Factor Surveillance System (BRFSS), an annual cross-sectional telephone survey conducted by the Centers for Disease Control (CDC) and all U.S. states to collect information on health outcomes and behaviors, health care utilization, and demographic characteristics among the civilian, non-institutionalized household population. One adult per household is randomly selected for the interview. In 2009-2012 questions about ACEs were available in an optional module for states. Over the four years, fourteen states incorporated the ACE module into their survey administrations: Arkansas and Louisiana (2009); Hawaii, Nevada, Vermont, Wisconsin, and the District of Columbia (2010); Minnesota, Montana, Vermont, Washington, and Wisconsin (2011); and Iowa, North Carolina, Oklahoma, Tennessee, and Wisconsin (2012). The core questions and ACE module questions were identical for all fourteen states over the four years, which enabled pooling the data for robust analysis. Because not all states participated in using the optional module, this particular sample of states underrepresents certain demographic groups, including Hispanics, metropolitan residents, and high-income households. To the extent that any of these groups are more or less likely to experience adverse events and poor health, our results could be upwardly or downwardly biased. See Appendix A for differences in characteristics among respondents in states with vs. without the ACE module. We will discuss the implications of these differences at

the end of the paper. Because some states are represented in our sample more than once, and to control for variation in respondent characteristics across states, we include fixed effects for the states in our regression models.

Our analytic sample includes 52,250 adults aged 18-64. We have chosen to restrict the sample in this way because it covers individuals in early adulthood and in midlife when the onset of health problems and disparities are thought to be at their greatest (Beckett 2000; House et al. 1994; O'Rand and Hamil-Luker 2005).

Measures

Adult health. The analyses examine three adult health outcomes: *self-rated health*, *chronic diseases*, and the presence of a *functional limitation*. For self-rated health, respondents were asked: "Would you say that in general your health is: excellent, very good, good, fair, or poor?" We maintained the variable in its ordinal scale for our analyses. Chronic diseases included heart attack/myocardial infarction, angina or coronary heart disease, and diabetes (except diabetes experienced only during pregnancy). We selected these three diseases because they were consistently asked in all four years of the survey and were the most common diagnoses among respondents. Each of these variables was dichotomized and examined in separate regression models. Functional limitation was measured with a binary question asking respondents to indicate whether they were "limited in any activities because of physical, mental, or emotional problems".

Adverse Childhood Experiences. The ACE module included eleven questions addressing adverse experiences related to a parent or another adult. The first five questions were dichotomous, asking the respondent to indicate whether his/her parents were separated or

divorced during childhood (*divorced*), whether s/he lived with anyone who was depressed, mentally ill or suicidal (*depression*), whether s/he lived with anyone who was a problem drinker or alcoholic (*alcoholism*), whether s/he lived with anyone who used illegal street drugs or who abused prescription medications (*drug abuse*), and whether s/he lived with anyone who served time or was sentenced to serve time in a prison, jail, or other correctional facility (*incarceration*). The six additional questions asked respondents about the frequency of various abusive events. With the options of: never, once, or more than once, respondents were asked the following: "How often did your parents or adults in your home ever slap, hit, kick, punch or beat each other up?" (*domestic violence*); "Before age 18, how often did a parent or adult in your home ever hit, beat, kick, or physically hurt you in any way not including spanking?" (*physical abuse*); "How often did a parent or adult in your home ever swear at you, insult you, or put you down?" (*verbal abuse*); "How often did anyone at least 5 years older than you or an adult, ever touch you sexually?"; "How often did anyone at least 5 years older than you or an adult, try to make you touch them sexually?"; and "How often did anyone at least 5 years older than you or an adult, force you to have sex?" Physical and verbal abuse were dummy coded (1 = more than once, 0 = never). We elected to examine the outcome in this way because even though all abuse, even that occurring only once, has potentially negative outcomes for children, abuse that occurs more than once is more representative of a pattern of adverse experiences in the home. We also ran regression models where we dichotomized the physical and verbal abuse outcomes as at least one instance vs. no instances, and the results were largely consistent. Due to strong correlations among the three sexual abuse items, we combined those items to create one dummy variable indicating whether the respondent had experienced *at least one* form of sexual abuse during childhood (*sexual abuse*). We elected to code sexual abuse in this way because unlike physical or

verbal abuse, a one-time sexual assault may potentially have a much stronger effect on enduring health conditions. Again, we reran the models with the alternate outcome coding (more than once vs. once or none), and the model results were consistent. An important caveat about the ACE questions is that some questions asked specifically about parents or other adults living in the home (domestic violence, physical abuse, verbal abuse, parental divorce), others asked just about anyone living in the home (depression, alcoholic, drug abuser, incarceration), and the sexual abuse questions asked about anyone at least 5 years older than the respondent, not restricted to inside the home.

Current Socioeconomic Status. Adult socioeconomic status is measured with four indicators. Dummy variables capture categories of *total household income*: less than $25,000, $25,000-49,999, $50,000-74,999, and $75,000 or more (reference category); *educational attainment*: less than high school, high school graduate and some college, and 4-year college graduate (reference category); *employment status*: employed (reference category), unemployed, retired, student, and unable to work; and a dummy variable to indicate whether the respondent had any kind of *health care coverage* (the BRFSS does not specify type of coverage).

Health and Health Behaviors. Dummy variables capture *smoking status*: current smoker, former smoker, and never smoked (reference category); *binge drinking*: males having five or more and females having four or more drinks on one occasion in the past month; *exercise*: participating in any physical activity or exercise such as running, calisthenics, golf, gardening, or walking for exercise in the past month; *weight status*: obese (BMI or 30 or higher), overweight (BMI of more than 25 but less than 30), and neither overweight or obese (reference category); and *HIV risk behaviors* where respondents were asked to indicate whether they had engaged in any of the following behaviors in the past year (without specifying which one): used intravenous

drugs, treated for a sexually transmitted or venereal disease, given or received money or drugs in exchange for sex, or had anal sex without a condom. The categorizations for binge drinking and weight status were predefined by the BRFSS. The literature suggests that stress, depression, and mental illness are common outcomes of adverse childhood experiences (Bell and Belicki 1998; Hyman et al. 2007), and poor mental health is often what leads to poor health behavior choices (Danese et al. 2009; Ford et all. 2011). Accordingly, we included an indicator of respondent's mental condition (*mental*) with an item that asked: "Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?" The variable was not normally distributed and the median was 0, so we dichotomized it with those at or above the 75th percentile (3 days) coded 1 and those below the 75th percentile coded 0. Model results were robust to different variable specifications.

Controls. We controlled for a variety of potential confounders that have been found to be associated with ACEs and adult health in previous research: sex, race/ethnicity, age, age-squared, marital status, presence of children in the household, total number of people living in the household, whether the respondent had received a routine physical health checkup in the past two years, metropolitan status, and state fixed effects. Unfortunately, the BRFSS does not include any questions about conditions or characteristics during childhood, except the ACEs. Therefore, we were unable to control for parental SES, other childhood characteristics, or the timing of the ACEs. Due to space constraints, we do not present the regression coefficients of our control variables for any of the models, but they are available from the authors upon request. To assess the potential of multicollinearity, we examined correlations between all independent and control variables included in the analyses and found only weak relationships. We also

examined the variance inflation factor (VIF) and multicollinearity (COL) diagnostics in each model and ruled out any problems with multicollinearity.

Analytic Strategy

We present descriptive statistics in Table 1 for all variables for the full sample and comparing adults who experienced at least one ACEs vs. adults who did not experience any of the nine adverse conditions. Although we recognize that not all of the ACEs are equal in their frequency or impact on the child and future adult, presenting descriptive statistics for variables included in the analysis across categories of those who experienced at least one vs. no adverse conditions is the most efficient way to display these statistics.

We estimate the relationships between ACEs and adult self-rated health with ordinal logistic regression models. These models estimate the cumulative probability of being at or below a particular category of self-rated health (in this case, the probability of having better health). Ordered logistic regression models are appropriate for the self-rated health variable because the variable is measured at the ordinal level and dichotomizing the variable would result in the loss of information about variability in self-rated health. Cumulative logit plots identified no concerns with violating the proportional odds assumption. We then estimate the relationships between the ACEs and each of the three chronic disease outcomes (diabetes, heart attack, and heart disease) using binary logistic regression. Finally, we examined the relationships between ACEs and the presence of a functional limitation using binary logistic regression models.

We first present unadjusted models, separately regressing self-rated health, chronic diseases, and functional limitations on each ACE in order to isolate the independent association of each adverse event on each health outcome, not accounting for the other adverse events (Table

2). We proceed by presenting the associations between each of the ACEs and self-rated health, adjusted for all other adverse childhood experiences (Table 3). Although weak correlations existed between the various ACEs, none of the correlations was so high as to create problems with multicollinearity in the regression models (according to VIF and TOL statistics). Model 2 includes all respondent demographic characteristics and fixed effects for states. Model 3 includes socioeconomic status indicators. Finally, model 4 integrates mental health and health behaviors. All analyses are weighted with the BRFSS individual survey weight to adjust for sampling, nonresponse, and telephone coverage bias. Regression analyses for the chronic diseases (Tables 4-6) and functional limitation (Table 7) follow in the same pattern. To formally test the hypotheses that adult SES and health behaviors mediate associations between ACEs and adult health, we checked for statistically significant declines in the coefficients (logged odds) for our ACEs with and without the additional variables in the model using the KHB method in Stata (Karlson et al. 2012; Karlson and Holm 2011; Kohler et al. 2011). The estimated coefficients from model 2 (demographic control model) were compared with the estimated coefficients from model 3 (the SES model) to determine whether adult SES mediated the effects of the ACE variables. Then, the estimated coefficients from model 3 were compared with those from model 4 (the health behaviors model) to determine whether health behaviors additionally mediated the associations of the ACE variables with adult health. Results of the mediation tests are presented in Appendix B.

Sample Characteristics

The total number of respondents aged 18-64 from states that included the adverse childhood experiences module over the four-year period was 62,370. After deletion of cases with

missing responses on the variables of interest, our final analytic sample included 52,250 adults aged 18-64. There were no significant differences between these respondents and those who were excluded due to missing responses. Table 1 displays descriptive statistics for all variables included in the analysis. Just over half (58%) of respondents indicated that they had experienced at least one of the nine ACEs. The most common ACE was verbal abuse (29%), followed by living with an alcoholic and experiencing parental divorce (25% each). The least common ACE was living with someone who had spent time in jail or prison (7%). About 21% of adults in the reported excellent health, 37% reported very good health, 29% reported good health, and 10% and 4% reported fair and poor health, respectively. The overwhelming majority of respondents reported no chronic diseases. Diabetes was the most common chronic disease at just over 7%. Nearly one-fifth of respondents indicated that their activities were limited by some physical, emotional, or mental problem.

<Table 1 about here>

Table 1 also demonstrates sharp differences in health status and respondent characteristics between individuals who experienced any adverse childhood conditions vs. those who did not experience any of the adverse conditions. Adults who experienced at least one adverse event in childhood reported worse health and were significantly more likely to report a diagnosis of diabetes, heart attack, and heart disease and more like to report a functional limitation than respondents who did not report an ACE. Compared to those who reported no ACEs, adults who reported a ACE were more likely to be female, non-white, divorced, separated or never married, have children living in the household, be unemployed, have lower household incomes and educational attainment, be current or former smokers, obese, binge drinkers, and have engaged in HIV risk behaviors in the past year. Adults who experienced adverse childhood

conditions were less likely than those who did not to have a routine physical health checkup in the past 2 years, have any kind of health insurance, to report exercising in the past month, and live in a non-metro area.

<Table 2 about here>

RESULTS

Unadjusted Models

Table 2 presents the results of the unadjusted models regressing each health outcome onto each ACE. All of the ACEs are significantly associated with worse self-rated health. The most pronounced relationship is for physical abuse; compared to respondents who did not report experiencing physical abuse, those who did report experiencing physical abuse in childhood have about 47% lower odds of being in a better health category. The results for the diabetes models are slightly different. For most of the ACEs (physical, verbal, and sexual abuse, domestic violence, and living with an alcoholic), there are increased odds of a diabetes diagnosis. However, there are not significant associations between living with a depressed person, living with a convicted offender, or parental divorce and odds of diabetes. All adverse experiences except parental divorce are associated with significantly increased odds of heart attack, and all but living with a someone who was depressed or abused drugs or experiencing parental divorce are significantly associated with increased odds of heart disease. Finally, all nine ACEs are associated with increased odds of having a functional limitation in adulthood; for example, respondents who reported childhood physical, verbal, or sexual abuse, witnessing parental domestic violence, and living with a depressed person all have over twice the odds of reporting a functional limitation than respondents who did not report those ACEs.

<Table 3 about here>

The Relationship between Adverse Childhood Experiences and Adult Self-Rated Health

The prior table suggests that ACEs are indeed inversely associated with adult health. These differences may be driven by demographic characteristics of respondents themselves or by additional factors associated with socioeconomic status or health behaviors that individuals may be using to cope with the adverse conditions they experienced during childhood. We consider each of these factors for self-rated health in Table 3. In Model 1, experiencing childhood physical, verbal, or sexual abuse, living with an alcoholic, and living with someone who had been incarcerated were negatively associated with self-rated health, net of controlling for each other. The remaining ACEs lost statistical significance once we accounted for the effects of concomitant ACEs. Although the effect sizes for the significant ACEs are fairly robust (e.g., respondents who reported physical abuse have about 28% lower odds of being in a better health category), as can be gleaned from examining the fit statistics at the bottom of the table (Pseudo-R^2 and c)[1], alone these adverse experiences do not do a great job of predicting adult self-rated health. The introduction of demographic variables in Model 2 does little to change the magnitude of the coefficients for physical abuse, verbal abuse, sexual abuse, and living with an alcoholic, but it does result in the elimination of statistical significance for living with a convicted offender, and introduces statistical significance for living with a depressed person and parental divorce. Therefore, among demographically similar respondents, those who lived with a depressed person or experienced parental divorce have significantly worse health than those who did not.

The introduction of socioeconomic covariates in Model 3 results in the elimination of the significance of parental divorce on self-rated health and also significantly mediates the associations between physical abuse, sexual abuse, and living with an alcoholic and self-rated

[1] The traditional R^2 that is calculated for OLS models cannot be calculated for logistic models. The pseudo-R^2 is not interpreted as the percentage of variation in the outcome that can be explained by the model, as in traditional OLS regression. Instead, the pseudo-R^2 should be viewed as one possible measure of model fit.

health. For example, including adult SES in the model led to a reduction in the effects of childhood physical abuse by 60%, childhood verbal abuse by 50%, and living with an alcoholic by 43%. The effect size for verbal abuse also significantly declined but remained significant and substantive. Adding mental health problems and stress-related health coping behaviors in Model 4 resulted in additional attenuation for physical, verbal and sexual abuse, living with a depressed person, and living with an alcoholic. Net of controls for demographic, SES, and health behavior characteristics, only childhood verbal abuse remained a significant predictor of adult self-rated health; respondents who reported more than once instance of verbal abuse in childhood have significantly worse self-rated health than respondents who reported only one or no instances of childhood verbal abuse.

In addition to childhood verbal abuse, respondents with lower households incomes and educational attainment and those who were retired or unable to work, without health insurance, in poor mental health, former or current smokers, and overweight or obese had significantly worse self-rated health, while binge drinking and exercise were positively associated with self-rated health.

<Table 4 about here>

The Relationship between Chronic Diseases and Adverse Childhood Experiences

The results of the analyses examining the relationships between ACEs and diabetes are presented in Table 4. Net of controls for concomitant ACEs (Model 1), respondents who experienced physical or sexual abuse or witnessed parental domestic violence had significantly greater odds of reporting a diabetes diagnosis, and respondents who reported living with someone who was depressed or abused drugs or who experienced parental divorce had significantly lower odds of reporting a diabetes diagnosis compared with respondents who did

not report each respective ACE. Among respondents with the same demographic characteristics (Model 2), respondents who reported physical or sexual abuse or domestic violence had about 23%, 36%, and 22% greater odds respectively of being diagnosed with diabetes than respondents who did not report those events. The introduction of adult SES in Model 3 attenuated the associations between physical abuse, verbal abuse, and domestic violence and diabetes. The introduction of adult health behaviors in Model 4 further attenuated the association with verbal abuse, resulting in non-significant differences in odds of diabetes between individuals who experienced any of the ACEs versus those who did not.

<Table 5 about here>

Table 5 presents the results of the models examining associations between ACEs and odds of having a heart attack. In Model 1, only physical abuse and domestic violence are significant predictors of having a heart attack; respondents who reported physical abuse in childhood had about twice the odds of having a heart attack compared to those who did not experience physical abuse, and respondents who witnessed parental domestic violence had about 30% greater odds of having a heart attack than those who did not witness parental domestic violence. Among demographically similar respondents (Model 2), more significant differences came to light. Respondents who experienced physical abuse or parental divorce or who lived with some who abused drugs or someone who had been incarcerated all had significantly and substantively greater odds of reporting a heart attack. When adult SES was added to the model (Model 3), the positive associations between physical abuse, parental divorce and living with someone who had been incarcerated and heart attack were mediated. The addition of SES did not significantly mediate the positive association between living with someone who abused drugs and odds of having a heart attack. Finally, the addition of mental health and health behaviors in

Model 4 further attenuated the association between physical abuse and living with a drug abuser and heart attack, but physical abuse remained significant, and health behaviors did not further mediate the positive association between parental divorce and heart attack. Among respondents with similar demographic, SES, and health behavior characteristics, odds of having a heart attack are greater among respondents who reported childhood physical abuse and parental divorce.

<Table 6 about here>

Table 6 displays the results of the models examining associations between ACEs and heart disease. Net of controls for the other ACEs (Model 1), physical abuse, parental domestic violence, and living with an alcoholic are associated with significantly greater odds of heart disease in adulthood. Among respondents of similar demographics however (Model 2), childhood physical abuse, living with someone who had been incarcerated, and experiencing parental divorce were all associated with increased odds of heart disease. The addition of adult SES (Model 3) mediated the positive associations between physical abuse, living with someone who had been incarcerated, and parental divorce and heart disease, but parental divorce remained significant. The addition of health behaviors in Model 4 did not further attenuate the significant positive association between parental divorce and heart disease; net of demographics, SES, and health behaviors, respondents who reported that their parents divorced in childhood had about 26% greater odds of reporting heart disease than did respondents whose parents did not divorce during childhood.

For each of the chronic diseases, the inclusion of ACEs alone in the regression models did not lead to very good model fit (see the pseudo-R^2 and c statistics in each table). Thus, although there are significant and substantive differences in diabetes, heart attack, and heart disease between individuals with vs. without ACEs, ACEs alone do not account for much of the

explanation for adult diseases. In all models, adult household income, employment status, educational attainment, and health behaviors were significantly associated with chronic disease, and the introduction of these variables into the models greatly improved model fit.

<Table 7 about here>

The Relationship between Functional Limitations and Adverse Childhood Experience

The final table (Table 7) displays the results of the analyses examining the associations between ACEs and odds of having a mental, emotional, or physical limitation to participation in activities. As shown in Model 1, net of controls for the other ACEs, physical, verbal, and sexual abuse and living with someone who was depressed or an alcoholic are significantly and positively associated with odds of having a functional limitation. Compared to individuals without the applicable ACE, respondents who experienced physical abuse have about 28% greater odds, respondents who experienced verbal abuse have about 41% greater odds, respondents who experienced sexual abuse have about 66% greater odds, respondents who lived with a someone who was depressed have about 42% greater odds, and respondents who lived with an alcoholic have about 27% greater odds of reporting a functional limitation in adulthood. Among the demographically similar (Model 2), physical, verbal, and sexual abuse, living with a depressed person, someone who abused alcohol or drugs or a convicted offender, and experiencing parental divorce are all associated with increased odds of reporting a functional limitation. The introduction of adult SES in Model 3 significantly mediates the associations for physical and sexual abuse, living with someone who was depressed, abused alcohol, or was incarcerated, and parental divorce, but not verbal abuse or living with someone who abused drugs. The introduction of health behaviors in Model 4 further attenuates the associations for physical, verbal, and sexual abuse, living with someone who was depressed, and living with

someone who abused alcohol. Net of controls for demographic, SES, and health behaviors, respondents who experienced verbal or sexual abuse in childhood or who lived with a depressed person have significantly greater odds of reporting a functional limitation in adulthood. Indeed, adults who were physically abused in childhood have over 50% greater odds, those who were sexually abused have almost 20% greater odds, and those who lived with a depressed person have 42% greater odds of reporting a limitation when they are adults compared to respondents who did not experience each of those conditions.

As with the other health outcomes, although ACEs are significantly associated with adult health, the inclusion of ACEs alone in a model did not produce good model fit. There are a number of other important characteristics that influence functional limitations, above and beyond ACEs and result in better model fit, including household income, employment status, educational attainment, health insurance, poor mental health, smoking, weight status, and exercise.

Discussion

We used data from the most recent four years in which the *adverse childhood experiences* module was available (2009-2012) from the Behavioral Risk Factor Surveillance System (BRFSS) to examine associations between ACEs and adult physical health and to explore plausible explanations for how adverse experiences during childhood may be connected to poor adult physical health. The results of this study highlight the importance of family-based ACEs on adult health outcomes and suggest that adult SES and stress-related coping behaviors may be crucial links between trauma in the childhood home and adult health, particularly for physical and sexual abuse.

This research advances the literatures on ACEs and life course determinants of health in a number of important ways. First, findings indicate that, net of controls for concomitant ACEs and demographic characteristics of respondents, there are several important associations between adverse conditions in childhood and all five indicators of adult health. While previous research has examined relationships between adult health and one particular adverse experience at a time or combined ACEs into a single summed construct, by integrating all nine adverse experiences into the same analyses, we were able to reduce the risk of confounding that occurs when excluding potentially concomitant experiences while at the same time maintaining the ability to delineate the unique health outcomes associated with each type of adverse experience. This is important because we found that the associations between ACEs and adult health outcome were not universal; some ACEs were associated with certain health outcomes but not others. Experiencing childhood physical abuse was significantly and substantively associated with worse self-rated health and increased odds of diabetes, heart attack, heart disease, and functional limitations; parental divorce was associated with increased odds of all but a diabetes diagnosis; verbal abuse, sexual abuse, living with someone who was depressed, and living with someone who abused alcohol were all associated with worse self-rated health and increased odds of a functional limitations; sexual abuse was additionally associated with increased odds of diabetes; living with someone who abused drugs or who had been incarcerated was associated with increased odds of a heart attack and a functional limitation; living with someone who had been incarcerated was additionally associated with increased odds of heart disease; and witnessing parental domestic violence was only significantly associated with increased odds of diabetes.

Second, results of this study largely support the hypothesis that adult SES helps to explain the relationship between ACEs and physical health outcomes. This is important

considering that a large proportion of previous research on the relationship between ACEs and adult health downplays or completely ignores the role of adult SES. Formal statistical mediation analyses revealed that SES significantly mediates associations between all five health outcomes and several of the ACEs. For example, when SES was added to the models, the previously significant and substantive associations between physical abuse and self-rated health, diabetes, and heart disease disappeared, as did associations between parental divorce and self-rated health, domestic violence and diabetes, living with someone who had been incarcerated and odds of having a heart attack, heart disease, or functional limitation, and parental divorce and functional limitation. Children who grow up in unsafe and unhealthy environments may be at greater risk of rejecting social norms related to socioeconomic success or of having lowered expectations or ambitions for SES attainment (Agnew 1999; Covey et al. 2013; Merton 1938). Given the well-established role of SES as a social determinant of health (Link and Phelan 1995) adult economic disadvantage stemming from adverse conditions during childhood may then result in worse health outcomes in adulthood. A limitation to this study is that we were unable to control for childhood SES, which has been found in previous research to be associated both with adult SES and adult health (Hayward and Gorman 2004; Poulton et al. 2002), leading to potential confounding in our results. Therefore, although the association between childhood adversity and adult health does appear to be at least partially explained by adult SES, this association is not independent of childhood SES. However, given recent findings that children who experienced abuse or neglect had lower SES in adulthood regardless of parental SES during childhood (Covey et al. 2013; Currie and Widom 2010), we are confident that our results would be robust to controls for childhood SES if they were available.

We also found that poor mental health and stress-related coping behaviors and outcomes, such as smoking, obesity, and lack of exercise were more prevalent among adults who experienced adverse conditions in childhood, and these behaviors helped to attenuate the relationships between ACEs and adult health. For example, net of demographic and SES characteristics, mental health and health behaviors helped to explain the associations between self-rated health and functional limitations and physical abuse, sexual abuse, and living with someone who was depressed or who abused alcohol. Health behaviors also mediated associations between sexual abuse and diabetes, between physical abuse and heart attack, and between living with someone who abused drugs and heart attack. These findings support the vast literature that suggests that individuals who experienced adverse childhood conditions often develop adaptive coping strategies that are harmful to their health (Briere 2002; Dube et al. 2003; Felitti et al. 1998; Ford et al. 2011; Kendall-Tackett et al. 2000; Spaccarelli 1994).

The results of this study also support and extend previous research (Irving and Ferraro 2006; Teicher et al 2006) that suggests that psychological maltreatment may be just as or more detrimental to health than physical abuse. Even after controlling for a host of individual characteristics, adult SES, and health coping behaviors, childhood verbal abuse remained a robust and enduring predictor of self-rated health and functional limitations, while physical abuse only remained associated with odds of having a heart attack and sexual abuse only remained associated with increased odds of having a functional limitation. It is interesting that the enduring relationships between verbal abuse and adult health existed for the two items that were self-rated by respondents rather than the disease diagnoses items. Childhood verbal abuse may have a more enduring effect on individuals' *perceptions* of their own health. Future research should explore the mechanisms that link childhood verbal abuse to adult perceptions of health in

an effort to propose interventions to reduce the lifelong burden of childhood verbal abuse. Parental divorce also remained significantly and positively associated with odds of having a heart attack and odds of heart disease, net of controls for demographics, SES, and health behaviors. Previous research suggests that parental divorce can be stressful to children's developmental processes (Amato 2010). The disadvantaged circumstances that often occur for families before, during, and after divorce may influence risk of cardiovascular problems later in life in ways that we were unable to capture with the existing health behavior variables in the BRFSS. For example, the BRFSS item about exercise asks only whether the respondent engaged in any form of exercise over the past 30 years, with no indication of frequency, amount, or energy expenditure, and the weight status variable uses the controversial proxy of body mass index which may not accurately capture obesity and obesogenic outcomes like heart disease and heart attack. Our measure of divorce is also unable to capture the overall family structure experience of respondents when they were children, including whether children were exposed to multiple divorces or other family transitions or whether the divorce improved or worsened living conditions for the child.

A number of additional limitations should be considered when interpreting the results of this research. First, this study cannot account for childhood health and other conditions, which may confound the findings. It is possible that having a child with health problems may lead to marital problems and parental frustration that may increase the risk for physical and verbal abuse toward the child and parental depression, substance abuse, and divorce. Second, the effects of ACEs on adult health are likely conditioned by the age at which the child experienced the adversity (Elder 1994; Macmillan 2001) as well as the duration and severity of the adversity. Due to the retrospective nature of these data, we were unable to assess variation in timing,

duration, and severity of ACEs, risking the potential of missing nuances in differential exposure and their relationship to the onset of health problems. Instances of abuse that occurred many decades in the past may alter respondents' interpretation of events, and this in turn may bias our results. This is particularly important for verbal abuse since it may be that those who are in poor health, and are therefore more pessimistic about their futures, retroactively interpret occasions of disagreement or discipline as more abuse than people who are in good health.

Third, there are many different ways to measure health, and even though we have examined three distinct measures, some sort of comprehensive health measure may more accurately represent an individual's health (Wolinsky and Zusman 1980). Fourth, some of the variables that are available in the BRFSS that we included in this study are vague and imperfect measures. For example, we found that binge drinking was associated with better health. Given the evidence that heavy drinking increases the risk of heart disease (Roerecke and Rehm 2010), the self-reported binge-drinking variable in the BRFSS is likely not capturing a pattern of problem drinking. Similarly, the functional limitation dependent variable is measured with a binary 'yes/no' response in the BRFSS. A scale or index of functional limitations would allow for a much more nuanced examination of the relationship between ACEs and functional limitations. Nevertheless, the SES and health behavior variables that we included did produce strong model fit. Indeed, the addition of these variables led to much improved model fit over the models that only incorporated the ACEs, suggesting that disparities in adult SES and health behaviors continue to be among the most salient predictors of adult health and should be a continued priority of focus for public health researchers and practitioners. The remaining variability in adult health outcomes that we were unable to explain in our models may be attributable to the impact of other variables that were not available in the BRFSS data, including

other childhood adversities like household poverty, poor nutrition, residential instability, and dangerous neighborhood conditions. Our inability to include these variables in our analysis may result in omitted variable bias.

Finally, due to the voluntary uptake of the ACE module in the BRFSS, this sample is not nationally representative. The states that included this module had lower percentages of Hispanic residents on average than the US as a whole. Given that Hispanics in our sample were more likely than whites to have reported ACEs and reported worse self-rated health and higher chronic disease prevalence, the most likely consequence of the under-representation of Hispanics in our sample is that our results underestimate the prevalence of ACEs in the US. Nevertheless, our sample is an improvement on previous research in this area because it uses a diverse sample of randomly selected respondents from multiple US states while the majority of previous research uses small community-based samples or data collected from one state.

Despite these limitations, this research extends previous research about the consequences of ACEs in the family environment on well-being into adulthood by examining the independent relationships between nine different ACEs and three different physical health outcomes, while controlling for the potential confounding effect of experiencing multiple adverse conditions during childhood. We were also able to demonstrate that the pathways linking ACEs to adult health vary across the type of adverse experience being considered.

Childhood is a period in the life course that has major implications for future educational, labor market, and health outcomes (Macmillan 2001; McLeod and Kaiser 2004). To the extent that ACEs are associated with poor health outcomes in adulthood, they should be considered life course social determinants of health and an issue deserving of public health attention. Given that ACEs may subject children to disadvantaged socioeconomic and health life-course trajectories,

early interventions with unstable or abusive parents may be one of several strategies to prevent future SES disparities *and* health disparities. Interventions targeting the early childhood origins of adult health disparities may be more effective than attempting to modify health behaviors or improve health care access in adulthood (Shonkoff et al. 2009). Finally, while child protective service agencies and doctors have historically been more concerned about the impact and prevention of physical and sexual abuse (Manning and Cheers 1995), the results of this study suggest that screening for verbal abuse should also be a priority.

References

Adler, Nancy E., Thomas Boyce, Margaret A. Chesney, Sheldon Cohen, Susan Folkman, Robert L. Kahn, and S. Leonard Syme. 1994. "Socioeconomic Status and Health: The Challenge of the Gradient." *American Psychologist* 49(1):15-24.

Agnew, Robert. 1999. "A General Strain Theory of Community Differences in Crime and Delinquency." *Criminology* 30:47-83.

Amato, Paul R. 1991. "Parental Absence during Childhood and Depression in Later Life." *The Sociological Quarterly* 32(4):543-556.

Amato, Paul R. 2010. "Research on Divorce: Continuing Trends and New Developments." *Journal of Marriage and Family* 72(3):650-666.

Bauldry, Shawn, Michael J. Shanahan, Jason D. Boardman, Richard A. Miech, and Ross Macmillan. 2012. "A Life Course Model of Self-Rated Health through Adolescence and Young Adulthood." *Social Science & Medicine* 75:1311-1320.

Beckett, Megan. 2000. "Converging Health Inequalities in Later Life – an Artifact of Mortality Selection?" *Journal of Health and Social Behavior* 41:106-119.

Bell, Diane and Kathy Belicki. 1998. "A Community-Based Study of Well-Being in Adults Reporting Child Abuse." *Child Abuse & Neglect* 22(7):681-685.

Bonomi, Amy E., Elizabeth A. Cannon, Melissa L. Anderson, Frederick P. Rivara, and Robert S. Thompson. 2008. "Association between Self-Reported Health and Physical and/or Sexual Abuse Experienced before age 18." *Child Abuse & Neglect* 32: 693-701.

Briere, John. 2002. "Treating Adult Survivors of Severe Childhood Abuse and Neglect: Further Development of an Integrative Model." Pp 175-203 in J.E.B. Myers, L. Berliner, J. Briere, C.T. Hendrix, T. Reid, and C. Jenny (Eds.) *The APSAC Handbook on Child Maltreatment (2nd edition)*. Thousand Oaks, CA: Sage Publications.

Briere, John and Diana M. Elliott. 2003. "Prevalence and Symptomatic Sequelae of Self-Report Childhood Physical and Sexual Abuse in a General Population Sample of Men and Women. *Child Abuse & Neglect* 27:1205-1222.

Caspi, Avshalom, Bradley R. Enter Wright, Terrie E. Moffitt, and Phil A. Silva. 1998. "Early Failure in the Labor Market: Childhood and Adolescent Predictors of Unemployment in the Transition to Adulthood." *American Sociological Review* 63:424-51.

Clausen, John S. 1991. "Adolescent Competence and the Shaping of the Life Course." *American Journal of Sociology* 96:805-42.

Covey, Herbert C., Scott Menard, and Robert J. Franzese. 2013. "Effects of Adolescent Physical Abuse, Exposure to Neighborhood Violence, and Witnessing Parental Violence on Adult Socioeconomic Status." *Child Maltreatment* 18(2):85-97.

Currie, Janet and Cathy Spatz Widom. 2010. "Long-term Consequences of Child Abuse and Neglect on Adult Economic Well-Being." *Child Maltreatment* 15(2):111-120.

Danese, Andrea and Bruce S. McEwen. 2012. "Adverse Childhood Experiences, Allostatis, Allostatic Load, and Age-Related Disease." *Physiology & Behavior* 106(1):29-39.

Dannefer, Dale. 2003. "Cumulative Advantage/Disadvantage and the Life Course: Cross-Fertilizing Age and Social Science Theory." *The Journal of Gerontology* 58(6): S327-337.

Dube, Shanta, Vincent Felitti, Maxi Dong, Daniel Chapman, Wayne H. Giles, and Robert F. Anda. 2003. "Childhood Abuse, Neglect, and Household Dysfunction and the Risk of Illicit Drug Use: The Adverse Childhood Experiences Study." *Pediatrics* 111(3):564-572.

Eckenrode, John, Molly Laird, and John Doris. 1993. "School Performance and Disciplinary Problems among Abused and Neglected Children." *Developmental Psychology* 29:53-62.

Elder Jr., Glen H. 1994. "Time, Human Agency, and Social Change: Perspectives on the Life Course." *Social Psychology Quarterly* 57:4-15.

Elder Jr., Glen H. 1998. "The Life Course as Development Theory." *Child Development* 69(1):1-12.

Elliott, Gregory C., Susan M. Cunningham, Meadow Linder, Melissa Colangelo, and Michelle Gross. 2005. "Child Physical Abuse and Self-Perceived Social Isolation among Adolescents." *Journal of Interpersonal Violence* 20(12):1663-1684.

Fagan, Jeffrey, Elizabeth S. Piper, and Yu-The Cheng. 1987. "Contributions of Victimization to Delinquency in Inner Cities." *The Journal of Criminal Law and Criminology* 78(3):586-613.

Felitti, Vincent J., Robert F. Anda, Dale Norenberg, David F. Williamson, Alison M. Spitz, Valerie Edwards, Mary P. Koss, and James S. Marks. 1998. "Relationship of Childhood Abuse and Household Dysfunction to Many of the Leading Causes of Death in Adults: The Adverse Childhood Experiences (ACE) Survey." *American Journal of Preventive Medicine* 14(4):245-258.

Ferraro, Kenneth F. and Jessica A. Kelley-Moore. 2003. "Cumulative Disadvantage and Health: Long-Term Consequences of Obesity?" *American Sociological Review* 68(5): 707-729.

Ford, Earl S., Robert F. Anda, Valerie J. Edwards, Grealdine S. Perry, Guixianf Zhao, Chaoyang Li, and Janet B. Croft. 2011. "Adverse Childhood Experiences and Smoking Status in Five States." *Preventive Medicine* 53(1):188-193.

Greenfield, Emily A. 2010. "Child Abuse as a Life-Course Social Determinant of Adult Health." *Maturitas* 66:51-55.

Hagan, John and Bill McCarthy 1997. *Mean Streets: Youth Crime and Homelessness*. Cambridge University Press: New York, NY.

Hager, Alanna and Marsha G. Runtz. 2012. "Physical and Psychological Maltreatment in Childhood and Later Health Problems in Women: An Exploratory Investigation of the Roles of Perceived Stress and Coping Strategies." *Child Abuse & Neglect* 36(5):393-403.

Hayward, Mark D. and Bridget K. Gorman. 2004. "The Long Arm of Childhood: The Influence of Early-Life Social Conditions on Men's Mortality." *Demography* 41(1):87-107.

Heim, Chrinstine, D. Jeffrey Newport, Dieter Wagner, Molly M. Wilcox, Andrew H. Miller, And Charles B. Nemeroff. 2002. "The Role of Early Adverse Experience and Adulthood Stress in the Prediction of Neuroendocrine Stress Reactivity in Women: A Multiple Regression Analysis." *Depression and Anxiety* 15:117-125.

Hemingway, Harry, Amanda Nicholson, Mai Stafford, Ron Roberts, and Michael Marmot. 1997. "The Impact of Socioeconomic Status on Health Functioning as Assessed by the SF-36 Questionnaire: The Whitehall II Study." *American Journal of Public Health* 87(9):1484-1490.

House, James S., Ronald C. Kessler, and A. Regular Herzog. 1990. "Age, Socioeconomic Status, and Health." *The Milbank Quarterly* 68(3):383-411.

Hyman Scott M., Prashni Paliwal, and Rajita Sinha. 2007. "Childhood Maltreatment, Perceived Stress, and Stress-Related Coping in Recently Abstinent Cocaine Dependent Adults." *Psychology of Addictive Behaviors* 21(2):233-238.

Idler, Ellen L. and Yael Benyamini. 1997. "Self-Rated Health and Mortality: A Review of Twenty-Seven Community Studies." *Journal of Health and Social Behavior* 38(1):21-37.

Illsley, Raymond and Deborah Baker. 1991. "Contextual Variations in the Meaning of Health Inequality." *Social Science & Medicine* 32(4):359-365.

Irving, Shalon and Kenneth F. Ferraro. 2006. "Reports of Abusive Experiences during Childhood and Adult Health Ratings: Personal Control as a Pathway?" *Journal of Aging and Health* 18(3):458-485.

Karlson, Kristian B., Anders Holm, and Richard Breen. 2012. "Comparing Regression Coefficients between Same-Sample Nested Models using Logit and Probit: a New Method." *Sociological Methodology* 42:286-313.

Karlson, Kristian B. and Anders Holm. 2011. "Decomposing Primary and Secondary Effects: A New Decomposition Method." *Research in Social Stratification and Mobility* 29:221-237.

Kelly-Irving, Michelle, Laurence Mabile, Pascale Grosclaude, Thierry Lang, and Cyrille Delpierre. 2013. "The Embodiment of Adverse Childhood Experiences and Cancer Development: Potential Biological Mechanisms and Pathways Across the Life Course." *International Journal of Public Health*. 58(1): 3-11.

Kendall-Tackett, Kathleen. 2002. "The Health Effects of Childhood Abuse: Four Pathways by which Abuse can Influence Health." *Child Abuse & Neglect* 26:715-729.

Kendall-Tackett, Kathleen, R. Marshall, and K.E. Ness. 2000. "Victimization, Healthcare Use, and Health Maintenance." *Family Violence and Sexual Assault Bulletin* 16:18-21.

Kohler, Ulrich, Kristian Karlson, and Anders Holm. 2011. "Comparing Coefficients of Nested Nonlinear Probability Models." *The Stata Journal* 11:420-438.

Laaksonen, Mikko, Ossi Rahkonen, Pekka Martikainen, and Eero Lahelma. 2005. "Socioeconomic Position and Self-Rated Health: The Contribution of Childhood Socioeconomic Circumstances, Adult Socioeconomic Status, and Material Resources." *American Journal of Public Health* 95(8):1403-1409.

Lantz, Paula M., James S. House, Richard P. Mero, and David R. Williams. 2005. "Stress, Life Events, and Socioeconomic Disparities in Health: Results from the Americans' Changing Lives Study." *Journal of Health and Social Behavior* 46:274-288.

Lin, Nan and Walter M. Ensel. 1989. "Life Stress and Health: Stressors and Resources." *American Sociological Review* 54(6): 382-399.

Link, Bruce G. and Jo Phelan. 1995. "Social Conditions as Fundamental Causes of Disease." *Journal of Health and Social Behavior* 35:80-94.

Macmillan, Ross. 2000. "Adolescent Victimization and Income Deficits in Adulthood: Rethinking the Costs of Criminal Violence from a Life Course Perspective." *Criminology* 38:553-88.

Macmillan, Ross. 2001. "Violence and the Life Course: The Consequences of Victimization for Personal and Social Development." *Annual Review of Sociology* 27:1-22.

Manning, Caroline and Brian Cheers. 1995. "Child Abuse Notification in a Country Town." *Child Abuse & Neglect* 19(4):387-397.

Merton, Robert K. 1938. "Social Structure and Anomie." *American Sociological Review* 3:672-682.

McLeod, Jane D. and Karen Kaiser. 2004. "Childhood Emotional Abuse and Behavioral Problems and Educational Attainment." *American Sociological Review* 69(5): 636-658.

Norman, Rosana E., Munkhtsetseg Byambaa, Rumna De, Alexander Butchart, James Scott. 2012. "The Long-Term Health Consequences of Child Physical Abuse, Emotional Abuse, and Neglect: A Systematic Review and Meta-Analysis." *PLOS Medicine* 9(11):1-31.

Oates, R.K.1984. "Personality Development after Physical Abuse." *Archives of Disease in Childhood* 59:147-150.

O'Rand, Angela M. and Jenifer Hamil-Luker. 2005. "Processes of Cumulative Adversity: Childhood Disadvantage and Increased Risk of Heart Attack across the Life Course." The *Journals of Gerontology Series B* 60(2):117-124.

Osofsky, Joy D. 2003. "Prevalence of Children's Exposure to Domestic Violence and Child Maltreatment: Implications for Prevention and Intervention." *Clinical Child and Family Psychology Review* 6(3):161-170.

Poulton, Richie, Avshalom Caspi, Barry J. Milne, W. Murray Thomson, Alan Taylor, Malcolm R. Sears, and Terrie E. Moffitt. 2002. "Association between Children's Experience of Socioeconomic Disadvantage and Adult Health: A Life-Course Study." *Lancet 360*: 1640-1645.

Repetti, Rena L., Shelley E. Taylor, and Teresa E. Seeman. 2002. "Risky Families: Family Social Environments and the Mental and Physical Health of Offspring." *Psychological Bulletin* 128(2):330-366.

Roerecke, Michael and Jurgen Rehm. 2010. "Irregular Heavy Drinking Occasions and Risk for Ischemic Heart Disease: A Systematic Review and Meta-Analysis." *American Journal of Epidemiology* 171(6):633-644.

Roettger, Michael E. and Jason D. Boardman. 2012. "Parental Incarceration and Gender-Based Risks for Increased Body Mass Index: Evidence from the National Longitudinal Study of Adolescent Health in the United States." *American Journal of Epidemiology* 175(7):636-644.

Sadeh, Avi, Robert M. Hayden, James P.D. McGuire, Henry Sach, and Roberta Civita. 1994. "Somatic, Cognitive, and Emotional Characteristics of Abused Children in a Psychiatric Hospital." *Child Psychiatry and Human Development* 24(3):191-200.

Schafer, Markus H. and Kenneth F. Ferraro. 2012. "Childhood Misfortunes as a Threat to Successful Aging: Avoiding Disease." *Gerontologist 52(1): 111-120.*

Schoeni. Robert F., Linda G. Martin, Patricia M. Andreski, and Vicki A. Freedman. 2005. "Persistent and Growing Socioeconomic Disparities in Disability among the Elderly: 1982-2002." *American Journal of Public Health* 95(11):2065-2070.

Shonkoff, Jack P., W. Thomas Boyce, and Bruce S. McEwen. 2009. "Neuroscience, Molecular Biology, and the Childhood Roots of Health Disparities: Building a New Framework for Health Promotion and Disease Prevention." *Journal of the American Medical Association* 301(21):2252-2259.

Spaccarelli, Steve. 1994. "Stress, Appraisal, and Coping in Child Sexual Abuse: A Theoretical and Empirical Review." *Psychological Bulletin* 116:1-23.

Springer, Kristen W., Jennifer Sheridan, Daphne Kuo, and Molly Carnes. 2007. "Long-Term Physical and Mental Health Consequences of Childhood Physical Abuse: Results from a Large Population-Based Sample of Men and Women." *Child Abuse & Neglect* 31(5):517-30.

Springer, Kristen W. 2009. "Childhood Physical Abuse and Midlife Physical Health: Testing a Multi-Pathway Life Course Model." *Social Science & Medicine* 69:138-146.

Stack, Steven. 1990. "The Effect of Divorce on Suicide in Denmark, 1951-1980." The Sociological Quarterly 31(3):359-370.

Straus, Murray A. and Richard J. Gelles. 1989. *Physical Violence in American Families: Risk Factors and Adaptations to Violence in 8,145 Families*. New Brunswick, NJ: Transaction.

Tang, Betty, Ellen Jamieson, Michael Boyle, Anne Libby, Amiram Gafni, and Harriet MacMillan. 2006. "The Influence of Child Abuse on the Pattern of Expenditures in Women's Adult Health Service Utilization in Ontario, Canada." *Social Science & Medicine* 63(7):1711-1719.

Teicher, Martin H., Jacqueline A. Samson, Ann Polcari, and Cynthia E. McGreenery. 2006. "Sticks, Stones, and Hurtful Words: Relative Effects of Various Forms of Childhood Maltreatment." *American Journal of Psychiatry* 163(6):993-1000.

Vissing, Yvonne M., Murray A. Straus, Richard J. Gelles, and John W. Harrop. 1991. "Verbal Aggression by Parents and Psychosocial Problems of Children." *Child Abuse & Neglect* 15(1): 223-238.

Wakefield, Sara and Christopher Wildeman. 2013. *Children of the Prison Boom: Mass Incarceration and the Future of American Inequality*. Oxford University Press.

Widom, Cathy S. 1989. "The Cycle of Violence." *Science* 244:160-66.

Winkleby, Marilyn, Darius E. Jatulis, Erica Frank, and Stephen P. Fortmann. 1992. "Socioeconomic Status and Health: How Education, Income, and Occupation Contribute to Risk Factors for Cardiovascular Disease." *American Journal of Public Health* 82(6):816-820.

Wolinsky, Frederic D. and Marty E. Zusman. 1980. "Toward a Comprehensive Health Status Measure." *The Sociological Quarterly* 21(4):607-622.

Zielinksi, David S. 2009. "Child Maltreatment and Adult Socioeconomic Well-Being". *Child Abuse & Neglect* 33:666-678.

Table 1. Percentages or Means(SD) for Variables included in the Analysis for Entire Sample and by Experience of Adverse Childhood Experience

	Sample (N=52,250) %/Mean(SD)	Any Adverse (N=30,563) %/Mean(SD)	No Adverse (N=21,687) %/Mean(SD)	
Physical abuse	12.0	------	------	
Verbal abuse	29.1	------	------	
Sexual abuse	11.6	------	------	
Domestic violence	12.5	------	------	
Lived with someone who was depressed	17.7	------	------	
Lived with someone who abused alcohol	25.2	------	------	
Lived with someone who abused drugs	11.2	------	------	
Lived with someone who was incarcerated	6.9	------	------	
Parental divorce	25.2	------	------	
Health Outcomes				
Self-rated health				
Excellent	20.9	18.8	23.9	***
Very Good	36.7	34.7	39.4	***
Good	29.0	30.4	27.1	***
Fair	9.8	11.7	7.2	***
Poor	3.6	4.5	2.5	***
Chronic Diseases				
Diabetes	7.4	7.9	6.8	***
Heart Attack	2.7	3.0	2.2	***
Health Disease	2.8	3.2	2.3	***
Functional Limitation	19.0	23.3	13.0	***
Demographic Characteristics				
Sex (Female)	50.3	52.6	47.2	***
Age	43.9 (12.55)	43.2 (12.29)	44.9 (12.85)	***
Race/Ethnicity				
Non-Hispanic White	79.3	78.4	80.5	***
Non-Hispanic Black	8.9	9.9	7.5	***
Hispanic	4.5	4.8	4.0	***
Non-Hispanic Other Race	7.4	6.9	8.0	***
Marital Status				
Married	64.9	61.5	69.6	***
Divorced/Separated	11.3	13.2	8.7	***
Widowed	2.0	2.0	2.0	
Never Married	21.8	23.3	19.7	***
Children in the household (Yes)	46.6	47.9	44.8	***
Number of people in household	3.2 (1.54)	3.2 (1.54)	3.2 (1.56)	
Lives in Non-Metro area	30.1	29.1	31.6	***
Had a routine health checkup in past 2 years	80.7	79.8	81.9	***

Socioeconomic Status				
Household income				
Less than $25,000	20.6	23.8	16.2	***
$25,000-49,999	25.4	25.6	25.1	
$50,000-74,999	18.9	18.5	19.4	**
$75,000+	35.1	32.1	39.3	***
Employment status				
Employed	70.8	68.8	73.7	***
Unemployed	13.3	8.9	16.5	***
Homemaker	6.3	6.4	6.3	
Student	3.9	4.0	3.8	
Retired	56.1	4.6	7.1	***
Unable to work	6.0	7.4	4.2	***
Education				
Less than high school	7.2	8.4	5.6	***
High school grad/some college	59.8	62.1	56.7	***
College grad	32.9	29.5	37.7	***
Has health insurance	85.3	83.5	87.8	***
Health History and Behaviors				
Poor mental health	24.9	31.0	16.7	***
Smoking status				
Never smoked	55.6	48.9	64.7	***
Former smoker	24.0	25.8	21.5	***
Current smoker	20.4	25.3	13.8	***
Weight status				
Not overweight or obese	34.0	33.4	34.8	**
Overweight	35.3	34.1	36.9	***
Obese	30.7	32.5	28.3	***
Binge drinker	19.6	21.1	17.5	***
Exercise	78.9	77.6	80.7	***
HIV risky behaviors	2.8	3.7	1.4	***

Note: 'Any adverse' indicates that the respondent experienced at least one of the nine adverse conditions in childhood; Independent samples t-tests for difference of means/percentages; **p<.01, ***p<.001; weighted values

Table 2. Unadjusted Models Regressing Health Outcomes on Adverse Childhood Experiences

	Self-Rated Health		Diabetes		Heart Attack		Heart Disease		Functional Limitation	
	O.R.	95% C.I.	O.R.	95% C.I.	O.R.	95% C.I.	O.R.	95% C.I.	O.R.	95% C.I.
Physical abuse	0.534***	0.487-0.586	1.432***	1.245-1.648	2.151***	1.726-2.679	1.744***	1.395-2.180	2.424***	2.196-2.675
Verbal abuse	0.677***	0.635-0.722	1.118*	1.001-1.248	1.307**	1.085-1.573	1.254*	1.055-1.491	2.081***	1.930-2.243
Sexual abuse	0.597***	0.548-0.650	1.431***	1.246-1.643	1.281**	1.028-1.595	1.305**	1.076-1.583	2.353***	2.147-2.580
Domestic violence	0.600***	0.549-0.657	1.498***	1.306-1.718	1.824***	1.453-2.289	1.827***	1.472-2.268	2.088***	1.894-2.301
Live with depressed person	0.742***	0.686-0.802	0.956	0.841-1.087	1.260*	1.004-1.580	1.142	0.917-1.422	2.058***	1.885-2.247
Live with alcohol abuse	0.669***	0.625-0.716	1.136*	1.018-1.268	1.373**	1.136-1.657	1.534***	1.285-1.831	1.823***	1.686-1.972
Live with drug abuse	0.684***	0.618-0.757	0.783**	0.654-0.937	1.448*	1.083-1.935	1.120	0.838-1.498	1.687***	1.508-1.887
Live with convicted offender	0.638***	0.557-0.729	1.051	0.833-1.326	1.880**	1.295-2.728	1.634**	1.135-2.352	1.632***	1.415-1.883
Parental divorce	0.794***	0.741-0.850	0.898	0.796-1.013	1.205	0.987-1.471	1.096	0.901-1.333	1.296***	1.193-1.408

Note: Unadjusted odds ratios and 95% confidence intervals reported from ordinal logistic regression (self-rated health) and binary logistic regression (diabetes, heart attack, heart disease, functional limitation) models; *p<.05; **p<.01, ***p<.001

Table 3. Odds Ratios from Ordinal Logistic Regression Models for Self-Rated Health Regressed on Adverse Childhood Experiences, Demographic Characteristics, Adult SES, and Health Behaviors

	Model 1		Model 2		Model 3		Model 4	
Adverse Childhood Experiences								
Physical abuse	0.724***	0.648-0.808	0.762***	0.682-0.852	0.891*	0.795-0.999	0.944	0.840-1.062
Verbal abuse	0.888***	0.823-0.958	0.838***	0.776-0.904	0.795***	0.735-0.860	0.855***	0.789-0.926
Sexual abuse	0.746***	0.682-0.817	0.756***	0.688-0.831	0.851***	0.775-0.935	0.981	0.893-1.077
Domestic violence	0.907	0.819-1.004	1.016	0.916-1.126	1.108	1.000-1.227	1.089	0.980-1.209
Live with depressed person	0.977	0.900-1.060	0.863**	0.791-0.940	0.865***	0.792-0.945	0.925	0.848-1.010
Live with alcohol abuse	0.828***	0.768-0.893	0.853***	0.790-0.921	0.906*	0.839-0.979	0.937	0.867-1.013
Live with drug abuse	0.973	0.870-1.089	0.900	0.803-1.009	0.915	0.817-1.026	0.921	0.821-1.035
Live with convicted offender	0.852*	0.740-0.981	0.892	0.770-1.034	1.119	0.964-1.299	1.151	0.991-1.336
Parental divorce	0.953	0.886-1.024	0.887***	0.823-0.957	0.982	0.910-1.060	1.007	0.933-1.097
Demographic Characteristics			a		a		a	
Socioeconomic Status								
Household income								
Less than $25,000					0.359***	0.319-0.404	0.440***	0.391-0.495
$25,000-49,999					0.569***	0.523-0.618	0.653***	0.601-0.709
$50,000-74,999					0.759***	0.701-0.821	0.837***	0.774-0.906
$75,000+ (REF)					------	------	------	------
Employment status								
Employed (REF)					------	------	------	------
Unemployed					0.812**	0.711-0.927	0.893	0.780-1.021
Homemaker					1.070	0.951-1.204	0.998	0.892-1.118
Student					1.043	0.845-1.287	0.976	0.791-1.205
Retired					0.899	0.801-1.009	0.887*	0.788-0.997
Unable to work					0.116***	0.096-0.139	0.147***	0.122-0.177
Education								
Less than high school					0.410***	0.348-0.482	0.488***	0.414-0.575
High school grad/some college					0.675***	0.632-0.719	0.785***	0.735-0.838
College grad (REF)					------	------	------	------

Has health insurance					1.181***	1.063-1.312	1.148**	1.036-1.272
Health History and Behaviors								
Poor mental health							0.466***	0.434-0.501
Smoking status								
Never smoked (REF)							------	------
Former smoker							0.831***	0.775-0.891
Current smoker							0.579***	0.531-0.632
Weight status								
Not overweight or obese (REF)							------	------
Overweight							0.650***	0.604-0.701
Obese							0.363***	0.335-0.392
Binge drinker							1.153***	1.061-1.253
Exercise							1.803**	1.731-1.878
HIV risky behaviors							1.063	0.874-1.292
Intercept - Excellent	-1.155***	(.013)	0.305**	(.114)	0.775***	(.125)	-0.122	(.128)
Intercept - Very Good	0.502***	(.011)	2.029***	(.114)	2.607***	(.126)	1.846***	(.129)
Intercept - Good	2.088***	(.105)	3.686***	(.115)	4.517***	(.127)	3.889***	(.130)
Intercept - Fair	3.514***	(.025)	5.149***	(.117)	6.285***	(.129)	5.731***	(.132)
Intercept - Poor (REF)	------							
AIC	145336.01		142056.88		133580.90		128235.15	
c	.562		.629		.697		.745	
Pseudo-R^2	.023		.088		.234		.315	

Note: Adjusted odds ratios and 95% confidence intervals reported from ordinal logistic regression models; *p<.05; **p<.01, ***p<.001

[a] Controls for gender, age, race/ethnicity, marital status, presence of children in the household, total number of people in the household, metropolitan status, receipt of routine physical health checkup in past 2 year, and state fixed effects.

Table 4. Odds Ratios from Binary Logistic Regression Models of Diabetes Regressed on Adverse Childhood Experiences, Demographic Characteristics, Adult SES, and Health Behaviors

	Model 1		Model 2		Model 3		Model 4	
Adverse Childhood Experiences								
Physical abuse	1.294***	1.082-1.548	1.231*	1.027-1.477	1.102	0.914-1.329	1.078	0.891-1.305
Verbal abuse	0.941	0.820-1.079	1.056	0.920-1.211	1.098	0.954-1.264	1.044	0.904-1.206
Sexual abuse	1.379***	1.188-1.602	1.358***	1.166-1.581	1.259**	1.075-1.473	1.126	0.959-1.323
Domestic violence	1.489***	1.242-1.786	1.216*	1.016-1.454	1.147	0.954-1.380	1.182	0.979-1.427
Live with depressed person	0.868*	0.755-0.997	1.018	0.882-1.175	1.009	0.869-1.171	0.967	0.827-1.131
Live with alcohol abuse	1.096	0.959-1.252	0.989	0.865-1.131	0.951	0.828-1.092	0.933	0.810-1.075
Live with drug abuse	0.646***	0.523-0.797	0.846	0.685-1.044	0.829	0.666-1.032	0.862	0.690-1.077
Live with convicted offender	1.097	0.827-1.455	1.246	0.968-1.604	1.052	0.814-1.360	1.078	0.833-1.396
Parental divorce	0.811**	0.711-0.926	1.061	0.924-1.219	0.995	0.861-1.150	1.005	0.863-1.170
Demographic Characteristics			a		a		a	
Socioeconomic Status								
Household income								
Less than $25,000					1.991***	1.611-2.459	1.772***	1.423-2.206
$25,000-49,999					1.539***	1.298-1.824	1.377***	1.159-1.637
$50,000-74,999					1.341**	1.126-1.597	1.223*	1.022-1.462
$75,000+ (REF)					------	------	------	------
Employment status								
Employed (REF)					------	------	------	------
Unemployed					1.360**	1.095-1.689	1.317*	1.049-1.652
Homemaker					1.037	0.800-1.345	1.098	0.833-1.447
Student					0.616	0.289-1.316	0.608	0.294-1.256
Retired					1.261***	1.057-1.503	1.259*	1.051-1.508
Unable to work					1.825***	1.435-2.322	1.559**	1.213-2.004
Education								
Less than high school					1.570***	1.224-2.014	1.403**	1.087-1.810
High school grad/some college					1.281***	1.127-1.456	1.108	0.972-1.264
College grad (REF)					------	------	------	------

Has health insurance					0.994	0.832-1.186	0.946	0.786-1.138
Health History and Behaviors								
Poor mental health							1.289	1.132-1.467
Smoking status								
Never smoked (REF)							------	------
Former smoker							1.071	0.945-1.214
Current smoker							0.930	0.787-1.100
Weight status								
Not overweight or obese (REF)							------	------
Overweight							2.124***	1.768-2.550
Obese							6.216***	5.235-7.381
Binge drinker							0.641***	0.522-0.786
Exercise							0.763***	0.676-0.862
HIV risky behaviors							1.158	0.784-1.711
Intercept	-2.549***	(.022)	-8.697***	(.368)	-8.773***	(.390)	-8.594***	(.408)
AIC	27473.27		24518.47		23731.57		22010.07	
C	.554		.728		.759		.817	
Pseudo-R^2	.010		.146		.181		.254	

Note: Adjusted odds ratios and 95% confidence intervals reported from binary logistic regression models; *p<.05; **p<.01, ***p<.001

[a] Controls for gender, age, race/ethnicity, marital status, presence of children in the household, total number of people in the household, metropolitan status, receipt of routine physical health checkup in past 2 year, and state fixed effects.

Table 5. Odds Ratios from Binary Logistic Regression Models of Heart Attack Regressed on Adverse Childhood Experiences, Demographic Characteristics, Adult SES, and Health Behaviors

	Model 1		Model 2		Model 3		Model 4	
Adverse Childhood Experiences								
Physical abuse	1.979***	1.556-2.518	1.755***	1.374-2.242	1.489**	1.149-1.929	1.414**	1.090-1.833
Verbal abuse	0.855	0.690-1.058	0.961	0.772-1.197	1.021	0.814-1.280	0.977	0.778-1.227
Sexual abuse	0.962	0.749-1.236	1.076	0.836-1.384	0.947	0.732-1.224	0.858	0.664-1.108
Domestic violence	1.293*	1.011-1.655	1.078	0.840-1.385	0.986	0.766-1.269	0.985	0.765-1.268
Live with depressed person	0.961	0.765-1.207	1.171	0.920-1.489	1.155	0.894-1.491	1.108	0.860-1.428
Live with alcohol abuse	1.073	0.873-1.320	0.945	0.764-1.168	0.877	0.709-1.085	0.842	0.682-1.040
Live with drug abuse	0.995	0.709-1.398	1.435*	1.030-1.998	1.425*	1.006-2.019	1.394	0.981-1.981
Live with convicted offender	1.537	0.935-2.528	1.748*	1.116-2.737	1.372	0.858-2.192	1.377	0.862-2.200
Parental divorce	0.975	0.770-1.234	1.419**	1.110-1.823	1.290*	1.013-1.642	1.277*	1.004-1.624
Demographic Characteristics			a		a		a	
Socioeconomic Status								
Household income								
Less than $25,000					2.017***	1.435-2.835	1.761**	1.245-2.492
$25,000-49,999					1.269	0.955-1.687	1.149	0.862-1.530
$50,000-74,999					1.078	0.780-1.490	1.000	0.725-1.380
$75,000+ (REF)					------	------	------	------
Employment status								
Employed (REF)					------	------	------	------
Unemployed					1.676**	1.164-2.415	1.578*	1.082-2.302
Homemaker					0.866	0.554-1.352	0.881	0.562-1.380
Student					3.376*	1.339-8.515	3.386*	1.330-8.620
Retired					1.331*	1.010-1.754	1.290*	0.972-1.711
Unable to work					2.172***	1.456-3.240	1.883*	1.266-2.799
Education								
Less than high school					2.586***	1.819-3.677	2.287***	1.601-3.267
High school grad/some college					1.685***	1.331-2.133	1.501**	1.181-1.908
College grad (REF)					------	------	------	------

Has health insurance					1.103	0.817-1.490	1.094	0.809-1.479
Health History and Behaviors								
Poor mental health							1.433**	1.165-1.762
Smoking status								
Never smoked (REF)							------	------
Former smoker							1.525**	1.199-1.940
Current smoker							1.458**	1.102-1.931
Weight status								
Not overweight or obese (REF)							------	------
Overweight							1.406**	1.091-1.812
Obese							1.888***	1.478-2.411
Binge drinker							0.839	0.602-1.169
Exercise							0.805*	0.666-0.975
HIV risky behaviors							1.764*	1.045-2.978
Intercept	-3.734***	(.037)	-8.246***	(.583)	-8.809***	(.622)	-8.619***	(.629)
AIC	12768.37		11048.15		10325.63		10170.42	
C	.570		.776		.820		.834	
Pseudo-R^2	.012		.149		.207		.242	

Note: Adjusted odds ratios and 95% confidence intervals reported from binary logistic regression models; *p<.05; **p<.01, ***p<.001

[a] Controls for gender, age, race/ethnicity, marital status, presence of children in the household, total number of people in the household, metropolitan status, receipt of routine physical health checkup in past 2 year, and state fixed effects.

Table 6. Odds Ratios from Binary Logistic Regression Models of Heart Disease Regressed on Adverse Childhood Experiences, Demographic Characteristics, Adult SES, and Health Behaviors

	Model 1		Model 2		Model 3		Model 4	
Adverse Childhood Experiences								
Physical abuse	1.444***	1.146-1.819	1.310*	1.038-1.655	1.138	0.889-1.456	1.078	0.841-1.381
Verbal abuse	0.899	0.741-1.090	1.016	0.835-.1234	1.045	0.855-1.278	1.001	0.819-1.223
Sexual abuse	1.059	0.840-1.336	1.123	0.895-1.411	0.995	0.787-1.257	0.902	0.713-1.140
Domestic violence	1.481***	1.194-1.836	1.224	0.979-1.532	1.143	0.906-1.440	1.140	0.903-1.438
Live with depressed person	0.910	0.730-1.133	1.061	0.842-1.336	1.026	0.807-1.303	0.978	0.771-1.240
Live with alcohol abuse	1.368**	1.233-1.653	1.199	0.987-1.458	1.147	0.941-1.397	1.100	0.903-1.339
Live with drug abuse	0.743	0.537-1.027	1.133	0.826-1.555	1.102	0.787-1.543	1.076	0.765-1.514
Live with convicted offender	1.460	0.906-2.355	1.778**	1.151-2.744	1.485	0.948-2.328	1.501	0.955-2.358
Parental divorce	0.892	0.715-1.113	1.341*	1.069-1.683	1.266*	1.018-1.575	1.258*	1.015-1.559
Demographic Characteristics			a		a		a	
Socioeconomic Status								
Household income								
Less than $25,000					1.731**	1.256-2.385	1.524***	1.100-2.110
$25,000-49,999					1.152	0.883-1.504	1.048	0.801-1.371
$50,000-74,999					0.995	0.753-1.315	0.933	0.707-1.232
$75,000+ (REF)					------	------	------	------
Employment status								
Employed (REF)					------	------	------	------
Unemployed					1.796**	1.230-2.622	1.691***	1.146-2.495
Homemaker					0.779	0.498-1.218	0.793	0.505-1.246
Student					0.970	0.306-3.068	0.958	0.304-3.014
Retired					1.416**	1.109-1.810	1.384***	1.082-1.771
Unable to work					2.105***	1.393-3.181	1.822***	1.219-2.724
Education								
Less than high school					1.391	0.960-2.016	1.250*	0.858-1.821
High school grad/some college					1.246*	1.013-1.532	1.127	0.912-1.393
College grad (REF)					------	------	------	------

Has health insurance					1.042	0.763-1.422	1.035	0.760-1.410
Health History and Behaviors								
Poor mental health							1.498***	1.237-1.814
Smoking status								
Never smoked (REF)							------	------
Former smoker							1.559***	1.262-1.926
Current smoker							1.424***	1.081-1.875
Weight status								
Not overweight or obese (REF)							------	------
Overweight							1.265**	1.012-1.582
Obese							1.635***	1.304-2.051
Binge drinker							0.757**	0.541-1.060
Exercise							0.869*	0.720-1.049
HIV risky behaviors							1.792***	1.138-2.821
Intercept	-3.677***	(.037)	-10.219***	(.688)	-9.746***	(.717)	-9.755***	(.729)
AIC	13271.30		11450.83		10906.01		10760.10	
c	.559		.775		.811		.824	
Pseudo-R^2	.010		.167		.192		.204	

Note: Adjusted odds ratios and 95% confidence intervals reported from binary logistic regression models; *p<.05; **p<.01, ***p<.001

[a] Controls for gender, age, race/ethnicity, marital status, presence of children in the household, total number of people in the household, metropolitan status, receipt of routine physical health checkup in past 2 year, and state fixed effects.

Table 7. Odds Ratios from Binary Logistic Regression Models of Functional Limitation Regressed on Adverse Childhood Experiences, Demographic Characteristics, Adult SES, and Health Behaviors

	Model 1		Model 2		Model 3		Model 4	
Adverse Childhood Experiences								
Physical abuse	1.381***	1.222-1.560	1.323***	1.168-1.148	1.168*	1.012-1.350	1.110	0.958-1.285
Verbal abuse	1.407***	1.283-1.542	1.485***	1.350-1.632	1.632***	1.468-1.814	1.513***	1.358-1.686
Sexual abuse	1.657***	1.496-1.836	1.511***	1.362-1.676	1.344***	1.196-1.510	1.187**	1.051-1.340
Domestic violence	1.111	0.984-1.254	0.988	0.873-1.118	0.920	0.796-1.063	0.937	0.808-1.086
Live with depressed person	1.416***	1.284-1.561	1.564***	1.413-1.732	1.537***	1.371-1.722	1.418***	1.262-1.594
Live with alcoholic abuse	1.270***	1.161-1.390	1.158**	1.055-1.270	1.113*	1.004-1.234	1.080	0.972-1.201
Live with drug abuse	0.958	0.839-1.093	1.163*	1.019-1.328	1.180*	1.016-1.372	1.161	0.955-1.355
Live with convicted offender	1.025	0.875-1.201	1.184*	1.008-1.391	0.988	0.821-1.190	0.992	0.822-1.197
Parental divorce	0.938	0.854-1.030	1.127*	1.023-1.241	1.093	0.982-1.216	1.098	0.986-1.223
Demographic Characteristics				a	a		a	
Socioeconomic Status								
Household income								
Less than $25,000					2.089***	1.793-2.434	1.672***	1.428-1.958
$25,000-49,999					1.434***	1.273-1.616	1.239**	1.096-1.400
$50,000-74,999					1.112	0.987-1.253	1.006	0.890-1.138
$75,000+ (REF)					------	------	------	------
Employment status								
Employed (REF)					------	------	------	------
Unemployed					1.987***	1.705-2.316	1.832***	1.563-2.148
Homemaker					1.633***	1.354-1.968	1.689***	1.406-2.028
Student					1.841***	1.336-2.536	1.860***	1.364-2.537
Retired					2.000***	1.752-2.284	2.080***	1.817-2.382
Unable to work					13.330***	10.803-16.447	11.391***	9.191-14.132
Education								
Less than high school					0.893	0.724-1.101	0.735**	0.595-0.907
High school grad/some college					1.009	0.920-1.106	0.894*	0.811-0.985
College grad (REF)					------	------	------	------

Has health insurance					1.106	0.967-1.265	1.138**	0.994-1.304
Health History and Behaviors								
Poor mental health							2.300***	2.095-2.526
Smoking status								
Never smoked (REF)							------	------
Former smoker							1.291***	1.169-1.427
Current smoker							1.391***	1.234-1.569
Weight status								
Not overweight or obese (REF)							------	------
Overweight							1.146*	1.028-1.278
Obese							1.696***	1.521-1.892
Binge drinker							0.713***	0.630-0.807
Exercise							0.655***	0.592-0.725
HIV risky behaviors							1.212	0.924-1.592
Intercept	-1.822***	(.016)	-4.774***	(.186)	-5.295***	(.219)	-4.807***	(.226)
AIC	48981.41		45909.08		39701.31		38156.20	
c	.621		.701		.777		.799	
Pseudo-R^2	.036		.097		.220		.251	

Note: Adjusted odds ratios and 95% confidence intervals reported from binary logistic regression models; *p<.05; **p<.01, ***p<.001

[a] Controls for gender, age, race/ethnicity, marital status, presence of children in the household, total number of people in the household, metropolitan status, receipt of routine physical health checkup in past 2 year, and state fixed effects.

Appendix A. Descriptive Statistics for Respondents Living in States that Included the ACE Module vs. States that Did Not

	Excluded States (N=776,096) %/Mean(SD)	Included States (N=56,976) %/Mean(SD)
Health Outcomes		
Self-rated health		
Excellent	22.3	20.7***
Very Good	35.5	36.2***
Good	28.7	29.3**
Fair	10.1	9.9
Poor	3.5	3.8***
Chronic Diseases		
Diabetes	7.4	7.6
Heart Attack	2.5	2.8***
Health Disease	2.6	2.9***
Stroke	1.6	1.9***
Functional Limitation	18.7	19.4***
Demographic Characteristics		
Sex (Female)	50.2	50.4
Age	42.6(12.72)	44.0(10.47)***
Race/Ethnicity		
Non-Hispanic White	68.7	78.7***
Non-Hispanic Black	10.5	9.1***
Hispanic	13.7	4.6***
Non-Hispanic Other Race	7.2	7.6***
Marital Status		
Married	62.7	64.6***
Divorced/Separated	11.2	11.6**
Widowed	1.9	2.0
Never Married	24.2	21.8***
Children in the household (Yes)	50.0	46.3***
Number of people in household	3.4(1.61)	3.2(1.29)***
Lives in Non-Metro area	16.9	30.2***
Had a routine health checkup in past 2 years	80.6	80.6
Socioeconomic Status		
Household income		
Less than $25,000	22.7	21.2***
$25,000-49,999	22.5	25.6***
$50,000-74,999	16.8	18.6***
$75,000+	38.0	34.5***
Employment status		
Employed	68.2	70.5***

Unemployed	14.9	13.8***
Homemaker	7.1	6.3***
Student	4.9	3.8***
Retired	4.8	5.6***
Unable to work	5.9	6.4***
Education		
Less than high school	9.1	7.7***
High school grad/some college	54.6	60.0***
College grad	36.3	32.3***
Has health insurance	83.7	85.0***
Health History and Behaviors		
Poor mental health	27.2	25.3***
Smoking status		
Never smoked	58.5	55.3***
Former smoker	22.4	24.0***
Current smoker	19.1	20.7***
Weight status		
Not overweight or obese	34.8	33.7***
Overweight	35.8	35.3*
Obese	29.4	31.0*
Binge drinker	18.1	19.4***
Exercise	78.6	78.6
HIV risky behaviors	3.3	2.9***

Note: Independent samples t-tests for difference of means/percentages; conducted after listwise deletion of cases with missing values on variables of interest
*p<.05; **p<.01, ***p<.001; weighted values

Appendix B. KHB Tests for Mediation

Self-Rated Health

	Model 2-Model 3			Model 3-Model 4		
	% change	est. diff	SE diff	% change	est. diff	SE diff
Physical abuse	60%	-0.175	(.024)***	52%	-0.063	(.020)**
Verbal abuse	-20%	0.039	(.015)**	36%	-0.089	(.013)***
Sexual abuse	50%	-0.165	(.022)***	89%	-0.149	(.017)***
Domestic violence	-2793%	-0.099	(.023)***	24%	0.027	(.018)
Live with depressed person	10%	-0.016	(.018)	51%	-0.081	(.016)***
Live with alcoholic	43%	-0.076	(.016)***	38%	-0.040	(.013)**
Live with drug abuser	11%	-0.011	(.024)	16%	-0.015	(.020)
Live with convicted offender	184%	-0.246	(.033)***	-18%	-0.021	(.024)
Parental divorce	86%	-0.111	(.016)***	155%	-0.020	(.013)

Diabetes

	Model 2-Model 3			Model 3-Model 4		
	% change	est. diff	SE diff	% change	est. diff	SE diff
Physical abuse	47%	0.087	(.013)***	35%	0.040	(.023)
Verbal abuse	-20%	-0.016	(.009)	56%	0.054	(.016)**
Sexual abuse	24%	0.074	(.122)***	50%	0.120	(.022)***
Domestic violence	30%	0.058	(.013)***	-12%	-0.018	(.021)
Live with depressed person	-35%	-0.002	(.011)	535%	0.041	(.019)*
Live with alcoholic	-291%	0.037	(.010)***	14%	-0.011	(.016)
Live with drug abuser	-9%	0.015	(.014)	23%	-0.045	(.024)
Live with convicted offender	72%	0.134	(.020)***	15%	0.014	(.030)
Parental divorce	108%	0.073	(.012)***	144%	-0.017	(.016)

Heart Attack

	Model 2-Model 3			Model 3-Model 4		
	% change	est. diff	SE diff	% change	est. diff	SE diff
Physical abuse	24%	0.128	(.020)***	12%	0.048	(.014)**
Verbal abuse	276%	-0.032	(.013)*	162%	0.060	(.112)***
Sexual abuse	188%	0.117	(.017)***	-272%	0.112	(.018)***
Domestic violence	126%	0.069	(.019)***	59%	-0.022	(.012)
Live with depressed person	-6%	-0.008	(.017)	30%	0.043	(.014)**
Live with alcoholic	-109%	0.068	(.014)***	-21%	0.030	(.011)**
Live with drug abuser	2%	0.008	(.019)	10%	0.038	(.017)*
Live with convicted offender	37%	0.183	(.030)***	6%	0.020	(.018)
Parental divorce	25%	0.085	(.019)***	7%	0.019	(.012)

Heart Disease

	Model 2-Model 3			Model 3-Model 4		
	% change	est. diff	SE diff	% change	est. diff	SE diff
Physical abuse	41%	0.091	(.016)***	39%	0.048	(.014)***
Verbal abuse	-30%	-0.010	(.010)	98%	0.059	(.011)***
Sexual abuse	106%	0.094	(.015)***	2318%	0.108	(.017)***
Domestic violence	29%	0.055	(.016)**	-22%	-0.024	(.012)*
Live with depressed person	39%	0.016	(.014)	187%	0.048	(.013)***
Live with alcoholic	24%	0.043	(.010)***	25%	0.031	(.011)**
Live with drug abuser	11%	0.012	(.016)	36%	0.041	(.017)*
Live with convicted offender	26%	0.141	(.025)***	3%	0.014	(.018)
Parental divorce	19%	0.057	(.016)**	7%	0.018	(.012)

Limitation

	Model 2-Model 3			Model 3-Model 4		
	% change	est. diff	SE diff	% change	est. diff	SE diff
Physical abuse	49%	0.152	(.027)***	37%	0.061	(.016)***
Verbal abuse	-4%	-0.018	(.015)	16%	0.078	(.011)***
Sexual abuse	37%	0.173	(.024)***	43%	0.132	(.015)***
Domestic violence	-444%	0.068	(.025)**	29%	-0.026	(.014)
Live with depressed person	15%	0.078	(.019)***	20%	0.087	(.013)***
Live with alcoholic	33%	0.052	(.017)**	32%	0.036	(.011)**
Live with drug abuser	-1%	-0.001	(.024)	15%	0.026	(.016)
Live with convicted offender	107%	0.178	(.036)***	24%	-0.002	(.020)
Parental divorce	32%	0.041	(.017)*	10%	0.011	(.011)

Note: KHB tests for mediation in Stata; '% change' represents percentage change in log odds between two models; 'est. diff' represents difference in log odds between two models; 'SE diff' represents the standard error of the difference between the two models
*p<.05; **p<.01; ***p<.001