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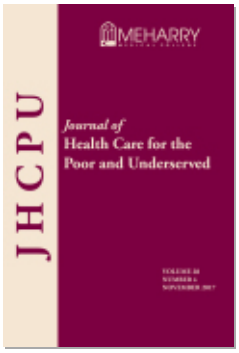

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ORIGINAL PAPER

Adverse Childhood Experiences (ACE) among American Indians in South Dakota and Associations with Mental Health Conditions, Alcohol Use, and Smoking

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Abstract: **Objectives**. To assess the prevalence of Adverse Childhood Experiences (ACEs) and their association with behavioral health in American Indian (AI) and non-AI populations in South Dakota. **Methods**. We included the validated ACE questionnaire in a statewide health survey of 16,001 households. We examined the prevalence of ACEs and behavioral health conditions in AI and non-AI populations and associations between ACEs and behavioral health. **Results**. Compared with non-AIs, AIs displayed higher prevalence of ACEs including abuse, neglect, and household dysfunction and had a higher total number of ACEs. For AIs and non-AIs, having six or more ACEs significantly increased the odds for depression, anxiety, PTSD, severe alcohol misuse, and smoking compared with individuals with no ACEs. **Conclusions**. American Indians in South Dakota experience more ACEs, which may contribute to poor behavioral health. Preventing and mitigating the effects of ACEs may have a significant impact on health disparities in AI populations.

Key words: Adverse childhood experiences; alcohol; anxiety; cross-sectional studies; depression; health surveys; Indians, North American; prevalence; smoking; South Dakota; stress disorders, post-traumatic; surveys and questionnaires.

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American Indians (AIs) in the United States experience a persistent and disproportionate burden of numerous health problems[1–3] including problem drinking,[4–6] post-traumatic stress disorder,[7] and suicide.[8] Many of these disparities are even more severe for AI communities in the Northern Plains region.[1,9–11] American Indian reservations and communities typically suffer from high rates of adverse social conditions including poverty, unemployment, and low high school graduation rates, known risk factors for behavioral health conditions.[12–15] American Indian communities also contend with historical and intergenerational trauma from decades of traumatic losses and forced assimilation.[16,17] Despite these inequities and persistent adversity, the majority of AI community members demonstrate a high degree of resilience, resourcefulness, and adaptability to overcome adverse circumstances and to survive the social and economic challenges of living on a reservation.[18,19] Existing evidence suggests that adverse childhood experiences and social conditions in AI communities contribute to poor health outcomes for AIs;[20] including parental alcoholism, childhood maltreatment, and out-of-home placement, on risk of lifetime DSM-IV (Diagnostic and Statistical Manual of Mental Disorders, 4th edition.[21–22] However, no statewide population survey has specifically examined adverse childhood experiences and their association with behavioral health conditions in AI populations.

The landmark Adverse Childhood Experiences (ACE) Study exposed a strong dose-response relationship between the breadth of exposure to childhood abuse or household dysfunction and the risk factors for several leading causes of death in adults.[23] Adverse Childhood Experiences have since been linked to numerous detrimental health behaviors and poor health outcomes across the lifespan including smoking,[24] alcohol abuse,[25,26] drug abuse,[27] depression,[28–30] suicide,[31] and general health-related quality of life.[32] Additional research indicates that some vulnerable populations are more likely to have been exposed to childhood trauma,[33] and populations that lack routine access to health care may face greater impacts from childhood trauma.[34] Evaluation of ACEs has grown as a state and national priority, with many states now assessing the prevalence of ACEs among adults through their Behavioral Risk Factor Surveillance System (BRFSS) surveys and data for U.S. children available through the National Survey of Children's Health.[35,36]

Understanding ACEs in AI populations is critical to preventing and mitigating their negative effects. However, existing regional, state, and national studies do not provide population data needed to link ACEs to AI health status. In this study, we assessed disparities in ACE prevalence and association with behavioral health conditions in AI and non-AI populations in South Dakota. Our hypotheses were twofold: 1) the AI population in South Dakota experiences higher ACE prevalence and ACE scores than the non-AI population; and 2) high ACE scores correlate with disparities in behavioral health conditions among AIs in South Dakota. To test these hypotheses, we used data from the South Dakota Health Survey (SDHS),[37] which provides representative statewide data on behavioral health conditions, access to care, and ACEs in a state where AIs make up nearly 10% of the population.[38] The SDHS is notable for its oversampling in AI communities, as population surveys rarely include sufficient numbers to assess the distinct health experiences of AI populations.[39]

Methods

We briefly summarize the methods for the South Dakota Health Survey (SDHS) here; a full description is available elsewhere.[37] The SDHS was a statewide, multimode, health needs assessment survey designed to determine the population prevalence of unmet behavioral health needs across the state. Validated questions and response scales were used when feasible including questions from the ACE study. The SDHS was conducted from November 2013 to October 2014.

Study population. The SDHS administered a combination of mail, telephone, and in-person surveys to a geographically representative, stratified random sample of 17,341 households in South Dakota. We used address-based sampling to select households for participation. Due to the relatively high number of AIs in South Dakota, AI communities were a secondary population of interest to the overall study and of primary interest for the current analysis. To ensure sufficient representation within AI subpopulations we set minimum sampling targets of 200 for each participating reservation community; these households received the same survey as others in the state, ensuring comparability of findings.

To encourage responses from AI populations, we also focused follow-up in-person data collection activities in areas where AI families were known to live. American Indians in South Dakota live in both reservation and non-reservation communities, in fact, nationally according to the 2010 U.S. Census, more AIs live outside AI areas (78%) than on reservations.[38] In Rapid City, South Dakota's second most populated city, AIs make up 12.4% of all residents.[39] Therefore, in each participating reservation community and in Rapid City, research assistants visited the homes of mail and telephone survey non-respondents and provided paper copies of the survey to potential participants. Participants would fill out the survey and return it to the research assistant in a sealed envelope to ensure confidentiality and prevent any undue influence on the respondent answers.

The SDHS yielded 7,675 survey responses, a 48% response rate. Of these, 516 respondents (9.3% of the total sample) self-identified their race as AI alone or in combination with other races or ethnicities, which is comparable to U.S. Census population estimates for South Dakota.[38] A total of 435 surveys were collected using this face-to-face approach for AI respondents compared with 81 mail and telephone surveys.

Tribal outreach. Our overall approach to data collection for the SDHS was informed by the nine principles of community-based participatory research (CBPR) identified by Israel and colleagues, who emphasized that "no one set of community based participatory research principles is applicable for all partnerships."[40 [p. 59]] Our work with reservation communities was informed by a SDHS co-Investigator and the manuscript's lead author (DW) who is a member of a South Dakota tribe and has a long history collaborating with AI communities in research and health improvement projects. Historically, AIs have been resistant to participating in research projects led by researchers from outside the Native community,[41,42] thus a CBPR framework is essential to promote AI participation in research to address health disparities.[43,44]

Nine federally recognized tribes are located in South Dakota. Our approach to data collection in reservation communities applied the core intentions of CBPR by

acknowledging the community; fostering co-learning; facilitating collaborative, equitable partnerships and co-learning; disseminating results and findings to partners so research can inform action; and supporting a long-term process and commitment.[45,46] For example, prior to fielding the SDHS in any tribal/reservation area, study investigators conducted outreach with Tribal Councils and other key stakeholder groups to promote participation in the project, recruit local research assistants for in-person data collection, and establish a framework for reporting results back to those community leaders. Stakeholders from AI communities were given an opportunity to review and modify an early draft of the survey, and were helpful in identifying community members to serve as research assistants. The survey was only conducted in tribal areas that approved the study; formal tribal approval for participation in the SDHS was granted by seven of the nine tribes in South Dakota. Each of the seven participating tribes provided the research team with either a Tribal Council Resolution in support of the project or a letter of support from the Tribal Institutional Review Board or the Tribal Chairman granting permission to conduct the study, depending on each tribe's standard processes. These resolutions and letters of support were available to share when recruiting potential respondents to participate in the survey.

Data collection, dissemination, and action also were informed by and collaboratively involved tribal members. Due to high rates of poverty, less access to landline telephones, and housing insecurity among AIs,[47,48] we expected limited response to mail and telephone surveys in AI communities. Therefore, we conducted face-to-face data collection in reservation communities and in Rapid City, which has a substantial urban AI population (12.4% of Rapid City vs. 8.8% of South Dakota).[49] Local research assistants were identified, trained, and hired in reservation communities and in Rapid City in order to locate and approach previously sampled households who did not respond to mail and phone surveys and provide them the option of completing the surveys in-person. Although tribes were not directly involved in the data analysis and interpretation of results since it was a statewide survey, investigators presented findings of the individual tribes to the communities to inform intervention next steps. Additionally, de-identified data were provided to individual tribes to allow for further internal analyses and application. Based on the primary author's extensive experience working with tribes in South Dakota, this is an unprecedented level of tribal participation for a state-based research project.

Measures. The survey instrument consisted of 79 multiple-choice questions that collected data on ACEs, mental health conditions, alcohol and tobacco use, and participant demographics. We used previously validated questions and response scales when feasible.

Adverse childhood experiences (ACEs). Ten categories of ACEs were assessed using questions adapted from previous ACE research.[23,27] Measures asked about traumatic experiences during the first 18 years of life including emotional, physical, and sexual abuse; emotional and physical neglect; and five categories of household dysfunction. The survey included two questions each to assess emotional, physical and sexual abuse as well as emotional and physical neglect, three questions to assess whether the mother was treated violently, and one question to assess each of the other four household dysfunction categories. A "yes" response to any question in a category was attributed one

point; points were summed, resulting in an ACE Score ranging from 0–10, capturing the prevalence of multiple types of childhood trauma.

Mental health conditions. We assessed prevalence of common behavioral health conditions using standardized clinical screening questions. The prevalence of depression was assessed with the two-question version of the Patient Health Questionnaire (PHQ-2),[50,51] anxiety with the two-question General Anxiety Disorder scale (GAD-2),[52] and Post-Traumatic Stress Disorder (PTSD) with the Primary Care PTSD Screen (PC-PTSD).[53]

Alcohol and tobacco use. The three-question Alcohol Use Disorders Identification Test (AUDIT-C) was used to assess alcohol misuse, with positive screens defined as scores of four or more for males and three or more for females.[54–56] We also tested for severe misuse using a more specific cutoff of AUDIT-C scores greater than 9 because a large percentage of the statewide population (>40%) screened positive using the lower cutoff.[37] We used measures based on the Behavioral risk Factor Surveillance System questionnaire (BRFSS)[57] to determine if respondents were current cigarette smokers.

Demographic characteristics. We used standard questions to determine participants self-reported race/ethnicity, age, gender, education level, employment status, and household income. Respondents reporting their race/ethnicity as AI alone or in combination with one or more other races or ethnicities were included as AI respondents. Participant ZIP codes were used to categorize households into five mutually exclusive geographic categories: urban, large rural, small rural, isolated, and reservation. We based the geographic categories on the Rural-Urban Community Areas (RUCA) taxonomy[58,59] and created an additional distinct "reservation" category for ZIP codes fully or partially within AI tribal land.

Data analysis. Survey responses were weighted to account for oversampling and to accurately represent the state's true population distribution. Respondents who completed all ACE questions, health condition measures, and race/ethnicity questions and for whom geographic data was available were included in the present analyses (n = 7,593).

We first used the chi-square test to compare prevalence of ACEs and health conditions among AI respondents and non-AI respondents statewide. We then assessed associations between ACE score and adult health conditions in AI and non-AI respondents using a survey weighted logistic regression, adjusting for age, gender, and race/ethnicity (AI vs. non-AI). Adverse Childhood Experience scores were included in the model as a 6-level categorical variable with 0 experiences as the referent due to the potential for a non-linear relationship with health outcomes. Adverse Childhood Experience scores of 4 or 5 and 6 or greater were combined into categories (4–5, ≥6) because of small sample sizes. We considered statistical significance at a p-value of less than 0.05. An interaction term between race/ethnicity and ACE score was included to assess if the effect of ACE differed between the groups. Data were analyzed using SAS version 9.3 (SAS Institute Inc., Cary, NC).

Results

Demographic characteristics. Table 1 shows the demographic characteristics of respondents. Compared with non-AI respondents, AI respondents tended to be younger, have

Table 1.

DEMOGRAPHIC CHARACTERISTICS FOR AI AND NON-AI RESPONDENTS

	American Indian (n = 516)	Non-American Indian (n = 7078)	Total (n = 7593)	p value
Age				.0002
18–34	36.63%	29.69%	30.34%	
35–64	57.62%	49.94%	50.65%	
65 and older	5.75%	20.37%	19.01%	
Gender				.21
Male	37.16%	43.08%	42.53%	
Female	62.84%	56.92%	57.47%	
Rural/Urban status				<.0001
Urban	38.07%	44.98%	44.34%	
Large rural	10.18%	28.01%	26.35%	
Small rural	8.07%	6.84%	6.96%	
Isolated	11.18%	18.32%	17.65%	
Reservation	32.49%	1.85%	4.70%	
Employment status				<.0001
Not employed	31.60%	7.58%	9.64%	
Employed part time	11.91%	19.63%	18.97%	
Employed full time	49.59%	54.47%	54.05%	
Retired	6.89%	18.31%	17.34%	
Income (%FPL)				<.0001
<50% FPL	38.90%	12.73%	15.17%	
50–138% FPL	22.48%	10.18%	11.33%	
138–250% FPL	17.29%	22.46%	21.98%	
250–400% FPL	11.13%	28.75%	27.11%	
>400% FPL	10.20%	25.88%	24.42%	
Education				<.0001
Less than high school	9.95%	3.23%	3.85%	
High school diploma or GED	39.29%	32.40%	33.05%	
Vocational or 2-yr. degree	24.86%	23.87%	23.96%	
4-year college degree	22.47%	25.69%	25.39%	
Advanced or graduate degree	3.44%	14.81%	13.75%	

Table 2.

STATEWIDE PREVALENCE OF ADVERSE CHILDHOOD EXPERIENCES BY AMERICAN INDIAN RACE/ETHNICITY COMPARED WITH NON-AMERICAN INDIAN RESPONDENTS

	American Indian (n = 516)	Non-American Indian (n = 7078)	Significance
Abuse			
Emotional Abuse	30.10%	17.41%	.0008*
Physical Abuse	24.51%	12.31%	.0002*
Sexual Abuse	15.53%	9.60%	.0263*
Neglect			
Emotional Neglect	25.87%	14.00%	.0005*
Physical Neglect	15.89%	2.78%	<.0001*
Household Dysfunction			
Mother Treated Violently	23.76%	5.31%	<.0001*
Household Substance Abuse	50.04%	21.49%	<.0001*
Household Mental Illness	24.36%	13.89%	.0032*
Parental Separation or Divorce	39.34%	20.17%	<.0001*
Incarcerated Household Member	22.57%	3.73%	<.0001*
Number of ACEs (Score)			<.0001*
0	16.84%	50.02%	
1	21.59%	23.02%	
2	16.20%	9.60%	
3	12.99%	6.09%	
4–5	13.10%	7.38%	
≥6	19.28%	3.89%	

Note
*statistically significant

lower incomes and education levels, and were less likely to be employed. Nearly one-third (31.6%) of AI respondents were not employed compared with 7.6% of non-AI respondents; 38.9% of AI respondents and 12.7% of non-AI respondents had incomes at or below 50% of the Federal Poverty Level (FPL). One-third (32.5%) of AI respondents lived in a ZIP code that includes reservation land.

Adverse childhood experiences. Statewide, the AI population had a significantly higher prevalence of ACEs compared with the non-AI population across all domains, and a significantly higher number of total ACEs experienced (Table 2). Only 4% of non-AI respondents experienced six or more ACEs, where almost 20% of AI respondents

Table 3.

STATEWIDE PREVALENCE OF MENTAL HEALTH CONDITIONS, ALCOHOL MISUSE, AND SMOKING STATUS BY AMERICAN INDIAN RACE/ETHNICITY COMPARED WITH NON-AMERICAN INDIAN RESPONDENTS

	American Indian (n = 516)	Non-American Indian (n = 7078)	Significance
Posttraumatic stress disorder (PC-PTSD)	13.2%	5.3%	<.01
Current Smoker	35.2%	15.1%	<.01
Depression (PHQ-2)	9.5%	5.1%	.07
Severe Alcohol Misuse (AUDIT-C 9+)	3.3%	2.4%	.46
Alcohol Misuse (AUDIT-C)	40.2%	42.6%	.63
Anxiety (GAD-2)	8.1%	7.4%	.80

experienced that many. Differences in several ACE domains were especially stark: 15.9% of AIs reported childhood experiences of physical neglect—a category that includes lack of sufficient food, clothing, protection, or medical care—compared with 2.8% of non-AIs; 23.8% of AIs versus 5.3% of non-AIs reported witnessing domestic violence in their household; and 22.6% of AIs versus 3.7% of non-AIs had a household member who went to prison.

Prevalence of mental health conditions, and alcohol and tobacco use. Table 3 shows the prevalence of mental health conditions, alcohol misuse, and cigarette smoking. We found that AIs had a significantly higher prevalence of posttraumatic stress disorder (PTSD) and were current smokers compared with non-AI, with 13.2% of AIs screening positive for PTSD compared with 5.3% of non-AIs ($p < .01$). More than one-third (35.2%) of AI respondents were current smokers, compared with 15.1% of non-AIs ($p < .01$). While only marginally statistically significant, prevalence of depression was high among AI respondents; 9.5% of AIs screened positive versus 5.1% of non-AI respondents ($p = .07$). We did not find significant differences in the prevalence of anxiety and alcohol misuse between AI and non-AI respondents, although AI respondents showed slightly higher rates of anxiety (8.1% versus 7.4%) and severe alcohol misuse (score of 9 or higher on the AUDIT-C scale) (3.3% versus 2.4%).

ACE score correlation to behavioral health conditions. ACE scores were positively correlated with mental health conditions, severe alcohol misuse, and cigarette smoking across the study sample (Table 4). We found significantly higher odds for depression, anxiety, post-traumatic stress disorder (PTSD), severe alcohol misuse, and cigarette smoking for individuals with six or more ACEs compared with those with no ACEs, after adjusting for age, gender, and AI effects. These conditions also display trends following a dose-response relationship with ACEs. There were no significant differences in the effect of ACEs for AI and non-AI populations on any of the mental health conditions.

Table 4.

ASSOCIATIONS BETWEEN ACE SCORE AND POSITIVE SCREEN FOR MENTAL HEALTH CONDITION, ALCOHOL MISUSE, AND CURRENT SMOKER

ACE Score	Depression (PHQ-9)		Anxiety (GAD-2)		PTSD (PC-PTSD)		Severe Alcohol Misuse (AUDIT 9+)		Current Smoker	
0	*referent*		*referent*		*referent*		*referent*		*referent*	
1	0.44		0.59		0.38		1.13		0.74	
	(0.26, 0.73)		(0.37, 0.94)		(0.24, 0.60)		(0.64, 2.00)		(0.55, 0.98)	
2	0.62		0.81		0.57		0.58		1.08	
	(0.41, 0.93)		(0.47, 1.40)		(0.31, 1.06)		(0.29, 1.17)		(0.74, 1.57)	
3	0.97		1.27		1.54		1.49		0.99	
	(0.59, 1.60)		(0.76, 2.12)		(0.84, 2.81)		(0.70, 3.19)		(0.66, 1.48)	
4–5	2.30		1.83		2.08		1.20		1.61	
	(1.45, 3.64)		(1.17, 2.87)		(1.33, 3.25)		(0.64, 2.25)		(1.14, 2.26)	
≥6	6.35		4.39		4.85		1.65		1.39	
	(3.99, 10.10)		(2.82, 6.84)		(3.06, 7.69)		(0.49, 5.55)		(0.94, 2.07)	
ACE Score	**AI**	**Non-AI**	**AI**	**Non-AI**	**AI**	**Non-AI**	**AI**	**Non-AI**	**AI**	**Non-AI**
0	*referent*	*referent*	*referent*	*referent*	*referent*	*referent*	*referent*	*referent*	*referent*	*referent*
1	0.44	0.54	0.59	0.66	0.40	0.18	1.62	1.04	0.30	0.31
	(0.26, 0.75)	(0.19, 1.52)	(0.37, 0.96)	(0.25, 1.74)	(0.24, 0.65)	(0.07, 0.48)	(0.32, 8.12)	(0.58, 1.87)	(0.14, 0.63)	(0.13, 0.75)
2	0.66	0.27	0.86	0.43	0.67	0.13	0.50	0.58	1.67	1.94
	(0.44, 1.00)	(0.09, 0.82)	(0.49, 1.52)	(0.13, 1.39)	(0.36, 1.26)	(0.04, 0.40)	(0.13, 1.90)	(0.27, 1.25)	(0.58, 4.79)	(0.55, 6.82)
3	1.03	0.84	1.37	0.73	1.43	2.20	2.22	1.28	0.66	0.59
	(0.60, 1.75)	(0.31, 2.27)	(0.80, 2.35)	(0.25, 2.14)	(0.75, 2.71)	(0.48, 10.16)	(0.47, 10.39)	(0.54, 3.06)	(0.24, 1.82)	(0.22, 1.59)
4–5	1.89	8.79	1.55	7.55	2.11	2.10	0.69	1.28	2.57	1.59
	(1.22, 2.94)	(2.61, 29.64)	(1.01, 2.38)	(2.02, 28.31)	(1.33, 3.36)	(0.57, 7.79)	(0.17, 2.84)	(0.64, 2.56)	(1.08, 6.13)	(0.61, 4.16)
≥6	6.73	8.44	4.46	6.43	5.02	5.21	0.60	2.16	0.93	0.75
	(4.13, 10.98)	(3.05, 23.36)	(2.82, 7.05)	(2.09, 19.75)	(3.09, 8.16)	(2.08, 13.04)	(0.21, 1.71)	(0.58, 8.01)	(0.45, 1.91)	(0.36, 1.58)

Discussion

The South Dakota Health Survey produced a unique and ground-breaking dataset in which AI population health outcomes and adverse childhood experiences (ACEs) can be directly compared with the non-AI population in a statewide sample. In this study, we found that AI respondents had a significantly higher prevalence of all categories of childhood abuse, neglect, and household dysfunction compared with non-AI respondents. These differences may contribute to the known health disparities and poor health outcomes faced by AIs across the lifespan and the significantly higher prevalence of PTSD, depression, and cigarette smoking observed in AI respondents in our study. Our findings showed evidence of the previously documented dose-response relationship between ACEs and behavioral health outcomes.[23–25, 28–29] Across the sample we found that ACE scores were associated with screening positive for anxiety, depression, PTSD, and current cigarette smoking (Table 4). Interestingly, we found the relationship between ACE scores and behavioral health outcomes to be similar for both AI and non-AI respondents. Lack of significant findings in this respect may indicate that there are other variables (community or individual characteristics) that are acting as protective factors in AI communities, especially considering the significantly higher prevalence of ACEs. In this case, the community-level exposure to higher ACEs may be a significant contributing factor to poor health status and outcomes at the individual-level.

Alcohol misuse was not significantly correlated with ACE scores using the typical alcohol misuse threshold for the AUDIT-C, but we did find correlations between ACE scores and more severe alcohol misuse (scores of 9 or greater on the AUDIT-C scale). Recent literature shows that contrary to common beliefs about elevated alcohol consumption among AIs compared with non-AIs, there is a bimodal distribution of alcohol use in AI populations with relatively high percentages of AIs who completely abstain from alcohol consumption and those who are heavy drinkers.[37] A recent study using the National Survey on Drug Use and Health dataset showed that a majority of AIs abstain from drinking alcohol at all (60% of AIs versus 43% of Whites).[60] It is plausible that some AIs may decide to abstain from alcohol consumption after observing the harmful effects of heavy drinking in their communities. These proactive behaviors may also indicate how many AIs have developed resiliency and the ability to adapt effectively to the demands and social challenges of reservation life.[61–66] It may also indicate that for some community members, reservation living may provide protective factors (e.g., cultural connectedness, use of traditional language, participation in ceremonies) which were not assessed in the present study. Additional research is warranted to explore the reasons that AIs choose to consume or abstain from alcohol use.

We found that AI respondents had significantly higher rates of PTSD and cigarette smoking. While AIs had higher rates of other mental health conditions and severe alcohol misuse, these findings were not significant. These findings are similar to other studies assessing the prevalence of mental health conditions in AI communities, however for some conditions there are few population-level studies of AIs that are capable of defining prevalence estimates.[7,67,68] Even with robust oversampling of AI communities, regional samples were still relatively small, limiting the ability to detect differences.

There are likely other contexts outside of race/ethnicity that are contributing to these differences. Given the social, political, and economic environment in South Dakota, it is important to include the possibility that the unmeasured effects of bias, discrimination, and racism for AI children and adults in South Dakota may also contribute to health disparities we observed.

The SDHS provides an unprecedented comparison of ACEs in AI and non-AI populations. This statewide survey is unique for the emphasis it placed on promoting participation of the AI population, gaining formal tribal approvals prior to conducting research and training local community members as research assistants to assist with in-person data collection within AI communities to ensure adequate response rates. Numerous other datasets may include AIs but at a much lower percentage of the sample, which limits the ability to assess AI disparities. In addition, most datasets produced by Indian Health Service or other agencies working with tribes typically do not result in data that is directly comparable. The ACE questionnaire in this statewide survey is particularly valuable given the dearth of comparable data and a growing body of evidence that points toward key associations between ACEs and poor behavioral health outcomes that are commonly observed among Northern Plains AI tribes.

Consistent with the findings of other national reports, we did not find significant differences in ACE scores or behavioral health outcomes between AIs who currently live in urban and reservation areas. Based on anecdotal reports and the primary author's experience, many AIs in this region have lived both on and off reservation communities during childhood. However, our survey did not include questions about where respondents grew up (reservation or not), nor could we determine the amount of movement back and forth between urban and reservation settings. Further inquiry is needed to determine the impact of living on reservations, in urban settings, or both on AI health outcomes in this region.

Adverse experiences and their health consequences may vary considerably between tribal populations, as revealed by Koss et al.[20] in their study of adverse childhood exposures in seven AI tribes. Future investigations should include an assessment of tribal characteristics to compare and understand differences by tribes. American Indians have unique cultural variables, socioeconomic circumstances, and stressors which were not assessed in the present study. Experiences such as attending boarding schools and being raised in foster care may be considered additional childhood trauma leading to poor health outcomes. In addition, the role of historical trauma and collective adverse experiences needs to be further explored. Other unique cultural variables such as community engagement and participation in traditional ceremonies and practices may serve as protective factors, moderating the effects of ACEs.[61–64] These and other variables that may promote resilience should also be assessed in future investigations.

The growing body of ACE research has spurred prevention- and resiliency-focused interventions in healthcare, public health, social services, and education.[69–73] Policies and programs to prevent and mitigate ACEs must account for significant health and socioeconomic disparities experienced by AI populations, as well as unique cultural variables. There are multiple avenues in which potential interventions and community-based treat-

ment to mitigate the effects of childhood trauma can be pursued. First, federal, tribal, and state policy aimed at preventing child abuse, promoting healthy child development, and building community capacity can be adopted as key strategies for improving public health, as modeled by Washington State's innovative ACEs legislation.[74] Tribes that are contending with significant ACEs can and should consider adapting these promising practices for their own communities in addition to developing strategies that that promote Native cultural values, traditional activities, and ceremonies to promote resiliency in the face of adversity. AIs live in a variety of communities, both urban and rural, not only in reservation areas.[39] Policy and programming solutions should be tailored and targeted to the individual needs of diverse AI communities.

Second, regardless of the prevalence of ACEs, community-based prevention strategies involving grass roots programming, home visitation, and engagement among community leaders and key stakeholder groups can help alleviate stress and the pressures of poverty. Community engaged and culturally relevant approaches can promote positive and traditional parenting in AI communities.

Third, ensuring that adequate resources are available to increase access to high-quality health care and behavioral health services should be a priority for Indian Health Service, Medicaid programs, and similar agencies. Efforts focused on prevention and early intervention can assist in supporting the healthy development of children and mitigate the lifelong and inter-generational health effects of childhood trauma. In the long term, efforts to prevent and mitigate the devastating health impact of ACEs will improve quality of life, reduce health disparities, and will decrease health care costs.

This study had several limitations. First, it was a cross-sectional state-wide survey which did not allow for measures of culture specific to AI communities, nor did it allow for measures of discrimination, racism, resiliency or other protective factors. These would be important items to include in future studies of ACEs in AIs. The randomization process for identifying representative households using postal service data in reservations communities was problematic. Many AIs encounter housing insecurity and may not have a permanent address. Additionally, many AIs move back and forth frequently between reservation and urban settings. Furthermore, self-reported data may be subject to recall bias. It is possible that the general lack of healthcare access in AI communities may have had an impact on self-reported diagnoses due to undiagnosed conditions, which is why we limited our analysis to common behavioral health conditions that use standardized clinical screening questions. It is also relevant to acknowledge that while our findings from a single state are informative, the diversity of tribal and urban AI populations nationally necessitates additional research on the impact of ACEs in these populations. The present study highlights a need to better understand the prevalence of childhood trauma experienced by AIs. More studies are needed to document further prevalence of ACEs in AI communities and their impact on health outcomes. Future studies should investigate other systemic factors specific to AI populations (boarding schools, forced assimilation, religious conversion, discrimination, etc.) that have resulted in additional traumas experienced by many AI communities. Future studies should also focus on building the evidence base of culturally specific interventions and assessing

the effectiveness of these programs to reduce disparities and to prevent or mitigate the impact of ACEs on AI populations.

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