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Examining Protective and Buffering Effects of Social and Cultural Factors on Adverse Childhood Experiences among American Indian Adults with Type 2 Diabetes: A Quantitative, Community-Based Participatory Research Approach

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T.B. was responsible for drafting the literature review, discussion and conclusions sections. J.E. edited and added substantive content to the manuscript. M.W. performed data analyses and drafted methods and results sections and oversaw data collection. All authors reviewed the final version of the manuscript.

Key Words: Adverse Childhood Experiences, ACEs, American Indians, Type 2 Diabetes, Culture

Abstract

Objectives:
The purpose of this study was to determine the frequency of select Adverse Childhood Experiences (ACEs) among a sample of American Indian adults living with type 2 diabetes and to examine associations between ACEs, social support, cultural factors, and self-rated physical and mental health.

Design:
Survey data for this observational study was collected using computer assisted survey interviewing techniques between 2013 – 2015.

Setting:
Participants were randomly selected from American Indians (AI) tribal clinic facilities on five reservations in the upper Midwestern United States.

Participants:
Inclusion criteria were; a diagnosis of type 2 diabetes, age 18 years or older, and self-identified as AI. The sample includes N=192 adults (55.7% female; mean age = 46.3 years).

Primary Measures:
We assessed nine adverse childhood experiences related to household dysfunction, violence, and emotional, physical, or sexual abuse. Independent variables included social support, diabetes specific support, and two cultural factors: traditional spiritual activities and connectedness. Primary outcomes of interest were self-rated physical and mental health.

Results:
An average of 3.05 adverse childhood experiences were reported by participants and 81.9% (n = 149) said they had experienced at least one ACE. Controlling for gender, age, and income, ACEs were negatively associated with self-rated mental and physical health ($p < .05$). Involvement in spiritual activities, social support, and diabetes-specific support were all positively and significantly associated with self-reported mental and physical health in these models. Social support variables moderated the impact of ACEs on physical health.

Conclusions:
This research demonstrates the impact of childhood experiences on adult AI diabetes patient wellbeing. Health professionals are able to use the findings from this study to supplement not only to augment their assessment of AI patients, but also to more clearly guide clients to appropriate social support services and resources for cultural involvement.

ARTICLE SUMMARY

Strengths and Limitations of this Study:

- This is the first quantitative observational study of which we are aware to examine American Indian adult cultural and social protective factors in the face of earlier life adversities and their potential moderating relationship between Adverse Childhood Experiences (ACEs) and adult self-rated mental and physical health.
- Study scope and methodology was developed using community-based participatory research principles to promote authentic researcher/community member collaboration.
- We contribute to a limited body of literature on ACEs and American Indian health by assessing ACE exposure and correlates for a clinical sample of Native adults.
- Our reliance on retrospective reports of ACEs may involve systematic error including recall bias that should be considered when interpreting findings.

INTRODUCTION

Adverse childhood experiences (ACEs) are early life stressful situations or traumatic events that often co-occur, and potent determinants of health linked to increased morbidity and mortality across the life course. [1-9] The foundational Centers for Disease Control and Prevention (CDC) Kaiser Permanente ACEs retrospective adult studies (Kaiser/CDC studies) identified a set of eight to ten childhood stressors including childhood emotional, physical, and sexual abuse, emotional and physical neglect, witnessing intimate partner violence, parental separation, and living with a substance abusing, mentally ill, or criminal household member.[5, 6] These childhood stressors have been shown to correspond with later life outcomes, such as Type 2 Diabetes (T2D), substance abuse, and suicide attempts, with strong graded relationships between number of ACE exposures and risk for health outcomes. [5, 6, 10] Similar studies like the National Survey of Children's Health have replicated and adapted from the Kaiser/CDC studies for diverse national samples.[11] In doing so, ACEs criteria have been expanded to include peer victimization, lack of friends, poor school performance, community violence, someone close having had a bad accident or illness, persistent parental arguing, exposure to racial or ethnic discrimination, parent death, and economic hardship.[11, 12] In the absence of protective factors, existing evidence suggests that early trauma and toxic stress can have lasting effects on physical and mental health.[3, 5, 6, 11]

The emerging literature on ACEs among the American Indian/Alaska Native (AI/AN) population has identified disproportionately high rates of co-occurring childhood stressors and associations with multiple health outcomes including suicidality, substance misuse, depressive and PTSD symptoms, and diabetes.[7, 8, 11-14] These findings are particularly salient given the pronounced health inequities within AI/AN communities. For example, AI/AN children and adults have the highest

prevalence of T2D in the United States (US). Data from 2013-2015 indicated adult overall prevalence for AI/ANs was 15.1%, versus 7.4% for non-Hispanic whites.[15] Further, T2D represents a modern epidemic among AI/ANs, especially considering that prior to the 1940's the diagnosis was relatively uncommon for this demographic.[16]

In the wake of the compelling evidence that early life stressors can lead to serious health consequences, researchers have begun identifying factors that may provide a protective effect against ACEs-related poor outcomes.[17] One way in which protective factors operate is through the fostering, building, and exertion of resilience as an ability to overcome significant life stressors, resulting from access to combinations of protective resources, and interacting stress processes.[18-22] In a U.S. sample, factors such as sense of community have shown to have direct and indirect protective effects on ACEs, including moderating roles for the impact of ACEs on adult mental health.[23]

Resilience promotion is not a new concept within Tribal communities. AI/ANs have longstanding traditional knowledge that include instructions on how to stay well and thrive. Indigenous theoretical literature also supports notions of sociocultural resource access and cultural participation as having protective effects.[24-26] AI/AN resilience is dynamic, evident in a life course framework, and accessed through familial, communal, and cultural knowledge and expressions (e.g., traditional activity participation, spiritual practices, positive identity promotion, social support, feelings of connectedness to family and nature)[24, 26] These deeply rooted beliefs and practices have been identified as multilevel factors that can buffer poor outcomes, strengthen resilience, and promote health.[27]

Preventing ACEs and increasing access to and participation in resilience-building opportunities could decrease ACEs-associated poor health and assist in closing the health equity gap for AI communities. An examination of moderating and health promoting factors is particularly salient for Tribal communities given complex health service delivery systems and limited systemic resources for

monitoring and addressing behavioral health on reservations.[19,28] Despite this great need, few studies have examined AI/AN-specific protective factors or resilience contributors in the context of co-occurring childhood stressors. Of the available AI/AN ACEs literature, Burnette and colleagues (2015) reported social support had a protective effect on depressive symptoms among AI/AN older adults who have experienced ACEs.[13] In another study, youth who experienced child maltreatment and other stressors had a reduced likelihood of suicidality if they discussed problems with friends or family and reported connectedness with family.[28] However, no AI/AN-specific studies of which we are aware have investigated adult cultural and social protective factors in the face of earlier life adversities and their potential for moderating the relationship between ACEs and adult self-rated mental and physical health.

The purpose of this study is to 1) determine the frequency of select ACEs within a sample of AI/AN adults living with T2D, and 2) examine associations between ACEs, social supports, cultural factors, and self-rated physical and mental health. Three hypotheses guided our inquiry:

H1: ACEs will be negatively associated with self-reported physical and mental health status.

H2: Social support (general and diabetes-specific) and Indigenous cultural factors will be positively associated with self-reported physical and mental health status.

H3: Social support and cultural factors will buffer (modify) the effects of ACEs on physical and mental health.

METHODS

The Maawaji' idi-oog Mino-ayaawin (Gathering for Health) project is a community-based participatory research (CBPR) collaboration between [removed for blind review] and five AI (i.e., Ojibwe) communities. The primary purpose of the study was to understand sources of stress and examine their impact on T2D-related outcomes for AIs. Tribal resolutions supporting the project were

granted by all five tribal nation governments. Community Research Councils (CRCs) from each tribe worked closely with the university research team to develop and implement study protocols, participate in data collection, interpretation, and dissemination. All CRCs read and/or contributed to this manuscript prior to journal submission, and the paper was approved for submission by the Indian Health Service (IHS) National Institutional Review Board. Project methodology and human subjects approval was granted by the University of [removed for blind review] (IRB) and the IHS IRB.

Sample

Staff at each IHS clinic site generated simple random samples for study recruitment from patient records. Inclusion criteria were; a diagnosis of type 2 diabetes, age 18 years or older, and self-identified as AI/AN. A total of 194 participants enrolled in the study, representing a baseline response rate of 67%.

Procedure

Clinic staff sent study letters of invitation and brochures to residences of randomly selected patients. Non-refusing individuals were contacted and screened for eligibility by trained community interviewers. Visits were scheduled at a location of participants' choosing, at which time interviewers gathered signed informed consent and HIPAA authorization forms prior to administering surveys. Data for this manuscript includes responses from the 192 participants for which we have baseline Computer-Assisted Personal Interviews (CAPI) completed from 2013 to 2015. Participants received a $50 incentive and a small, culturally meaningful gift.

Measures

Three control variables were included in analyses: *age* (in years), *gender* (male = 0, female = 1), and *per capita household income* were each assessed via self-report survey responses. Two dependent variables, self-rated mental health and self-rated physical health, each ranged in value from

0 (poor) to 4 (excellent); thus, higher scores indicate better health. A continuous ACEs measure was created by summing affirmative responses to 9 experiences related to household dysfunction, witnessing violence, and emotional, physical, and sexual abuse while growing up; participants were included in this continuous measure if they answered at least 5 of the 9 ACE items (n = 182). Several protective independent variables were also included. Social support was assessed by 9 items adapted from previous measures of perceived emotional and instrumental support.[29] Diabetes-specific support (adapted from Fitzgerald)[30] includes 5 items and assesses perceived support directly related to diabetes management. Traditional spiritual activities include summed 'yes' responses to 10 spiritually relevant cultural activities, such as seeking advice/guidance from a spiritual advisor or participating in a sweat lodge, which were engaged in during the prior year. We also utilized an adapted Awareness of Connectedness measure that included 6 items assessing degree of connection to nature, family, and community.[1]

Statistical Analysis

We used SPSS v. 24 to conduct all analyses with list-wise deletion of missing values, including Ordinary Least Squares (OLS) regression analyses for multivariate models. There were few missing cases across variables; full sample responses were given for age, gender, and communal mastery and missing data for remaining variables ranges from 1 – 4 cases total, with the exception of individual ACE items (Table 1). We generated a total of eight separate OLS models to examine the associations between the four protective factors and their potentially moderating effects for each of the two outcome variables (mental and physical health) after accounting for controls. Tests of moderation included a multiplicative interaction term for each protective variable x ACE scores.

RESULTS

The average age of the study participants was 46.3 years (SD = 12.2), mean per capita household income was $3,750, and slightly more than half were female (55.7%). Frequencies of nine ACEs appear in Table 1. An average of 3.05 (SD = 2.46) ACEs were reported by participants and 81.9% (n = 149) reported at least one ACE (not displayed).

Table 1: Adverse Childhood Experiences among American Indian Adults Living with Type 2 Diabetes

	Never/No At	Least Once/Yes
When you were growing up, did you live with a household member who was a problem drinker or alcoholic, or misused street or prescription drugs? (n = 181)	51.9%	48.1%
When you were growing up, did you live with a household member who was depressed, mentally ill, or suicidal? (n = 180)	78.3%	21.7%
When you were growing up, did you live with a household member who was ever sent to jail or prison? (n =179)	68.2%	31.8%
When you were growing up, how often did you see or hear a parent or household member in your home being slapped, kicked, punched, or beaten up? (n=180)	52.2%	47.8%
When you were growing up, how often did a parent, guardian, or other household member yell, scream, swear at you, insult you, or humiliate you? (n = 182)	51.1%	48.9%
When you were growing up, how often did a parent, guardian, or other household member spank you, slap you, kick you, punch you, or beat you up? (n = 179)	43.6%	56.4%
When you were growing up, how often did someone touch or fondle you in a sexual way when you did not want them to? (n = 179)	76.5%	23.5%
When you were growing up, how often did someone make you touch their body in a sexual way when you did not want them to? (n = 177)	86.4%	13.6%
When you were growing up, how often did someone actually have oral, anal, or vaginal intercourse when you did not want them to? (n = 181)	83.4%	16.6%

Table 2 displays results of OLS regression analyses. As hypothesized (H1), across all models and controlling for gender, age, and income, ACEs were negatively associated with mental and physical health. Also as hypothesized (H2), involvement in spiritual activities, stronger awareness of connectedness, social support, and diabetes-specific support were all positively and significantly associated with self-reported mental and physical health in these models.

Table 2: Results from Ordinary Least Squares Regression Analyses

	Mental Health		Physical Health		Mental Health		Physical Health		Mental Health		Physical Health		Mental Health		Physical Health	
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Age	-.01(.01)	-.08	-.00(.01)	-.03	-.01(.01)	-.09	-.00(.01)	-.04	-.01(.01)	-.06	-.00(.01)	-.02	-.01(.01)	-.07	-.00(.01)	-.01
Gender	-.15(.15)	-.07	-.02(.13)	-.01	-.15(.14)	-.08	-.02(.13)	-.01	**-.23(.14)**	**-.12$^{\tau}$**	-.05(.13)	-.03	-.13(.15)	-.07	.05(.13)	.03
Per Capita HH Income	**.02(.01)**	**.22****	**.02(.01)**	**.18***	**.02(.01)**	**.20****	**.02(.01)**	**.15***	**.02(.01)**	**.15***	**.01(.01)**	**.14$^{\tau}$**	**.02(.01)**	**.20***	**.01(.01)**	**0.15$^{\tau}$**
ACEs	**-.09(.03)**	**-.23****	**-.08(.03)**	**-.22****	**-.08(.03)**	**-.20****	**-.07(.03)**	**-.20****	**-.06(.03)**	**-.16***	**-.06(.03)**	**-.17***	**-.07(.30)**	**-.18***	**-.06(.03)**	**-.17***
Spiritual Activities	**.06(.03)**	**.15***	.03(.03)	.07												
Awareness of Connectedness					**.07(.03)**	**.18$^{\tau}$**	**.08(.03)**	**.23****								
Social Support									**.50(.10)**	**.35*****	**.27(.10)**	**.20****				
Support x ACEs											**-.07(.04)**	**-.14$^{\tau}$**				
Diabetes Specific Support													.03(.02)	.10	**.06(.02)**	**.21****
Diabetes Support x ACEs															**-.02(.01)**	**-.15***

***p </= .001; **p </= .01; *p</= .05, $^{\tau}$p</= .10; two-tailed tests

We included interaction terms for each of the protective factors by ACEs for all independent variables; two of these emerged as statistically significant and are plotted in Figure 1 and Figure 2. As shown and in partial support of the third hypothesis (H3), social support and diabetes-specific support moderated the negative associations between ACEs and physical health. More specifically, physical health ratings were highest (better) for those reporting high support and low ACEs. Even when reporting higher ACEs, those in high support contexts still had better self-reported physical health than those with lower ACE scores but less supportive environments.

INSERT FIGURE 1 and FIGURE 2 HERE

DISCUSSION

Approximately 82% of this AI sample reported experiencing at least one ACE. Although caution is necessary in comparing rates across studies due to measurement variability, our finding is much higher compared to the less than two-thirds of adults who report one or more ACE among 10 states and Washington, DC.[32] Our estimate of this Midwest AI sample more closely mirrors the 78.1% minimum exposure rate reported by adolescent AIs on one northern plains reservation [7] and the 86% of participants in a seven tribe study.[33]

As hypothesized, self-rated physical and mental health were negatively associated with ACEs for this sample of adults managing T2D, a complex chronic disease. This is not surprising given what is known from the general literature on ACEs and health outcomes.[34-36] As many AI/ANs exhibit drastic health disparities, these conclusions are useful to public health and tribal health systems for consideration in long-term diabetes reduction strategies. Primary and secondary prevention efforts targeting ACE exposures and intermediate health outcomes (e.g. behavioral health), respectively, may reduce the prevalence of T2D within Tribal communities.

Better physical health was associated with spiritual activity involvement, family, community and nature connectedness, social support, and diabetes-specific support, even when accounting for ACEs and control variables. We advance the literature by documenting protective associations between Indigenous cultural factors (i.e., involvement in spiritual activities and awareness of connectedness) and health that persist even when accounting for ACE exposures and demographic variables. Cultural connectedness, social support, and traditional practices as wellness promoting factors are widely understood within Tribal communities. Therefore, this research supports Indigenous knowledges and underscores the critical importance of "a community-based prevention approach [that]

recognizes the inherent knowledge of community members and their expertise."[37] We provide evidence that this approach should extend to treatment and management of chronic diseases like T2D.

While social support has a well-documented positive impact on patients with diabetes, [38-40] we add to this literature by demonstrating that adult support appears to moderate the negative effects of childhood adversities among AIs. That is, our findings suggest that adulthood social support networks may buffer the harmful impact of ACEs on health. This includes diabetes-specific support for AIs diagnosed with T2D, and diabetes interventions promoting socially supportive environments may prove useful for better prognosis.

Limitations

This study has several limitations that need to be considered. First, retrospective ACE studies may involve systematic error such as recall bias and false negative findings.[41] Important measurement and methodology differences hamper our ability to draw firm conclusions about the prevalence of AI/AN ACEs shown here and those documented nationally. Nevertheless, our findings demonstrate in particular may promote health by ameliorating the negative impact of ACEs for AIs. Given variability in the types and severity of ACEs potentially experienced across cultures and community context, our estimates may be conservative and underscores the importance of culturally meaningful ACE and placed-based assessments.[7] Future research should include identification of specific forms and types of childhood stressors that are particularly harmful to Native people, including measurement development for AI communities.

CONCLUSIONS

For health professionals, this research underscores the importance of life-course histories and the lingering impact of childhood experiences on adult AI wellbeing. Diabetes care providers in particular should consider strategies for promoting help-seeking skills and social belonging for

patients, particularly among those reporting a multitude of childhood adversities. Mental health professionals should encourage the building of social networks and cultural activity participation for AI patients interested in these outlets. Supporting and encouraging AI diabetes patients who wish to seek and engage in cultural and social activities may prove beneficial in promoting physical and mental health.

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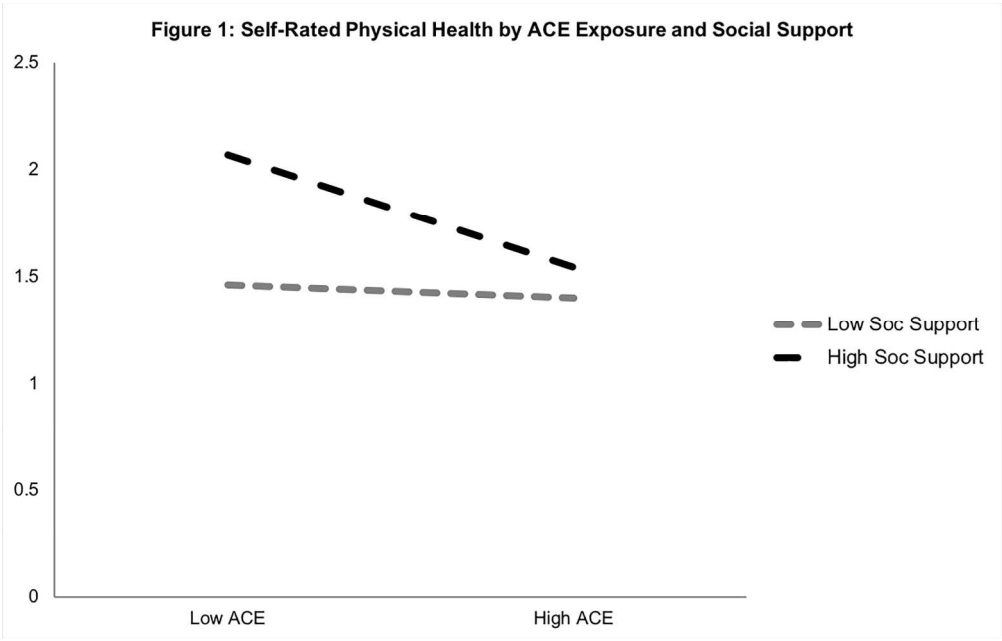

Figure 1

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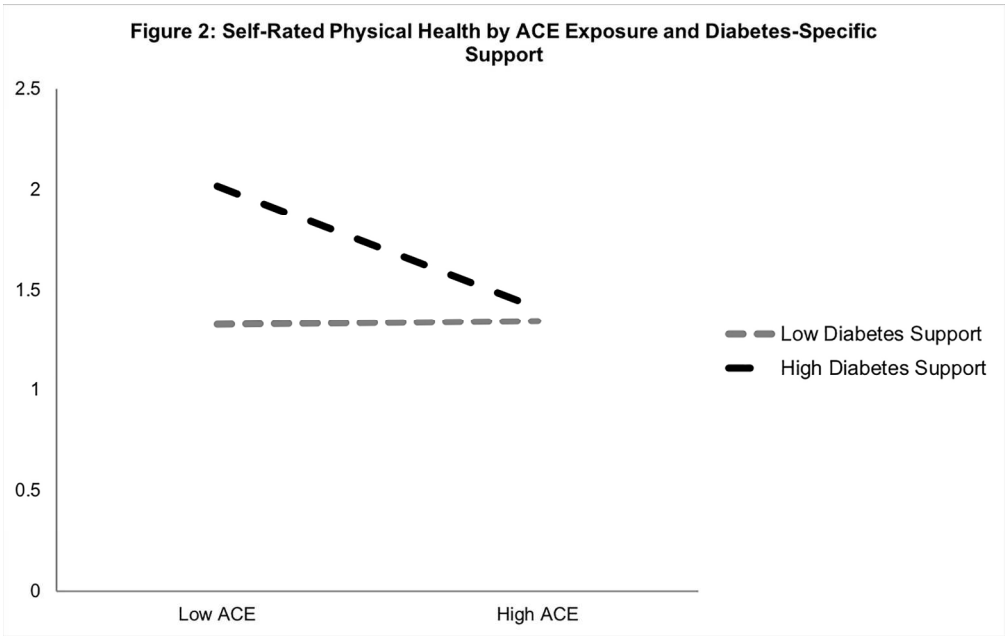

Figure 2

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract. X Page 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found X Page 2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported X Pages 4-6
Objectives	3	State specific objectives, including any prespecified hypotheses Page 6
Methods		
Study design	4	Present key elements of study design early in the paper X Page 2 & 6-8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection X Pages 6 -8
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants X Page 7
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable X Pages 7 -8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group X Pages 7 -8
Bias	9	Describe any efforts to address potential sources of bias see Page 12
Study size	10	Explain how the study size was arrived at X Page 7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why X Page 8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding X Page 8
		(*b*) Describe any methods used to examine subgroups and interactions X Pgs 8-10
		(*c*) Explain how missing data were addressed X Page 7
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy X Page 6-8
		(*e*) Describe any sensitivity analyses N/A

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed X Page 7
		(b) Give reasons for non-participation at each stage N/A
		(c) Consider use of a flow diagram N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders X Page 8
		(b) Indicate number of participants with missing data for each variable of interest X Page 8-9
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures X Page 9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included X page 10
		(*b*) Report category boundaries when continuous variables were categorized N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses X Page 10
Discussion		
Key results	18	Summarise key results with reference to study objectives X Pages 9-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias X Page 12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence X Page 12-13
Generalisability	21	Discuss the generalisability (external validity) of the study results X Page 12
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based X Page 17

BMJ Open

Examining Protective and Buffering Effects of Social and Cultural Factors on Adverse Childhood Experiences among American Indian Adults with Type 2 Diabetes: A Quantitative, Community-Based Participatory Research Approach

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Examining Protective and Buffering Effects of Social and Cultural Factors on Adverse Childhood Experiences among American Indian Adults with Type 2 Diabetes: A Quantitative, Community-Based Participatory Research Approach

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Author Statement of Contributions:

T.B. was responsible for drafting the literature review, discussion and conclusions sections. J.E. edited and added substantive content to the manuscript. M.W. performed data analyses and drafted methods and results sections and oversaw data collection. All authors reviewed the final version of the manuscript.

Key Words: Adverse Childhood Experiences, ACEs, American Indians, Type 2 Diabetes, Culture

Abstract

Objectives:
The purpose of this study was to determine the frequency of select Adverse Childhood Experiences (ACEs) among a sample of American Indian adults living with type 2 diabetes and the impact of ACEs on health. We also examined protective effects of socio-cultural factors on physical and mental health, including possible buffering effects.

Design:
Survey data for this observational study was collected using computer assisted survey interviewing techniques between 2013 – 2015.

Setting:
Participants were randomly selected from American Indian tribal clinic facilities on five reservations in the upper Midwestern United States.

Participants:
Inclusion criteria were a diagnosis of type 2 diabetes, age 18 years or older, and self-identified as AI. The sample includes N=192 adults (55.7% female; mean age = 46.3 years).

Primary Measures:
We assessed nine ACEs related to household dysfunction, violence, and emotional, physical, or sexual abuse. Independent variables included social support, diabetes support, and two cultural factors: spiritual activities and connectedness. Primary outcomes were self-rated physical and mental health.

Results:
An average of 3.05 ACEs were reported by participants and 81.9% (n = 149) said they had experienced at least one ACE. Controlling for gender, age, and income, ACEs were negatively associated with self-rated mental and physical health ($p < .05$). Involvement in spiritual activities, social support, and diabetes support were all positively, significantly associated with mental and physical health. Social support variables moderated the impact of ACEs on physical health.

Conclusions:
This research demonstrates the negative impact of ACEs on adult AI diabetes patient wellbeing. The findings further demonstrate the promise of social and cultural integration as a critical component of wellness, a point of relevance for all cultures. Health professionals can use findings from this study to augment their assessment of patients and guide them to health-promoting social support services and resources for cultural involvement.

ARTICLE SUMMARY

Strengths and Limitations of this Study:

- This is the first quantitative observational study of which we are aware to examine American Indian adult cultural and social protective factors in the face of earlier life adversities and their potential moderating relationship between Adverse Childhood Experiences (ACEs) and adult self-rated mental and physical health.
- Study scope and methodology was developed using community-based participatory research principles to promote authentic researcher/community member collaboration.
- We contribute to a limited body of literature on ACEs and American Indian health by assessing ACE exposure and correlates for a clinical sample of Native adults.
- We rely on retrospective reports of ACEs that may involve systematic error including recall bias that should be considered when interpreting findings.

INTRODUCTION

Adverse childhood experiences (ACEs) are early life stressful situations or traumatic events that often co-occur, and potent determinants of health linked to increased morbidity and mortality across the life course. [1-9] The foundational Centers for Disease Control and Prevention (CDC) Kaiser Permanente ACEs retrospective adult studies (Kaiser/CDC studies) identified a set of eight to ten childhood stressors including childhood emotional, physical, and sexual abuse, emotional and physical neglect, witnessing intimate partner violence, parental separation, and living with a substance abusing, mentally ill, or criminal household member.[5, 6] These childhood stressors have been shown to correspond with later life outcomes, such as Type 2 Diabetes (T2D), substance abuse, and suicide attempts, with graded, positive relationships between the number of ACE exposures and risk for health outcomes.[5, 6, 10] Adaptations of the Kaiser/CDC measures across settings have expanded ACE criteria to include, for example, peer isolation and rejection,[11] peer victimization, [12] and community level indicators like community violence[12] and poverty.[13] In the absence of protective factors, existing evidence suggests that early trauma and toxic stress can have lasting effects on physical and mental health.[3, 5, 6, 11]

The emerging literature on ACEs among the American Indian/Alaska Native (AI/AN) population has identified disproportionately high rates of ACEs and childhood stressors that are associated with multiple health outcomes including suicidality,[7] substance misuse,[8] diabetes,[14] and worse mental health including depressive symptoms.[15-16] There is also movement to identify ACEs appropriate for AI/AN culture and context, such as historical loss associated symptoms and discrimination[7,]. Elevated and unique experiences with ACEs offer explanation for the pronounced health inequities experienced by AI/AN communities, including heightened rates of T2D. For example, data from 2013-2015 indicated adult overall prevalence of T2D for AI/ANs was 15.1%, versus 7.4%

for non-Hispanic whites.[17] Further, T2D represents a modern epidemic among AI/ANs, especially considering that prior to the 1940's the diagnosis was relatively uncommon for this demographic.[18]

In the wake of such compelling evidence that ACEs can lead to serious health consequences, researchers have begun identifying factors that may provide a protective effect against ACE impacts.[19] One way in which protective factors operate is through the fostering, building, and exertion of resilience as an ability to overcome significant life stressors.[20-24] In a US sample, factors such as sense of community have been shown to have direct and indirect protective effects on ACEs, including moderating roles for the impact of ACEs on adult mental health.[25]

Resilience promotion is not a new concept within Tribal communities. AI/ANs have longstanding traditional knowledges that include instructions on how to stay well and thrive, and Indigenous theoretical literature supports the assertion that sociocultural resources and cultural participation is health-promoting.[26-28] AI/AN resilience is dynamic and accessed through familial, communal, and cultural knowledge and expressions (e.g., traditional activity participation, spiritual practices, positive identity promotion, social support, feelings of connectedness to family and nature).[26,28] These deeply rooted beliefs and practices have been identified as multilevel factors that can buffer poor outcomes, strengthen resilience, and promote health.[29]

Preventing ACEs and increasing access to and participation in resilience-building opportunities could contribute to closing the health equity gap for AI communities. An examination of moderating and health promoting factors is particularly salient for Tribal communities given complex health service delivery systems and limited systemic resources for monitoring and addressing behavioral health on reservations.[21, 30] Despite this great need, few studies have examined AI/AN-specific protective factors or resilience contributors in the context of ACEs. As an exception, Burnette and colleagues (2015) found that social support had a protective effect on depressive symptoms among

AI/AN older adults who experienced ACEs.[15] In another study, youth who experienced child maltreatment and other stressors had a reduced likelihood of suicidality if they discussed problems with friends or family and reported connectedness with family.[30] However, no AI/AN-specific studies of which we are aware have investigated adult cultural and social protective factors in the face of earlier life adversities and their potential for moderating the relationship between ACEs and adult self-rated mental and physical health.

The purpose of this study is to 1) determine the frequency of select ACEs within a sample of AI/AN adults living with T2D, and 2) examine associations between ACEs, social supports, cultural factors, and self-rated physical and mental health. Three hypotheses guided our inquiry:

H1: ACEs will be negatively associated with self-reported physical and mental health status.

H2: Social support (general and diabetes-specific) and Indigenous cultural factors will be positively associated with self-reported physical and mental health status.

H3: Social support and cultural factors will buffer (moderate) the effects of ACEs on physical and mental health.

METHODS

The Maawaji' idi-oog Mino-ayaawin (Gathering for Health) project is a community-based participatory research (CBPR) collaboration between the University of Minnesota and five AI (i.e., Ojibwe) communities. The primary purpose of the study was to understand sources of stress and examine their impact on T2D-related outcomes for AIs. Tribal resolutions supporting the project were granted by all five tribal nation governments.

Patient and Public Involvement

Community Research Councils (CRCs) from each tribe worked closely with the university research team to develop and implement study protocols, participate in data collection, interpretation,

and dissemination. Members of the CRCs included patients living with type 2 diabetes, patient providers, community members, and elders. As such, patient perspectives were incorporated into the design and conduct of this study. All CRCs read and/or contributed to this manuscript prior to journal submission, and the paper was approved for submission by the Indian Health Service (IHS) National Institutional Review Board. Participants will receive a mailed infographic summarizing major overall study results. In addition, the research team has/will continue to present findings within each tribal community via written technical reports and in-person presentations at local health fairs, tribal council meetings, and public gatherings.

Procedure and Sample

Project methodology and human subjects approval was granted by the University of Minnesota (IRB) and the IHS IRB. The study involved 2 major phases: 1) a qualitative step including two sets of focus groups to identify salient community stressors and adapt/develop survey measures, and 2) a quantitative phase including survey data from computer-assisted personal interviews (CAPI; details below). The goal of this process was to maximize measurement validity for local culture and contexts. Prior to CAPI field entry, we also piloted any adapted or new measures with a convenience sample of AI participants and asked for open-ended feedback on question applicability and comprehension. Feedback from pilot surveys permitted us to further refine measures in collaboration with CRC members. Data presented in this study are from Phase 2 CAPI responses.

Staff at each IHS clinic site generated simple random samples for Phase 2 study recruitment from patient records. Inclusion criteria were a diagnosis of type 2 diabetes, age 18 years or older, and self-identified as AI/AN. A total of 194 participants enrolled in the study, representing a baseline response rate of 67%.

Clinic staff sent study letters of invitation and brochures to residences of randomly selected patients. Non-refusing individuals were contacted and screened for eligibility by trained community interviewers. Visits were scheduled at a location of participants' choosing, at which time interviewers gathered signed informed consent and HIPAA authorization forms prior to administering surveys. We analyzed responses from the 192 participants for which we have baseline CAPI completed from 2013 to 2015. Participants received a $50 incentive and a small, culturally meaningful gift for their participation.

Measures

Three control variables were included in analyses: *age* (in years), *gender* (male = 0, female = 1), and *per capita household income* were each assessed via self-report survey responses. Two dependent variables, self-rated mental health and self-rated physical health, each ranged in value from 0 (poor) to 4 (excellent); thus, higher scores indicate better health. A continuous ACEs measure was created by summing affirmative responses to 9 experiences related to household dysfunction, witnessing violence, and emotional, physical, and sexual abuse while growing up; participants were included in this continuous measure if they answered at least 5 of the 9 ACE items (n = 182; Cronbach's alpha = .77).

Several protective independent variables were also included. Social support was assessed by 9 items adapted from a previous measure of perceived emotional and instrumental support received from others.[31] Example items include: *there is at least one person I can share most things with*; *I have someone to help me if I am physically unwell*; *I feel that I have a circle of people who value me*, and, *when I am feeling down, there is someone I can lean on* (Cronbach's alpha = .89) Diabetes-specific support (adapted from Fitzgerald)[32] includes 5 items and assesses perceived support directly related to diabetes management including help to *follow a healthy meal plan, handle feelings about diabetes*, and

test (my) blood sugar (Cronbach's alpha = .86). Traditional spiritual activities include summed 'yes' responses to 9 spiritually relevant cultural activities, such as seeking advice/guidance from a spiritual advisor or participating in a sweat lodge, which were engaged in during the prior year (Cronbach's alpha = .81). We also utilized an adapted Awareness of Connectedness[33] measure that included 6 items assessing degree of connection to nature, family, and community (e.g., *I feel connected to nature; When I am hurting, my family hurts with me; My community's happiness is a part of my happiness*; Cronbach's alpha = .74.

Statistical Analysis

We used SPSS v. 24 to conduct all analyses with list-wise deletion of missing values, including Ordinary Least Squares (OLS) regression analyses for multivariate models. There were few missing cases across variables; full sample responses were given for age, gender, and communal mastery and missing data for remaining variables ranges from 1 – 4 cases total, with the exception of individual ACE items (Table 1). We generated a total of eight separate OLS models to examine the associations between the four protective factors and their potentially moderating effects for each of the two outcome variables (mental and physical health) after accounting for controls. Tests of moderation included a multiplicative interaction term for each protective variable x ACE scores.

RESULTS

The average age of the study participants was 46.3 years (SD = 12.2), mean per capita household income was $9,767.00, and slightly more than half were female (55.7%). Frequencies of nine ACEs appear in Table 1. An average of 3.05 (SD = 2.46) ACEs were reported by participants and 81.9% (n = 149) reported at least one ACE (not displayed).

Table 1: Adverse Childhood Experiences among American Indian Adults Living with Type 2 Diabetes

	Never/No	At Least Once/Yes
When you were growing up, did you live with a household member who was a problem drinker or alcoholic, or misused street or prescription drugs? (n = 181)	51.9%	48.1%
When you were growing up, did you live with a household member who was depressed, mentally ill, or suicidal? (n = 180)	78.3%	21.7%
When you were growing up, did you live with a household member who was ever sent to jail or prison? (n =179)	68.2%	31.8%
When you were growing up, how often did you see or hear a parent or household member in your home being slapped, kicked, punched, or beaten up? (n=180)	52.2%	47.8%
When you were growing up, how often did a parent, guardian, or other household member yell, scream, swear at you, insult you, or humiliate you? (n = 182)	51.1%	48.9%
When you were growing up, how often did a parent, guardian, or other household member spank you, slap you, kick you, punch you, or beat you up? (n = 179)	43.6%	56.4%
When you were growing up, how often did someone touch or fondle you in a sexual way when you did not want them to? (n = 179)	76.5%	23.5%
When you were growing up, how often did someone make you touch their body in a sexual way when you did not want them to? (n = 177)	86.4%	13.6%
When you were growing up, how often did someone actually have oral, anal, or vaginal intercourse when you did not want them to? (n = 181)	83.4%	16.6%

Table 2 displays results of OLS regression analyses. As hypothesized (H1), across all models and controlling for gender, age, and income, ACEs were negatively associated with mental and

physical health. Also as hypothesized (H2), involvement in spiritual activities, stronger awareness of connectedness, social support, and diabetes-specific support were all positively and significantly associated with self-reported mental and physical health in these models. Two of the control variables were also related to health in the multivariate analyses. Per capita household income was significantly and positively associated with mental and physical health across all models, and being female was associated with worse mental health in one model only.

Table 2: Results from Ordinary Least Squares Regression Analyses

	Mental Health		Physical Health		Mental Health		Physical Health		Mental Health		Physical Health		Mental Health		Physical Health	
	N = 176				N = 177				N = 176				N = 177			
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Age	-.01(.01)	-.08	-.00(.01)	-.03	-.01(.01)	-.09	-.00(.01)	-.04	-.01(.01)	-.06	-.00(.01)	-.02	-.01(.01)	-.07	-.00(.01)	-.01
Gender	-.15(.15)	-.07	-.02(.13)	-.01	-.15(.14)	-.08	-.02(.13)	-.01	**-.23(.14)**	**-.12^{T}**	-.05(.13)	-.03	-.13(.15)	-.07	.05(.13)	.03
Per Capita HH Income	**.02(.01)**	**.22****	**.02(.01)**	**.18***	**.02(.01)**	**.20****	**.02(.01)**	**.15***	**.02(.01)**	**.15***	**.01(.01)**	**.14^{T}**	**.02(.01)**	**.20****	**.01(.01)**	**0.15^{T}**
ACEs	**-.09(.03)**	**-.23****	**-.08(.03)**	**-.22****	**-.08(.03)**	**-.20****	**-.07(.03)**	**-.20****	**-.06(.03)**	**-.16***	**-.06(.03)**	**-.17***	**-.07(.30)**	**-.18***	**-.06(.03)**	**-.17***
Spiritual Activities	**.06(.03)**	**.15***	.03(.03)	.07												
Awareness of Connectedness					**.07(.03)**	**.18**	**.08(.03)**	**.23****								
Social Support									**.50(.10)**	**.35*****	**.27(.10)**	**.20****				
Support x ACEs											**-.07(.04)**	**-.14^{T}**				
Diabetes Specific Support													.03(.02)	.10	**.06(.02)**	**.21****
Diabetes Support x ACEs															**-.02(.01)**	**-.15***

***p </= .001; **p </= .01; *p</= .05, ^{T}p</= .10; two-tailed tests

We included interaction terms for each of the protective factors by ACEs for all independent variables; two of these emerged as statistically significant and are plotted in Figure 1 and Figure 2. As shown and in partial support of the third hypothesis (H3), social support and diabetes-specific support moderated the negative associations between ACEs and physical health. More specifically, physical health ratings were highest (better) for those reporting high support and low ACEs. Even when reporting higher ACEs, those in high support contexts still had better self-reported physical health than those with lower ACE scores but less supportive environments.

INSERT FIGURE 1 and FIGURE 2 HERE

DISCUSSION

This study adds important evidence to the limited research on ACEs and T2D among American Indians who have a demonstrated higher prevalence of both compared to non-Indigenous US populations.[7,17] In this multisite community study, cultural and social indicators were linked to better mental and physical health even when accounting for ACEs. We also found partial evidence for ACE-buffering effects of social support on health.

Approximately 82% of this AI sample reported experiencing at least one ACE. Our finding is much higher than the less than two-thirds of non-Native adults who report one or more ACEs in the now classic Kaiser/CDC study.[34] Our percentage of 82% in this Midwest AI sample is consistent with the 78.1% minimum exposure rate (one or more ACE) reported by adolescent AIs on one northern plains reservation[7] and the 86% of participants in a seven tribe study.[8]

As hypothesized, self-rated physical and mental health were negatively associated with ACEs for this sample of adults managing T2D, a complex chronic disease. This is not surprising given what is known from research showing strong associations between ACEs and health outcomes including T2D itself.[35-37] As many AI/ANs exhibit drastic health disparities, these conclusions are useful to public health and tribal health systems for consideration in long-term diabetes reduction strategies. Primary and secondary prevention efforts targeting ACE exposures and intermediate health outcomes (e.g. behavioral health), respectively, may reduce the prevalence of T2D within Tribal communities.

Better physical health was associated with spiritual activity involvement, family, community and nature connectedness, social support, and diabetes-specific support. We thus advance the literature by documenting protective associations between Indigenous cultural factors (i.e., involvement in spiritual activities and connectedness) and health that persist even when accounting for ACE exposures and demographics. Cultural connectedness, social support, and traditional practices as wellness promoting factors are widely understood within Tribal communities. Therefore, this research supports

Indigenous knowledges and underscores the critical importance of "a community-based prevention approach [that] recognizes the inherent knowledge of community members and their expertise."[38]

While social support has a well-documented positive impact on patients with diabetes,[39-41] we add to this literature by demonstrating that adult support appears to moderate the negative effects of childhood adversities among AIs. That is, our findings suggest that adulthood social support networks may buffer the harmful impact of ACEs on health. This includes diabetes-specific support for AIs diagnosed with T2D. Diabetes interventions promoting socially supportive environments may prove useful for better prognosis.

Our findings also revealed a consistent, inverse relationship between per capita household income and health status. Poverty is a fundamental determinant of health driving health inequities,[42, 43] and pervasive poverty impacts many reservation communities including those participating in this study. The protective impact of increasing incomes documented here lends evidence to the importance of addressing structural issues related to health including unemployment and low-paying jobs.[44,45] In addition, gender emerged as a significant correlate of mental health in one of the models wherein women reported worse mental health than men Although this was not a robust finding in these analyses, it is consistent with prior research indicating higher levels of internalizing symptoms in females relative to males.[46]

Limitations and Future Research

This study has several limitations for consideration. First, retrospective ACE studies may involve systematic error such as recall bias and false negative findings.[47] Measurement and methodology differences hamper our ability to draw firm conclusions about the prevalence of AI/AN ACEs shown here and those documented nationally. ACEs reflected in this study are similar to most others in that they rely on a set of childhood stressors developed for mostly white, middle-class

individuals with health insurance and who lived in Southern California; as such, results should be interpreted with these specific adversities in mind. A host of additional adversities including culturally-specific ACEs are beginning to be addressed[7] and deserve additional attention in future research. Given variability in the types and severity of ACEs potentially experienced across cultures and community context, our estimates may be conservative and underscore even more the importance of culturally meaningful ACEs and placed-based assessments as a regular part of diabetes care and health care in general.[7] Future research should include identification of specific forms and types of childhood stressors as well as the severity and frequency of the exposure that are particularly harmful to Native people alongside appraisal of socio-cultural contexts that promote healing and wellbeing.

CONCLUSIONS

Our findings importantly demonstrate how cultural and family supports relate to better health and in certain cases ameliorate the negative impact of ACEs among T2D patients who face the complexities of managing chronic disease care. For policy makers, our work suggests that funding allocations could support community-level resilience building activities and thus move beyond individual-level behavior change (e.g., diet, exercise). Specifically, programs that enhance social support and include opportunities for cultural connectedness should be encouraged.

For health professionals, this research highlights the importance of life-course histories to assess childhood experiences and the lingering impact of childhood experiences on adult AI wellbeing. At the same time, providers including diabetes care professionals should encourage strategies for promoting help-seeking skills, social belonging, and cultural activity participation for patients, particularly among those reporting a multitude of childhood adversities. Such support and encouragement could prove beneficial in promoting physical and mental health. These results also support the work of program development staff in tribal communities who regularly engage in efforts

to incorporate cultural group activities as wellness promotion and prevention mechanisms. These implications can inform wider health promotion strategies within and outside the health care system. For example, tribes may want to incorporate research findings into their design of trauma-informed care strategies and integrated behavioral health care. Finally, these findings have implications for health promotion across all cultures by highlighting the potential for socio-cultural integration to improve human wellness.

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Figure Legends:

— — **Low Social Support** — — **Low Diabetes Support**

— **High Social Support** — **High Diabetes Support**

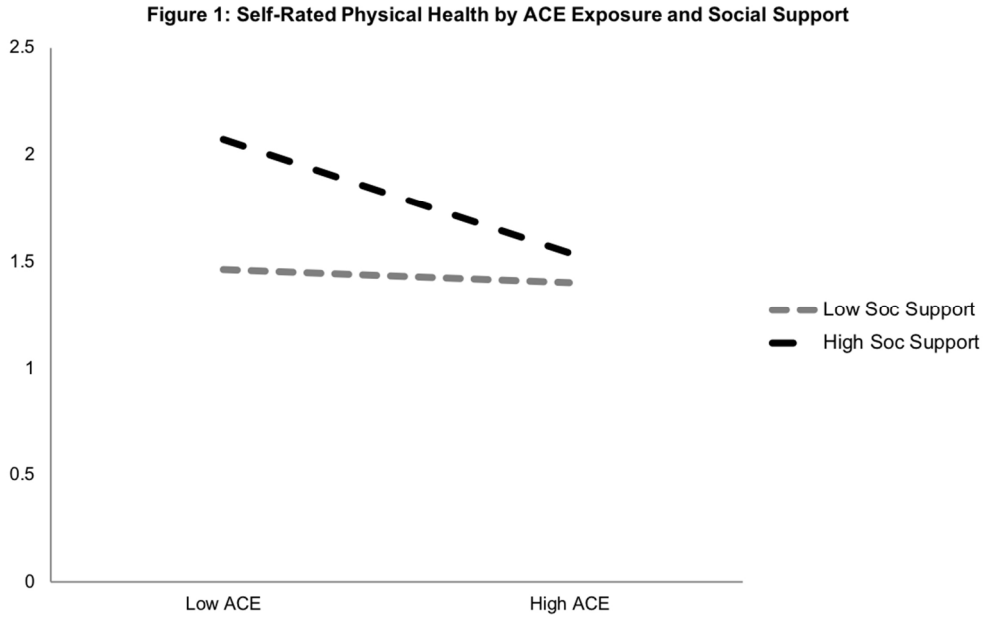

Figure 1

194x123mm (300 x 300 DPI)

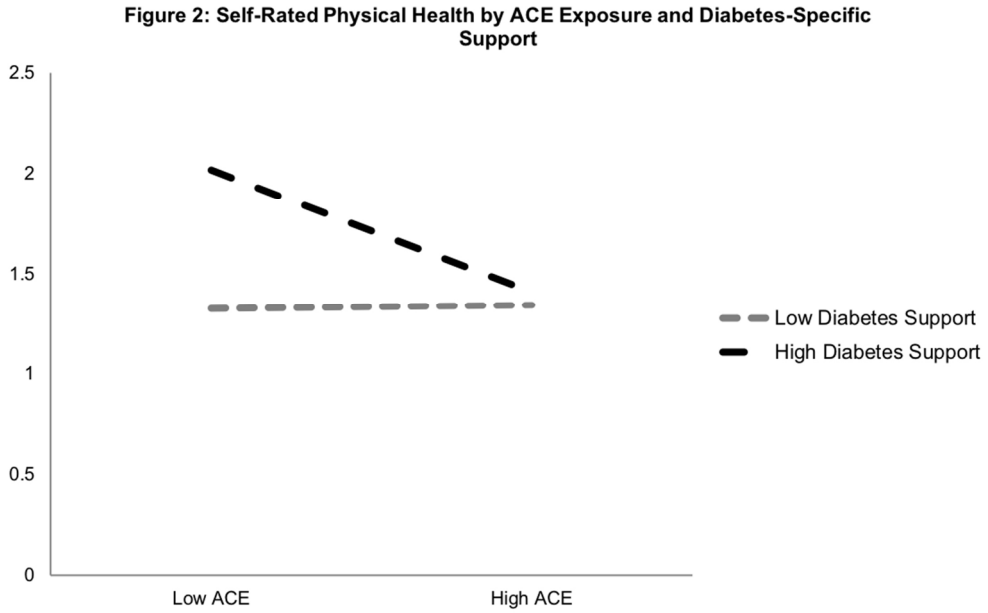

Figure 2

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract. X Page 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found X Page 2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported X Pages 4-6
Objectives	3	State specific objectives, including any prespecified hypotheses Page 6
Methods		
Study design	4	Present key elements of study design early in the paper X Page 2 & 6-8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection X Pages 6 -8
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants X Page 7
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable X Pages 7 -8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group X Pages 7 -8
Bias	9	Describe any efforts to address potential sources of bias see Page 12
Study size	10	Explain how the study size was arrived at X Page 7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why X Page 8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding X Page 8
		(*b*) Describe any methods used to examine subgroups and interactions X Pgs 8-10
		(*c*) Explain how missing data were addressed X Page 7
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy X Page 6-8
		(*e*) Describe any sensitivity analyses N/A

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed X Page 7
		(b) Give reasons for non-participation at each stage N/A
		(c) Consider use of a flow diagram N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders X Page 8
		(b) Indicate number of participants with missing data for each variable of interest X Page 8-9
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures X Page 9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included X page 10
		(*b*) Report category boundaries when continuous variables were categorized N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses X Page 10
Discussion		
Key results	18	Summarise key results with reference to study objectives X Pages 9-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias X Page 12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence X Page 12-13
Generalisability	21	Discuss the generalisability (external validity) of the study results X Page 12
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based X Page 17

BMJ Open

Examining Protective and Buffering Associations Between Socio-Cultural Factors and Adverse Childhood Experiences among American Indian Adults with Type 2 Diabetes: A Quantitative, Community-Based Participatory Research Approach

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Keywords:	Adverse Childhood Experiences, ACEs, American Indians, Type 2 Diabetes, Culture

Examining Protective and Buffering Associations Between Socio-Cultural Factors and Adverse Childhood Experiences among American Indian Adults with Type 2 Diabetes: A Quantitative, Community-Based Participatory Research Approach

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T.B. was responsible for drafting the literature review, discussion and conclusions sections. J.E. edited and added substantive content to the manuscript. M.W. performed data analyses and drafted methods and results sections and oversaw data collection. All authors reviewed the final version of the manuscript.

Key Words: Adverse Childhood Experiences, ACEs, American Indians, Type 2 Diabetes, Culture

Abstract

Objectives:
The purpose of this study was to determine the frequency of select Adverse Childhood Experiences (ACEs) among a sample of American Indian adults living with type 2 diabetes and the associations between ACEs on health. We also examined protective associations between socio-cultural factors and physical and mental health, including possible buffering processes.

Design:
Survey data for this observational study was collected using computer assisted survey interviewing techniques between 2013 – 2015.

Setting:
Participants were randomly selected from American Indian tribal clinic facilities on five reservations in the upper Midwestern United States.

Participants:
Inclusion criteria were a diagnosis of type 2 diabetes, age 18 years or older, and self-identified as AI. The sample includes N=192 adults (55.7% female; mean age = 46.3 years).

Primary Measures:
We assessed nine ACEs related to household dysfunction, violence, and emotional, physical, or sexual abuse. Independent variables included social support, diabetes support, and two cultural factors: spiritual activities and connectedness. Primary outcomes were self-rated physical and mental health.

Results:
An average of 3.05 ACEs were reported by participants and 81.9% (n = 149) said they had experienced at least one ACE. Controlling for gender, age, and income, ACEs were negatively associated with self-rated mental and physical health ($p < .05$). Involvement in spiritual activities, social support, and diabetes support were all positively, significantly associated with mental and physical health. Social support variables moderated associations between ACEs and physical health.

Conclusions:
This research demonstrates inverse associations between ACEs and adult AI diabetes patient wellbeing. The findings further demonstrate the promise of social and cultural integration as a critical component of wellness, a point of relevance for all cultures. Health professionals can use findings from this study to augment their assessment of patients and guide them to health-promoting social support services and resources for cultural involvement.

ARTICLE SUMMARY

Strengths and Limitations of this Study:

- This is the first quantitative observational study of which we are aware to examine American Indian adult cultural and social protective factors in the face of earlier life adversities and their potential moderating relationship between Adverse Childhood Experiences (ACEs) and adult self-rated mental and physical health.
- Study scope and methodology was developed using community-based participatory research principles to promote authentic researcher/community member collaboration.
- We contribute to a limited body of literature on ACEs and American Indian health by assessing ACE exposure and correlates for a clinical sample of Native adults.
- We rely on retrospective reports of ACEs that may involve systematic error including recall bias that should be considered when interpreting findings.

INTRODUCTION

Adverse childhood experiences (ACEs) are early life stressful situations or traumatic events that often co-occur, and potent determinants of health linked to increased morbidity and mortality across the life course. [1-9] The foundational Centers for Disease Control and Prevention (CDC) Kaiser Permanente ACEs retrospective adult studies (Kaiser/CDC studies) identified a set of eight to ten childhood stressors including childhood emotional, physical, and sexual abuse, emotional and physical neglect, witnessing intimate partner violence, parental separation, and living with a substance abusing, mentally ill, or criminal household member.[5, 6] These childhood stressors have been shown to correspond with later life outcomes, such as Type 2 Diabetes (T2D), substance abuse, and suicide attempts, with graded, positive relationships between the number of ACE exposures and risk for health outcomes.[5, 6, 10] Adaptations of the Kaiser/CDC measures across settings have expanded ACE criteria to include, for example, peer isolation and rejection,[11] peer victimization, [12] and community level indicators like community violence[12] and poverty.[13] In the absence of protective factors, existing evidence suggests that early trauma and toxic stress can have lasting effects on physical and mental health.[3, 5, 6, 11]

The emerging literature on ACEs among the American Indian/Alaska Native (AI/AN) population has identified disproportionately high rates of ACEs and childhood stressors that are associated with multiple health outcomes including suicidality,[7] substance misuse,[8] diabetes,[14] and worse mental health including depressive symptoms.[15-16] There is also movement to identify ACEs appropriate for AI/AN culture and context, such as historical loss associated symptoms and discrimination[7,]. Elevated and unique experiences with ACEs offer explanation for the pronounced health inequities experienced by AI/AN communities, including heightened rates of T2D. For example, data from 2013-2015 indicated adult overall prevalence of T2D for AI/ANs was 15.1%, versus 7.4%

for non-Hispanic whites.[17] Further, T2D represents a modern epidemic among AI/ANs, especially considering that prior to the 1940's the diagnosis was relatively uncommon for this demographic.[18]

In the wake of such compelling evidence that ACEs can lead to serious health consequences, researchers have begun identifying factors that may provide a protective effect against ACE impacts.[19] One way in which protective factors operate is through the fostering, building, and exertion of resilience as an ability to overcome significant life stressors.[20-24] In a US sample, factors such as sense of community have been shown to have direct and indirect protective effects on ACEs, including moderating roles for the impact of ACEs on adult mental health.[25]

Resilience promotion is not a new concept within Tribal communities. AI/ANs have longstanding traditional knowledges that include instructions on how to stay well and thrive, and Indigenous theoretical literature supports the assertion that sociocultural resources and cultural participation is health-promoting.[26-28] AI/AN resilience is dynamic and accessed through familial, communal, and cultural knowledge and expressions (e.g., traditional activity participation, spiritual practices, positive identity promotion, social support, feelings of connectedness to family and nature).[26,28] These deeply rooted beliefs and practices have been identified as multilevel factors that can buffer poor outcomes, strengthen resilience, and promote health.[29]

Preventing ACEs and increasing access to and participation in resilience-building opportunities could contribute to closing the health equity gap for AI communities. An examination of moderating and health promoting factors is particularly salient for Tribal communities given complex health service delivery systems and limited systemic resources for monitoring and addressing behavioral health on reservations.[21, 30] Despite this great need, few studies have examined AI/AN-specific protective factors or resilience contributors in the context of ACEs. As an exception, Burnette and colleagues (2015) found that social support had a protective effect on depressive symptoms among

AI/AN older adults who experienced ACEs.[15] In another study, youth who experienced child maltreatment and other stressors had a reduced likelihood of suicidality if they discussed problems with friends or family and reported connectedness with family.[30] However, no AI/AN-specific studies of which we are aware have investigated adult cultural and social protective factors in the face of earlier life adversities and their potential for moderating the relationship between ACEs and adult self-rated mental and physical health.

The purpose of this study is to 1) determine the frequency of select ACEs within a sample of AI/AN adults living with T2D, and 2) examine associations between ACEs, social supports, cultural factors, and self-rated physical and mental health. Three hypotheses guided our inquiry:

H1: ACEs will be negatively associated with self-reported physical and mental health status.

H2: Social support (general and diabetes-specific) and Indigenous cultural factors will be positively associated with self-reported physical and mental health status.

H3: Social support and cultural factors will buffer (moderate) the associations between ACEs and physical and mental health.

METHODS

The Maawaji' idi-oog Mino-ayaawin (Gathering for Health) project is a community-based participatory research (CBPR) collaboration between the University of Minnesota and five AI (i.e., Ojibwe) communities. The primary purpose of the study was to understand sources of stress and examine their impact on T2D-related outcomes for AIs. Tribal resolutions supporting the project were granted by all five tribal nation governments.

Patient and Public Involvement

Community Research Councils (CRCs) from each tribe worked closely with the university research team to develop and implement study protocols, participate in data collection, interpretation,

and dissemination. Members of the CRCs included patients living with type 2 diabetes, patient providers, community members, and elders. As such, patient perspectives were incorporated into the design and conduct of this study. All CRCs read and/or contributed to this manuscript prior to journal submission, and the paper was approved for submission by the Indian Health Service (IHS) National Institutional Review Board. Participants will receive a mailed infographic summarizing major overall study results. In addition, the research team has/will continue to present findings within each tribal community via written technical reports and in-person presentations at local health fairs, tribal council meetings, and public gatherings.

Procedure and Sample

Project methodology and human subjects approval was granted by the University of Minnesota (IRB) and the IHS IRB. The study involved 2 major phases: 1) a qualitative step including two sets of focus groups to identify salient community stressors and adapt/develop survey measures, and 2) a quantitative phase including survey data from computer-assisted personal interviews (CAPI; details below). The goal of this process was to maximize measurement validity for local culture and contexts. Prior to CAPI field entry, we also piloted any adapted or new measures with a convenience sample of AI participants and asked for open-ended feedback on question applicability and comprehension. Feedback from pilot surveys permitted us to further refine measures in collaboration with CRC members. Data presented in this study are from Phase 2 CAPI responses.

Staff at each IHS clinic site generated simple random samples for Phase 2 study recruitment from patient records. Inclusion criteria were a diagnosis of type 2 diabetes, age 18 years or older, and self-identified as AI/AN. A total of 194 participants enrolled in the study, representing a baseline response rate of 67%.

Clinic staff sent study letters of invitation and brochures to residences of randomly selected patients. Non-refusing individuals were contacted and screened for eligibility by trained community interviewers. Visits were scheduled at a location of participants' choosing, at which time interviewers gathered signed informed consent and HIPAA authorization forms prior to administering surveys. We analyzed responses from the 192 participants for which we have baseline CAPI completed from 2013 to 2015. Participants received a $50 incentive and a small, culturally meaningful gift for their participation.

Measures

Three control variables were included in analyses: *age* (in years), *gender* (male = 0, female = 1), and *per capita household income* were each assessed via self-report survey responses. Two dependent variables, self-rated mental health and self-rated physical health, each ranged in value from 0 (poor) to 4 (excellent); thus, higher scores indicate better health. A continuous ACEs measure was created by summing affirmative responses to 9 experiences related to household dysfunction, witnessing violence, and emotional, physical, and sexual abuse while growing up; participants were included in this continuous measure if they answered at least 5 of the 9 ACE items (n = 182; Cronbach's alpha = .77).

Several protective independent variables were also included. Social support was assessed by 9 items adapted from a previous measure of perceived emotional and instrumental support received from others.[31] Example items include: *there is at least one person I can share most things with*; *I have someone to help me if I am physically unwell*; *I feel that I have a circle of people who value me*, and, *when I am feeling down, there is someone I can lean on* (Cronbach's alpha = .89) Diabetes-specific support (adapted from Fitzgerald)[32] includes 5 items and assesses perceived support directly related to diabetes management including help to *follow a healthy meal plan, handle feelings about diabetes*, and

test (my) blood sugar (Cronbach's alpha = .86). Traditional spiritual activities include summed 'yes' responses to 9 spiritually relevant cultural activities, such as seeking advice/guidance from a spiritual advisor or participating in a sweat lodge, which were engaged in during the prior year (Cronbach's alpha = .81). We also utilized an adapted Awareness of Connectedness[33] measure that included 6 items assessing degree of connection to nature, family, and community (e.g., *I feel connected to nature; When I am hurting, my family hurts with me; My community's happiness is a part of my happiness*; Cronbach's alpha = .74. A full listing of survey measures included in this manuscript is provided as a supplementary file.

Statistical Analysis

We used SPSS v. 24 to conduct all analyses with list-wise deletion of missing values, including Ordinary Least Squares (OLS) regression analyses for multivariate models. There were few missing cases across variables; full sample responses were given for age, gender, and communal mastery and missing data for remaining variables ranges from 1 – 4 cases total, with the exception of individual ACE items (Table 1). We generated a total of eight separate OLS models to examine the associations between the four protective factors and their potentially moderating relationships for each of the two outcome variables (mental and physical health) after accounting for controls. Tests of moderation included a multiplicative interaction term for each protective variable x ACE scores.

RESULTS

The average age of the study participants was 46.3 years (SD = 12.2), mean per capita household income was $9,767.00, and slightly more than half were female (55.7%). Frequencies of nine ACEs appear in Table 1. An average of 3.05 (SD = 2.46) ACEs were reported by participants and 81.9% (n = 149) reported at least one ACE (not displayed).

Table 1: Adverse Childhood Experiences among American Indian Adults Living with Type 2 Diabetes

	Never/No	At Least Once/Yes
When you were growing up, did you live with a household member who was a problem drinker or alcoholic, or misused street or prescription drugs? (n = 181)	51.9%	48.1%
When you were growing up, did you live with a household member who was depressed, mentally ill, or suicidal? (n = 180)	78.3%	21.7%
When you were growing up, did you live with a household member who was ever sent to jail or prison? (n =179)	68.2%	31.8%
When you were growing up, how often did you see or hear a parent or household member in your home being slapped, kicked, punched, or beaten up? (n=180)	52.2%	47.8%
When you were growing up, how often did a parent, guardian, or other household member yell, scream, swear at you, insult you, or humiliate you? (n = 182)	51.1%	48.9%
When you were growing up, how often did a parent, guardian, or other household member spank you, slap you, kick you, punch you, or beat you up? (n = 179)	43.6%	56.4%
When you were growing up, how often did someone touch or fondle you in a sexual way when you did not want them to? (n = 179)	76.5%	23.5%
When you were growing up, how often did someone make you touch their body in a sexual way when you did not want them to? (n = 177)	86.4%	13.6%
When you were growing up, how often did someone actually have oral, anal, or vaginal intercourse when you did not want them to? (n = 181)	83.4%	16.6%

Table 2 displays results of OLS regression analyses. As hypothesized (H1), across all models and controlling for gender, age, and income, ACEs were negatively associated with mental and physical health. Also as hypothesized (H2), involvement in spiritual activities, stronger awareness of connectedness, social support, and diabetes-specific support were all positively and significantly associated with self-reported mental and physical health in these models. Two of the control variables were also related to health in the multivariate analyses. Per capita household income was significantly and positively associated with mental and physical health across all models, and being female was associated with worse mental health in one model only.

Table 2: Results from Ordinary Least Squares Regression Analyses

	Mental Health		Physical Health		Mental Health		Physical Health		Mental Health		Physical Health		Mental Health		Physical Health	
	N = 176				N = 177				N = 176				N = 177			
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Age	-.01(.01)	-.08	-.00(.01)	-.03	-.01(.01)	-.09	-.00(.01)	-.04	-.01(.01)	-.06	-.00(.01)	-.02	-.01(.01)	-.07	-.00(.01)	-.01
Gender	-.15(.15)	-.07	-.02(.13)	-.01	-.15(.14)	-.08	-.02(.13)	-.01	**-.23(.14)**	**-.12^{T}**	-.05(.13)	-.03	-.13(.15)	-.07	.05(.13)	.03
Per Capita HH Income	**.02(.01)**	**.22****	**.02(.01)**	**.18***	**.02(.01)**	**.20****	**.02(.01)**	**.15***	**.02(.01)**	**.15***	**.01(.01)**	**.14^{T}**	**.02(.01)**	**.20****	**.01(.01)**	**0.15^{T}**
ACEs	**-.09(.03)**	**-.23****	**-.08(.03)**	**-.22****	**-.08(.03)**	**-.20****	**-.07(.03)**	**-.20****	**-.06(.03)**	**-.16***	**-.06(.03)**	**-.17***	**-.07(.30)**	**-.18***	**-.06(.03)**	**-.17***
Spiritual Activities	**.06(.03)**	**.15***	.03(.03)	.07												
Awareness of Connectedness					**.07(.03)**	**.18**	**.08(.03)**	**.23****								
Social Support									**.50(.10)**	**.35*****	**.27(.10)**	**.20****				
Support x ACEs											**-.07(.04)**	**-.14^{T}**				
Diabetes Specific Support													.03(.02)	.10	**.06(.02)**	**.21****
Diabetes Support x ACEs															**-.02(.01)**	**-.15***

***p </= .001; **p </= .01; *p</= .05, ^{T}p</= .10; two-tailed tests

We included interaction terms for each of the protective factors by ACEs for all independent variables; two of these emerged as statistically significant and are plotted in Figure 1 and Figure 2. As shown and in partial support of the third hypothesis (H3), social support and diabetes-specific support moderated the negative associations between ACEs and physical health. More specifically, physical health ratings were highest (better) for those reporting high support and low ACEs. Even when reporting higher ACEs, those in high support contexts still had better self-reported physical health than those with lower ACE scores but less supportive environments.

INSERT FIGURE 1 and FIGURE 2 HERE

DISCUSSION

This study adds important evidence to the limited research on ACEs and T2D among American Indians who have a demonstrated higher prevalence of both compared to non-Indigenous US populations.[7,17] In this multisite community study, cultural and social indicators were linked to better mental and physical health even when accounting for ACEs. We also found partial evidence for the moderating role of social support on associations between ACEs and health.

Approximately 82% of this AI sample reported experiencing at least one ACE. Our finding is much higher than the less than two-thirds of non-Native adults who report one or more ACEs in the now classic Kaiser/CDC study.[34] Our percentage of 82% in this Midwest AI sample is consistent with the 78.1% minimum exposure rate (one or more ACE) reported by adolescent AIs on one northern plains reservation[7] and the 86% of participants in a seven tribe study.[8]

As hypothesized, self-rated physical and mental health were negatively associated with ACEs for this sample of adults managing T2D, a complex chronic disease. This is not surprising given what is known from research showing strong associations between ACEs and health outcomes including T2D itself.[35-37] As many AI/ANs exhibit drastic health disparities, these conclusions are useful to public health and tribal health systems for consideration in long-term diabetes reduction strategies. Primary and secondary prevention efforts targeting ACE exposures and intermediate health outcomes (e.g. behavioral health), respectively, may reduce the prevalence of T2D within Tribal communities.

Better physical health was associated with spiritual activity involvement, family, community and nature connectedness, social support, and diabetes-specific support. We thus advance the literature by documenting protective associations between Indigenous cultural factors (i.e., involvement in spiritual activities and connectedness) and health that persist even when accounting for ACE exposures and demographics. Cultural connectedness, social support, and traditional practices as wellness promoting factors are widely understood within Tribal communities. Therefore, this research supports

Indigenous knowledges and underscores the critical importance of "a community-based prevention approach [that] recognizes the inherent knowledge of community members and their expertise."[38]

While social support has a well-documented positive impact on patients with diabetes,[39-41] we add to this literature by demonstrating that adult support appears to moderate the harms of childhood adversities among AIs. That is, our findings suggest that adulthood social support networks may buffer the negative relationships between ACEs and health. This includes diabetes-specific support for AIs diagnosed with T2D. Diabetes interventions promoting socially supportive environments may prove useful for better prognosis.

Our findings also revealed a consistent, inverse relationship between per capita household income and health status. Poverty is a fundamental determinant of health driving health inequities,[42, 43] and pervasive poverty impacts many reservation communities including those participating in this study. The protective impact of increasing incomes documented here lends evidence to the importance of addressing structural issues related to health including unemployment and low-paying jobs.[44,45] In addition, gender emerged as a significant correlate of mental health in one of the models wherein women reported worse mental health than men Although this was not a robust finding in these analyses, it is consistent with prior research indicating higher levels of internalizing symptoms in females relative to males.[46]

Limitations and Future Research

This study has several limitations for consideration. First, retrospective ACE studies may involve systematic error such as recall bias and false negative findings.[47] Measurement and methodology differences hamper our ability to draw firm conclusions about the prevalence of AI/AN ACEs shown here and those documented nationally. ACEs reflected in this study are similar to most others in that they rely on a set of childhood stressors developed for mostly white, middle-class

individuals with health insurance and who lived in Southern California; as such, results should be interpreted with these specific adversities in mind. A host of additional adversities including culturally-specific ACEs are beginning to be addressed[7] and deserve additional attention in future research. Given variability in the types and severity of ACEs potentially experienced across cultures and community context, our estimates may be conservative and underscore even more the importance of culturally meaningful ACEs and placed-based assessments as a regular part of diabetes care and health care in general.[7] Future research should include identification of specific forms and types of childhood stressors as well as the severity and frequency of the exposure that are particularly harmful to Native people alongside appraisal of socio-cultural contexts that promote healing and wellbeing.

CONCLUSIONS

Our findings demonstrate how cultural and family supports relate to better health and in certain cases ameliorate the harms of ACEs among T2D patients who face the complexities of managing chronic disease care. For policy makers, our work suggests that funding allocations could support community-level resilience building activities and thus move beyond individual-level behavior change (e.g., diet, exercise). Specifically, programs that enhance social support and include opportunities for cultural connectedness should be encouraged.

For health professionals, this research highlights the importance of life-course histories to assess childhood experiences and the lingering impact of childhood experiences on adult AI wellbeing. At the same time, providers including diabetes care professionals should encourage strategies for promoting help-seeking skills, social belonging, and cultural activity participation for patients, particularly among those reporting a multitude of childhood adversities. Such support and encouragement could prove beneficial in promoting physical and mental health. These results also support the work of program development staff in tribal communities who regularly engage in efforts

to incorporate cultural group activities as wellness promotion and prevention mechanisms. These implications can inform wider health promotion strategies within and outside the health care system. For example, tribes may want to incorporate research findings into their design of trauma-informed care strategies and integrated behavioral health care. Finally, these findings have implications for health promotion across all cultures by highlighting the potential for socio-cultural integration to improve human wellness.

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Figure Legend:

Figure 1: – – **Low Social Support**

— **High Social Support**

Figure 2: – – **Low Diabetes Support**

— **High Diabetes Support**

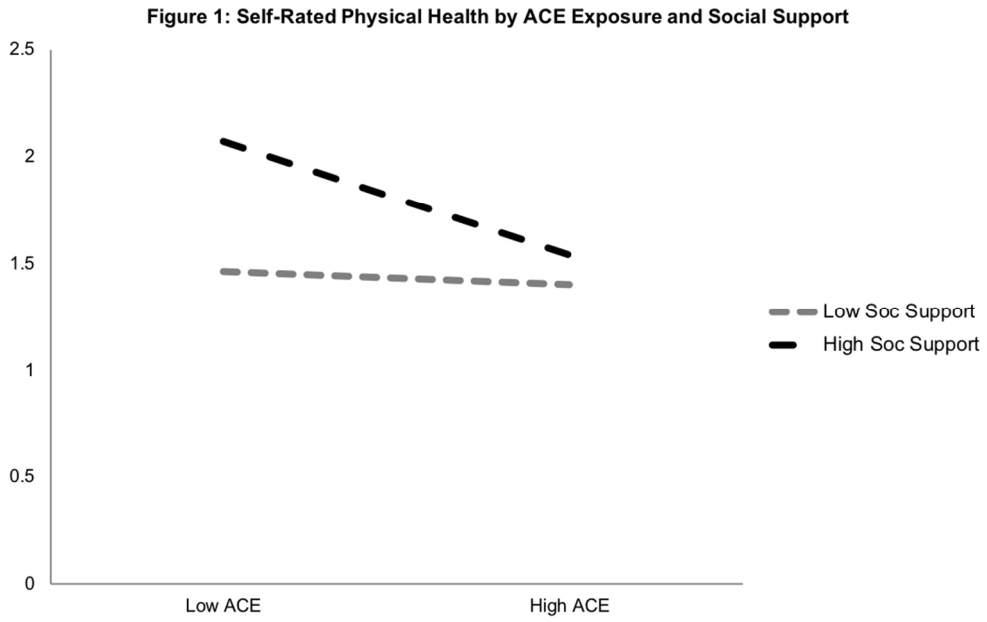

Figure 1

194x123mm (300 x 300 DPI)

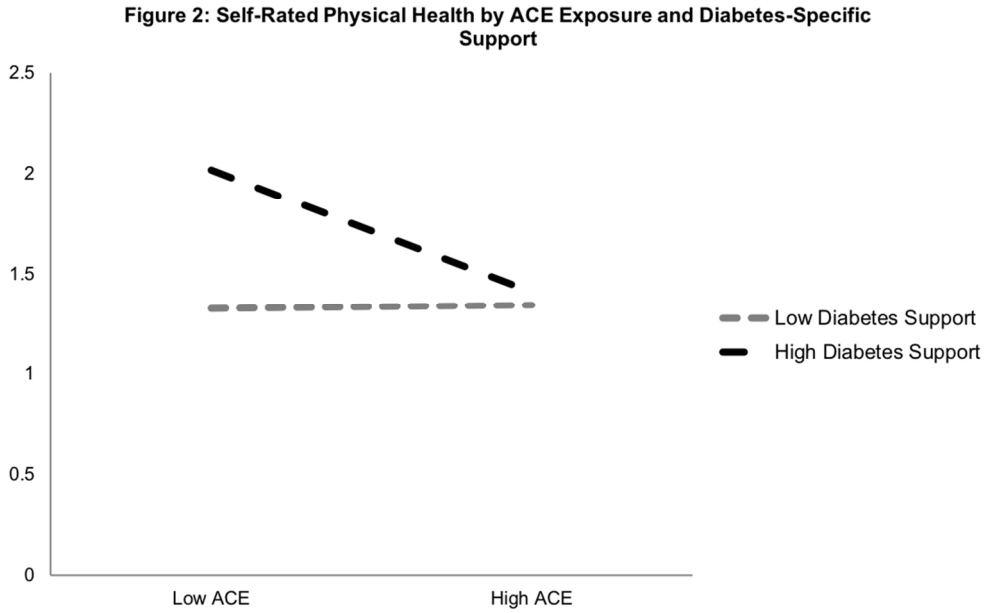

Figure 2

189x119mm (300 x 300 DPI)

Measures included in ***Examining Protective and Buffering Associations Between Socio-Cultural Factors and Adverse Childhood Experiences among American Indian Adults with Type 2 Diabetes: A Quantitative, Community-Based Participatory Research Approach***

Source	Construct	Question(s)	Response Options
n/a	Date of Birth	What is your date of birth?	Verbatim Response
n/a	Gender	Many of the questions that we will ask throughout this interview depend on your gender. To make sure we skip you into the right questions, please tell me if your gender is male or female.	• Male • Female
n/a	Income	Which of the categories best describes your total annual combined household income from all sources?	• Less than $5,000 • $5,001 to $9,999 • $10,000 to $14,999 • $15,000 to $19,999 • $20,000 to $29,999 • $30,000 to $39,999 • $40,000 to $49,999 • $50,000 to $59,999 • $60,000 to $69,999 • $70,000 or more
The World Health Organization World Mental Health Composite International Diagnostic Interview (WHO WMH-CIDI).	Self-Rated Mental Health and Self-Rated Physical Health	1. How would you rate your overall physical health? 2. How would you rate your overall mental health?	• Excellent • Very Good • Good • Fair • Poor

Adapted from: Centers for Disease Control and Prevention. *Behavioral Risk Factor Surveillance System Survey ACE Module Data, 2010.*	Adverse Childhood Experiences	1. When you were growing up, did you live with a household member who was a problem drinker or alcoholic, or misused street or prescription drugs? 2. When you were growing up, did you live with a household member who was depressed, mentally ill, or suicidal? 3. When you were growing up, did you live with a household member who was ever sent to jail or prison? 4. When you were growing up, how often did you see or hear a parent or household member in your home being slapped, kicked, punched, or beaten up? 5. When you were growing up, how often did a parent, guardian, or other household member yell, scream, swear at you, insult you, or humiliate you? 6. When you were growing up, how often did a parent, guardian, or other household member spank you, slap you, kick you, punch you, or beat you up? 7. When you were growing up, how often did someone touch or fondle you in a sexual way when you did not want them to? 8. When you were growing up, how often did someone make you touch their body in a sexual way when you did not want them to? 9. When you were growing up, how often did someone actually have oral, anal, or vaginal intercourse when you did not want them to?	• Yes • No

Adapted from: Shakespeare-Finch, J., & Obst, P. L. (2011). The development of the 2-way social support scale: A measure of giving and receiving emotional and instrumental support. *Journal of personality assessment*, *93*(5), 483-490.	2-Way Social Support Scale	*Now I am going to read a list of statements about social support. Please tell us the degree to which each statement is true for you.* 1. There is at least one person that I can share most things with. 2. There is someone in my life I can get emotional support from. 3. When I am feeling down, there is someone I can lean on. 4. If I am stranded somewhere there is someone who would get me. 5. I have someone to help me if I am physically unwell. 6. There is someone who would give me financial assistance. 7. There is someone who can help me fulfill my responsibilities when I am unable. 8. I feel that I have a circle of people who value me.	• Not at all true • Sometimes true • Often true • Always true
Adapted from: Fitzgerald, J. T., Davis, W. K., Connell, C. M., Hess, G. E., Funnell, M. M., & Hiss, R. G. (1996). Development and validation of the Diabetes Care Profile. *Evaluation & the health professions*, *19*(2), 208-230.	Diabetes-specific support	*Now, think about support you receive as it relates specifically to your diabetes and tell me how much you agree or disagree with the following statements. My family or friends help and support me a lot to…* 1. Follow a healthy meal plan. 2. Take my medicine. 3. Get enough physical activity. 4. Test my blood sugar. 5. Handle my feelings about diabetes.	• Strongly Agree • Agree • Disagree • Strongly Disagree
Adapted from: Whitbeck, L. B., Hoyt, D. R., Stubben, J. D., & LaFromboise, T. (2001). Traditional culture and academic success among American Indian children in the upper Midwest. *Journal of American Indian Education*, 48-60.	Traditional spiritual activities	*In the past 12 months, have you…* 1. Offered tobacco? 2. Participated in a sweat? 3. Gone to ceremonial feasts? 4. Gone to a traditional healer? 5. Sought advice from a spiritual advisor? 6. Used traditional medicine? 7. Smudged or saged? 8. Been taught ceremonial songs? 9. Gone to Midewiwin Ceremonies?	• Yes • No

Adapted from: Mohatt, N. V., Fok, C. C. T., Burket, R., Henry, D., & Allen, J. (2011). Assessment of awareness of connectedness as a culturally-based protective factor for Alaska native youth. *Cultural Diversity and Ethnic Minority Psychology*, *17*(4), 444.	Awareness of connectedness	*I am going to read you a list of statement about community, nature, and family.* 1. I feel connected to nature. 2. I treat nature with respect. 3. When I am hurting, my family hurts with me. 4. My family's happiness is part of my happiness. 5. My community believes I am important. 6. My community's happiness is part of my happiness.	• Not at all • Somewhat • A lot

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract. X Page 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found X Page 2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported X Pages 4-6
Objectives	3	State specific objectives, including any prespecified hypotheses Page 6
Methods		
Study design	4	Present key elements of study design early in the paper X Page 2 & 6-8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection X Pages 6 -8
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants X Page 7
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable X Pages 7 -8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group X Pages 7 -8
Bias	9	Describe any efforts to address potential sources of bias see Page 12
Study size	10	Explain how the study size was arrived at X Page 7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why X Page 8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding X Page 8
		(*b*) Describe any methods used to examine subgroups and interactions X Pgs 8-10
		(*c*) Explain how missing data were addressed X Page 7
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy X Page 6-8
		(*e*) Describe any sensitivity analyses N/A

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed X Page 7
		(b) Give reasons for non-participation at each stage N/A
		(c) Consider use of a flow diagram N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders X Page 8
		(b) Indicate number of participants with missing data for each variable of interest X Page 8-9
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures X Page 9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included X page 10
		(*b*) Report category boundaries when continuous variables were categorized N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses X Page 10
Discussion		
Key results	18	Summarise key results with reference to study objectives X Pages 9-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias X Page 12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence X Page 12-13
Generalisability	21	Discuss the generalisability (external validity) of the study results X Page 12
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based X Page 17