Published in final edited form as:

J Health Care Poor Underserved. 2021 ; 32(3): 1384–1402. doi:10.1353/hpu.2021.0139.

Adverse Childhood Experiences and Chronic Disease Risk in the Southern Community Cohort Study

Maureen Sanderson, PhD, Charles P. Mouton, MD, MS, Mekeila Cook, PhD, Jianguo Liu, William J. Blot, PhD, Margaret K. Hargreaves, PhD

MAUREEN SANDERSON, MEKEILA COOK, and JIANGUO LIU are affiliated with Meharry Medical College. CHARLES P. MOUTON is affiliated with the University of Texas Medical Branch. WILLIAM J. BLOT is affiliated with the Vanderbilt University Medical Center. MARGARET K. HARGREAVES was affiliated with Meharry Medical College.

Abstract

We used the Southern Community Cohort Study of people residing in 12 states in the southeastern United States (n=38,200 participants) to examine associations between adverse childhood experiences (ACEs) and chronic disease risk. After adjustment for confounding, there were statistically significant positive associations for people reporting four or more ACEs relative to those reporting no ACEs, and this was true for all chronic diseases except hypertension. The most elevated risk was seen for depression when measured as a yes/no variable (odds ratio (OR) 2.84, 95% confidence interval (CI) 2.64–3.06) or when using the 10-item Center for Epidemiologic Student Depression (CESD) scale (OR 1.88, 95% CI 1.75–2.02). There were also statistically significant monotonic increases in risk with worsening ACE score for all chronic diseases except hypertension, cancer, and high cholesterol. The need to establish programs that build resilience during childhood is paramount for preventing chronic diseases that may result from childhood abuse, neglect, and household dysfunction.

Keywords

Adverse childhood experiences; chronic disease; Southern Community Cohort Study; cross-sectional analysis

Adverse childhood experiences (ACEs) present as untoward development and are typically assessed through a series of 10 or more questions addressing abuse, neglect, and household dysfunction prior to age 18.¹ Based on a recent report from the Centers for Disease Control and Prevention that used Behavioral Risk Factor Surveillance System (BRFSS) data from 25 states, a total of 60.9% of participants reported having at least one ACE and 15.6% of participants reported having four or more ACEs.² In a previous analysis of the Southern Community Cohort Study (SCCS), we found that 54% of men and 60% of women reported at least one ACE.³

Adverse childhood experiences are known to negatively affect subsequent chronic disease during adulthood.^{1–2,4} In the BRFSS study, there were significantly elevated odds ratios for all eight chronic diseases examined (ranging from 1.4 for diabetes and cancer to 5.3 for depression) for participants reporting four or more ACEs relative to participants reporting no ACEs.² Chronic diseases in adulthood linked to exposure to ACEs include depression,^{2,4–6} cardiovascular disease,^{1–2,4,7–10} diabetes,^{2,4,8,11} and cancer.^{1–2,4,12–16} In fact, ACE exposure has been linked with lower risk of dying prematurely.^{17,18} The majority of studies of ACEs and chronic disease have investigated the odds of disease among people with several ACEs relative to those with none. Dose-response of ACEs on chronic disease have been reported for depression,^{5–6} frequent mental distress,⁸ coronary heart disease,^{1,7–9} heart attack,^{8,10} stroke,⁸ diabetes,⁸ cancer,^{1,12} and chronic bronchitis or emphysema.¹ To our knowledge, none of these studies have examined the dose-response of ACEs on chronic disease separately for non-Hispanic Whites and African Americans/Blacks.

In our previous SCCS analysis, there were statistically significant monotonic increases in ACE scores associated with a chronic disease index score that combined the eight chronic diseases.³ That paper showed increases in ACE scores for those with one or two chronic diseases ($p < .0001$) and those with three to eight chronic diseases ($p < .0001$) relative to those with no chronic diseases.³ In an attempt to better characterize the association between childhood adversity and adult chronic disease, we have disaggregated the chronic disease index score to look at each chronic disease individually. We examined the dose-response of ACEs on chronic disease by race, which has been a limitation of other studies.^{17,18} We hypothesized that a statistically significant dose-response of ACEs would exist for most chronic diseases regardless of race.

Methods

Detailed methods of the SCCS^{3,19} appear elsewhere. Briefly, the SCCS population included men and women aged 40–79 at enrollment who completed a baseline interview in 12 southeastern states between 2002 and 2009. Primarily, participants had low incomes, and a large majority (86%) enrolled in person at participating community health centers (CHCs). (The remaining participants were sampled from the general population.) Computer-assisted in-person interviews were conducted for CHC enrollees, while general population participants completed mailed questionnaires. The baseline survey was used for most of the variables including whether a doctor had ever told participants they had a specific chronic disease. A follow-up survey, completed with 40,584 participants between 2012 and 2015, included household income, marital status, weight, smoking, and a series of 10 ACE questions.^{1,19} Half of the chronic diseases were available from the baseline survey only (hypertension, COPD, depression based on the yes/no question and the 10-item Center for Epidemiologic Studies Depression (CESD) scale, high cholesterol), while half (diabetes, cancer, stroke, myocardial infarction) were also available from the follow-up survey and updated appropriately. The 10-item CESD scale was dichotomized using sums of 0–9 = no and 10 = yes (with having occurred rarely or none of the time = 0, some of the time = 1, much of the time = 2, and most or all of the time = 3).²⁰

The Institutional Review Boards of Vanderbilt University Medical Center and Meharry Medical College approved this study's protocol. In this cross-sectional analysis, after excluding those missing race/ethnicity ($n = 440$), races/ethnicities other than non-Hispanic White and African American ($n = 1,621$) since there were too few for analysis, and participants who did not answer all 10 ACE questions ($n = 323$), there were 38,200 participants for analysis. The number of ACEs that participants identified were summed and categorized as 0, 1, 2, 3, and 4 or more. Based on a 10% or more change in the crude odds ratio we adjusted for the following confounders of the ACE and chronic disease associations: age, race/ethnicity, sex, educational level, annual household income, marital status, neighborhood deprivation index (quartiles), alcohol intake, current smoking, severe obesity (<35 vs. ≥ 35 body mass index [BMI]), sedentary status (quartiles of total hours sitting per day), and enrollment source. Statistical analyses were performed with SAS version 9.4 (Copyright © 2020, SAS Institute Inc., Cary NC, USA). We used logistic regression to estimate the odds ratio of chronic diseases associated with ACEs while adjusting for confounding factors.²¹ Tests for trend across ACE scores were performed by entering categorical variables as ordered categorical variables into the models. In supplemental analyses, we stratified by race/ethnicity and sex as was done in our previous SCCS analysis,³ and by annual household income ($<\$15,000$ and $\geq \$15,000$) among Blacks.

Results

Table 1 presents the distribution of positive ACE scores for each chronic disease. The chronic disease associated with the lowest report of ACEs was COPD (ranging from 6.4% to 12.6%) while hypertension (ranging from 52.2% to 57.5%) was the chronic disease with the highest report of ACEs exposure. The chronic disease with the lowest report of four or more ACEs was stroke (11.2%), while hypertension (52.2%) was associated with the highest report of four or more ACEs. The chronic diseases that did not exhibit a trend of increasing disease prevalence with increasing ACE score were cancer and high cholesterol, with a range of 17.4% of people with one ACE through 20.4% of those with four or more ACEs for cancer, and 39% to 37% for high cholesterol. Hypertension showed a negative trend with increasing ACE score with a range of 57.5% of those with no ACE through 52.2% of people with four or more ACEs.

Table 2 presents the odds ratios (ORs) and 95% confidence intervals (CI) for the associations between ACE score and various chronic diseases. After adjustment for confounding using logistic regression, there were statistically significant positive associations for people reporting four or more ACEs compared with those reporting no ACEs for all chronic diseases except hypertension. The largest association of chronic disease associated with four or more ACEs was seen for depression when measured as a yes/no variable (OR 2.84, 95% CI 2.64–3.06) or when using the CESD 10-item scale (OR 1.88, 95% CI 1.75–2.02). There were also statistically significant monotonic increases in risk with worsening ACE score for all chronic diseases except hypertension, cancer, and high cholesterol. In comparison with those who had no ACEs, people with one (OR 0.97, 95% CI 0.89–1.05) ACE were at similar risk of cancer and people with one (OR 1.01, 95% CI 0.95–1.08) or 2 (OR 0.99, 0.91–1.07) ACE were at similar risk of high cholesterol. There was no association between worsening ACE score and hypertension ($p_{\text{for trend}} = 0.16$).

Supplemental tables 1a–4b present the distributions and ORs for the association between ACE score and chronic disease among non-Hispanic Whites, African Americans/Blacks, men, and women. The non-significant trend for ACE score and hypertension was evident in each of the groups (non-Hispanic Whites $p_{\text{for trend}} = .26$; males $p_{\text{for trend}} = .59$; females $p_{\text{for trend}} = .08$) except African Americans/Blacks, who exhibited an inverse trend ($p_{\text{for trend}} = .001$). The trend for ACE score associated with high cholesterol overall was no longer significant among non-Hispanic Whites ($p_{\text{for trend}} = .10$) and males ($p_{\text{for trend}} = .22$), while the significant trend for ACE score and cancer overall was no longer significant among males ($p_{\text{for trend}} = .09$).

Discussion

In agreement with several studies that used a similar ACE questionnaire, we found that nearly all chronic diseases exhibited statistically significant associations when comparing people who reported four or more ACEs with people who reported no ACEs.^{1–2, 4} A recent meta-analysis reported an OR less than 2 for diabetes; ORs from 2–3 for cancer, heart disease, and respiratory disease; and an OR of 3–6 for mental health conditions for people reporting four or more ACEs relative to those reporting none.⁴ With the exception of diabetes in which we found an OR of 1.21, our study reported weaker associations than those in the meta-analysis (OR 1.24 for cancer, OR 1.66 for COPD, OR 1.88/2.84 for depression, and OR 1.44 for heart attack). Our finding of depression having the most elevated risk associated with four or more ACEs (OR 1.88, 95% CI 1.75–2.02 based on CESD 10-item scale; OR 2.84, 95% CI 2.64–3.06 based on yes/no variable) is comparable to the findings of Dong et al.⁷ who reported a two to three-fold increase in depressed affect among people who reported four or more ACEs in a study in San Diego primarily of non-Hispanic Whites.

In addition, in agreement with previous studies we found that nearly all chronic diseases including diabetes,⁸ cancer,^{1,12} COPD,¹ depression,^{5,6} heart attack,^{8,10} and stroke⁸ exhibited statistically significant positive trends associated with worsening ACE scores. Our finding overall that hypertension did not exhibit a dose-response with ACE score ($p_{\text{for trend}} = .16$) differs from that of Allen et al.²² who reported a 1.0 percent increase in the probability of a diagnosis of hypertension based on self-report with each increasing ACE ($p < .001$); however, it is comparable for measured hypertension (140 mm HG/ 90 mmHG) among racially mixed low-income Oregonians. It also differs from Iniguez et al.²³ who reported a significant inverse relationship with ACE score ($p = .011$) among a nearly all-non-Hispanic White rural population in Wisconsin. When we stratified by race and by sex, the lack of a significant association held true except among African Americans/Blacks for whom there was a statistically significant trend of decreasing risk of hypertension associated with increasing ACE score ($p_{\text{for trend}} = .001$). When we stratified by annual household income (<\$15,000 and \$15,000+), this finding was no longer evident among lower-income African Americans/Blacks ($p_{\text{for trend}} = .06$) but was still evident among middle to higher-income African Americans/Blacks ($p_{\text{for trend}} = .01$) (data not shown). A possible explanation is so-called John Henryism whereby prolonged, high-effort coping with difficult psychosocial stressors or striving results in an inverse association between socioeconomic status (SES) and hypertension in African Americans/Blacks, meaning the physiological cost of striving

is greater in persons of low SES than high SES.²⁴ To our knowledge, our study and that of Iniguez et al.²² are the only two studies that reported inverse associations between ACE score and hypertension. Of note, Doom et al.²⁵ reported higher striving was associated with lower risk of cardiovascular disease and depression regardless of child maltreatment or race.

The lack of a monotonic increase in risk with worsening ACE score for cancer (evident at 1 or more) and high cholesterol (evident at 3 or more) may have been due to the type of reported ACE with regard to chronic disease. In our study, the most frequently reported ACE among people reporting one or two ACEs was divorce (59% for 1, 57% for 2) followed by parental substance abuse (12% for 1, 36% for 2). In a review of the ACE questionnaire, Zarse et al.²⁶ implied that childhood household dysfunction appeared to have less impact on subsequent health than childhood abuse and neglect.

One biological mechanism proposed to link ACEs with chronic disease is toxic stress that results from exposure to frequent adversity in childhood with no support from a caregiver.²⁷ Toxic stress leads to inflammation negatively affecting the structure of the brain and other organ systems which, in combination with epigenetic changes, may result in chronic diseases.²⁷ It is important to note that persons who have reported ACEs but have developed some means of adaptation or resilience have better educational and health outcomes as children²⁸ and health outcomes as adults.²⁹ A recent systematic review of child adversity intervention programs reported improvements in cortisol levels, brain development, and epigenetic regulation.³⁰

Limitations of our study include the reliance on self-report of ACEs and chronic diseases, and the cross-sectional nature of the analysis. A reliability study³¹ and a validation study³² of the ACE questionnaire have reported on its ability to collect unbiased information. A validation sub-study conducted within the SCCS found that 96% of self-reported diabetes could be confirmed through medical records or elevated HbA1c measurements.³³ Although the cross-sectional nature of the analysis typically limits the establishment of temporal sequence, in all likelihood the ACEs reported prior to age 18 preceded the chronic diseases. A previous analysis of a subset of the SCCS identified higher ACE scores associated with an increased prevalence of smoking, but not with other adult risk behaviors.³⁴ Adjusting for smoking as a confounder may have resulted in overadjustment, but the strong associations argue against a substantial effect. Strengths of our study include the large sample size and the racially diverse population. The large sample size allowed us to examine associations and trends in ACEs and chronic disease within categories of race/ethnicity and sex, thereby enabling us to identify the inverse trend between ACE score and hypertension among African Americans/Blacks.

Although the American Academy of Pediatrics has indicated that universal screening for ACEs may be premature,³⁵ our study provides additional support for this effort. Regardless, the need to establish programs that build resilience during childhood is paramount in preventing chronic diseases that may result from abuse, neglect, and household dysfunction.⁴

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The Southern Community Cohort Study was supported by the National Cancer Institute (grants R01 CA092447 and U01 CA202979). Data collection was performed by the Survey and Biospecimen Shared Resource which is supported in part by the Vanderbilt-Ingram Cancer Center (P30 CA68485).

References

1. 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;14(4):245–58. 10.1016/S0749-3797(98)00017-8 [PubMed: 9635069]
2. Merrick MT, Ford DC, Ports KA, et al. Vital Signs: Estimated proportion of adult health problems attributable to adverse childhood experiences and implications for prevention—25 states, 2015–2017. *MMWR Morb Mortal Weekly Rep.* 2019;118(44):999–1005. 10.15585/mmwr.mm6844e1
3. Hargreaves MK, Mouton CP, Liu J, et al. Adverse childhood experiences and health care utilization in a low-income population. *J Health Care Poor Underserved.* 2019;30(2):749–67. 10.1353/hpu.2019.0054 [PubMed: 31130549]
4. Hughes K, Bellis MA, Hardcastle KA, et al. The effect of multiple adverse childhood experiences on health: a systematic review and meta-analysis. *Lancet Public Health.* 2017;2(8):e356–66. Epub 2017 Jul 31. 10.1016/S2468-2667(17)30118-4 [PubMed: 29253477]
5. Merrick MT, Ports KA, Ford DC, et al. Unpacking the impact of adverse childhood experiences on adult mental health. *Child Abuse Negl.* 2017;69:10–9. Epub 2017 Apr 15. 10.1016/j.chiabu.2017.03.016 [PubMed: 28419887]
6. Whitaker RC, Dearth-Wesley T, Gooze RA, et al. Adverse childhood experiences, dispositional mindfulness, and adult health. *Prev Med* 2014;67:147–53. Epub 2014 Jul 30. 10.1016/j.ypmed.2014.07.029 [PubMed: 25084563]
7. Dong M, Giles WH, Felitti VJ, et al. Insights into causal pathways for ischemic heart disease: adverse childhood experiences study. *Circulation.* 2004;110(13):1761–6. Epub 2004 Sep 20. 10.1161/01.CIR.0000143074.54995.7F [PubMed: 15381652]
8. Gilbert LK, Breiding MJ, Merrick MT, et al. Childhood adversity and adult chronic disease: an update from ten states and the District of Columbia, 2010. *Am J Prev Med.* 2015;48(3):345–9. Epub 2014 Oct 6. 10.1016/j.amepre.2014.09.006 [PubMed: 25300735]
9. Wade R Jr, Cronholm PF, Fein JA, et al. Household and community-level Adverse Childhood Experiences and adult health outcomes in a diverse urban population. *Child Abuse Negl.* 2016;52:135–45. Epub 2015 Dec 23. 10.1016/j.chiabu.2015.11.021 [PubMed: 26726759]
10. Chanlongbutra A, Singh GK, Mueller CD. Adverse childhood experiences, health-related quality of life, and chronic disease risks in rural areas of the United States. *J Environ Public Health.* 2018;2018:7151297. 10.1155/2018/7151297 [PubMed: 30112012]
11. Lown EA, Lui CK, Karriker-Jaffe K, et al. Adverse childhood events and risk of diabetes onset in the 1979 Longitudinal Survey of Youth Cohort. *BMC Public Health.* 2019;19(1):1007. 10.1186/s12889-019-7337-5 [PubMed: 31351463]
12. 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;19:10:20. 10.1186/1471-2458-10-20 [PubMed: 20085623]
13. Brown MJ, Cohen SA. Association between abusive and non-abusive adverse childhood experiences and diagnosis of cancer in Wisconsin, USA. *J Community Med Health Educ.* 2014;S2:008. 10.4172/2161-0711.S2-008

14. Brown MJ, Thacker LR, Cohen SA. Association between adverse childhood experiences and diagnosis of cancer. *PLoS ONE*. 2013;611;8(6):e65524. 10.1371/journal.pone.0065524 [PubMed: 23776494]
15. Felitti VJ, Anda RF. The relationship of adverse childhood experiences to adult medical disease, psychiatric disorders, and sexual behavior: implications for healthcare. In: Lanius RA, Vermetten E, Pain C, eds. *The impact of early life trauma on health and disease: the hidden epidemic*. Cambridge, UK: Cambridge University Press, 2010;77–87. 10.1017/CBO9780511777042.010
16. van der Meer LB, van Duijn E, Wolterbeek R, et al. Adverse childhood experiences of persons at risk for Huntington's disease or BRCA1/2 hereditary breast/ovarian cancer. *Clin Genet*. 2012;81(1):18–23. Epub 2011 Oct 3. 10.1111/j.1399-0004.2011.01778.x [PubMed: 21895638]
17. Brown DW, Anda RF, Tiemeier H, et al. Adverse childhood experiences and the risk of premature mortality. *Am J Prev Med*. 2009;11;37(5):389–96. 10.1016/j.amepre.2009.06.021 [PubMed: 19840693]
18. Centers for Disease Control and Prevention (CDC). Adverse childhood experiences reported by adults—5 states, 2009. *MMWR Morb Mortal Weekly Rep*. 2010;1217;59(49):1609–13.
19. Signorello LB, Hargreaves MK, Blot WJ. The Southern Community Cohort Study: investigating health disparities. *J Health Care Poor Underserved*. 2010;21(1 Suppl):26–37. 10.1353/hpu.0.0245
20. Andresen EM, Malmgren JA, Carter WB, et al. Screening for depression in well older adults: evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale). *Am J Prev Med*. 1994;Mar-Apr;10(2):77–84. 10.1016/S0749-3797(18)30622-6 [PubMed: 8037935]
21. Dupont WD. *Statistical modeling for biomedical researchers: a simple introduction to the analysis of complex data*, 2nd ed. Cambridge, United Kingdom: Cambridge University Press, 2009. 10.1017/CBO9780511575884
22. Allen H, Wright BJ, Vartanian K, et al. Examining the prevalence of adverse childhood experiences and associated cardiovascular disease risk factors among low-income uninsured adults. *Circ Cardiovasc Qual Outcomes*. 2019;12(9):e004391. Epub 2019 Aug 27. 10.1161/CIRCOUTCOMES.117.004391 [PubMed: 31450964]
23. Iniguez KC, Stankowski RV. Adverse childhood experiences and health in adulthood in a rural population-based sample. *Clin Med Res*. 2016;12;14(3–4):126–37. Epub 2016 Aug 8. 10.3121/cmr.2016.1306 [PubMed: 27503793]
24. James SA, Strogatz DS, Wing SB, et al. Socioeconomic status, John Henryism, and hypertension in blacks and whites. *Am J Epidemiol*. 1987;10;126(4):664–73. 10.1093/oxfordjournals.aje.a114706 [PubMed: 3631056]
25. Doom JR, Hazzard VM, Bauer KW, et al. Does striving to succeed come at a physiological or psychosocial cost for adults who experienced child maltreatment? *Dev Psychopathol*. 2017;12;29(5):1905–19. 10.1017/S0954579417001481 [PubMed: 29162192]
26. Zarse EM, Neff MR, Yoder R, et al. The adverse childhood experiences questionnaire: two decades of research on childhood trauma as a primary cause of adult mental illness, addiction, and medical diseases. *Cogent Med*. 2019;6:1581447. 10.1080/2331205X.2019.1581447
27. Bucci M, Silverio Marques S, Oh D, et al. Toxic stress in children and adolescents. *Adv Ediatr*. 2016;63(1):403–28. 10.1016/j.yapd.2016.04.002
28. Bethell CD, Newacheck P, Hawes E, et al. Adverse childhood experiences: assessing the impact on health and school engagement and the mitigating role of resilience. *Health Aff*. 2014;12;33(12):2106–15. 10.1377/hlthaff.2014.0914
29. Poole JC, Dobson KS, Pusch D. Childhood adversity and adult depression: the protective role of psychological resilience. *Child Abuse Negl*. 2017;64:89–100. Epub 2017 Jan 2. 10.1016/j.chiabu.2016.12.012 [PubMed: 28056359]
30. Purewal Boparai SK, Au V, Koita K, et al. Ameliorating the biological impacts of childhood adversity: a review of intervention programs. *Child Abuse Negl*. 2018;7;81: 82–105. Epub 2018 May 1. 10.1016/j.chiabu.2018.04.014 [PubMed: 29727766]
31. Dube SR, Williamson DF, Thompson T, et al. Assessing the reliability of retrospective reports of adverse childhood experiences among adult HMO members attending a primary care clinic. *Child Abuse Negl*. 2004;7;28(7):729–37. 10.1016/j.chiabu.2003.08.009 [PubMed: 15261468]

32. Hardt J, Vellaisamy P, Schoon I. Sequelae of prospective versus retrospective reports of adverse childhood experiences. *Psychol Rep* 2010;107(2):425–40. 10.2466/02.04.09.10.16.21.PR0.107.5.425-440 [PubMed: 21117468]
33. Cohen SS, Matthews CE, Bradshaw PT, et al. Sedentary behavior, physical activity, and likelihood of breast cancer among Black and White women: a report from the Southern Community Cohort Study. *Cancer Prev Res (Phila)*. 2013;6(6):566–76. Epub 2013 Apr 10. 10.1158/1940-6207.CAPR-13-0045 [PubMed: 23576427]
34. Mouton CP, Hargreaves MK, Liu J, et al. Adult cancer risk behaviors associated with adverse childhood experiences in a low income population in the Southeastern United States. *J Health Care Poor Underserved*. 2016; 27(1):68–83. 10.1353/hpu.2016.0027 [PubMed: 27168716]
35. Garner AS, Shonkoff JP, Committee on the Psychosocial Aspects of Child and Family Health, et al. Early childhood adversity, toxic stress, and the role of the pediatrician: translating developmental science into lifelong health. *Pediatrics*. 2012;129(1):e224–31. Epub 2011 Dec 26. 10.1542/peds.2011-2662 [PubMed: 22201148]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 1.

DISTRIBUTION OF POSITIVE ACE SCORES FOR EACH CHRONIC DISEASE, SOUTHERN COMMUNITY COHORT STUDY, 2002–2015

Chronic diseases	ACE score									
	0		1		2		3		4	
	n	%	n	%	n	%	n	%	n	%
Diabetes	6409	41.2	3481	42.3	1817	42.4	1176	43.7	2923	44.8
Cancer	3004	19.6	1417	17.4	764	18.2	506	19.0	1315	20.4
Hypertension	9079	57.5	4701	56.3	2305	53.4	1447	53.1	3444	52.2
Stroke	1250	8.1	696	8.5	402	9.6	278	10.5	716	11.2
COPD	1014	6.4	635	7.6	415	9.6	278	10.2	828	12.6
Depression (CESD)	4433	29.3	2777	34.4	1703	40.9	1149	43.8	3257	50.8
Depression	2686	17.0	1822	21.8	1225	28.4	890	32.7	2819	42.7
High cholesterol	6164	39.1	3066	36.8	1552	36.0	987	36.4	2428	36.8
Heart attack	1815	11.7	961	11.7	475	11.2	325	12.2	964	14.9

Table 2

ADJUSTED^a ODDS RATIOS (AND 95% CONFIDENCE INTERVALS) FOR CHRONIC DISEASES ASSOCIATED WITH ACE SCORES, SOUTHERN COMMUNITY COHORT STUDY, 2002–2015

Chronic diseases	ACE score					P for trend
	0	1	2	3	4	
Diabetes	1.0 (ref)	1.01 (.95–1.08)	1.05 (.96–1.13)	1.12 (1.02–1.24)	1.21 (1.12–1.29)	<.0001
Cancer	1.0 (ref)	.97 (.89–1.05)	1.06 (.96–1.18)	1.18 (1.05–1.33)	1.24 (1.14–1.35)	<.0001
Hypertension	1.0 (ref)	.98 (.92–1.04)	.91 (.84–.99)	.96 (.87–1.06)	.96 (.90–1.03)	.16
Stroke	1.0 (ref)	1.03 (.92–1.15)	1.23 (1.08–1.41)	1.36 (1.17–1.60)	1.42 (1.27–1.59)	<.0001
COPD	1.0 (ref)	1.25 (1.12–1.41)	1.44 (1.25–1.65)	1.49 (1.27–1.74)	1.66 (1.48–1.86)	<.0001
Depr (CESD)	1.0 (ref)	1.19 (1.11–1.27)	1.48 (1.36–1.61)	1.57 (1.42–1.73)	1.88 (1.75–2.02)	<.0001
Depression	1.0 (ref)	1.32 (1.22–1.42)	1.77 (1.61–1.93)	2.03 (1.83–2.26)	2.84 (2.64–3.06)	<.0001
High cholest	1.0 (ref)	1.01 (.95–1.08)	.99 (.91–1.07)	1.07 (.97–1.18)	1.12 (1.05–1.20)	.001
Heart attack	1.0 (ref)	1.06 (.96–1.17)	1.04 (.92–1.18)	1.17 (1.02–1.35)	1.44 (1.31–1.60)	<.0001

Note:

^a Adjusted for age, race, sex, education, household annual income, marital status, neighborhood deprivation index, alcohol intake, current smoking, severe obesity, sedentary status and recruitment source.