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Adult Cancer Risk Behaviors Associated with Adverse Childhood Experiences in a Low Income Population in the Southeastern United States

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Abstract

Objectives—Adverse childhood experiences (ACE) can affect health in adulthood. We investigate the relationship between childhood experiences and adult cancer risk and screening behaviors in a racially diverse, low income population.

Methods—Nearly 22,000 adults 40 years and older in the Southern Community Cohort Study were administered the ACE questionnaire. We estimated odds ratios (OR) for the prevalence of smoking, alcohol consumption, BMI and five cancer screening methods in relation to the ACE score.

Results—Over half reported at least one ACE, with percentages higher for women (61%) than men (53%). Higher ACE scores were related to increased prevalence of smoking (ORs 1.25 (1.05–1.50) to 2.33 (1.96–2.77). Little association was seen between rising ACE score and alcohol consumption or BMI, except for a modest trend in morbid obesity (BMI ≥ 40 kg/m^2). Mammography and cervical cancer screening decreased with rising ACE scores, but no trends were seen with prostate or colorectal cancer screening.

Conclusions—Adverse childhood experiences are strong predictors of adult cancer risk behaviors, particularly increased likelihood of smoking, and among women, lower mammography and Pap screening rates.

Cancer is the leading cause of death among Americans age 45–64.[1–3] The American Cancer Society estimates that about 170,000 cancer deaths annually will be caused by tobacco use

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alone, and another third attributed to poor eating habits, overweight/obesity, physical inactivity, and excessive alcohol consumption.[4] Increased understanding of factors that may influence these risks, as well as use of screening modalities for early detection of cancer may lead to strategies that reduce their effect on cancer incidence and mortality.

Besides the specific risk behaviors, cancer has been associated with certain socio-environmental determinants.[5–7] Neighborhood safety, affected by violence, is one of the socio-environmental factors that has been reported to have adverse health outcomes, such as poor health status, depression, alcoholism, substance abuse, gastrointestinal disorders, and chronic diseases, including cancer.[8–16] However, there are currently limited data on the potential effect of childhood violence and abuse on cancer risk behaviors.[11,17–18]

Violence and abuse can occur across the lifespan and may occur even among children. In the 1990s, a systematic evaluation led by Kaiser Permanente and the Centers for Disease Control and Prevention (CDC) formulated a series of questions on childhood abuse with a resultant Adverse Childhood Experience (ACE) index and found that physical and/or mental abuse episodes, as well as neglect and household dysfunction, were common.[19] In subsequent administrations of the ACE questionnaire, 59% of respondents reported having at least one adverse childhood experience (ACE), and 9% reported five or more ACEs.[20] This survey and others also noted that ACEs were linked to a range of adverse health outcomes in adulthood, including substance abuse,[21–23] smoking,[24] depression,[23,25–26] cardiovascular disease,[27–28] diabetes,[29] cancer, [16,18,30–32] and premature mortality.[20, 33] Individual reports have shown a four- to 12-fold increased risk of alcoholism, drug abuse, depression, and suicide attempts among people who had experienced four or more categories of adverse childhood exposures, compared with those who had experienced none, as well as increases in poorer health behaviors, including a 1.5- to four-fold increase in smoking and 1.4- to 1.6-fold increase in physical inactivity and severe obesity.[19,29,34–36]

Except for a recent study in urban Philadelphia,[37] most of the prior research on ACE, including the original Kaiser and the national Behavioral Risk Factor Surveillance System (BRFSS) surveys, has been carried out in middle-income and upper-income, predominantly White populations. The study reported herein was designed to examine the association of adverse childhood experiences with cancer risk and screening behaviors in a large, diverse, mostly low-income cohort recruited from medically-underserved areas of the South. We hypothesized that adverse childhood exposures may be particularly common in such a population and that these experiences are associated with increased prevalence of several behaviors in middle-aged and older adulthood contributing to increased cancer risk and/or reduced utilization of cancer prevention and early detection services.

Methods

Study population

We conducted this analysis as part of the Southern Community Cohort Study (SCCS), a multi-year prospective cohort study of adults enrolled at ages 40–79 during 2002–2009 from 12 Southern states, namely Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia. Most

(85%) of the nearly 86,000 individuals, two-thirds African American, were recruited at community health centers with the remainder selected from general population. Recruitment included a large lower-income, vulnerable segment of society often not included in research. The Vanderbilt Institutional Review Board approved this study and consent was obtained from study participants. The SCCS was established to address many unresolved questions about the root causes of cancer health disparities; details of the SCCS enrollment have been described previously.[38–39]

Survey instruments

An extensive questionnaire was administered upon enrollment via computer-assisted personal interviews at community health centers or via self-completed questionnaires for the general population sample. The SCCS baseline questionnaire acquired information on the following: demographic characteristics, anthropometry, tobacco use, diet, alcohol consumption, physical activity, personal medical history, family medical history, reproductive history (for women), medication use, emotional well-being and social support, religion/spirituality, health insurance, use of medical and cancer screening services, prevalent medical conditions, occupational history, and other miscellaneous factors.

The first follow-up questionnaire was administered to nearly 55,000 SCCS participants during 2009–2012, with a second follow-up questionnaire administered beginning in 2012, to update exposure (including current smoking status), health status (including current weight), and health services utilization (including cancer screening). Copies of the questionnaires are available on line at www.Southerncommunitystudy.org. Much shorter than the baseline questionnaire, the follow-up questionnaires offered the opportunity to ascertain additional information not collected at baseline. In the second ongoing follow-up questionnaire, we included the 10 questions regarding adverse childhood experiences (ACE). Response to each ACE item was recorded as a yes or no. A total ACE score was determined by the sum of all “yes” responses with the maximum possible ACE score of 10. The ACE score was categorized as 0 (no events), 1 (a single event), 2 (two events), 3 (three events), and 4 (four or more events).

Statistical analyses

We accessed information from the initial SCCS participants who completed the second follow-up questionnaire containing the ACE responses. We first examined contingency and 2×2 tables to describe the distribution between the ACE score and gender, race, income, education, and other demographic variables. Included in the latter category was a neighborhood deprivation index (NDI) calculated based on a composite of indices for the census tracts of the participants' residences at cohort entry.[40]

The cancer risk behaviors of interest were cigarette smoking, alcohol drinking, and obesity as measured by body mass index (BMI), and the cancer screening variables were yes/no indicator terms for utilization of annual mammography, Pap smear testing every four years, and ever use of PSA screening for prostate cancer, sigmoidoscopy for colorectal cancer and colonoscopy for colorectal cancer. These were considered the dependent variables in subsequent analyses. The risk behavior/condition variables were categorized as follows: for

smoking: never, former, current fewer than 20 cigarettes per day (cpd), and current 20 or more cpd; for frequency of alcoholic beverage drinking: never/rarely, 1–3 times per month, 1–6 times per week, and daily; for BMI: less than 25, 25–29, 30–34, 35–39, and ≥40 kg/m^2. The chi-square test was used to test for significant differences of the distribution of the ACE scores across the strata of these variables.

For each of the smoking, drinking, and BMI variables, polychotomous logistic regression models were used to calculate odds ratios (ORs) and corresponding 95% confidence intervals (CIs) of participants having the behavior/condition, with bivariate logistic models used for assessing use of cancer screening. Included as covariates in the models were terms for age (40–49/50–59/60–79), sex, race, education (<high school/high school/> high school), household annual income (less than $15,000/$15,000–$24,999/$25,000–$49,000/$50,000 or more), marital status (married or living with a partner/widowed/separated/single) and neighborhood deprivation index (in quartiles). For screening utilization, the covariates also included current smoking (ref=no), alcohol consuming (ref=no), and obesity (ref=bmi<35). Because of small percentages of individuals reporting race other than White or Black, the logistic regression analyses were performed for the White and Black participants only. To explore racial and gender differences in the relationship of the categories of ACE exposure with the odds ratios of the listed risk factors and screening utilization, the logistic regression models were run separately for Blacks and Whites and for men and women.

All statistical analyses were two-sided and a p-value of less than .05 was considered statistical significant. We conducted all analyses by using the SAS software version 9.2 (SAS Institute, Cary, NC).

Results

Among the 22,379 SCCS participants who completed the second follow-up questionnaire, 22,227 (99%) provided information enabling computation of ACE scores. At least one adverse childhood experience was reported by 53% of adult men and 61% of adult women (Table 1). Adverse experiences were reported across all domains queried, with women reporting at least one event within the categories of abuse (21%), neglect (21%) and household dysfunction (33%), respectively. Corresponding percentages for men were 17%, 13% and 30%, respectively.

Among all respondents, 22% reported one event, 12% reported two events, 7% reported three events, and 18% reported four or more ACE events (Table 2). The chi-square tests showed that the ACE score group (0, 1, 2, 3, 4+) was associated (p<.0001) with most of the variables in Table 2, with participants who reported having four or more ACEs being more often younger, female, poorer, and separated/divorced. Little differences, however, were seen with education level, and racial differences were such that Blacks were somewhat more likely to report any ACE but less likely to report four or more such experiences.

Table 3 shows that the crude percentages of participants who were current smokers rose steadily with increasing ACE score among race-gender groups, with the prevalence of current smokers nearly twice as high among those reporting four or more compared with no

ACEs. In contrast, little association was seen with alcohol consumption and ACE score in either sex. The distributions of BMI did not differ greatly by ACE score, except that the prevalence of severe obesity (BMI≥40 kg/m^2) rose modestly with increasing ACE score. The crude percentages of cancer screening use also tended to decline with increasing ACE score, except for use of sigmoidoscopy.

Table 4 shows adjusted ORs and CIs of the health behaviors and screening according to ACE score. The odds of being a smoker rose steadily with increasing ACE score, with ORs of being a current heavy (≥20 cpd) smoker among those with four or more vs. no ACEs of 2.33 (95% CI 1.96–2.77) after adjustment for the multiple covariates in the regression model. Little association was seen with alcoholic beverage drinking. Associations with BMI were minor across the mid to lower ranges of BMI, although the OR for morbid obesity (BMI≥40 kg/m^2) relative to normal (BMI<25kg/m^2) among those with four or more ACEs reached 1.35 (95% CI 1.16–1.57). Among women the odds of having annual mammography and Pap smears every four years declined steadily with rising ACE score, with ORs of screening as low as 0.75 (95% CI 0.67–0.84) and 0.67 (95% CI 0.57–0.80) for mammograms and Pap smears, respectively. However, there was little trend in the odds of PSA screening among men or colorectal cancer screening by either colonoscopy or sigmoidoscopy among either men or women with rising ACE score.

When regression modelling was performed within strata defined by race and gender (supplement table 1, and 2), the patterns between ACE score and smoking were generally similar among Blacks and Whites, and among men and women. Odds ratios (CIs) for being a heavy current smoker among those with four or more vs. no ACEs were 2.78 (2.12–3.65) among Blacks and 2.06 (1.64–2.58) among Whites. However, for alcohol drinking the percentages in all the drinking categories (relative to never/rare drinkers) significantly rose with increasing ACE score among Blacks, with no concomitant trends among Whites. Odds ratios (CIs) for being a daily drinker for those with four or more vs. no ACEs were 1.42 (1.13–1.78) among Blacks and 0.83 (0.62–1.10) among Whites. Additionally, for BMI, percentages of adults with BMI≥40 kg/m^2 significantly rose with increasing ACE score only among Whites and among women. Odds ratios (CIs) for being in this high BMI category for those with four or more vs. no ACEs were 1.73 (1.37–2.19) among Whites and 1.10 (0.89–1.34) among Blacks and 1.40 (1.18–1.66) among women and 1.27 (0.88–1.84) among men.

Discussion

In this low-income diverse population across 12 Southern states, we found that over half of adults age 40 and above reported adverse childhood experiences, including sizeable fractions reporting abuse, neglect, and household dysfunction before age 18. Although causal inferences cannot be made from our observational study, strong associations were found between high ACE scores and adult behaviors linked to poor health. Those with the highest ACE scores were more than twice as likely as others to be current smokers, with the prevalence of smoking rising in proportion to the numbers of adverse events. These positive associations were observed regardless of race or gender, with near equal strengths of association in each race-gender group, indicating a robustness of the findings. Weaker relationships were seen between ACE score and alcohol consumption and high BMI, with

stronger links to drinking among Blacks than Whites and to morbid obesity among Whites than Blacks and women than men. We also found strong trends of decreasing utilization of breast and cervical cancer screening with rising ACE scores, but little association with prostate or colorectal cancer screening.

The overall findings are in accordance with previous research suggesting ACEs are associated with negative health behaviors and outcomes.[19–24,31,36] However, our study extends the populations covered in previous work, with a cohort composition of Southern Blacks and Whites of similar (typically low) income and education and highlights that childhood experiences can have marked affect the underserved and vulnerable.

Our large study size enabled relatively precise examination of trends in risk behaviors and cancer screening according to ACE scores, and provided one of the clearest demonstrations of a strong and monotonic rise in smoking prevalence and intensity with increasing ACE score, even after adjusting for education, income, and other factors contributing to smoking behaviors. We did not find a clear cut relationship between ACE score and alcohol consumption, possibly due to the low prevalence of heavy drinking among SCCS members. Because of the high prevalence of obesity in SCCS participants, we assessed associations between ACE score and obesity. We did not find strong links to obesity, although the prevalence of class III obesity (BMI≥ 40 kg/m^2) significantly rose from 13% among women reporting no ACEs to 18% among women reporting four or more ACEs.

Our regression analyses indicated highly significant associations between rising ACE scores and reduced breast and cervical screening among women. Women with a history of violence may have increased rates of cancer, but there has been limited research on the effect on cancer screening. Cancer may go undetected due to lower rates of health services utilization among those with adverse experiences.[40–42] One study reported that a history of childhood or adult violence among women was associated with more advanced stage at cancer diagnosis.[14] The study also indicated that while overall adherence to annual mammograms after age 40 and colonoscopy after age 50 did not significantly differ among women, women with a history of adverse experiences or victimization were more likely to report not seeing a physician in the year before their cancer diagnoses.[14] According to Olesen and others,[43] in a study that examined personal factors influencing the use of cervical cancer screening services, rates were significantly lower among women who were obese, current smokers, reported childhood sexual abuse, and those with anxiety symptoms. They suggest that targeting of women with these observable risk-factors could reduce non-participation in cancer screening by 74%.[43] In addition to common cancer risk behaviors, our findings strongly suggest that exposure to ACEs affects cancer screening participation among women, demonstrating the need for further research exploring ACEs as a determinant for encouraging patients to pursue screening for possible cancers.

Since the ACE questionnaire was not administered at entry into the SCCS but only as part of routine follow up of cohort members, we cannot prospectively evaluate cancer incidence according to ACE responses. Others have reported that ACEs are associated with an increased risk of several forms of cancer, including lung cancer.[16,32,44–45] An association with lung cancer would be expected based on the trends we observed between ACE score

and smoking prevalence. Indeed, compared with people without ACEs, the risk of lung cancer for those with six or more ACEs has been reported to be increased approximately three-fold.[16] Physical abuse by either parent, but particularly by the father for men and by the mother for women, has been reported to be associated with increased overall cancer risk, and ACE exposure has been associated with increased risk of breast and gynecologic cancers.[32,44–45] A more than doubled risk of cervical cancer has been associated with violence against women, including intimate partner violence, adult exposure to forced sex, and childhood exposure to sexual abuse.[46] In addition to a direct effect through sexual assaults and transmission of human papilloma virus, the increase may also be indirectly related to psychosocial stress, negative coping behaviors, and less frequent cervical screening.[47] Indeed, several authors have hypothesized that an ACE-related increased risk of cancer may be due to increased environmental stressors resulting from ACE exposure.[17,32,48] Our study suggests an additional explanation related to an increase in lifestyle behaviors associated with increased cancer risk and reduced cancer screening rates. Further research on the role of abuse and other adverse experiences starting in childhood is potentially important in advancing our understanding of cancer etiology and developing appropriate prevention policies.[45]

A limitation of our study is that the ACE questionnaire, which was developed and validated elsewhere,[19,49] relies on self-report and recall of the exposure to adverse events. Similarly, all measures of smoking, drinking, weight, and height in this study were based on retrospective self-report data and consequently subject to error in participant recall. Although recall of ACE events may be limited, those participants who were able to remember adverse childhood experiences likely internalized the experience(s) more strongly. Additionally, recall of adult health behaviors is subject to misclassification, although validation studies based on serum cotinine revealed good agreement for smoking status and among SCCS participants who had weight measured during a clinic visit correlations between measured and self-reported weight exceeded 95%.[39]

Despite the generic limitations of epidemiologic studies like ours, our findings that ACEs are associated with an increase in cancer risk behaviors suggest an opportunity for intervention. Developing strategies to address the effect of ACEs, avoidance of adverse experiences in childhood, and understanding ways to promote resilience once adverse experiences occur, may be significant approaches towards improving cancer risk behavior and health outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

References

1. Xu JQ, Kochanek KD, Murphy SL, et al. Deaths: final data for 2007. National Vital Statistics Reports. 2010 May 20.58(19) Available at: http://www.cdc.gov/nchs/data/nvsr/nvsr58/nvsr58_19.pdf.
2. National Center for Health Statistics. Health, United States, 2010: with special feature on death and dying. Hyattsville, MD: National Center for Health Statistics; 2011.

3. American Cancer Society. Cancer facts & figures 2014. Atlanta, GA: American Cancer Society; 2014. Available at: http://www.cancer.org/acs/groups/content/@research/documents/webcontent/acspc-042151.pdf
4. American Cancer Society. The importance of behavior in cancer prevention and early detection. Atlanta, GA: American Cancer Society; 2014. Available at: http://www.cancer.org/research/researchprogramsfunding/behavioralresearchcenter/theimportanceofehaviorincancerpreventionandearlydetection/
5. Locker, D. Social determinants of health and disease. In: Graham, S., editor. Sociology as applied to medicine. 6th. UK: Elsevier Health Sciences; 2008. p. 18-37.
6. National Cancer Institute. Cancer causes and risk factors. Rockville, MD: National Cancer Institute; 2014. Available at: http://www.cancer.gov/cancertopics/causes
7. Lim SS, Vos T, Flaxman AD, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet. 2012 Dec 15; 380(9859):2224–60. http://dx.doi.org/10.1016/S0140-6736(12)61766-8. [PubMed: 23245609]
8. Macintyre S, MacIver S, Sooman A. Area, class and health: should we be focusing on places or people? J Soc Policy. 1993; 22:213–34. http://dx.doi.org/10.1017/S0047279400019310.
9. McGinnis JM, Foege WH. Actual causes of death in the United States. JAMA. 1993 Nov 10; 270(18):2207–12. http://dx.doi.org/10.1001/jama.270.18.2207http://dx.doi.org/10.1001/jama.1993.03510180077038. [PubMed: 8411605]
10. Breen N. Stage of Breast and Cervical cancer diagnosis in disadvantaged neighborhoods: a prevention policy perspective. Am J Prev Med. 1996 Sep-Oct;12(5):319–26. [PubMed: 8909640]
11. Krug EG, Mercy JA, Dahlberg LL, et al. The world report on violence and health. Lancet. 2002 Oct 5; 360(9339):1083–8. http://dx.doi.org/10.1016/S0140-6736(02)11133-0. [PubMed: 12384003]
12. Cohen DA, Mason K, Bedimo A, et al. Neighborhood physical conditions and health. Am J Public Health. 2003 Mar; 93(3):467–71. http://dx.doi.org/10.2105/AJPH.93.3.467. [PubMed: 12604497]
13. Williams DR, Jackson PB. Social sources of racial disparities in health. Health Af(Millwood). 2005 Mar-Apr;24(2):325–34. http://dx.doi.org/10.1377/hlthaf.24.2.325.
14. Modesitt SC, Gambrell AC, Cottrill HM, et al. Adverse impacgt of a history of violence for women with breast, cervical, endometrial, or ovarian cancer. Obstet Gynecol. 2006 Jun; 107(6):1330–6. http://dx.doi.org/10.1097/01.AOG.0000217694.18062.91. [PubMed: 16738160]
15. Johnson SL, Solomon BS, Shields WC, et al. Neighborhood violence and its association with mothers' health: assessing the relative importance of perceived safety and exposure to violence. J Urban Health. 2009 Jul; 86(4):538–50. Epub 2009 Apr 3. http://dx.doi.org/10.1007/s11524-009-9345-8. [PubMed: 19343500]
16. Brown DW, Anda RF, Felitti VJ, et al. Adverse childhood experiences are associated with the risk of lung cancer: a prospective cohort study. BMC Public Health. 2010 Jan 19.10:20. http://dx.doi.org/10.1186/1471-2458-10-311http://dx.doi.org/10.1186/1471-2458-10-20. [PubMed: 20085623]
17. Fuller-Tomson E, Brennenstuhl S. Making a link between childhood physical abuse and cancer: results from a regional representative survey. Cancer. 2009 Jul 15; 115(14):3341–50. http://dx.doi.org/10.1002/cncr.24372. [PubMed: 19472404]
18. Lanius, RA.; Vermetten, E.; Pain, C. The impact of early life trauma on health and disease: the hidden epidemic. Cambridge, MA: Cambridge University Press; 2010. http://dx.doi.org/10.1017/CBO9780511777042
19. Felitti VJ, Anda RF, Nordenberg D, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. Am J Prev Med. 1998 May; 14(4):245–58. http://dx.doi.org/10.1016/S0749-3797(98)00017-8. [PubMed: 9635069]
20. Centers for Disease Control and Prevention (CDC). Adverse childhood experiences reported by adults—five states, 2009. MMWR Morb Mortal Wkly Rep. 2010 Dec; 59(49):1609–13. [PubMed: 21160456]

21. Felitti VJ. Origins of addictive behavior: evidence from the adverse childhood experiences. Prax Kinderpsychol Kinderpsychiatr. 2003 Oct; 52(8):547–59. [PubMed: 14619682]
22. Dube SR, Miller JW, Brown DW, et al. Adverse childhood experiences and the association with ever using alcohol and initiating alcohol use during adolescence. J Adolesc Health. 2006 Apr; 38(4):444.e1–10. http://dx.doi.org/10.1016/j.jadohealth.2005.06.006. [PubMed: 16549308]
23. Strine TW, Dube SR, Edwards VJ, et al. Associations between adverse childhood experiences, psychological distress, and adult alcohol problems. Am J Health Behav. 2012 Mar; 36(3):408–23. http://dx.doi.org/10.5993/AJHB.36.3.11. [PubMed: 22370441]
24. Anda RF, Crof JB, Felitti VJ, et al. Adverse childhood experiences and smoking during adolescence and adulthood. JAMA. 1999 Nov; 282(17):1652–8. http://dx.doi.org/10.1001/jama.282.17.1652. [PubMed: 10553792]
25. LaNoue M, Graeber D, de Hernandez BU, et al. Direct and indirect effects of childhood adversity on adult depression. Community Ment Health J. 2012 Apr; 48(2):187–92. Epub 2010 Dec 3. http://dx.doi.org/10.1007/s10597-010-9369-2. [PubMed: 21127974]
26. Lanoue M, Graeber DA, Helitzer DL, et al. Negative affect predicts adults' ratings of the current, but not childhood, impact of adverse childhood events. Community Ment Health J. 2013 Oct; 49(5):560–6. Epub 2012 Mar 30. http://dx.doi.org/10.1007/s10597-012-9511-4. [PubMed: 22460928]
27. Poulton R, Caspi A, Milne BJ, et al. Association between children's experience of socioeconomic disadvantage and adult health: a life-course study. Lancet. 2002 Nov 23; 360(9346):1640–5. http://dx.doi.org/10.1016/S0140-6736(02)11602-3. [PubMed: 12457787]
28. Dong M, Giles WH, Felitti VJ, et al. Insights into causal pathways for ischemic heart disease adverse childhood experiences study. Circulation. 2004 Sep 28; 110(13):1761–6. Epub 2004 Sep 20. http://dx.doi.org/10.1161/01.CIR.0000143074.54995.7F. [PubMed: 15381652]
29. Tomas C, Hyppönen E, Power C. Obesity and type 2 diabetes risk in midadult life:the role of childhood adversity. Pediatrics. 2008 May; 121(5):e1240–9. http://dx.doi.org/10.1542/peds.2007-2403. [PubMed: 18450866]
30. Van der Meer LB, van Duijn E, Wolterbeek R, et al. Adverse childhood experiences of people at risk for Huntington's disease or BRCA1/2 hereditary breast/ovarian cancer. Clin Genet. 2012 Jan 23; 81(1):18–23. http://dx.doi.org/10.1111/j.1399-0004.2011.01778.x. [PubMed: 21895638]
31. Brown MJ, Thacker LR, Cohen SA. Association between adverse childhood experiences and diagnosis of cancer. PLoS One. 2013 Jun 11.8(6):e65524. http://dx.doi.org/10.1371/journal.pone.0065524. [PubMed: 23776494]
32. Brown MJ, Cohen SA. Association between abusive and non-abusive adverse childhood experiences and diagnosis of cancer in Wisconsin, USA. J Comm Med Health Educ. 2014 Apr 7.S2:008.
33. Anda RF, Butchart A, Felitti VJ, et al. Building a framework for global surveillance of the public health implications of adverse childhood experiences. Am J Prev Med. 2010 Jul; 39(1):93–8. http://dx.doi.org/10.1016/j.amepre.2010.03.015. [PubMed: 20547282]
34. Kendall-Tackett K. The health effects of childhood abuse: Four pathways by which abuse can influence health. Child Abuse Negl. 2002 Jun; 26(6–7):715–29. http://dx.doi.org/10.1016/S0145-2134(02)00343-5. [PubMed: 12201164]
35. Fairbank JA, Fairbank DW. Epidemiology of child traumatic stress. Curr Psychiatry Rep. 2009 Aug; 11(4):289–95. http://dx.doi.org/10.1007/s11920-009-0042-9. [PubMed: 19635237]
36. Yeoman K, Safranek T, Buss B, et al. Adverse childhood experiences and adult smoking, Nebraska, 2011. Prev Chronic Dis. 2013 Sep 19.10:E159. http://dx.doi.org/10.5888/pcd10.130009. [PubMed: 24050529]
37. Research and Evaluation Group. Findings from the Philadelphia urban ACE study. Philadelphia, PA: Public Health Management Corp.; 2013.
38. Signorello LB, Hargreaves MK, Steinwandel MD, et al. Southern Community Cohort Study: establishing a cohort to investigate health disparities. J Natl Med Assoc. 2005 Jul; 97(7):972–9. [PubMed: 16080667]

39. Signorello LB, Hargreaves MK, Blot WJ. The Southern Community Cohort Study: Investigating Health Disparities. J Health Care Poor Underserved. 2010 Feb; 21(Suppl 1):26–37. http://dx.doi.org/10.1353/hpu.0.0245. [PubMed: 20173283]
40. Scott Collins, K.; Schoen, C.; Joseph, S., et al. Health concerns across a woman's lifespan: the Commonwealth Fund 1998 survey of women's health. New York, NY: The Commonwealth Fund; 1999.
41. Smith RA, Cokkinides V, Brooks D, et al. Cancer screening in the United States, 2010: a review of current American Cancer Society guidelines and issues in cancer screening. CA Cancer J Clin. 2010 Mar-Apr;60(2):99–119. http://dx.doi.org/10.3322/caac.20063. [PubMed: 20228384]
42. Watson-Johnson LC, Townsend JS, Basile KC, et al. Cancer screening and history of sexual violence victimization among U.S. adults. J Womens Health (Larchmt). 2012 Jan; 21(1):17–25. Epub 2011 Oct 19. http://dx.doi.org/10.1089/jwh.2011.2751. [PubMed: 22011207]
43. Olesen SC, Butterworth P, Jacomb P, et al. Personal factors influence use of cervical cancer screening services: epidemiological survey and linked administrative data address the limitations of previous research. BMC Health Serv Res. 2012 Feb 14.12:34. http://dx.doi.org/10.1186/1472-6963-12-34. [PubMed: 22333392]
44. Morton PM, Schafer MH, Ferraro KF. Does childhood misfortune increase cancer risk in adulthood? J Aging Health. 2012 Sep; 24(6):948–84. Epub 2012 Jul 4. http://dx.doi.org/10.1177/0898264312449184. [PubMed: 22764155]
45. Kelly-Irving M, Lepage B, Dedieu D, et al. Childhood adversity as a risk for cancer: findings from the 1958 British birth cohort study. BMC Public Health. 2013 Aug 19.13:767. http://dx.doi.org/10.1186/1471-2458-13-767. [PubMed: 23957659]
46. Coker AL, Follingstad D, Garcia LS, et al. Association of intimate partner violence and childhood sexual abuse with cancer-related well-being in women. J Womens Health (Larchmt). 2012 Nov; 21(11):1180–8. Epub 2012 Sep 4. http://dx.doi.org/10.1089/jwh.2012.3708. [PubMed: 22946631]
47. Coker AL, Sanderson M, Fadden MK, et al. Intimate partner violence and cervical neoplasia. J Womens Health Gend Based Med. 2000 Nov; 9(9):1015–23. http://dx.doi.org/10.1089/15246090050200051. [PubMed: 11103102]
48. Jacobs J, Bovasso GB. Early and chronic stress and their relation to breast cancer. Psychol Med. 2000 May; 30(3):669–78. http://dx.doi.org/10.1017/S0033291799002020. [PubMed: 10883721]
49. Edwards VJ, Anda RF, Nordenberg DF, et al. Bias assessment for child abuse survey: Factors affecting probability of response to a survey about childhood abuse. Child Abuse Negl. 2001 Feb; 25(2):307–12. http://dx.doi.org/10.1016/S0145-2134(00)00238-6. [PubMed: 11330927]

Table 1

Percentages of Men and Women Responding "Yes" To The 10 Childhood Abuse Questions Asked

ACE question	Male N=7,196	Female N=15,031	p[a]
Abuse			
1. Verbal abuse	17	21	<.0001
2. Physical abuse	15	18	<.0001
3. Sexual abuse	8	20	<.0001
Neglect			
4. Emotional, unloved	13	21	<.0001
5. Unfed, unclothed, neglected	7	8	.032
Household dysfunction			
6. Parents separated or divorced	30	33	<.0001
7. Mother had been abused	10	14	<.0001
8. Live with alcoholic or drug user	21	25	<.0001
9. Depression/mental illness in household	11	16	<.0001
10. Household member in prison	12	12	.86
Total (answered yes to any question)	53	61	<.0001

[a]Chi-Square test

Table 2

Percentage Distribution of Ace Scores According to Demographic Indices

Variables	ACE score 0 N=9315	1 N=4775	2 N=2566	3 N=1618	4 N=3953	p[a]
All	42	22	12	7	18	
Age (Years, mean±SD)	55.4±8.9	53.6±8.6	52.7±8.2	51.7±7.9	51.2±7.7	
Age group						
40 to 49 (N=8172)	34	22	13	9	23	<.0001
50 to 59 (N=8406)	42	21	12	7	17	
60 to 79 (N=5649)	54	21	9	5	11	
Race						
White (N=8722)	44	19	11	7	19	<.0001
African American (N=12330)	41	24	12	7	16	
Gender						
Male (N=7196)	47	22	11	6	14	<.0001
Female (N=150311)	39	21	12	8	20	
Household Income ($/Y)						
Less than $15,000 (N=8570)	36	21	12	8	23	<.0001
$15,000–<$25,000 (N=4255)	40	22	12	7	18	
$25,000–<$50,000 (N=3876)	45	22	11	7	15	
$50,000+ (N=4011)	51	22	11	6	11	
Education						
< High School (N=4079)	39	22	12	8	20	.012
High School (N=6574)	43	22	11	7	17	
> High School (N=11103)	42	21	12	7	17	
Marital status						
Married/living with a partner (N=9194)	47	21	11	6	15	<.0001
Separated/divorced (N=6059)	34	22	13	9	23	
Widowed (N=3211)	47	20	10	8	15	
Single (N=3429)	38	22	13	8	19	

Variables	ACE score					p^a
	0 N=9315	**1** N=4775	**2** N=2566	**3** N=1618	**4** N=3953	
Neighborhood deprivation index group (Quartile)						
Q1 (N=3247)	47	20	11	6	16	<.0001
Q2 (N=4024)	42	20	12	7	19	
Q3 (N=5005)	42	21	11	7	18	
Q4 (N=9500)	40	23	12	8	18	

[a] Chi-Square test

Table 3

Smoking, Alcohol Drinking, Bmi and Cancer Screening Prevalences Among Men and Women According to the Ace Score (White or Black Participants)

	ACE score					
Health-risk behaviors	**0**	**1**	**2**	**3**	**4+**	**p[a]**
Smoker (White males)	N=1575	N=528	N=287	N=160	N=387	
Never	41	31	32	28	27	<.0001
Former	46	50	48	53	43	
Current < 20 cpd	6	7	6	9	12	
Current ≥ 20 cpd	8	13	13	9	17	
Smoker (White females)	N=2020	N=974	N=580	N=395	N=1187	
Never	55	52	44	38	34	<.0001
Former	29	29	35	36	32	
Current < 20 cpd	9	11	10	15	17	
Current ≥ 20 cpd	6	8	11	11	16	
Smoker (Black males)	N=1356	N=798	N=397	N=219	N=439	
Never	28	26	25	18	13	<.0001
Former	36	34	30	28	27	
Current < 20 cpd	30	34	38	42	46	
Current ≥ 20 cpd	6	6	7	12	13	
Smoker (Black females)	N=2906	N=1721	N=911	N=581	N=1311	
Never	54	48	45	41	37	<.0001
Former	24	26	25	27	27	
Current < 20 cpd	20	23	26	27	30	
Current ≥ 20 cpd	3	3	3	5	6	
Alcohol drinker (males)	N=3149	N=1442	N=738	N=407	N=890	
Never/rarely	45	45	41	44	47	.38
1–3 times per month	14	14	15	14	11	
1–6 times per week	28	27	32	28	28	
Daily	13	13	12	14	13	
Alcohol drinker (females)	N=5526	N=2997	N=1637	N=1072	N=2698	

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Health-risk behaviors	ACE score 0	1	2	3	4+	p[a]
Never/rarely	71	69	67	67	67	<.001
1–3 times per month	12	13	15	14	14	
1–6 times per week	13	15	13	14	14	
Daily	4	4	4	5	5	
BMI (kg/m^2) (males)	N=3128	N=1426	N=730	N=398	N=882	
<25	27	29	29	27	27	.004
25–29	41	37	36	36	34	
30–34	19	20	20	20	24	
35–39	8	8	9	9	9	
≥40	4	5	6	8	6	
BMI (kg/m^2) (females)	N=5442	N=2946	N=1620	N=1062		
<25	22	19	20	18	18	<.0001
25–29	28	27	25	24	23	
30–34	24	24	25	25	25	
35–39	14	14	15	16	15	
≥40	13	17	14	17	18	
Annual mammogram (females)	68	67	63	61	58	<.0001
Pap screening (females)	74	75	71	68	68	<.0001
Ever PSA screening (males)	67	63	61	58	54	<.0001
Ever sigmoidoscopy	30	29	28	28	29	.29
Ever colonoscopy	70	66	64	64	62	<.0001

[a]Chi-Square test

Table 4

Adjusted Odds Ratios (And 95% Ci) of Smoking, Alcohol Drinking, Bmi and Cancer Screening Prevalences According to Ace Score[a]

	ACE score					
Health-risk behavior	**0**	**1**	**2**	**3**	**4+**	**$p_{for\ trend}$**
Smoker (relative to never smoker)						
Former	1.0 (ref)	1.17 (1.07–1.29)	1.32 (1.17–1.49)	1.60 (1.37–1.85)	1.63 (1.46–1.82)	<.0001
Current <20 cpd	1.0 (ref)	1.23 (1.09–1.38)	1.34 (1.16–1.56)	1.66 (1.39–1.98)	1.95 (1.71–2.21)	<.0001
Current >20 cpd	1.0 (ref)	1.25 (1.05–1.50)	1.50 (1.21–1.86)	1.74 (1.35–2.24)	2.33 (1.96–2.77)	<.0001
Alcohol Drinking Frequency (relative to never/rarely drink)						
1–3 times per month	1.0 (ref)	1.08 (0.96–1.22)	1.23 (1.07–1.42)	1.16 (0.98–1.39)	1.09 (0.96–1.24)	.032
1–6 times per week	1.0 (ref)	1.04 (0.93–1.15)	1.05 (0.92–1.20)	1.05 (0.89–1.23)	1.05 (0.94–1.18)	.35
Daily	1.0 (ref)	0.97 (0.83–1.14)	0.99 (0.81–1.20)	1.12 (0.89–1.42)	1.06 (0.89–1.26)	.31
BMI (relative to <25 kg/m^2)						
25–29	1.0 (ref)	0.99 (0.89–1.10)	0.90 (0.78–1.03)	1.03 (0.86–1.22)	1.02 (0.91–1.16)	.96
30–34	1.0 (ref)	1.04 (0.93–1.17)	1.03 (0.90–1.19)	1.15 (0.96–1.38)	1.22 (1.08–1.39)	.001
35–39	1.0 (ref)	1.01 (0.88–1.16)	1.04 (0.88–1.23)	1.25 (1.02–1.54)	1.17 (1.00–1.36)	.020
≥40	1.0 (ref)	1.24 (1.08–1.43)	1.00 (0.84–1.20)	1.31 (1.06–1.62)	1.35 (1.16–1.57)	.0002
Annual mammogram (yes vs. no)	1.0 (ref)	0.95 (0.85–1.06)	0.88 (0.77–1.01)	0.79 (0.68–0.92)	0.75 (0.67–0.84)	<.0001
4-year Pap screening (yes vs. no)	1.0 (ref)	1.02 (0.90–1.15)	0.84 (0.73–0.97)	0.67 (0.57–0.80)	0.74 (0.66–0.84)	<.0001
Ever PSA screening (yes vs. no)	1.0 (ref)	1.14 (0.96–1.34)	1.11 (0.90–1.36)	1.30 (1.00–1.70)	1.08 (0.89–1.30)	.24
Ever sigmoidoscopy (yes vs. no)	1.0 (ref)	0.98 (0.89–1.08)	0.99 (0.88–1.12)	1.03 (0.89–1.19)	1.08 (0.97–1.20)	.07
Ever colonoscopy (yes vs. no)	1.0 (ref)	0.99 (0.90–1.08)	0.91 (0.81–1.02)	1.00 (0.87–1.15)	1.03 (0.94–1.14)	.54

[a]For health risk factors, model was adjusted with neighborhood deprivation index (ref= Ql), age (ref= 40 to 49), gender (ref=male), race (ref=White), education (ref= <high school), household annual income (ref=less than $15,000), and marital status (ref=married/living with a partner). For cancer screening outcomes, model was adjusted with above variables plus current smoker (ref=no), alcohol consumer (ref=no), and severe obesity (ref=bmi<35).

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