Published in final edited form as:

J Am Coll Health. 2018 ; 66(4): 246–251. doi:10.1080/07448481.2018.1431892.

A multivariate analysis of adverse childhood experiences and health behaviors and outcomes among college students

Michael Windle, PhD, Regine Haardörfer, PhD, Beth Getachew, MPH, Jean Shah, MPH, Jackie Payne, MPH, Dina Pillai, MPH, and Carla J. Berg, PhD, MBA

Department of Behavioral Sciences and Health Education, Emory University School of Public Health, Atlanta, Georgia, USA

Abstract

Objective—This study investigated associations between adverse childhood experiences (ACE) prior to age 18 years and multiple health behaviors (eg, cigarette and other substance use) and outcomes (eg, obesity, depression) for a large college sample.

Participants—2,969 college students from seven universities in the state of Georgia were included in the analysis.

Methods—Web-based surveys were completed by students (45–60 minutes) during the spring semester, 2015.

Results—Findings indicate that more ACEs are associated with higher levels of depressive symptoms, ADHD symptoms, cigarette use, alcohol use, marijuana use, and BMI, in addition to lower levels of fruit and vegetable intake, and sleep.

Conclusion—ACEs may carry forward in the lifespan to influence a range of unhealthy outcomes among college students. College intervention programs may benefit by recognizing the pervasiveness of ACEs and their associations with health behaviors and outcomes, and include interventions across more than one health behavior.

Keywords

Adverse childhood experiences; ADHD; alcohol use; BMI; college students; depression; marijuana use; tobacco use

Adverse childhood experiences (ACE) have been associated with a range of chronic diseases in adulthood^{1–5} and with premature death.⁶ ACEs refer to a number of adverse experiences (eg, physical and sexual abuse, parental neglect, parental alcoholism, parental divorce) that have occurred prior to age 18 years that pose substantial risk for the subsequent development of negative health outcomes. Significant associations between ACEs and morbidity and mortality have been indicated in adulthood. Similarly, in adolescence and early young adulthood, ACEs have been associated with unhealthy behaviors and outcomes, including higher levels of substance use and poor mental health,⁷ cigarette use,⁸ and obesity.⁹

Although many studies examining associations between ACEs and health behaviors and outcomes have focused on general population samples, some studies have focused on college samples and reported significant associations between selected ACEs (eg, childhood sexual abuse) and an adverse consequence (eg, depression).^{10,11} However, two limitations of studies based on college samples include: (1) they have used typically one or only a few ACEs and this may restrict the strength of associations between ACEs and health behaviors and outcomes; and (2) they have focused on only one or a few health behaviors and outcomes and thus may not capture the extent of the impact of ACEs on a broader range of health behaviors and outcomes.

This study sought to contribute to the literature by addressing both of the limitations referred to above. First, we included a commonly used measure of ACEs that includes 10 ACE^{4,12} to provide a broader range of ACE scores. Second, we assessed eight health behaviors and outcomes that span mental health, substance use, cigarette use, nutrition, body mass index, and sleep. This somewhat broader approach (ie, multiple ACEs and multiple health behaviors) is consistent with three different theoretical approaches. First, currently there is a major emphasis on college campuses on the prevention of sexual assault, with a White House Task Force recommending the use of a school climate survey to identify and ultimately prevent sexual assault incidents on college campuses.¹³ Research has indicated that higher levels of ACEs in childhood are associated with increasing risk of sexual risk behaviors in women¹⁴ and an increased risk of sexual victimization during the college years.¹⁵ Hillis et al¹⁴ suggested that the families of women coming from high ACEs' backgrounds may not have provided the needed parental protection for offspring in childhood and that these prior experiences may predispose offspring to being unprepared to protect themselves or evaluate risks in challenging situations during young adulthood, including those encountered in college.

Second, an extensive literature in neurobiology and health psychology is emerging that suggests that higher levels of ACEs are associated with modifications in biological system responses to severe stress (eg, alterations in hormonal and immune system factors) that may "rewire" the brain so as to make individuals more vulnerable to subsequent stressors.^{16,17} Third, with respect to health behaviors, extant literature suggests that in adolescence and young adulthood many unhealthy behaviors co-occur^{18,19} with some common and some unique precursors. Consistent with the broader literature on ACEs,^{4,20} it is proposed that ACEs may be more of a common causal agent for the subsequent expression of a range of health behaviors and associated outcomes rather than simply related to one or two health behavior outcomes.

Methods

Participants and procedure

Project DECOY (Documenting Experiences with Cigarettes and Other Tobacco in Youth) is a two-year, six-wave longitudinal cohort study involving 3,418 racially/ ethnically diverse young adults attending seven Georgia colleges/universities. Project DECOY was approved by the Emory University and ICF International Institutional Review Boards as well as those of the participating colleges. More detailed information on sampling and recruitment are

provided elsewhere²¹ and are briefly summarized here. Contact information (eg, email addresses) was obtained from the registrar's office from each college/university for students meeting eligibility criteria (ie, ages 18–25 and able to speak English) and the study was promoted on campus via flyers and posted on campus Websites. Our intent was to enroll participants who were engaged in email and were potentially more likely to be retained in the subsequent waves of the larger, multi-wave longitudinal project.

Three thousand randomly selected 18–25 year olds were selected from one private and two public universities (total of 9,000 potential students). Each of the remainder of the schools had 18–25-year-old student populations of less than 3,000; thus, the entire student population of that age range at each of those schools was included in recruitment. Response rates ranged from 15.4% to 27.6% at the technical colleges; 12.0% and 19.2% at the public colleges/universities; 18.8% and 59.4% at the private universities; and 23.1% at the historically black university. Our overall response rate of 22.9% (N = 3,574/15,607), albeit low, was over a very short time frame (24 hours at the private schools to seven days at the technical colleges) and met our sampling quota targets.²¹ At Wave 1, 156 students did not confirm their participation in the study via email and were excluded from the study.

Data collection began in Fall 2014 and consisted of individual assessments every four months for two years (during Fall, Spring, and Summer). We employed a graduated compensation schedule (\$30 for the first two assessments, \$40 for the second two, \$50 for the final two), with an additional \$100 incentive for participating in all assessments. The data for the current analyses are Wave 2 data collected in Spring 2015 when key measures (eg, ACEs, ADHD symptoms) were administered. At Wave 2, a total of 2,969 of the 3,418 students (86.9%) were retained and their data were used in this study. Less than 1% of the sample had any missing data for the variables used in this study and their missing data were estimated via maximum likelihood estimation. Based on a number of Monte Carlo simulation studies and analytic studies of missing value estimation procedures, maximum likelihood estimators have been reported to be yield parameter estimates that are less biased and more efficient than other missing value methods (eg, listwise or pairwise deletion).^{22,23}

Measures

Adverse Childhood Experiences (ACE)—A variable number of items has been used to assess ACE and we elected to use the ten items from the CDC-developed ACE^{12,24} that is used in the Behavioral Risk Surveillance Survey. The 10-items were used to assess stressful and potential traumatic experiences of participants that occurred prior to age 18. Events included household exposures such as parents with mental health or substance use problems and parental partner interpersonal violence, as well as various forms of child maltreatment (eg, neglect) and physical and sexual abuse. Response options were 0 “No” and 1 “Yes.” The internal consistency for the ACE in this study was .75.

Depressive Symptoms—The Patient Health Questionnaire – 9 item (PHQ-9)²⁵ was used and each of the nine items was responded to in reference to the past two weeks with 4-point item response options ranged from “Not at all” to “Nearly every day”. Cronbach's alpha for the PHQ-9 in this study was .87.

Attentional Deficit-Hyperactivity Disorder (ADHD) Symptoms—The Adult ADHD Self-Report Scale Symptom Checklist²⁶ was used to assess ADHD. The six screening items from the checklist were used in this study because they provide the highest predictive validity of full scale ADHD diagnosis. Each of the six items was rated along a five-point scale ranging from “Never” to “Very Often.” The time referent for each item was last 6 months. Sample items included “difficulty getting things in order when a task requires organization” and “feel overly active and compelled to do things as if you were driven by a motor”. Cronbach’s alpha for this scale in this study was .74.

Tobacco Use—Cigarette use was assessed by the survey item “In the past 30 days, on how many days have you used cigarettes?” with answer choices ranging from 0 to 30.

Alcohol Use—Alcohol use was measured in reference to the last 30 days and included the frequency (ie, number of days) of alcohol use.

Marijuana Use—Marijuana use was assessed by the survey item “In the past 30 days, on how many days have you used each of the following products?” with answer choices ranging from 0 to 30.

Fruit and Vegetable Consumption—Two survey items, one for fruits and one for vegetables, were asked with reference to number of cups of each consumed each day, with seven-point response options ranging from “None” to “ 4 cups.” Cup-size equivalents were provided for 9 fruits and 9 vegetables to facilitate the self-reporting of these items. The two items were combined and divided by two to form a single index of fruit and vegetable intake. Cronbach’s alpha for these two items was .74.

Body Mass Index and Obesity—Self-reports of current height and weight were requested from each participant and these indicators were then used to calculate a body-mass index (BMI) via standard conversion formulas (weight in kilograms was divided by height in meters squared). *Sleep.* A single survey item was used that requested “On average, how many hours of sleep do you get in a 24-hour period?”

Sociodemographic Variables—We included age, gender, and race/ethnicity as covariates. Four groups were used for race/ethnicity: non-Hispanic white, non-Hispanic black, Hispanic white, and Asian American and Pacific Islanders.

Data analysis plan

The primary statistical model used to evaluate relationships between ACE and health behaviors and outcomes was a multivariate regression model with covariates. There were eight dependent variables for this model covering mental health (depressive symptoms, ADHD symptoms), substance use (cigarette, alcohol, and marijuana use), and lifestyle factors (fruit and vegetable intake, BMI, and average sleep duration). The ACE score was treated as a continuous variable and covariates included in the multivariate regression model were sex, age, and race/ethnicity. To evaluate the significance of findings, the overall multivariate *F*-statistic was provided as well as the *F*-statistics associated with the univariate

breakdowns. Significance levels were reported for each ACE as a predictor while controlling for the covariates.

Results

Preliminary analyses

To facilitate comparisons of the distribution of ACE scores in this college sample with larger adult samples, Table 1 provides a summary of the prevalence of ACEs for men, women, and the total sample used in this study, in addition to total sample prevalence for a large sample of adults collected by the CDC.²⁴ The latter more population-based data were used for descriptive comparative purposes to evaluate the prevalence of individual and number of ACEs in relation to our college sample. The descriptive findings indicated that our total sample prevalence was higher for emotional abuse, parental separation or divorce, and incarcerated household member. In addition, our total sample prevalence was lower with regard to physical and sexual abuse, physical neglect, and household substance use. Thus, our college sample relative to the larger CDC sample experienced a lower rate for some of the more severe ACEs (eg, sexual and physical abuse) but did report a high rate of events occurring with parents in the home setting. Furthermore, while the overall prevalence of number of “0” ACEs was higher for our college sample, the prevalence for those with equal-to-or-greater-than 4 ACEs were almost equal across samples.

Primary analyses

Table 2 provides a summary of the multivariate regression findings for eight health behaviors predicted by the ACE continuous score while adjusting for age, sex, and race-ethnicity. The overall *F*-statistic for the multivariate regression model was 798.62, *df* = 8, 2,900, *p* < .001. The univariate *F*-statistics reported in Table 2 further indicated that there were significant group differences for each of the eight dependent variables. Higher ACE scores significantly predicted higher levels of depressive symptoms, ADHD symptoms, cigarette use, alcohol use, marijuana use, and BMI. They also predicted lower levels of fruit and vegetable consumption and lower levels of average hours of sleep.

Ancillary analyses

To evaluate the robustness of the obtained relationships reported in Table 2, we also conducted a multivariate regression model in which we included depressive symptoms as a covariate rather than as an outcome variable. This analysis was done to rule out the plausible hypothesis that ACE scores contribute to depression, which in turn, contributes to other health behaviors (eg, higher self-medicating substance use; negative affect eating). The overall *F*-statistic for the multivariate regression model was 863.01, *df* = 6, 2,901, *p* < .001. With one exception, the univariate findings were largely unaltered by the inclusion of depressive symptoms as a covariate. The inclusion of depressive symptoms as a covariate yielded the “fruit and vegetable intake” health behavior as nonsignificant; the other seven health behaviors remained statistically significant (*p* < .001). We also tested two-way interactions between participant gender by ACE score to evaluate if gender moderated the relationships between ACEs and our measured health variables. There were no statistically significant interactions; thus gender did not moderate the relationship between ACE scores

and the health variables. Finally, we also evaluated the potential importance of school as a clustering variable by including this complex design specification in our general linear model; the inclusion of the clustering variable did not alter our reported findings in Table 2.

Comment

The findings of this study have supported and extended the literature on ACEs and health behaviors and outcomes in two major ways. First, the prevalence of ACEs among college students was consistent with the previous, single-event literature (eg, child abuse) among college students in indicating that many students enter college with prior serious victimization that may impact optimal academic and social performance. This notion was further supported by the overall level of self-reported ACEs for our college sample relative to a broader adult age-range sample. The percentage of college students who had experienced four or more ACEs prior 18 years of age was similar to that of a large adult sample, though there were some differences with regard to specific events. The college student sample reported higher levels of potential poorer parenting and family difficulties (eg, emotional abuse, parental divorce), whereas the large adult sample reported higher levels of physical and sexual abuse. Because the larger adult sample included both college and noncollege participants, it is possible that unmeasured factors related to college attendance may have impacted these sample differences. Nevertheless, the measurement of multiple ACEs in this study and their prevalence advances our appreciation of the range of potential detrimental events that may contribute to challenges to these students as they enter and progress through college, as well as facilitate a recognition that single-event approaches may underestimate student needs.

A second way that our findings contributed importantly to the literature was that significant relationships were indicated for ACE scores and all eight health behaviors. Higher ACE scores significantly predicted poorer mental health (ie, more depressive symptoms, more ADHD symptoms), higher substance use (ie, cigarette, alcohol marijuana), and poorer lifestyle habits (ie, lower fruit and vegetable intake, higher BMI, fewer hours of sleep). These findings strongly support the pervasiveness of ACEs on these health behaviors and suggest that ACE scores may serve as a marker of need for college services so as to optimize student functioning and success in college settings.

The findings of this study are also consistent with contemporary prominent issues in college health and with various theoretical perspectives. The White House Task Force¹³ is focusing on the prevention of sexual assault incidents on college campuses. Given that higher levels of ACEs are associated with an increased risk of sexual victimization during the college years^{14,15} it is appropriate to draw upon the larger trauma framework to guide assessments and interventions on college campuses. Although not directly measured in this study, findings in neurobiology and health psychology regarding modifications in biological system responses to severe stress (eg, alterations in hormonal and immune system factors) may be drawn upon to further guide and evaluate interventions.^{5,16,17} Finally, consistent with other findings in the health behavior literature, many unhealthy behaviors and outcomes (eg, poor mental health, substance use, obesity) co-occur.^{18,19} Given our findings, ACE

scores may be a common rather than unique causal agent across various health behaviors and outcomes.

Limitations

Although our findings are consistent with and extend the literature on ACEs and health behaviors and outcomes among college students, several limitations need to be acknowledged. First, while the sampling plan achieved diversity with respect to colleges and universities and racial/ethnic group composition, all schools were selected from the State of Georgia. Moreover, our sample included a greater proportion of women than is representative of the participating campuses. The generalizability of these findings across campuses around the United States and globally remains unknown. In addition, this study focused on college students and ACEs also occur among noncollege young adults. In state or national studies of young adults, these noncollege adults have been included, though analyses have typically focused on educational status distinctions such as not completing high school, high school completion only, and some college or more. These studies have indicated that lower levels of education are associated with higher levels of ACEs.²⁷ Hence, future research on ACEs and health behaviors should include a focus on college, as well as, noncollege, young adults.

A second limitation was that all survey measures relied on self-report and thus may be impacted by reporter bias. Although we did use a Web-based approach that may have reduced under-reporting of sensitive information, other methods (eg, bogus pipeline; biological indicators) were not used to reduce rater bias. A third limitation was that the ACE assessment relies on retrospective reporting of sensitive events that occurred prior to age 18 years and are subject to potential systematic confounds (eg, forgetting, distortion, social desirability bias). Despite these limitations, the findings provide evidence of robust associations between more ACEs and poorer health behaviors and outcomes across mental health, substance use, and lifestyle factor domains (eg, fruit and vegetable consumption, BMI). The findings may be useful for many healthcare stakeholders within college communities. For example, screening for ACEs may be beneficial in college health services settings with greater attention directed toward those with higher ACE scores in fostering the development of skills (eg, problem solving coping, seeking social support, avoiding risky situations) that cut across multiple behaviors¹⁸ that compromise health and health risk among college students. Likewise, counselors may benefit from knowledge of ACEs by using this information to gain insight into the backgrounds and experiences of students that may facilitate the development of intervention plans guided by the strengths and exposures of their clients. Student services and academic programs may also want to assume a more proactive posture in increasing awareness about the occurrence of ACEs and their associations with adverse health behaviors, and provide referrals or self-help groups to minimize the impact of adverse effects on health risk behaviors and outcomes.

Acknowledgments

Funding

This research was supported by the National Cancer Institute (1R01CA179422-01; principal investigator: Berg).

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Table 1

Prevalence of adverse childhood experiences for project DECOY compared to CDC estimates.

ACE items	Women ¹	Men ²	Total ³	CDC total ⁴
Emotional abuse	20.7	15.1	18.7	10.6
Physical abuse	10.3	9.9	10.2	28.3
Sexual abuse	10.3	3.2	7.7	20.7
Emotional neglect	16.6	10.8	14.5	14.8
Physical neglect	2.5	3.1	2.7	9.9
Mother treated violently	7.3	4.7	6.4	12.7
Household substance abuse	17.2	14.2	16.2	26.9
Household mental illness	18.0	11.6	15.8	19.4
Parental separation or divorce	37.0	26.9	33.4	23.3
Incarcerated household member	9.1	6.7	8.3	4.7
Number of ACE				
0	42.1	55.2	46.8	36.1
1	22.6	19.4	21.3	26.0
2	12.5	11.3	12.1	15.9
3	8.5	5.3	7.4	9.5
4	14.3	8.8	12.4	12.5

¹N ranged from 1852 to 1885;²N ranged from 1024 to 1034;³N ranged from 2885 to 2916;⁴N = 17,337.

Table 2
Regression model findings for the prediction of health behaviors by adverse childhood experiences.

Variable	B	SE	b	F-statistic	df	R ²
Depressive symptoms	0.635	0.052	0.22 ***	18.23	7, 2095	0.06
ADHD symptoms	0.234	0.043	0.10 ***	7.33	7, 2095	0.043
Cigarette use	0.397	0.055	0.13 ***	6.98	7, 2095	0.025
Alcohol use	0.006	0.002	0.07 ***	4.61	7, 2095	0.026
Marijuana use	0.011	0.003	0.08 ***	2.54	7, 2095	0.012
Fruit and vegetable intake	-0.057	0.019	-0.056 **	1.92	7, 2095	0.010
BMI	0.285	0.061	0.084 ***	2.92	7, 2095	0.081
Sleep (hrs/night)	-0.10	-0.02	-0.11 ***	18.23 ***	7, 2095	0.014

These regression coefficients are adjusted for sex, age, race, and ethnicity.

* $p < .05$;

** $p < .01$;

*** $p < .001$.