


Adults' exposure to adverse childhood experiences in the United States nationwide and in each state: modeled estimates from 2019-2020

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ABSTRACT

Background Although preventable, adverse childhood experiences (ACEs) can result in lifelong health harms. Current surveillance data on adults' exposure to ACEs are either unavailable or incomplete for many U.S. states.

Methods Current estimates of the proportion of U.S. adults with past ACEs exposures were obtained by analysing individual-level data from 2019 to 2020 Behavioural Risk Factor Surveillance System—annual nationally representative survey of noninstitutionalized adults aged 18+years. Standardised questions measuring ACEs exposures (presence of household member with mental illness, substance abuse, or incarceration; parental separation; witnessing intimate partner violence; experiencing physical, emotional, or sexual abuse during childhood) were categorised into 0, 1, 2–3, or 4+ACEs and reported by sociodemographic group in each state. Missing ACEs responses (state did not offer ACEs questions or offered to only some respondents; respondent skipped questions) were modelled through multilevel mixed-effects logistic (MMEL) and jackknifed MMEL regressions.

Results In 2019–2020, an estimated 62.8% of U.S. adults had past exposure to 1+ACEs (range: 54.9% in Connecticut; 72.5% in Maine), including 22.4% of adults who were exposed to 4+ACEs (range: 11.9% in Connecticut; 32.8% in Nevada). At the national and state levels, exposure to 4+ACEs was highest among adults aged 18–34 years, those who did not graduate from high school, or adults who did not have a healthcare provider. Racial/ethnic distribution of adults exposed to 4+ACEs varied by age and state.

Conclusions ACEs are common but not equally distributed. ACEs exposures estimated by state and sociodemographic group can help decisionmakers focus public health interventions on populations disproportionately impacted in their area.

INTRODUCTION

Adverse childhood experiences (ACEs)—preventable, potentially traumatic childhood events—can result in lifelong negative health and socioeconomic effects, including increased risk of substance misuse, violence, sexually transmitted infections, maternal and child health problems, or limited access to life opportunities (eg, education or stable employment).^{1–5} Current surveillance data on adults' exposure to ACEs is unavailable for many U.S. states. By 2020, all states included ACEs questions in at least one annual Behavioural Risk Factor Surveillance

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Although preventable, adverse childhood experiences (ACEs) are associated with lifelong negative health outcomes.
- ⇒ Current surveillance data on adults' exposure to ACEs are unavailable for many states in the United States.

WHAT THIS STUDY ADDS

- ⇒ Estimates from a nationally representative survey for 2019–2020 demonstrated 22% of adults in the United States had past exposure to 4+ACEs (range: 12% in Connecticut; 33% in Nevada).
- ⇒ At national and state levels, exposure to 4+ACEs was highest among adults who did not graduate from high school, had no healthcare provider, or were aged 18–34 years. Racial/ethnic distribution of adults who were exposed to 4+ACEs varied considerably by age and state.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ Public health and medical practitioners could optimise the targeting of interventions to prevent adverse childhood experiences by focusing on sociodemographic groups at higher risk in their state.

System (BRFSS) survey.⁶ However, some states last offered ACEs questions in 2011, altered questions' language, or queried only a fraction of respondents,^{6–8} while in other states, up to 33% of BRFSS respondents skipped ACEs questions.⁹ Limitations of BRFSS data could have impacted interpretation of previously reported ACEs estimates.^{6–9–10} With some states last offering ACEs questions in 2011, differences in ACEs estimates across states may either reflect the actual differences in ACEs burden or be an artefact of delayed reporting. Altered language of ACEs questions might have affected respondents' comprehension, complicating the comparison of ACEs estimates across states. Offering ACEs questions to a fraction of respondents in some states could have resulted in a small sample size, potentially limiting ACEs analyses by sociodemographic group in those states. High non-response rates for ACEs questions may trigger concerns about non-random responses.



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In this study, current estimates of adults' past exposure to ACEs—comparable across states and sociodemographic groups—were estimated using self-reported data from 2019 to 2020 BRFSS surveys, with missing ACEs responses (state did not offer ACEs questions in 2019–2020 or offered to only some respondents; respondents skipped questions) modelled through small area estimation (SAE) technique.^{11–14} ACEs estimates—stratified by sociodemographic group in each U.S. state—can help decisionmakers focus social, educational, and public health interventions on populations disproportionately impacted in their area.

METHODS

Current by-state estimates of the proportion of U.S. adults exposed to 0, 1, 2–3, or 4+ACEs (ACEs score of 0, 1, 2–3, or 4+)^{5,6,9} were obtained by analysing individual-level ACEs data on adults aged 18+years from 2019 to 2020 BRFSS surveys.^{7,8} BRFSS is an annual, random-digit-dialled telephone survey conducted by all 50 states to collect self-reported information from U.S. adults aged 18+years who live in private residences or college housing. BRFSS is the largest telephone-based (landline and cellular telephone) survey of health behaviours and factors in the world, with 418 268 interviews completed in 2019 and 401 958 interviews completed in 2020 (median survey response rates of 49.4%/47.9% in 2019/2020, respectively). Because 2019–2020 BRFSS is a publicly available database that eliminates all patient identifiers, this study did not require institutional review board approval.

In 2019–2020 BRFSS, 37 U.S. states included standardised ACEs questions¹⁵ (presence of household member with mental illness, substance abuse, or incarceration; parental separation; witnessing intimate partner violence; experiencing physical, emotional, or sexual abuse during childhood; online supplemental table 1). However, 8 out of 37 states offered ACEs questions to a random sample of 17–34% of survey respondents (online supplemental table 2). Among those who received

questions, $\leq 33\%$ of respondents skipped at least one ACEs question and $\leq 28\%$ skipped all questions (online supplemental table 2). All missing ACEs responses (state did not offer ACEs questions or offered to only some respondents; respondent skipped questions) were modelled through SAE.^{11–14} Predictive SAE models—logistic regressions (LR) and multilevel mixed-effects LR (MMEL) performed on each ACEs score (Stata v17.0)—controlled for health/socioeconomic factors associated with ACEs,¹ including individual-level factors from BRFSS (respondent's sociodemographic characteristics, access to care, health outcomes associated with ACEs; online supplemental table 3) and state-level factors from five additional sources^{16–20} (online supplemental table 3). Models with best predictive performance were selected by comparing the non-missing ACEs scores directly estimated from BRFSS to modelled ACEs scores by using standard statistics (sensitivity/specificity, positive/negative predicted values, percent modelled to observed answers, and Pearson correlation coefficient). Survey-weighted estimates and 95% confidence intervals (CIs) by ACEs score were obtained from a combination of direct estimates (if reported in the survey) and modelled SAE estimates (if direct estimates were missing). For states that included ACEs questions in both 2019–2020 we combined both years,^{7,8} since data quality was comparable across years (comparable survey response rates^{7,8}; stable direct ACEs estimates (online supplemental table 4)). LR/MMEL examined associations between the survey-weighted individual-level ACEs proportions and respondents' sociodemographic characteristics. Resampling methods—jackknifed MMEL/LR that leave out one state at a time—were used as sensitivity analyses, since they reduce possible state-specific non-response bias by resampling models with different ACEs non-response patterns.^{21,22}

RESULTS

SAE models demonstrated high predictive performance,^{11,14} with modelled ACEs scores closely fitting directly estimated ACEs scores at the national and state levels for those survey respondents

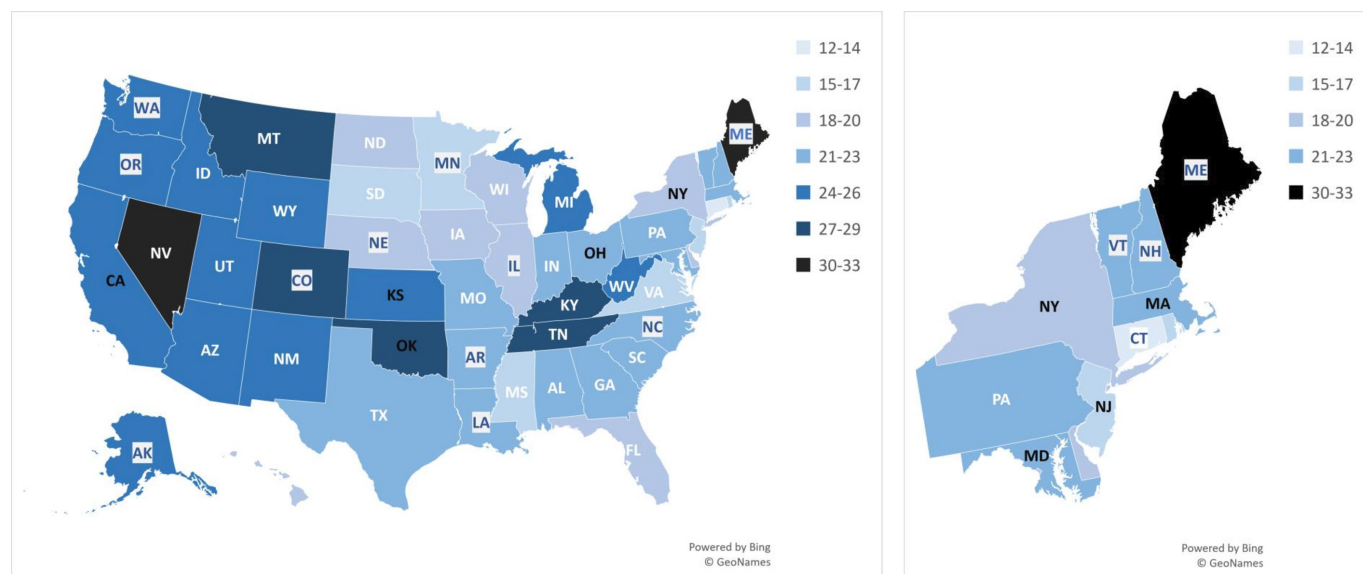


Figure 1 Percent of adults in each state who were exposed to four or more ACEs during childhood, United States, 2019–2020. ACEs, adverse childhood experiences. AK, AR, CO, CT, IL, LA, ME, MN, NE, NH, NC, OR, VT, WA (abbreviations in blue, white box): all ACEs scores were modelled, since states did not include ACEs questions in their 2019–2020 BRFSS surveys. CA, KS, MA, MD, NJ, NY, OH, OK (abbreviations in black): >70% of ACEs scores were modelled, since states offered ACEs questions only to a fraction of BRFSS respondents. AL, AZ, DC, DE, FL, GA, HI, ID, IN, IA, KY, MI, MS, MO, MT, NV, NM, ND, PA, RI, SC, SD, TN, TX, UT, VA, WV, WI, WY (abbreviations in white): <33% of ACEs scores were modelled, since states offered ACEs questions to all BRFSS respondents, and up to 33% of respondents skipped at least one ACEs question.

Table 1 Estimates of adults who were exposed to four or more ACEs during childhood by geographic, demographic, and socio-economic characteristics, United States, 2019–2020

	Percent (95% CIs) of adults who were exposed to 4+ACEs during childhood	Odds* (95% CIs) of exposure to 4+ACEs during childhood	
		Unadjusted ORs	Adjusted ORs†
National Estimates	22.4 (22.2–22.6)	NA	NA
Metropolitan statistical area			
Yes	22.5 (22.3–22.7)	1.06 (1.03–1.08)	1.10 (1.07–1.13)
No	21.6 (21.2–21.9)	reference	reference
Sex			
Male	17.9 (17.7–18.2)	reference	reference
Female	26.6 (26.3–26.9)	1.66 (1.62–1.70)	1.82 (1.78–1.87)
Race/ethnicity			
White, non-Hispanic	21.8 (21.6–22.0)	reference	reference
African American, non-Hispanic	24.0 (23.3–24.6)	1.13 (1.09–1.17)	0.97 (0.93–1.01)
Asian, non-Hispanic	12.5 (11.6–13.4)	0.51 (0.47–0.56)	0.37 (0.34–0.40)
American Indian or Alaskan Native, non-Hispanic	26.6 (24.9–28.4)	1.30 (1.19–1.43)	1.02 (0.93–1.13)
Hispanic	24.8 (24.2–25.5)	1.19 (1.14–1.23)	0.69 (0.66–0.72)
Age, years			
18–34	30.9 (30.5–31.4)	reference	reference
35–54	25.7 (25.4–26.1)	0.77 (0.75–0.80)	0.78 (0.60–0.80)
55 or older	12.9 (12.7–13.1)	0.33 (0.32–0.34)	0.30 (0.29–0.31)
Annual household income from all sources, USD			
Less than \$25 000 or missing	23.5 (23.2–23.9)	0.82 (0.79–0.84)	0.76 (0.74–0.78)
\$25,000–\$50 000	27.4 (26.9–27.9)	reference	reference
\$50 000 or more	19.1 (18.8–19.4)	0.63 (0.61–0.65)	0.64 (0.62–0.66)
Education			
Did not graduate from high school	29.6 (28.8–30.3)	reference	reference
Graduated from high school	23.5 (23.1–23.9)	0.73 (0.70–0.76)	0.67 (0.64–0.70)
Attended college or graduated from college	20.3 (20.1–20.6)	0.61 (0.59–0.63)	0.57 (0.54–0.59)
Access to a personal healthcare provider			
Yes	20.7 (20.5–20.9)	reference	reference
No	27.9 (27.4–28.4)	1.48 (1.44–1.52)	1.14 (1.04–1.17)
Observations, non-weighted	804 641	804 641	804 641
Observations, weighted	257 057 289	257 057 289	257 057 289

*ORs are reported for logistic regressions that assessed the association between exposure to four or more ACEs during childhood and characteristics of BRFSS respondents listed in this table.

†Adjusted for geography (metropolitan statistical area (MSA) identifier; state identifiers), demographic characteristics (sex; age), and socio-economic characteristics of BRFSS respondents (annual household income from all sources; respondents' education; respondent's access to a personal healthcare provider). ACEs, adverse childhood experiences.

who answered ACEs questions (online supplemental tables 5–7). Sensitivity analysis underscored stability of model estimates, with the baseline MMEL/LR estimates plotted against the jackknifed MMEL/LR estimates tightly clustering around a 45 degree line (online supplemental figure 1).

Nationwide, an estimated 62.8% (95% CI=62.6% to 63.0%) of adults had past exposure to 1+ACE during childhood (range: 54.9% in Connecticut; 72.5% in Main), including 22.4% adults who were exposed to 4+ACEs (figure 1, table 1, online supplemental table 6). Exposure to 4+ACEs was higher among females (26.6%; table 1) than males (17.9%), adults aged 18–34 years (30.9%) than 55+ years (12.9%), adults who did not graduate from high school (29.6%) than adults who attended or graduated from college (20.3%), or adults who did not have a personal healthcare provider (27.9%) than adults who did (20.7%). Exposure to 4+ACEs varied substantially by race/ethnicity. Overall, exposure to 4+ACEs was higher among non-Hispanic American Indian or Alaskan Native adults (26.6%; table 1), Hispanic adults (24.8%), and non-Hispanic African

American adults (24.0%) and lower among non-Hispanic White adults (21.8%), and non-Hispanic Asian adults (12.5%). However, when stratified by age to account for systematic age differences between non-Hispanic White respondents and other races/ethnicity categories (online supplemental table 8), lower exposure to 4+ACEs among non-Hispanic White adults persisted chiefly for ages 55+ years (figure 2). By contrast, for ages 18–34 years, non-Hispanic White adults had the highest exposure to 4+ACEs as compared with other races/ethnicities. At the state level, exposure to 4+ACEs ranged from 32.8% (figure 1, online supplemental table 9) in Nevada to 11.9% in Connecticut. Exposure to 4+ACEs remained consistently higher among adults aged 18–34 years, those who did not graduate from high school, or adults who did not have a personal healthcare provider (online supplemental table 9). When adjusted for age and sex, exposure to 4+ACEs among White non-Hispanic adults was higher or comparable to other races/ethnicities in 23 U.S. states (online supplemental table 9).

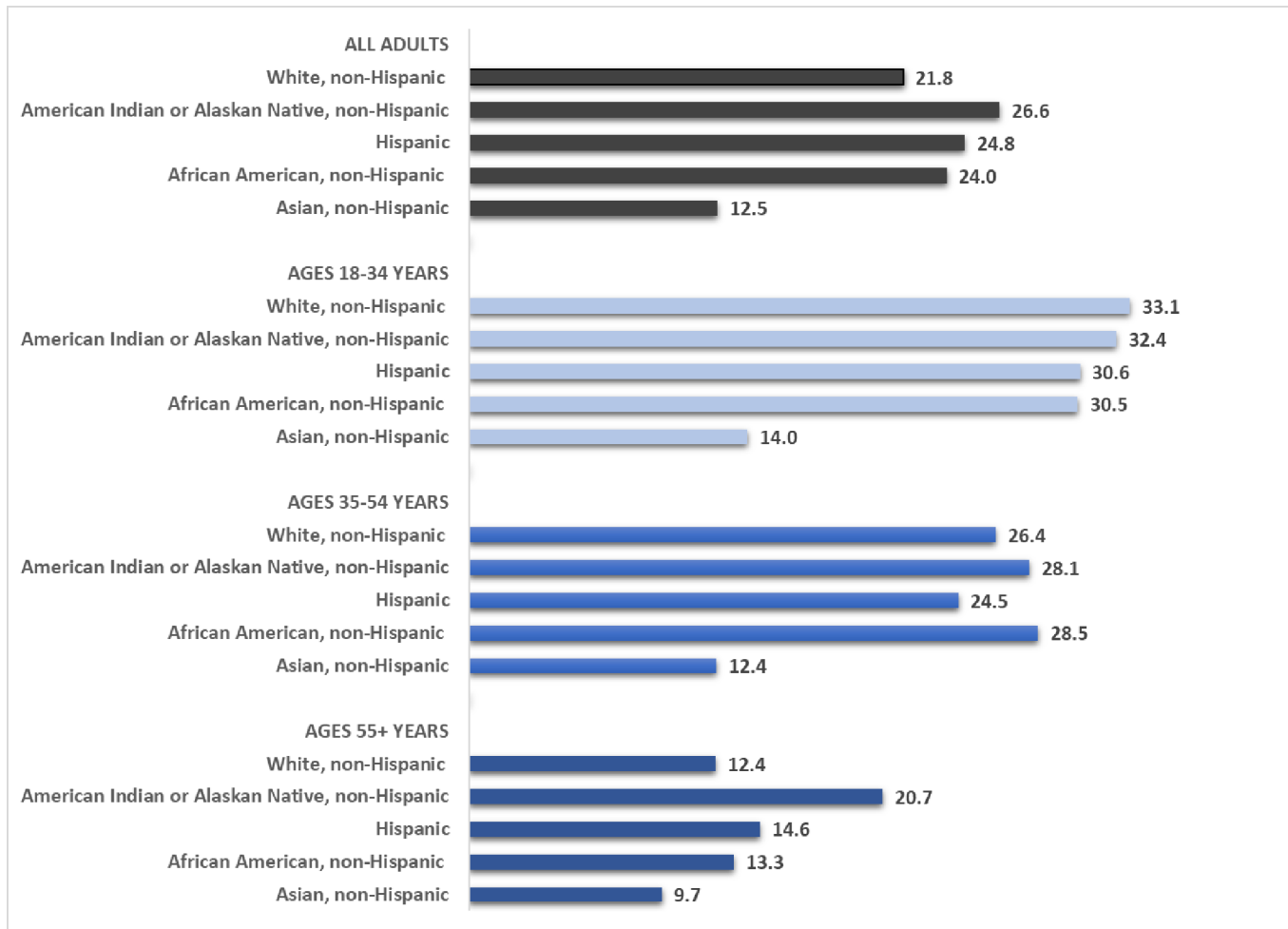


Figure 2 Estimated percent of adults who were exposed to four or more ACEs during childhood by race/ethnicity and age, United States, 2019–2020. ACEs, adverse childhood experiences.

DISCUSSION

Exposure to ACEs is common among U.S. adults and varies substantially by state and sociodemographics. An estimated 62.8% of U.S. adults had past exposure to 1+ACEs, including 22.4% adults who were exposed to 4+ACEs. Past exposure to 4+ACEs at the national and state levels was highest among adults who did not graduate from high school or had no personal healthcare provider, supporting previous findings that exposure to multiple ACEs in childhood may limit opportunities later in life.⁹ High exposure to 4+ACEs among adults aged 18–34 years underscores the importance of preventative measures among children and adolescents. Overall, our findings highlight missed opportunities to lessen ACEs harms among adults who do not have access to medical care and underscore the necessity of evidence-based strategies to prevent ACEs, such as policies that ensure strong start for children (eg, early childhood home visitation programmes, high-quality childcare), policies that establish positive networks for adolescents (eg, connecting youth to caring teachers, coaches, or community volunteers), or policies that strengthen household financial security (eg, tax credits, childcare subsidies, livable wages),¹ with state-specific interventions geared towards sociodemographic groups at higher risk for ACEs in each location.

By using SAE and standardised ACEs questions, this report filled in significant surveillance gaps by presenting current comparable ACEs estimates nationally and across all individual U.S. states (including states that skipped ACEs questions in their 2019–2020 BRFSS surveys). Additionally, this report estimated

ACEs exposure for all survey respondents (including those who did not receive or skipped ACEs questions), thereby mitigating survey non-response bias and ensuring sufficient sample size to conduct analyses by sociodemographic group in each U.S. state.

The key results from this study are consistent with ACEs estimates from Swedo *et al*⁶ for those states that recently included ACEs questions in their BRFSS surveys. For overlapping years, the difference between percentage of adults with past exposure to 4+ACEs from this study and from Swedo *et al* was greatest for Nevada (10.7 percentage points), of which 2.2 percentage points were attributable to model assumptions (online supplemental table 10). The remaining 8.5 percentage point difference demonstrated that 33.1% of BRFSS respondents in Nevada who skipped ACEs questions in 2020 (respondents omitted in Swedo *et al*) were more likely to be exposed to 4+ACEs than respondents who answered the questions. For states that last included ACEs questions in 2011–2014, our estimates based on 2019–2020 data exceeded Swedo *et al* estimates based on 2011–2014 data, highlighting the need for a thorough analysis to explain 2011–2020 ACEs trends.

Limitations

This study has several limitations. First, BRFSS relies on self-reported data that may be subject to recall bias.⁶ Second, BRFSS data are collected for private residences and exclude populations

who might be particularly vulnerable to multiple ACEs exposures (eg, those incarcerated or homeless). Third, considering the complex nature of ACEs,¹ predictive SAE model may not capture the impact of all factors associated with the outcome. Fourth, SAE could not address the survey non-participation bias, since BRFSS did not include the individual-level ACEs predictors for those eligible BRFSS respondents who were never available for an interview.⁷

CONCLUSIONS

These findings highlight opportunities for medical and public health practitioners to prevent ACEs or lessen harm among affected persons by focusing interventions on sociodemographic groups at higher risk in their state. A CDC-developed resource¹ outlines activities with greatest potential for impact.

Contributors All authors have participated sufficiently in the work to take public responsibility for its entire content. All authors participated in designing the study concept, analyzing and interpreting the data, drafting and critically revising the manuscript. Statistical analysis was conducted and verified by Aslam, Swedo, and Florence.

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