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CENTERING NATIVE YOUTHS' NEEDS AND PRIORITIES: FINDINGS FROM THE 2020 NATIVE YOUTH HEALTH TECH SURVEY

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Abstract: Health advocates are increasingly using social media and mobile technology to reach American Indian and Alaska Native (AI/AN) youth to address important health topics and enhance protective factors. Public health experts did not know to what extent AI/AN youth used these tools to access health resources during the pandemic. The Native Youth Health Tech Survey was administered online from October to November 2020 with 349 AI/AN youth 15 to 24 years old. Survey results indicated frequent technology use—68.7% sent 1–50 text messages per day, and 65.3% were on social media 3–7 hours per day. Instagram was the most popular channel used, and 53.5% of participants relied heavily on the Internet to access health information. The three most important health topics were Native identity, mental health, and social justice and equality. These findings can inform the design and dissemination of culturally grounded health resources across AI/AN communities to improve their reach and appeal, improving health outcomes, self-esteem, and cultural connectedness.

INTRODUCTION

American Indian and Alaska Native (AI/AN) youth are smart, diverse, creative, passionate, and engaged (Center for Native American Youth [CNAY], n.d.). An estimated 9.7 million people in the United States identify as AI/AN, and approximately 42% of the total AI/AN population in the United States are 24 years old or younger (CNAY, n.d.; Indian Country Today, 2021). Nearly 75% of AI/AN youth live in urban communities; the rest live on reservations, rancherias, villages, and other tribal lands (CNAY, n.d.). Due to colonization and forced removal via the Indian Relocation Act of 1956, tribal communities are widespread, spanning both reservation and urban communities (Evans-Campbell, 2008; Weaver & Brave Heart, 1999). Colonization stripped many tribes of cultural practices and community connectedness, while simultaneously exacerbating economic, social, and health inequities. As a result, many Native youth now live in communities

that are disproportionately affected by high rates of poverty, unemployment, health disparities, substance misuse, low education attainment, family violence, and crime (Evans-Campbell, 2008; Weaver & Brave Heart, 1999; Kaufman et al., 2007). Nurturing the development of culturally tailored programs and interventions that cultivate protective factors for AI/AN youth are critically needed to counter these challenges. Important protective factors for AI/AN youth include positive self-image, self-efficacy, familial and non-familial connectedness, positive opportunities, positive social norms, and cultural connectedness (SAMHSA, 2018).

While public health practitioners now recognize racism as a systemic public health crisis (American Public Health Association, 2021), many Native youth face daily micro-aggressions, fueled by negative stereotypes, the perpetuation of AI/AN mascots, and invisibility in the mainstream media and the historical record. Additionally, Native youth face lateral violence from peers questioning their "Nativeness," which can impede self-esteem and cultural pride (Svetax et al., 2018). While all people reflect multiple intersectional identities, such as gender and sexual orientation, cultural, religious, and nationality, to name a few, the development of ethnic and racial identities are particularly meaningful for minority youth because they experience the contrasting and dominant culture of their retrospective ethnic majority (ACT for Youth, 2019). Navigating these intersectional-identities are frequent topics of concern on Native social media platforms. For example, We R Native's Ask Auntie,[1] an anonymous question and answer (Q&A) service run by www.weRnative.org, reports that nearly half of the service's 400+ Q&As address youths' concerns about cultural and gender identity, mental health, stress, historical trauma, stigma, and stereotypes (Northwest Portland Area Indian Health Board [NPAIHB], 2020). There is a critical need to better understand AI/AN adolescent identity, their prioritized health topics and preferred sources of health information, as well as their interests and concerns, to better center their needs and priorities in the development and delivery of culturally tailored health programs.

Health advocates are increasingly using social media and mobile technology to reach Native youth to address important health topics and enhance protective factors (Craig Rushing et al., 2020). Technology and social media use has become a daily ritual for most American teenagers and is widely accessible by most. A 2018 report showed 27% of youth in the United States checked their social media accounts on an hourly basis, and 16% reported constantly checking their social media pages (Statista, 2018). These findings are comparable to the last Native Youth Health Tech Survey conducted in 2016 with 675 AI/AN teens and young adults nationwide (NPAIHB, 2016).

[1] https://wernative.worldsecuresystems.com/ask-auntie/chat.htm

Nearly 78% of youth surveyed had regular access to a smartphone, and 46% had regular access to a computer at that time (NPAIHB, 2016). Over 92% reported accessing the Internet from a phone on a daily or weekly basis, and 50% reported going online from a computer as often (NPAIHB, 2016). Researchers are also finding social media platforms like Twitter can create a sense of identity and community among AI/AN youth, by bonding over common concerns like social justice movements, environmental protections, voting rights, and Missing and Murdered Indigenous Women (Around Him et al., 2020). A recent analysis of Native youths' conversations on social media platforms found they are highly engaged in health-related conversations in these spaces and use these networks for self-help, peer support, and health activism (MarketCast, 2020a). Recent reports also shed light on changes in conversational themes that took place during the COVID-19 pandemic, concluding Native youth are increasingly using these channels to discuss the structural and societal conditions that undermine mental health and to advocate for inclusive health resources for transgender, Two-Spirit, and non-binary youth (MarketCast, 2020b).

Building resources that foster cultural pride and positive identity must be central to programs or technologies that address mental health and resilience for AI/AN youth. To meet young people where they are and utilize their preferred communication channels, it is essential to better understand their access to and use of the Internet, mobile technologies, and social media – particularly in light of the disrupted access to these technologies that took place during the COVID-19 pandemic. To fill this gap, we surveyed 349 AI/AN youth 15-24 years-old in 2020 on their technology use and health priorities. Findings from the survey can help inform the design and dissemination of culturally grounded health services to improve health outcomes, self-esteem, and cultural connectedness across AI/AN communities.

METHODS

Study Partners

Housed at the Northwest Portland Area Indian Health Board (NPAIHB), We R Native is a multimedia health resource for Native youth, by Native youth. The service was designed using formative research and inclusive design principles with AI/AN teens and young adults (Craig Rushing et al., 2018). We R Native health messages are designed to address the social, structural, and environmental stressors that influence adolescent health, with particular focus on the prevention of suicide, bullying, sexually transmitted diseases, teen pregnancy, and drug and

alcohol use. The We R Native site contains over 400 health and wellness pages that have been reviewed by Native youth and topical experts. Since its launch, the website has received over 1 million pageviews.

The 2020 Native Youth Health Tech Survey (NYHTS) was carried out in collaboration with the Centers for American Indian and Alaska Native Health at the Colorado School of Public Health (CAIANH). The CAIANH is the largest, most comprehensive, and longest standing program of its kind in the country. Its mission is to promote the health and well-being of AI/ANs, of all ages, by pursuing research, training, continuing education, technical assistance, and information dissemination within a biopsychosocial framework that recognizes the unique cultural contexts of this special population.

Study Design

The study instruments and recruitment procedures were collaboratively developed and deployed by the NPAIHB and the CAIANH. The study procedures were reviewed and approved by the Portland Area Indian Health Service Institutional Review Board at the NPAIHB. OpenEpi software was used to determine an adequate sample size of 384 respondents, which would allow us to report results segmented by age and gender with an error of ±5% at the 95% confidence level (Openepi.com, n.d.).

Survey Tool and Outcome Measures

The goals of the NYHTS were to: (a) identify to what extent AI/AN teens and young adults use media technologies (media types, frequency, and duration); (b) determine how they use those technologies (online behaviors and activities); and (c) explore ways they might be used to promote adolescent health (online health-seeking practices and preferences). We also collected demographic information, including age, race/ethnicity, gender, and sexual orientation (straight/heterosexual, 2SLGBT+,[2] unsure/don't know), and State of residence. The survey was first designed by staff at the NPAIHB, drawing questions from several existing questionnaires that have been validated in other settings (Craig Rushing & Stephens, 2011). Where appropriate, response options were updated, and several questions were added to the tool to assess the impact of COVID-19 on youths' access to and use of technology.

[2] Two-spirit, lesbian, gay, bisexual, transgender, queer

Our survey measures collected information on demographics, technology use and device access, social media use, physical and mental health, COVID-19 impacts, and other important topics. The survey included two health questions, "How good is your physical health?" and "How good is your mental health?" Response options were based on a four-point Likert-type scale where 4 = Excellent and 1 = Poor. To document where AI/AN youth get information, the survey included 11 questions with information sources listed, for example parents, health classes, and social media. For each source youth selected how often they access information using a 4-point Likert-type scale where 4 = A lot (weekly) and 1 = Never. Youth also self-reported if they owned or had regular access to the following technology: desktop/laptop computer, basic cell phone, Smartphone, tablet, or gaming console and selected all responses that applied to them. The next question asked youth, "About how many text messages do you send and receive per day?" Response options were 1-50, 51-100, 101-150, 151-200, and more than 200. The survey asked youth, "How often do you get online on your phone, or use a wearable health tracker?" Response options were based on a 4-point Likert-type scale where 4 = Daily and 1 = Never. Youth also responded to questions about their use of various social media platforms, like Facebook and TikTok, and listening to podcasts; response options were based on a 4-point Likert type scale where 4 = Daily and 1 = Never. Other survey questions were fixed response and based on previous YHTS tools and asked youth about time spent on social media, favorite things to do online, health concerns, interests in health topics, involvement in We R Native in the past six months, and satisfaction with We R Native resources. Unique to this iteration of the YHTS, COVID-19 measures were developed collaboratively between NPAIHB and CAIANH to determine Internet and online frequency changes, if any, to better understand this unique aspect on AI/AN youth. Youth selected their top three health topics from a list of 15, including alcohol or drug misuse, domestic violence, dating and healthy relationships, diet and nutrition, communication skills, life hacks, the environment, mental health, making a difference, Native identity or cultural pride, physical health, sexual health, spiritual health, social justice and equality, and wellness skills.

The survey was deployed online using Qualtrics, a HIPAA-compliant data collection software hosted at CAIANH, with imbedded consent forms and skip patterns, which included both quantitative measures and open-ended responses.

Study Participants and Setting

Between October 2020 and November 2020, AI/AN adolescents were invited to participate in the survey. Participants were eligible if they were between the ages of 15-24, identified as

AI/AN, and resided within the United States. Participants were recruited primarily through a judgement sampling method. Judgement sampling is a form of convenience sampling, where the study team selects the sample based on their judgement (Fricker, 2012). In this case, the judgement was to invite all We R Native followers and users. The study team utilized youth-focused AI/AN social media channels, We R Native's text messaging service, and other purposive approaches to optimize the number of AI/AN youth in the study. Upon completion of the survey, respondents were sent a $10 Amazon e-gift card in appreciation for their time.

Data Analysis

All quantitative analyses were completed using SPSS (Version 26; IBM Corporation). In order to better understand the specific interests and health needs of sexual and/or gender minority (SGM) participants, additional analyses were conducted by combining both sexual and gender minorities into a single variable and running comparisons. Independent t-tests were used to examine differences in mental and physical health ratings based on SGM and non-SGM status. The open-ended qualitative data were coded using classical content analysis methods (Barcus, 1959). The first author reviewed and coded all qualitative responses via NVivo into themes, and the final themes were then quantified via frequency counts to further understand both technology use and the importance of culturally competent resources among AI/AN youth. Quotes from respondents were identified to further illustrate overall themes and meaning.

RESULTS

Participant Sociodemographics

In total, 349 youth met the study's inclusion criteria and participated in the 2020 NYHTS (Table 1). Participants ranged in age from 15 to 24 (M = 19.19; SD = 2.84). As seen in Table 1, the sample was split about evenly between those who identified exclusively as AI/AN and those who identified as multiracial AI/AN (51.3% and 48.7%, respectively). While the majority of participants identified as female (n = 248) or male (n = 72), wide representation was obtained from individuals who identify as a sexual and/or gender minority (full results can be seen within Table 1). Altogether, 36.4% (n = 138) identified as a sexual or gender minority. The survey garnered wide representation of AI/AN youth across the United States, including 37 States and Puerto Rico.

Table 1
Sociodemographic characteristics (n = 349)

	N	%	M	SD
Age			19.19	2.84
Age Groups				
15-18	157	45.0		
19-21	100	28.7		
22-24	90	25.8		
Race/ethnicity				
AI/AN	179	51.3		
Multiracial AI/AN	170	48.7		
Gender Identity				
Male	72	20.6		
Trans-man	2	.6		
Female	248	71.1		
Trans-woman	2	.6		
Genderqueer	17	4.9		
Cisgender	2	.6		
Other	5	1.4		
Sexual Identity				
Heterosexual	198	56.7		
Lesbian/Gay	22	6.3		
Bisexual	76	21.8		
Two-spirit	15	4.3		
Something else	14	4.0		
I don't know	14	4.0		
Prefer not to answer	3	.9		

Technology Use and Device Access

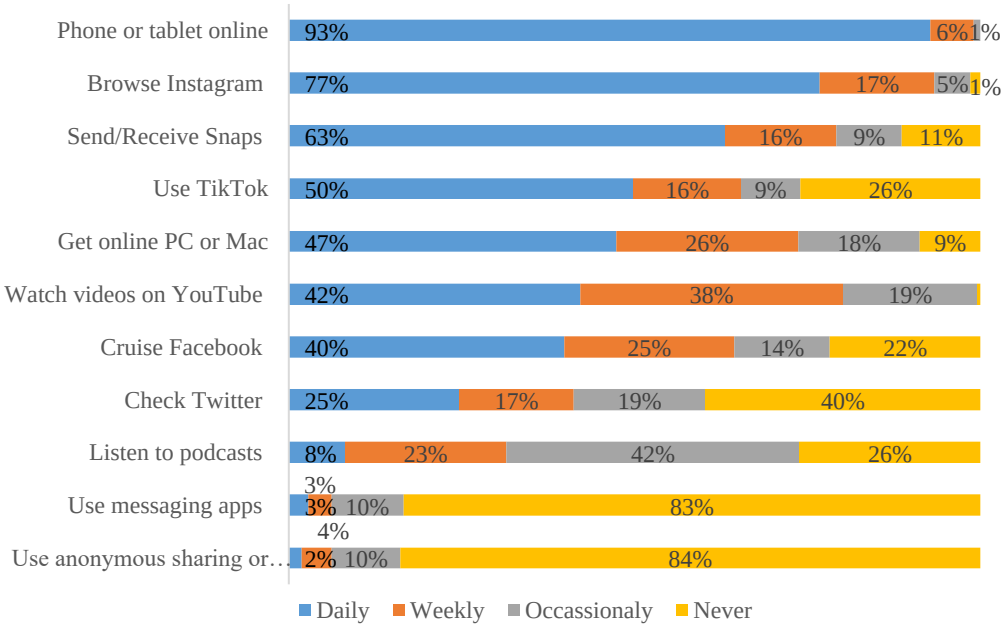
Unique to this iteration of the NYHTS, data was collected on the types of devices used to complete the survey itself, in addition to self-reported technology use by AI/AN youth. As seen in Table 2, 69.3% of respondents accessed the survey from an iPhone, while the rest utilized Android devices or desktop computers. Of the 349 total participants, 87.1% indicated they had regular, daily access to a desktop or laptop computer, and 95.4% indicated they had regular, daily access to a smartphone. Only 15.4% of youth indicated they had a basic cellphone with no Internet access. Most participants (64.7%) reported sending 1-50 text messages per day.

Table 2
Technology devices (n = 349)

Technology Device to Access Survey	N	%
iPhone	242	69.3
Android	55	15.7
Desktop	44	12.6
Other	8	.02

As seen in Figure 1, the research team was able to gain a better understanding of youths' reported technology use on a daily, weekly, and occasional basis, including platform-specific behaviors. The most popular daily technology use among AI/AN youth involved browsing Instagram (74.0%), sending/receiving snap messages via Snapchat (60.0%), using TikTok (50.4%), and watching videos on YouTube (48.4%). The least reported daily technology use (4.0%) involved messaging apps such as Whisper, YikYak, and Ask.Fm; platforms that have drawn recent concerns regarding cyberbullying and hate-speech (Black et al., 2016). Other less popular technologies among AI/AN youth included health trackers and podcasts, which were rarely or never used by the participants.

Figure 1. Technology and social media use frequencies (n = 211)



Social Media Behavior

Altogether, 65.3% of respondents reported using social media 3-7 hours per day, with 86.0% reporting their primary activity on social media as "scrolling," followed by watching videos (75.1%), sharing memes (68.8%), checking in on family members or friends (68.8%), and following influencers or celebrities (39.5%; see Table 3). Researchers also sought to identify youths' preferred social media platforms. Overall, 36.7% of AI/AN youth reported Instagram was their preferred social media platform, and 21.2% reported Snapchat as their preferred channel, with TikTok and Facebook sharing popularity, with 16.6% and 17.2%, respectively.

Table 3
Online engagement (n = 349)

Favorite Ways to Engage Online	N	%
Scroll	300	86.0
Watch videos	262	75.1
Check on friends and family members	240	68.8
Share memes	233	68.8
Follow influencers/celebrities	138	39.5
Post original content	116	33.2
Vent	90	25.8
Other	21	6.0
Go "live"	14	4.0

Youth also reported frequently seeing people "stirring up drama" on social media – 70.0% reported seeing such posts on a daily or weekly basis. Similarly, 75.2% reported seeing references to drug or alcohol use on social media, 62.8% reported seeing references to violence on social media, and 46.1% reported seeing people posting concerning messages on social media (sharing references to depression, suicide, or self-harm). Conversely, 49.0% reported "people supporting you through challenging or tough times on social media" (see Appendix Table A1).

Self-Reported Physical and Mental Health

An independent-samples t-test was conducted to compare self-reported physical health for SGM AI/AN youth and non-SGM AI/AN youth. There was a significant difference in self-reported general physical health for non-SGM AI/AN youth (M = 3.07, SD = 0.71) and SGM AI/AN youth

(*M* = 2.77, *SD* = 0.71), t (339) = -3.76, p <.001. To assess for differences in self-reported mental health between SGM AI/AN youth and non-SGM AI/AN youth, we utilized the same analysis process. There was a significant difference in self-reported mental health for non-SGM AI/AN youth (*M* = 2.44, *SD* = 0.82) and SGM AI/AN youth (*M* = 1.87, *SD* = 0.79), t (340) = -6.49, p <.001. Non-SGM AI/AN youth reported better overall physical and mental health than SGM AI/AN youth.

Health Sources

When asked where they get information about health, participants reported consulting the Internet (51.9%), followed by social media (47.6%), and parents (22.6%) on a weekly basis. Those more-frequent sources were followed by friends or siblings (15.2%), trusted adults (12.7%), health classes in school (11.4%), and doctors, nurses, and clinic staff (10.0%). Other sources that youth consulted less than 10% of the time included television or ads, text messages, radio, and other sources, such as church, counseling, Google, podcasts, programming, teachers, and significant others.

COVID-19 and its Impact on AI/AN Youth

The COVID-19 pandemic has had a disproportionate impact on tribal communities compared to other marginalized populations (Fortuna et al., 2020), and justifiably most research conducted thus far has focused primarily on the health and socioeconomic impact of the pandemic on the AI/AN population. We assessed how Internet access may have been impacted by COVID-19. Overall, 61.9% of AI/AN youth reported being online more during the pandemic compared to before; only 6.0% of youth reported being online less than before. Additional analysis indicated that 8.0% of AI/AN youth had decreased Internet access; the majority of those negatively impacted resided in California, Oregon, and Washington. If respondents indicated they had decreased access to the Internet, they were prompted to share where they accessed the Internet before the pandemic – the majority (30.6%) said at home, the rest (28.2%) reported they used the Internet at school.

Open-ended Responses from AI/AN Youth

In open-ended responses, survey participants were asked what additional topics and resources would be most helpful to them and their peers. The most common themes mentioned by

youth were mental health, historical trauma, and intergenerational trauma. Within mental health, participants shared specific topics of importance, including anxiety, eating disorders, and post-traumatic stress disorder. Overwhelmingly, participants valued having culturally relevant resources and connecting with caring adults. One participant, a 15-year-old from Colorado, valued the empowerment provided by having culturally relevant programs: "It makes me love myself more. I love being Native and it makes me proud of who I am." Several participants voiced that programs that share cultural teachings and stories help them stay connected to their culture and other AI/AN youth. Another participant, an 18-year-old from Michigan, shared similar sentiments of culturally relevant programming while being isolated from other individuals within their community, "I like the cultural information [We R Native], and how it's accessible for someone like me, who isn't always able to get info from people I know in real life, especially living in a white-majority town."

DISCUSSION

Technology use among Native youth has continued to grow since the first NYHTS was conducted in 2009. Altogether, 93% of youth in this sample reported using their phone to get online at least once a day in 2020, and most reported having regular access to multiple technologies, including a desktop or laptop computer in addition to their smartphones. Participants reported frequent communication with friends or family—on average sending 1-50 text messages per day—while 38% reported spending an average of 3-4 hours on social media per day, most often scrolling, watching videos, and checking-in on family and friends.

The comparison of 2016 responses to 2020 responses illuminates some important similarities and differences in what youth say they see scrolling through their social media channels. Youth in the 2020 NYHTS reported seeing more frequent references to drug or alcohol use on social media (69.8% in 2016 vs. 75.2% in 2020). They also reported a decrease in posts mentioning self-harm, depression, or suicide (57.8% in 2016 vs. 46.2% in 2020; see Table A1). There were no changes, however, in the percentage of youth who reported feeling supported during "challenging or tough times on social media," reported by just under half of respondents (49%).

In 2020, the most important health and wellness topics reported by participants included Native identity, mental health, and social justice and equality (see Table A2). Open-ended responses also highlighted the need for culturally relevant resources addressing mental health, historical trauma, and intergenerational trauma. Most patterns in technology access and use were similar for SGM youth and non-SGM youth; however, non-SGM AI/AN youth reported better overall physical

and mental health than SGM AI/AN youth. This finding underscores the critical importance of developing culturally relevant, holistic health resources specifically for Two-Spirit and LGBTQ+ youth. One such program—the Paths (Re)Membered Project[3]—centers the 2SLGBTQ+ community, including its strengths, resiliencies, and histories in its movement toward health equity.

The 2020 NYHTS results reinforce recent studies that find Native youth value having reliable access to established culturally relevant mHealth (mobile health) technologies and feel confident navigating their use (Stephens et al., 2020). Additional tools and training are needed to support youths' adoption of wellness skills and resilience strategies, both on- and off-line; instill cultural pride; prepare them to navigate the positive and negative pressures that surround social media use; and support help-seeking from trusted adults, peers, and other health care providers when confronted with concerning content. To meet young people where they are and utilize their preferred communication channels, these tools should be designed for delivery using social media and text messaging and incorporate culturally tailored health messages, images, and videos.

Results from the 2020 NYHTS can be used to guide the development and delivery of mHealth interventions for Native youth across a wide range of health topics. While culturally relevant research and programming for AI/AN youth has come a long way in the last decade, more must be done to build health promotion resources that resonate with Native teens and young adults. Many AI/AN youth continue to receive insufficient health education and clinical services. Technology-based interventions can help bridge the access gap in ways that are familiar, inviting, and culturally relevant. The most essential findings from this survey are as follows:

1. Most AI/AN youth spend a considerable amount of time (3+ hours) on social media channels each day.
2. AI/AN youths' favorite online engagement activities include scrolling, watching videos, sharing memes, or checking in on family and friends.
3. The most important health topics to AI/AN youth are Native identity and cultural pride, mental health, and social justice and equality.

Limitations

Findings demonstrate that AI/AN youth use media technologies in multiple ways to access health resources and connect with other AI/AN youth for support. However, there are some

[3] www.pathsremembered.org

limitations to the data collected. First, these results are not generalizable to all AI/AN youth. Participants were recruited using judgement sampling methods through existing We R Native and AI/AN youth social media platforms. Second, participants lived in 37 states in the United States and Puerto Rico. Data were not analyzed by region or location and do not account for differences in technology use based on urban, rural, or reservation locations. Access to high-speed Internet or technology likely varies by geographic location, where AI/AN youth living in rural and reservation locations may report different engagement and use patterns than AI/AN youth living in more urban areas with reliable technology access. Third, 71% of survey respondents report female gender identity. Results may overrepresent female technology-use patterns and underrepresent other gender identity categories. Lastly, COVID-19 contributed to several limitations and constraints. Where in previous years, NPAIHB collected surveys at live, in-person youth events using paper and pencil to reduce bias, this was not possible due to COVID-19 meeting restrictions. Even with these limitations, survey data provide a solid foundation for understanding AI/AN youth technology use.

CONCLUSION

Building resources that foster cultural pride and positive identity must be central to any programs or technologies that address mental health and resilience for AI/AN youth. Findings from the 2020 NYHTS can help inform their design and dissemination by aligning their delivery methods to the communication channels used by AI/AN youth, including the development of tailored health resources for SGM youth. Health educators working throughout Indian Country may use these data to center Native youths' needs and priorities in the programs they develop.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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APPENDIX

Table A1
2016 and 2020 survey comparison*

	2016 YHTS (N = 677)	2020 NYHTS (N = 210)
See people stirring up drama on social media?	70.3%	70.0%
See references to drug or alcohol use on social media?	69.8%	75.2%
See references to violence on social media?	60.1%	62.9%
See people posting concerning messages on social media (like references to depression, suicide, or self-harm)?	57.8%	46.2%
Experience people supporting you through challenging/tough times on social media?	49.1%	49.0%

*Note: Survey was titled "Youth Health Technology Survey" in 2016, but "Native" was added in 2020 to differentiate it from other surveys.

Table A2
Most important health topics (n = 349)

Topic	*N*	%
Native identity or cultural pride	256	73.0
Mental health	198	57.0
Social justice and equality	107	31.0
Physical health	64	18.0
Alcohol or drug abuse	62	18.0
Making a difference	56	16.0
Sexual health	50	14.0
Spiritual health	48	14.0
The environment	42	12.0
Domestic violence or sexual assault	41	12.0
Dating and healthy relationships	38	11.0
Diet and nutrition	25	7.0
Communication skills	24	7.0
Wellness skills	18	5.0
Life hacks	10	3.0
Other	8	2.0

THE INTERPLAY BETWEEN GROUP IDENTITY, SUICIDALITY, AND BULLYING IN MIDWESTERN MIDDLE SCHOOL YOUTH

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Abstract: Bullying peaks in middle school and is a risk factor for negative mental health outcomes, including suicidality. Suicide rates are higher in nonmetropolitan/rural areas and for American Indian/Alaska Natives compared to other racial/ethnic groups. Stigma-related bullying, a type of interpersonal discrimination, is increasingly considered an important driver of peer victimization. This study centers on the group identity characteristics of race/ethnicity, weight status, and sex to explore how school-based and electronic-bullying victimization mediate suicidality amongst a cohort of middle school students in North Dakota. Bivariate, multivariate, and structural equation modeling were performed using data from the 2015 North Dakota Middle School Youth Risk Behavior Survey. Minoritized race/ethnicity, very overweight, and female students all experienced statistically higher suicidality than comparison groups, mediated in some instances by bullying. Group identity, stigma, and discrimination may influence suicidality in North Dakota middle school youth. More information is needed on stigma and discrimination, including intersections of identity, as drivers of bullying and suicidality in minoritized youth in nonmetropolitan/rural areas.

INTRODUCTION

Suicide is the second most frequent cause of death amongst 10- to 21-year-olds in the United States, with rates increasing throughout adulthood (Ivey-Stephenson et al., 2017). Suicide rates are higher in nonmetropolitan/rural areas and for American Indian/Alaska Native (AI/AN) persons compared to other racial/ethnic groups, with recent increases observed amongst non-AI/AN minoritized youth (Kann et al., 2018; Kalb et al., 2019; Herne et al., 2014). Between 1999 and 2016, suicide rates in North Dakota, a state with a large rural and AI/AN population, increased by 58%, the largest increase in the United States over that same period and twice the national

average (Stone et al., 2018). Additionally, the prevalence of bullying victimization, a risk factor for suicidality, is amongst the highest in the nation for adolescents aged 12-17 living in North Dakota (Lebrun-Harris et al., 2020).

Since colonists first arrived on Turtle Island, colonist government-led efforts have sought to "erase the Indian and save the child" through investments in germ warfare, reservation systems, government boarding schools, and disproportionate uptake of Native children into child protective systems, amongst other strategies to oppress Indigenous persons (Warne & Lajimodiere, 2015). Warne and Lajimodiere (2015) propose a model for the intergenerational basis for chronic health disparities amongst AI/AN persons, describing the connection between historical trauma, adverse experiences, food systems, and chronic health disparities. Suicidality and racism are presented as adverse experiences significant to Indigenous people.

Non-Indigenous minoritized racial/ethnic groups in the United States also face systemic oppression, which is increasingly acknowledged by the medical community as driving health disparities, including suicide (Trent et al., 2019). Sanders-Phillips et al. (2009) provide a conceptual model that describes the impact of individual- and structural-level racism on psychological and biological responses in children which then impact child health outcomes and disparities. Exposure to racial discrimination is described within microsystems (individual level), such as through teasing and bullying, and macrosystems (structural level), such as normalization of Native-themed mascots in the media (Montoro et al., 2021; Chaney et al., 2011). Discrimination and other experiences not included in initial adverse childhood experiences assessments are increasingly being considered in characterizing stress and trauma experiences of minoritized youth (Wade et al., 2014).

Bullying peaks in middle school and is a risk factor for negative mental health outcomes, including suicidality (Lear et al., 2020; Holt et al, 2014; Arango et al., 2016; Holland et al., 2017). Swearer and Carey relate peaks in middle school bullying to shifts in peer groups and youth need to establish social status (2003). Social identity theory suggests that perceived group memberships are important sources of pride and self-esteem and that in-group members will discriminate against out-group members to enhance self-image (Tajfel & Turner, 1979; Ybarra et al., 2019).

The social devaluation and discrediting of individuals based on out-group characteristics is termed stigma-related bullying. Stigma-related bullying is a significant element of peer victimization (Eisenberg, et al., 2018; Rivara & Le Menestrell, 2016; Trent et al., 2019; Pont et al., 2017). Stigma-related bullying due to race/ethnicity (Rhee et al., 2017); weight (Nabors et al., 2019; Wang et al., 2010); gender and sexual identity (Leaper & Brown, 2008, Eisenberg et al.,

2018; Mittleman, 2019); physical, mental, intellectual, and/or sensory abilities (Pinquart, 2017); and intersectional experiences of discrimination (Ghavami et al., 2020; Byrd & Carter Andrews, 2016; Bucchianeri et al., 2016; Rosenthal et al., 2015; Mueller et al., 2015) have all been tied to negative health outcomes for youth. Amongst Native youth, high levels of racial/ethnic victimization have been previously described and associated with adverse psychological outcomes (Hautala & Sittner, 2019; Gloppen et al., 2018; Walls et al., 2016). Indigenous intragroup peer victimization, a phenomenon born out of Indian Residential Schools, is increasingly being considered in relation to negative impact on the development of healthy Indigenous identities (Truth and Reconciliation Commission of Canada, 2012; Matheson et al., 2016).

There is evidence that stigma-related bullying may be particularly high in rural youth (Bhatta et al., 2014). While friend and family connectedness are important protective factors for youth living in rural settings, rural youth have unique health needs related to remoteness and lower population density including, but not limited to, decreased access to mental health and medical care services, increased gun ownership, increased poverty, and decreased access to healthy food (Ivey-Stephenson et al., 2017; Caldwell et al., 2016; Jernigan et al., 2010; Smokowski et al., 2009).

The AI/AN population has long been the largest racial minority group in North Dakota; however, there have been recent significant increases in the non-Hispanic Black and Hispanic/Latinx populations (North Dakota Census Office, 2017). Given high suicidality amongst AI/AN persons and increases in suicide across other minoritized populations, it is useful to explore the degree to which bullying mediates suicidality amongst socially salient identity groups living in North Dakota. This study explores an a priori conceptual model of how school-based and electronic-bullying victimization mediate the association between stigmatized characteristics and suicidality amongst a cohort of diverse middle school students in North Dakota. Understanding the interplay between group identity, bullying, and suicidality is important to prioritize interventions to support the well-being of AI/AN, rural, and diverse students.

METHODS

Instruments

Secondary data analysis was performed using cross sectional data from the 2015 North Dakota Middle School-Youth Risk Behavior Survey (NDMS-YRBS) which collects data on behaviors related to leading causes of death and disability among youth attending public schools to

assess how risk and protective behaviors change over time (North Dakota Department of Public Instruction, 2015). The NDMS-YRBS was developed by the state health department in collaboration with local health education agencies and other federal agencies and is based on the standard YRBS questionnaire provided by the Division of Adolescent and School Health, located in the National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, part of the Centers for Disease Control and Prevention (CDC). Schools must have a minimum of 10 enrolled students to participate and may take part if selected for a representative CDC sample or through voluntarily participation.

Participants

During the 2014-2015 school year, 15,367 7th- and 8th-grade students attended eligible North Dakota public middle schools; of these, during the spring of 2015, 7,469 students from 93 middle schools completed the NDMS-YRBS. Participating students included those attending schools selected for the statewide CDC sample (n = 2047 students) and students from schools/classes that voluntarily participated in the YRBS (n = 5422). Six schools, all located in small towns on or near tribal land, reported majority AI/AN student enrollment (85.2-100%), representing 43% of AI/AN students. The remainder of AI/AN students were primarily concentrated in larger towns located near tribal land and cities (0.8-22.9%).

Measures

Variables applied to the analysis from the NDMS-YRBS included student self-report of the following socially salient characteristics: race, ethnicity, sex, weight status, school year/grade, bullying victimization, and suicidality.

Race/Ethnicity

The NDMS-YRBS race variables include AI/AN, Asian, Black or African American (Black/AA), Native Hawai'ian (NH) or Other Pacific Islander (OPI), and White. A multiracial variable was created for the purpose of this study to reflect students who indicated more than one race. The survey measured ethnicity by asking, "Are you Hispanic or Latino" with a binary yes/no response. Following typical YRBS data analysis methods, students who identified as "Hispanic or Latino" (Hispanic/Latinx) were classified for this study as a stand-alone racial/ethnic category regardless of reported race (e.g., identifying as both Hispanic/Latinx and AI/AN would result in categorization as Hispanic/Latinx).

Sex

Student sex was measured as female or male and analyzed as a binary variable. The 2015 NDMS-YRBS did not include a measure of gender.

Weight

Weight status was assessed with the question, "How do **you** describe your weight?" with response options: "very underweight," "slightly underweight," "about the right weight," "slightly overweight," or "very overweight."

School Year/Grade

The NDMS-YRBS assessed school year/grade through the question, "In what grade are you?" with the option of selecting one of four responses: "6th grade," "7th grade," "8th grade," or "Ungraded or other grade." Only respondents who indicated "7th grade" or "8th grade" were included in the analysis to limit responses to middle school students.

Bullying Victimization

Two NDMS-YRBS measures of peer harassment were included in the study with binary yes/no response options: "Have you ever been bullied on school property" and "Have you ever been electronically bullied?" Each measure was examined separately as binary outcomes in the logistic regression models described below, with each model predicting a "yes" answer (see Appendix Table A2). In the multivariate path models, each measure was included separately as binary mediators (see Figures 1-3).

Suicidality

Three measures of suicidality were included in the survey with binary yes/no response options: "Have you ever **seriously** thought about killing yourself;" "Have you ever made a **plan** about how you would kill yourself;" and "Have you ever **tried** to kill yourself?" Each measure was used separately as a binary outcome, with each model predicting a "yes" answer (see Table A2; Figures 1-3).

Procedure

Youth participation was voluntary with consent implied through survey completion. Passive permission was utilized, meaning that parent/guardians were notified of the study via a

permission denial form and sent back a signed form only if they did not want their child to participate in the survey. Students complete the self-administered questionnaire during one class period, recording their responses directly on a computer-scannable answer sheet.

Approval

This secondary data set analysis was determined to be exempt from review by the Mayo Clinic Institutional Review Board.

Data Analysis

Descriptive data and bivariate associations between all independent and dependent variables were determined using SPSS (IBM Corp, 2013). Logistic regression models were run to further determine how race/ethnicity, weight status, and sex were associated with bullying victimization and suicidality, holding constant the other described socially salient characteristics.

In the multivariate analysis, race/ethnicity was analyzed through two different sub-paths. The first path included AI/AN students compared to White students. The second path compared students who identified as Asian, Black/AA, Multiracial, NH or OPI, and Hispanic/Latinx to White students. The second path was constructed to demonstrate impact on minoritized race/ethnicity students who did not identify solely as AI/AN. Examining experiences of minoritized race/ethnicity students provides opportunity to consider concordant and discordant experiences of being a minoritized or oppressed racial/ethnic group in North Dakota (Graham et al., 2011).

In multivariate analysis, responses were collapsed to a binary variable “very overweight” versus a combined “slightly overweight,” “about the right weight,” and “slightly underweight” variable. “Very underweight” was excluded from multivariate analysis of the impact of weight status based on the a priori study purpose of examining overweight group identity and theoretical differences in experiences of bullying and suicidality between overweight and underweight youth (Lee et al., 2019). Students who identified as underweight were not excluded from models focused on race or sex.

Three path analysis models were constructed to test how bullying mediates suicidality for socially salient identity groups. Path analysis modeling allowed determination of whether the data fit into an a priori conceptual model with independent mediating and dependent variables modeled simultaneously. Mplus 8.1 was used for logistic regression and path analysis (Muthén & Muthén, 1998-2017).

RESULTS

Descriptive Statistics

A total of 7,402 students met study inclusion criteria. Student race/ethnicity included 563 AI/AN (7.6%), 122 Asian (1.6%), 227 Black/AA (3.1%), 568 Hispanic/Latinx (7.7%), 392 Multiracial (5.3%), 29 NH or OPI (0.4%), and 5,353 White (72.3%; see Table A1) youth. Student sex in the study sample was balanced. Most students identified as being "about the right weight" (n = 4145, 55.7%) with 3% (n = 224) identifying as "very overweight."

Almost half of all students reported ever being bullied on school property (n = 3536, 47.8%) and 28% (n = 2076) reported ever being bullied electronically. One in five students had ever seriously considered suicide; one in seven students had ever developed a plan to commit suicide; and one in thirteen students had ever attempted suicide.

Bivariate Analyses

Multiracial students, followed by AI/AN, White and Hispanic/Latinx students reported the highest school-based bullying victimization ($p < 0.01$, $X^2 = 34.17$; see Table A1). Electronic bullying was highest among Multiracial and AI/AN students, followed by Hispanic/Latinx and White students ($p < 0.01$, $X^2 = 34.30$). Both types of bullying victimization were highest in students who reported being "very overweight" and "very underweight," whereas students who identified as "about the right weight" reported the lowest levels of bullying victimization ($p < 0.01$, $X^2 = 125.4$ & 76.75). Female students were significantly more likely than male students to report being bullied, both on school property and electronically ($p < 0.01$, $X^2 = 63.76$ & 385.6).

Reporting suicidal thoughts and plans was highest among AI/AN, Hispanic/Latinx, Multiracial, and White students ($p < 0.01$, $X^2 = 62.47$ & 75.63). Suicide attempts were highest among AI/AN, Hispanic/Latinx students, and Black/AA students ($p < 0.01$, $X^2 = 125.09$). Students who reported being "very overweight" reported the highest suicidality ($p < 0.01$, $X^2 = 280.32, 250.76, 186.44$). Female students were significantly more likely than male students to have suicidal thoughts, plans, or attempts ($p < 0.01$, $X^2 = 257.14, 144.68, 103.43$). Suicidal thoughts and plans were higher amongst eighth compared to seventh graders ($p<0.01$, $X^2 = 12.90$ & 29.99).

Logistic Regression

Five multivariate models were constructed using the following core variables to investigate impact on bullying and suicidality, adjusted for independent variables: AI/AN versus White; Asian, Black/AA, Multiracial, NH or OPI, and Hispanic/Latinx versus White; very overweight versus slightly overweight/about the right weight/slightly underweight; female versus male; and eighth versus seventh grade (see Table A2). When AI/AN students were compared to White students, no difference was seen for either type of bullying, yet AI/AN students were significantly more likely to report all types of suicidality ($p < 0.001$). Asian, Black/AA, Multiracial, NH or OPI, and Hispanic/Latinx students compared to White students were less likely report experiencing bullying on school property (no difference was seen for electronic bullying) yet significantly more likely to report each type of suicidality ($p < 0.001$).

Very overweight students were significantly more likely than overweight/about the right weight/slightly underweight students to report both types of bullying and all types of suicidality ($p < 0.001$). Identifying as female compared to male was significantly associated with both types of bullying victimization ($p < 0.001$) and all types of suicidality ($p < 0.001$). Eighth graders were significantly more likely than seventh graders to report bullying on school property ($p<0.05$), suicidal thoughts ($p<0.05$), and suicidal plans ($p<0.001$).

Path Analyses

Three path analysis models were used to examine school-based and electronic bullying victimization as mediators of youth suicidality amongst diverse identity groups (see Figures 1-3). Grade was excluded from path analyses to simplify modeling. For all models, identifying as AI/AN compared to White was directly associated with all types of suicidality ($p < 0.001$), mediated by electronic ($p < 0.05$) but not school-based ($p = 0.097$-0.102) bullying victimization. Identifying as Asian, Black/AA, Multiracial, NH or OPI, and Hispanic/Latinx compared to White was also directly associated with all types of suicidality ($p < 0.001$), negatively mediated by bullying on school property ($p < 0.05$).

For all models, identifying as very overweight, compared to the combined slightly overweight/about the right weight/slightly underweight students, and as female compared to male students, was directly associated with all types of suicidality ($p < 0.001$), mediated by both types of bullying victimization ($p < 0.001$).

Figure 1. Path analysis of school-based and electronic bullying victimization as mediators of suicidal ideation (N = 5403)

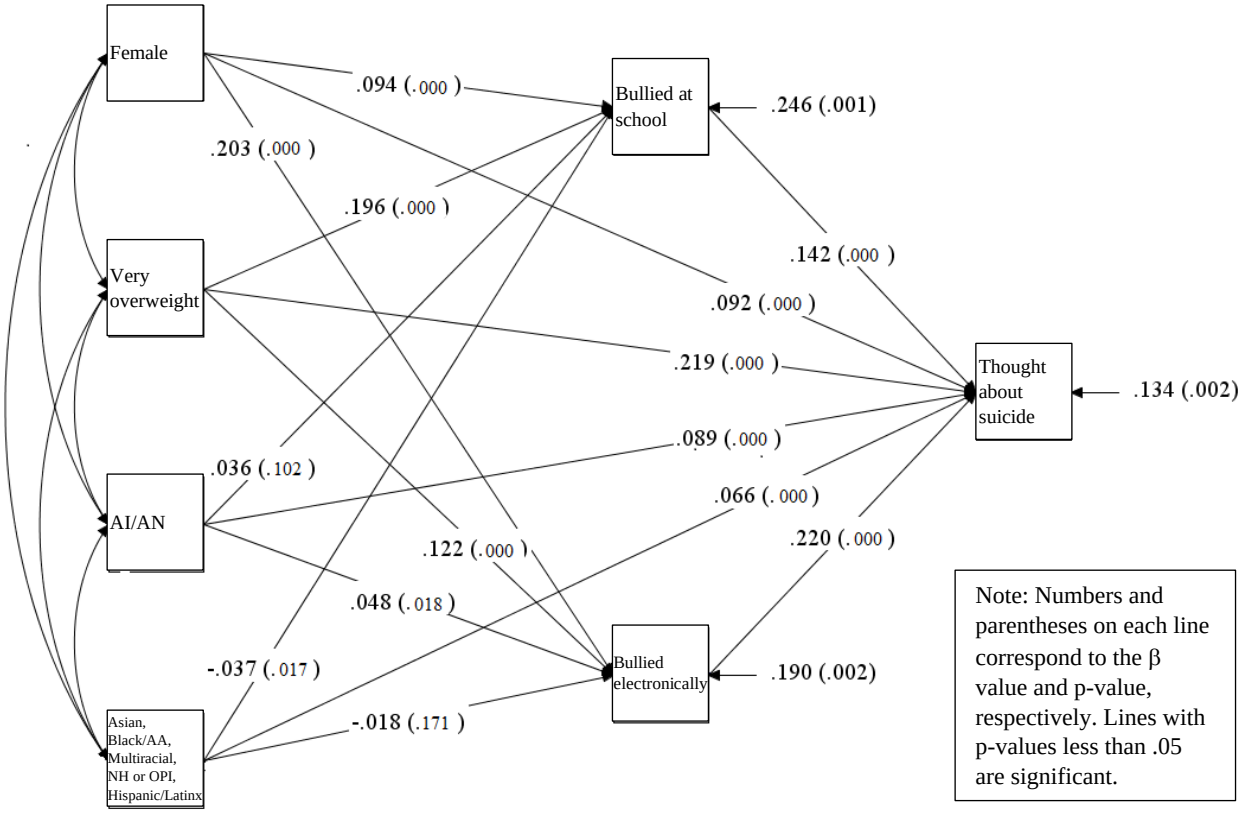


Figure 2. Path analysis of school-based and electronic bullying victimization as mediators of suicide plan (N = 5792)

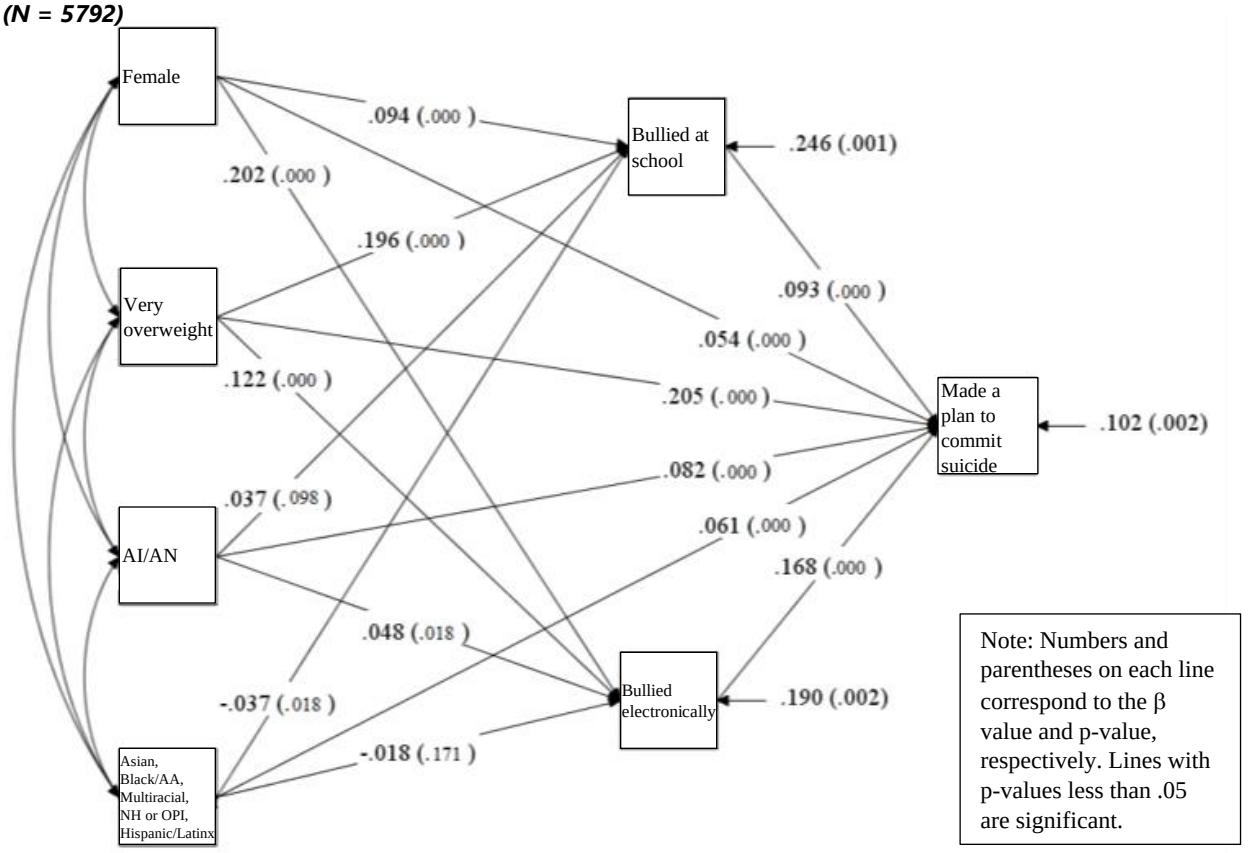
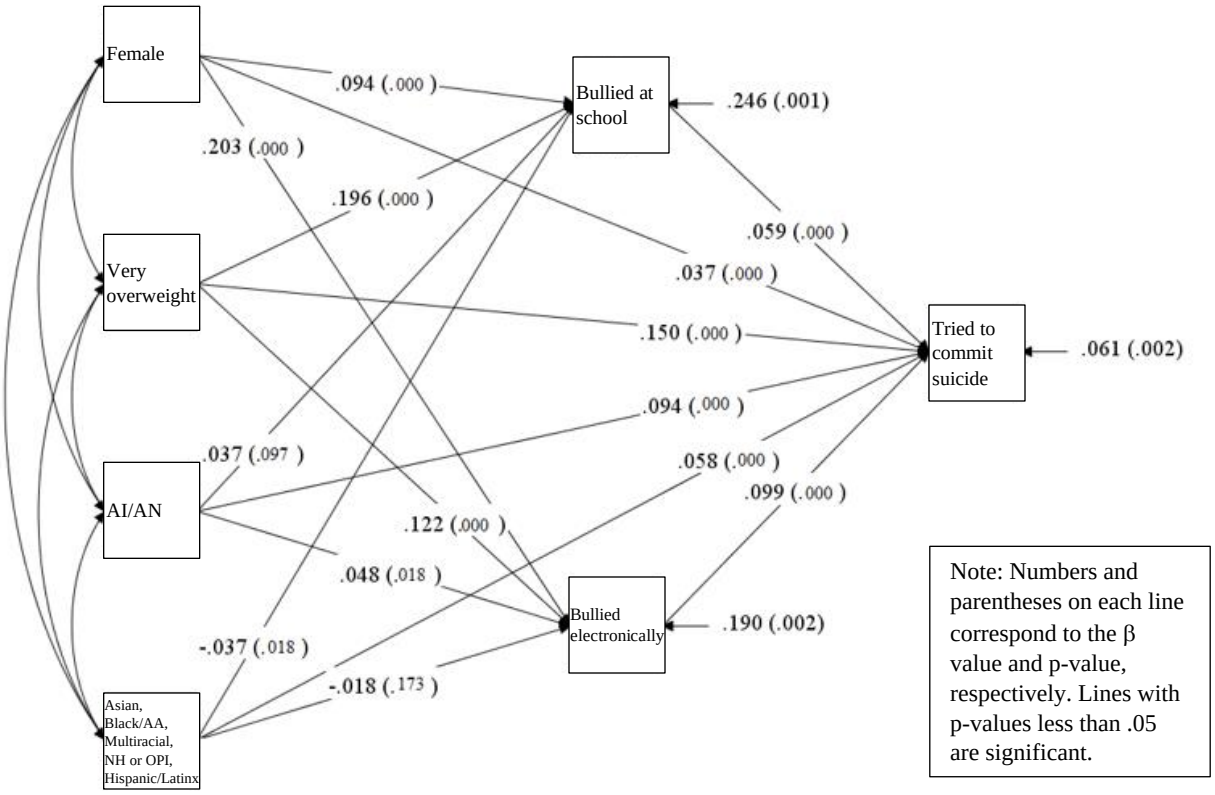


Figure 3. Path analysis of school-based and electronic bullying victimization as mediators of a suicide attempt (N = 5894)



DISCUSSION

It is well established that persons who identify as minoritized race/ethnicity, high weight status, and female sex have increased lived experience of bias, stigma, and discrimination (Trent et al., 2019; Pont et al., 2017; Brown & Stone, 2016). In this study, minoritized race/ethnicity, very overweight, and female middle school students living in North Dakota reported statistically higher suicidality than comparison groups, mediated in some instances by bullying victimization. These data are concerning, novel, and important as they center on youth in North Dakota, a state which leads the country in suicidality and peer victimization but for which there is a paucity of granular data related to youth behaviors.

AI/AN and White students reported similarly high levels of bullying victimization on school property, with Asian, Black/AA, Multiracial, NH or OPI, and Hispanic/Latinx students reporting less bullying on school property compared to White students. Yet, minoritized race/ethnicity students reported significantly higher suicidality than White students. High levels of bullying victimization paired with high suicidality amongst AI/AN and other minoritized

race/ethnicity students in this sample is notable and concerning. Bullying victimization amongst youth of minoritized races and ethnicities is multifactorial and impacted by historic and contemporary sociopolitical influences that differ by geopolitical context and school-setting, including but not limited to school climate and composition (Kiang et al., 2016; Seaton et al., 2013). Minoritized race/ethnicity students are more likely than White students to experience race-based bullying, which is as or more harmful than bullying victimization not related to racial prejudice, and more likely to report elevated rates of other forms of harassment (Bowser et al., 2018; Rhee et al., 2017; Bucchianeri et al., 2016; Russell et al., 2012; Carlyle & Steinman, 2007). Underreporting of bullying victimization has been previously described in minoritized youth and may explain the findings of no difference and lower bullying victimization amongst Asian, Black/AA, Multiracial, NH or OPI, and Hispanic/Latinx students compared to White students in this sample (Lai & Kao, 2018).

In the current study, electronic bullying victimization mediated suicidality in AI/AN students only. Electronic bullying is a unique form of peer harassment previously found to be high in AI/AN youth (Carlyle & Steinman, 2007). Social media provides Native and other minoritized youth with opportunities to enhance cultural identity and community and family connections, perhaps especially needed in rural and other areas where safe cultural spaces may be less common (Rice et al., 2016). Compared to other forms of bullying, electronic bullying is associated with unique and significant negative mental health concerns, including anxiety, depression, and suicidality (Hoge et al., 2017; Broll et al., 2017; Hamm et al., 2015; Wang et al., 2009; Wang et al., 2011). Intervening against and mitigating the negative impact of electronic bullying victimization is likely to be particularly important amongst youth vulnerable to cyber-racism.

This study is consistent with others in demonstrating a significant association between high weight status, peer victimization, and suicidality (Nabors et al., 2019; Wang et al., 2010; Rosenthal et al., 2015; Eaton et al., 2005; Eisenberg et al., 2003). High weight stigma occurs as early as preschool and is one of the most frequent forms of peer harassment reported by students (Pont et al., 2017). Youth experiencing high weight stigma experience negative psychological impact, including increased mood disorders, substance abuse and self-harm, as well as increased social isolation and poorer academic outcomes compared to peers. High weight stigma is obesogenic, related to stress-response cortisol and stigma-associated unhealthy eating behaviors, decreased exercise motivation, and decreased physical activity (Puhl et al., 2020). A 2013 study found, compared to normalized weight and underweight youth, overweight and obese youth reported

higher rates of racial, socioeconomic, and sexual harassment (Bucchianeri et al., 2013; Bucchianeri et al., 2016). A more recent study found that increased ethnic diversity in school settings offset peer victimization among higher weight adolescents, underscoring the importance of identifying protective factors, including but not limited to perspective taking, against weight stigma (Lanza et al., 2018). Further exploration of the relationship between high weight-stigma, intersectional harassment, and suicidality is needed.

The findings of high bullying victimization and suicidality amongst female students in this sample is consistent with national trends. Similarly, the mediation of suicidality by bullying is consistent with established knowledge regarding the negative impact of gender-based discrimination—which includes both gender-bias and sexual harassment—on girls' social-emotional health, body image, and achievement (Leaper & Friedman, 2007; Wichstrøm, 1999). While this study did not examine bullying victimization across intersectional identities, prior studies show that weight and race-based harassment may be even more prevalent than gender-based harassment amongst female adolescents (Bucchianeri et al., 2013). Increases in female death by suicide and narrowing of the gap in suicide deaths between females and males underscore the importance of intervening upon the unique and intersectional types of bullying victimization experienced by female students (Curtin et al., 2016; Ruch et al., 2019; Nabors et al., 2019).

The patterns of bullying victimization and suicidality found in this study are consistent with previous literature and suggest opportunity to further develop interventions to support youth from stigmatized identity groups (Stone et al., 2018, Ivey-Stephenson et al., 2017; Kann et al., 2018; Kalb et al., 2019; Earnshaw et al., 2018). Mixed evidence exists on the positive impact of bullying intervention programs on middle school youth (Bauer & Rivara, 2007; Cissner & Ayoub, 2014; Espelage et al., 2013; Jenson et al., 2013; Gaffney et al., 2021). Evidence suggests that prosocial bystanders can effectively support adolescent bully victims in racially/ethnically diverse rural settings (Evans & Smokowski, 2015). Sources of Strength, a suicide-prevention program developed for rural and tribal communities in North Dakota, has been shown to reduce suicide by improving peer leader adaptive norms regarding suicide and increasing youth-adult connectedness (Wyman et al., 2010). Leveraging peer leaders as prosocial bystanders may be an opportunity to reduce bullying victimization and suicidality amongst North Dakota minoritized identity groups.

Cultural pride promotion has been shown to mitigate negative outcomes from peer victimization in minoritized youth and should be further explored. Identity-specific affinity groups have been used to reduce hopelessness and suicide attempts in youth experiencing stigma (Davis

et al., 2014; Newman, 2005; Bannon et al. 2009). Efforts within Native communities to apply local knowledge to better understand and address peer victimization and suicide and to catalyze community healing hold promise and should be prioritized (Allen et al., 2021; Trout et al., 2018; Matheson et al., 2016). Increased attention to protective factors, such as social support and healthy sleep habits, should be prioritized when developing interventions to address youth suicide (Ersan & Rodriguez, 2021; Gloppen et al., 2018).

Finally, increased attention in recent years has been given to racial discrimination as a form of toxic stress and the importance of trauma-informed services for minoritized youth (Carter, 2007; Dueweke et al., 2019). Broader application of trauma-informed and restorative practices in educational settings hold promise to prevent, intervene, and provide healing for young people experiencing racialized trauma (Kataoka et al., 2018). Community healing, resilience, and wellness will be best achieved when schools, health systems, and community partners collaborate towards addressing childhood adverse childhood experiences and toxic stressors such as stigma-related bullying (Ellis & Dietz, 2017).

Limitations

Although this study documents trends in bullying victimization and suicidality across specific identity groups, data analysis is based on cross-sectional surveys and can only provide an indication of association, not causality. The NDMS-YBRS does not provide a measure for stigma-specific bullying, therefore this study implies stigma-specific bullying whereas actual bullying experiences may differ and/or be multifactorial. Similarly, the analysis implies temporal order of events; however, it is not known when bullying victimization has occurred in relation to suicidality.

AI/AN student identity may have been underappreciated in this analysis as students who identified as Hispanic/Latinx were not evaluated in any other race/ethnicity category and granular racial identity is not provided within the Multiracial category. Statistical analysis did not explore membership in more than one stigmatized group, which may be associated with worse outcomes. Students in North Dakota, as in the rest of the United States, are highly concentrated between and within schools by racial/ethnic group, and this study does not account for how bullying and suicidality differed by school settings (e.g., racial/ethnic homogenous or heterogenous environments). Due the nature of the secondary data set, a school-specific variable was not part of the public use data set; therefore, adjustment for clustering by school was not possible.

The YRBS has additional limitations. All YRBS data are self-reported, and therefore the extent of underreporting or overreporting of behaviors cannot be determined. As the survey is descriptive, it is not intended to explain reasoning behind trends. Studies have shown that any participation in bullying increases the risk for suicide; therefore, this study is further limited in that it did not look at bullying perpetration. Data are not representative of all persons in this age group as they only include youth who attend school. The study sample includes students from both randomly selected and voluntary schools; therefore, results cannot be extrapolated to represent all middle school students from eligible schools but are limited in representing mainly the students from participating schools. The study is further limited in the absence of additional measures such as sexual orientation, gender, and socioeconomic status, which have been shown to mediate the relationship between bullying and suicidality but were not available in the dataset.

CONCLUSION

Higher suicidality amongst minoritized race/ethnicity, very overweight, and female students, mediated in some instances by bullying, suggest that group identity, stigma, and discrimination may influence suicidality in middle school youth in North Dakota. More information is needed on stigma and discrimination, including intersections of identity, as drivers of bullying and suicidality in minoritized youth in nonmetropolitan/rural areas.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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APPENDIX

Table A1

Descriptive statistics and bivariate analyses

	N	%	Ever been bullied on school property	X2	Ever been bullied electronically	X2	Ever seriously thought about killing self	X2	Ever made plan about how would kill self	X2	Ever tried to kill self	X2
	N=7402		*n* = 3536		*n* = 2076		*n* = 1518		*n* = 1025		*n* = 555	
Sex												
Female	3714	(50.2)	1944 (52.8)	63.76*	1421 (38.3)	385.6*	1040 (28.1)	257.14*	691 (18.7)	144.68*	393 (10.6)	103.43*
Male	3670	(49.6)	1581 (43.5)		650 (17.7)		474 (13.0)		328 (9.0)		160 (4.4)	
School Year												
7th grade	3730	(50.4)	1749 (47.4)	1.98	1009 (27.1)	3.67	703 (18.9)	12.90*	435 (11.7)	29.99*	265 (7.1)	1.74
8th grade	3672	(49.6)	1787 (49)		1067 (29.1)		815 (22.3)		590 (16.1)		290 (7.9)	
Race/Ethnicity												
AI/AN	563	(7.6)	288 (51.4)	34.17*	180 (32.0)	34.30*	161 (28.6)	62.47*	119 (21.2)	75.63*	89 (15.9)	125.09*
Asian	122	(1.6)	43 (35.2)		23 (19.0)		22 (18.0)		15 (12.3)		10 (8.2)	
Black/AA	227	(3.1)	74 (33.0)		33 (14.6)		40 (17.7)		24 (10.7)		26 (11.5)	
Hispanic/Latinx	568	(7.7)	271 (48.2)		163 (28.8)		156 (27.7)		120 (21.3)		80 (14.2)	
Multiracial	392	(5.3)	203 (51.8)		128 (32.7)		106 (27.0)		74 (19.0)		35 (8.9)	
NH or OPI	29	(0.4)	13 (44.8)		6 (21.4)		6 (20.7)		4 (14.3)		2 (6.9)	
White	5353	(72.3)	2577 (48.6)		1503 (28.1)		1001 (18.7)		646 (12.1)		303 (5.7)	
Weight Status												
Very underweight	152	(2.1)	103 (68.2)	125.4*	65 (43.0)	76.75*	59 (38.8)	280.32*	41 (27.2)	250.76*	30 (19.9)	186.44*
Slightly underweight	1095	(14.8)	533 (49.3)		314 (28.7)		200 (18.3)		141 (13.0)		82 (7.5)	
About the right weight	4145	(55.7)	1786 (43.5)		1024 (24.7)		639 (15.5)		401 (9.7)		202 (4.9)	
Slightly overweight	1747	(23.6)	949 (54.8)		572 (32.8)		503 (28.9)		348 (20.0)		181 (10.4)	
Very overweight	224	(3)	148 (66.7)		91 (40.8)		108 (48.4)		86 (38.6)		54 (24.3)	

* $p<0.01$

AI/AN - American Indian/Alaska Native AA - African American NH - Native Hawai'ian OPI - Other Pacific Islander

Table A2
Logistic regression

	Ever been bullied on school property		Ever been bullied electronically		Ever seriously thought about killing self		Ever made plan about how would kill self		Ever tried to kill self	
	OR (95% CI)	**p-value**	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**
Female (vs. male)	1.46 (1.31 - 1.62)	<.001	2.87 (2.54 - 3.24)	<.001	2.70 (2.35 - 3.10)	<.001	2.30 (1.95 - 2.70)	<.001	2.60 (2.08 - 3.24)	<.001
American Indian/Alaska Native (vs. White)	1.14 (.94 - 1.38)	0.18	1.20 (.97 - 1.48)	0.1	1.70 (1.36 - 2.13)	<.001	2.01 (1.57 - 2.58)	<.001	3.20 (2.39 - 4.29)	<.001
Asian, Black/AA, Multiracial, NH or OPI, and Hispanic/Latinx (vs. White)	.87 (.76 - .99)	0.048	.89 (.76 - 1.03)	0.12	1.45 (1.23 - 1.71)	<.001	1.72 (1.43 - 2.07)	<.001	2.44 (1.93 - 3.08)	<.001
Very Overweight (vs. "slightly overweight," "about the right weight," and "slightly underweight")	1.63 (1.46 - 1.82)	<.001	1.50 (1.32 - 1.69)	<.001	2.40 (2.10 - 2.73)	<.001	2.57 (2.20 - 2.99)	<.001	2.48 (2.02 - 3.03)	<.001
8th Grade (vs. 7th grade)	1.13 (1.02 - 1.25)	0.02	1.11 (.99 - 1.25)	0.07	1.23 (1.08 - 1.40)	<0.05	1.45 (1.24 - 1.69)	<.001	1.10 (.90 - 1.35)	0.35

AA - African American NH - Native Hawai'ian OPI - Other Pacific Islander

UNDERSTANDING HISTORICAL TRAUMA AMONG URBAN INDIGENOUS ADULTS AT RISK FOR DIABETES

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Abstract: Historical trauma has been posited as a key framework for conceptualizing and addressing health equity in Indigenous populations. Using a community-based participatory approach, this study aimed to examine historical trauma and key psycho-social correlates among urban Indigenous adults at risk for diabetes to inform diabetes and other chronic disease prevention strategies. Indigenous adult participants (n=207) were recruited from an urban area in California and were asked to identify whether their Indigenous heritage was from a group in the United States, Canada, or Latin America. Historical trauma was assessed using the Historical Loss (HLS) and Historical Loss Associated Symptoms (HLAS) scales. Nearly half (49%) of Indigenous participants from the United States or Canada endorsed thinking about one or more historical losses weekly, daily, or several times a day, compared to 32% for Indigenous participants from Mexico, Central America, and South America. Most participants (62%) reported experiencing one or more historical loss-associated symptoms, such as depression and anger, sometimes, often, or always. Ancestry from the United States or Canada, depression, and participation in cultural activities were associated with greater HLS and HLAS scores, indicating a greater number of losses and associated symptoms. Results suggest a need to consider historical trauma when designing diabetes prevention interventions and the need to further consider ancestry differences. As preventive efforts for Indigenous adults expand in urban environments, behavioral interventions must incorporate strategies that address community-identified barriers in order to succeed.

INTRODUCTION

American Indian, Alaska Native (AI/AN), and Indigenous communities have the highest prevalence of diabetes among all racial and ethnic groups in the United States (Centers for Disease

Control and Prevention [CDC], 2017). In 2018, the prevalence of type 2 diabetes was two times greater in AI/AN adults relative to non-Hispanic White adults (CDC, 2020). In addition to a higher prevalence, diabetes is the leading cause of blindness and lower-extremity amputation among AI/AN adults, for whom these complications appear at an earlier age (McLaughlin, 2010). Although interventions that encourage moderate weight loss and physical activity mitigate the onset of diabetes and are effective across multiple racial/ethnic groups (Knowler et al., 2002), including some reservation settings (Jiang et al., 2013), there remains a dearth of research demonstrating the successful translation of diabetes prevention efforts among Indigenous adults, including for those residing in urban areas. Thus, interventions and health promotion efforts that are specifically tailored for this population are crucial.

Genuine and bidirectional partnership with Indigenous community members and organizations is critical for understanding barriers to effective diabetes prevention and informing interventions. A community-university partnership, known as *Pathways to American Indian and Alaska Native Wellness*, came together to investigate successful models for diabetes prevention in a northern California urban Indigenous community. The community is an area where many Indigenous people relocated from reservation communities as a result of the 1950's Relocation Act (Ablon, 1964). Over years of planning and implementing their Diabetes Prevention Program (DPP) intervention, the community partner identified historical trauma as a key underlying challenge to successful diabetes prevention efforts and a construct requiring additional understanding in order to better implement DPP interventions within community and primary care settings (Rosas et al., 2016).

Historical trauma—the cumulative and transgenerational experience of group-wide trauma manifesting as emotional and psychosocial distress among Indigenous people (Brave Heart & DeBruyn, 1998; Whitbeck et al., 2004)—has been posited as a potential pathway explaining high prevalence of chronic conditions among Indigenous populations (Evans-Campbell, 2008; Walters, Beltran et al., 2011). Historical traumatic experiences—including starvation, disease, forced relocation and displacement, boarding school reeducation and assimilation, and culturally-restrictive policies—are hypothesized to be intergenerationally re-experienced as historical trauma and manifest as associated biopsychosocial symptoms such as post-traumatic stress (e.g., anger, numbing), depression, anxiety, sleep loss, and feelings of social isolation (Whitbeck et al., 2004; Whitbeck et al., 2009). Scholars have linked historical trauma to epigenic changes contributing to neurobiological changes, which along with proximal

stressors, place individuals at higher risk for cardiovascular diseases, immune response dysfunction, and other physical and mental health concerns (Walters, Beltran et al., 2011; Walters, Mohammed et al., 2011). Stress responses have also been linked to deleterious coping behaviors (e.g., eating, drinking, smoking) and lack of engagement in healthy behaviors (Pascoe & Smart Richman, 2009). The confluence of these factors may not only increase the risk of developing chronic conditions, including diabetes, but may also impact individuals' abilities to engage in prevention programs.

Little is known about how and to what degree urban Indigenous communities experience historical trauma. With approximately 70% of Indigenous individuals in the United States residing in urban areas (Indian Health Service, 2018), there exists an urgent need to understand how Indigenous adults at risk for diabetes may experience historical trauma. The objective of this study was therefore to examine experiences of historical trauma and key psycho-social correlates among urban Indigenous adults at risk for diabetes to inform diabetes and other chronic disease prevention strategies for this population.

METHODS

Study Design and Participants

Data for this analysis were collected from 2014 to 2016 using a baseline assessment conducted prior to participation in a randomized comparative effectiveness trial of a standard DPP and a culturally enhanced DPP for urban Indigenous adults in northern California. The trial design and outcomes have been previously described (Rosas et al., 2016; 2020). Study participants (n = 207) were recruited from Santa Clara County, CA. Sample size was determined based on having 80% power to detect significant differences in the primary outcome of body mass index (BMI) change between study groups of the trial. From the overall baseline sample (n = 207), two individuals were excluded due to concerns for staff safety. Another 12 participants did not complete questionnaires of interest for the present study (i.e., HLS, HLAS), culminating in a sample size of 193 participants. All study procedures were performed in accordance with the 1964 Helsinki declaration and its later amendments and approved by the Institutional Review Boards of Stanford University School of Medicine (IRB #30015). All participants provided written informed consent. Given the diversity among our participants in terms of ancestry, with a large proportion identifying as having Mexican, South, or Central American Indigenous descent, we chose

"Indigenous" rather than "AI/AN" as the main terminology for this manuscript. We continue to use AI/AN when citing specific findings from the literature to accurately depict the samples being described by other authors.

Eligibility Criteria

Inclusion criteria included a BMI between 30 and 55 kg/m^2, no type 2 diabetes diagnosis, and one or more criteria for metabolic syndrome (triglycerides >150 mg/dL, high-density lipoprotein cholesterol <40 mg/dL among men and <50 mg/dL among women, blood pressure >130/80 mmHg or current anti-hypertensive treatment, and fasting glucose 100–125 mg/dL). Participants self-reported their Indigenous ancestry. Multiple allowed responses included Indigenous to the United States or Canada; Indigenous to Mexico, South, or Central America (Latin America hereafter); and Indigenous ancestry from two or more of following regions: North or Latin America, Caribbean, and Pacific Islands. Exclusion criteria included taking atypical antipsychotics or multiple medications, certain comorbidities (e.g., heart failure, unstable metabolic disorders, and substance abuse), pregnancy, and plans to relocate during the study. Exclusions were in place for participants' safety (e.g., pregnancy and unstable medical conditions) and to ensure retention in the larger study (e.g., relocation).

Community Engagement

This study was led by a community-university partnership between Stanford University School of Medicine and Pathways to American Indian and Alaska Native Wellness. The American Indian Community Action Board served as the partnership governing body and consisted of leaders from the urban Indigenous community. The American Indian Community Action Board was involved in all phases of the research process, including study design; intervention development and delivery; and data collection, analysis, and interpretation.

Measures

Outcome Measures

Trained staff collected data using an interviewer-administered questionnaire. The Historical Loss Scale (HLS) and the Historical Loss Associated Symptoms Scale (HLAS) developed by Whitbeck et al. (2004) were used to assess historical trauma. These measures assess both losses due to historical trauma (e.g., loss of land, language, traditional ways, loss of family

ties because of boarding schools), as well as symptoms related to these losses (e.g., sadness, anger). Specific losses and symptoms were developed in collaboration with Indigenous elders and tribal advisory boards (Whitbeck et al., 2004). Participants who self-identified as Indigenous to the United States or First Nations of Canada were administered the standard HLS. Participants who self-identified as Indigenous to Latin America completed a modified version of the HLS developed by Brave Heart and colleagues (2011), which reflects differences in historical experiences. For example, for Indigenous participants from Latin America, loss of land was assessed with items indicating loss due to the Spanish colonization, immigration or migration, and/or due to being a refugee. The standard (13 items) and modified (21 items) HLS were scored on a scale of one to six ("never" = 1, "several times a day" = 6), and items on the HLAS (17 items) were scored on a scale of one to five ("never" = 1, "always" = 5). Mean HLS and HLAS scores were calculated by summing scores and dividing by the total number of items. Higher scores indicated participants thought more frequently about a given historical loss or more commonly experienced a symptom associated with historical loss.

Covariates

Socioeconomic variables included education (less than high school, high school graduate, some college, and college graduate or more) and income (0-200% Federal Poverty Level [FPL], 200-400% FPL, and >400% FPL). Healthy and unhealthy dietary scores were summed and divided into tertiles using a food frequency questionnaire (FFQ; Teufel-Shone et al., 2015). Greater scores corresponded to increased consumption. Physical activity was assessed via the Women's Health Initiative (WHI) physical activity scale (Meyer et al., 2009) and categorized as 500-1,000 MET-minutes/week, <500 MET-minutes/week, and >1,000 MET-minutes/week (Physical Activity Guidelines Advisory Committee, 2018). Items on this measure are gender neutral (e.g., "Think about the walking you do outside the home. How often do you walk outside the home for more than 10 minutes without stopping?"), and the measure allows for collecting physical activities according to intensity, which reduces time of completion and hence participant burden. Moreover, prior studies using the WHI physical activity scale have included Indigenous samples (McTiernan et al., 2003; Meyer et al., 2009; Stefanick et al., 2021). Participants were categorized as high-risk or normal-risk drinkers using the Alcohol Use Disorders Identification Test (AUDIT-C) scale (Bush et al., 1998). For smoking, participants were categorized as smokers or non-smokers using the question, "Do you smoke cigarettes every day, some days, or not at all?" (Nguyen & Zhu,

2009). Depressive symptoms were evaluated using the Center for Epidemiologic Studies Depression (CES-D) scale (Knight et al., 1997). Based on the measure recommended cut-off of 16 points, individuals were classified as having low or high risk of depression. Food security was evaluated using the Six-Item Short Form of the US Household Food Security Survey (Blumberg et al., 1999).

Participants self-reported participation in cultural (e.g., cooking traditional foods, attended powwow/gathering/big time, participated in talking/healing circle) and spiritual activities (e.g., participated in a sweat, ceremonial feasts, smudged, or saged) within the last 12 months (Peterson, 2006). A modified Multigroup Ethnic Identity Measure (MEIM) was used to assess individuals' sense of identification and belonging with their ethnic group (Phinney, 1992). Higher scores corresponded with a stronger sense of identification and belonging with Indigenous identity. Indigenous identity scores were classified into tertiles.

Statistical Analyses

Statistical analyses were performed using SAS Enterprise Guide 6.1. Sample characteristics were summarized using percentages, means, and standard deviations. Data were imputed when no more than 20% of the data necessary to score a scale were missing. HLS and HLAS responses were summarized using percentage frequencies, replicating the approach by Whitbeck and colleagues (2004). Responses to the HLS were grouped into categories based on the frequencies with which participants thought about each historical loss: (1) never, yearly, or only during special times; (2) monthly; and (3) weekly, daily, or several times a day. Correlations were examined between HLS and HLAS scores. Using conditional formatting features in Excel, heat maps were created to graphically depict correlations. Associations between participant characteristics and HLS and HLAS scale scores were examined using the Wilcoxon Rank Sum and Kruskal-Wallis tests. Predictors with statistically significant bivariate associations with HLS and HLAS scores were examined using multivariable logistic regression. Average HLS and HLAS scores were classified as >2 or ≤2. HLS scores >2 corresponded with thinking about historical losses monthly or more frequently, on average. HLAS scores >2 corresponded with experiencing historical loss associated symptoms sometimes, often, or always, on average.

RESULTS

Baseline Characteristics

Participants were predominantly middle-aged (53%), Indigenous to the United States or Canada (65%), and Hispanic/Latinx (57%; Table 1). Participants with a high school education or less comprised 35% of the sample. Approximately one-third of participants (33%) reported depressive symptoms consistent with risk for clinical depression. Most participants engaged in spiritual and cultural activities, with 81% and 52% reporting participation in one or more cultural or spiritual activities, respectively, in the last year.

Table 1
Participant sociodemographic characteristics by ancestry

	All *n* = 193	US/Canada *n* = 126	Latin America *n* = 67	*p* value
Demographic characteristics				
Age				0.43
18 - 39	20.7	18.2	25.4	
40 - 59	52.9	53.2	52.2	
60+	26.4	28.6	22.4	
Female	79.3	79.4	79.1	0.97
Household income[1]				0.20
0 - 200% FPL	59.4	56.1	65.6	
200% - 400% FPL	26.7	30.9	18.6	
400% +FPL	13.9	13.0	15.6	
Education				0.051
<High school	14.0	9.5	22.4	
High school graduate	20.7	19.1	23.9	
Some college	44.0	48.4	35.8	
College or more	21.2	23.0	17.9	
Ethnicity				<.001
Hispanic/Latino/x	56.5	34.1	98.5	
Non-Hispanic/Non-Latino/x	43.5	65.9	1.5	
Behavioral & psychosocial characteristics				
Alcohol				0.98
High-risk drinker	15.0	15.1	14.9	
Normal-risk drinker	85.0	84.9	85.1	
Smoking				0.10
Non-smoker	88.9	86.2	94.0	
Smoker	11.1	13.8	6.0	
Healthy food score[2]				0.30
First tertile (9-21)	34.7	37.3	29.9	
Second tertile (22-26)	43.0	43.7	41.8	
Third tertile (27-32)	22.3	19.0	28.4	

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Table 1 Continued
Participant sociodemographic characteristics by ancestry

	All *n* = 193	US/Canada *n* = 126	Latin America *n* = 67	*p* value
Unhealthy food score[2]				0.87
First tertile (14-31)	33.2	32.5	34.3	
Second tertile (32-39)	38.3	39.7	35.8	
Third tertile (40-58)	28.5	27.8	29.9	
Physical Activity[3]				0.70
<500 MET-minutes/week	28.6	27.5	30.6	
500 - 1000 MET-minutes/week	20.3	19.2	22.6	
>1000 MET-minutes/week	51.1	53.3	46.8	
Depression symptomatology (CES-D)				0.48
High depression risk	33.2	34.9	29.9	
Low depression risk	66.8	65.1	70.1	
Food Security				0.12
Very low security	16.6	18.8	10.4	
Low security	25.4	27.0	22.4	
High security	58.0	53.2	67.2	
Cultural activity participation (per year)				0.63
None	19.2	20.6	16.4	
One	16.1	17.5	13.4	
Two	18.6	19.0	17.9	
Three or more	46.1	42.9	52.2	
Spiritual activity participation (per year)				0.70
None	47.7	47.6	47.8	
One	16.6	15.1	19.4	
Two	14.0	15.9	10.5	
Three or more	21.8	21.4	22.4	
Indigenous identity score[4], mean (sd)	36.8 (6.0)	37.0 (5.9)	36.3 (6.0)	0.46
Historical loss score, mean (sd)	2.1 (1.0)	2.3 (1.1)	1.7 (0.7)	<.001
Historical loss symptoms score, mean (sd)	1.7 (0.7)	1.8 (0.7)	1.4 (0.5)	<.001

Note. Percentages are displayed unless otherwise specified.
[1]Household Income was classified using poverty level (FPL) guidelines. [2]The food frequency questionnaire incorporated culturally-relevant foods, and items were scored on a scale of 1 – 6, with 6 corresponding to greater consumption. "Healthy" foods are those recommended for increased intake (e.g., leafy greens), and "unhealthy" foods are those recommended for decreased intake (e.g., soft drinks). [3]Physical activity categories reflect recommendations by the Physical Activity Guidelines Advisory Committee. [4]The Multigroup Ethnic Identity Measure (MEIM) was modified to eleven items with five possible responses ranging from "strongly disagree" to "strongly agree."

Historical Loss and Historical Loss Associated Symptoms

The average HLS score was 2.1 (*SD* = 1.0), and the mean HLAS score was 1.7 (*SD* = 0.7), see Table 1. Full data on all items of the HLS and HLAS is provided in the Appendix. Among participants Indigenous to the United States or Canada, 49% thought about one or more historical losses weekly, daily, or several times a day. The top five historical losses Indigenous persons from

the United States or Canada thought about at least weekly were as follows: "The losses from the effects of drugs on our people" (31%), "The losses from the effects of alcoholism on our people" (29%), "Loss of respect by our children and grandchildren for elders" (29%), "Losing our culture" (24%), and "Loss of respect by our children for traditional ways" (23%).

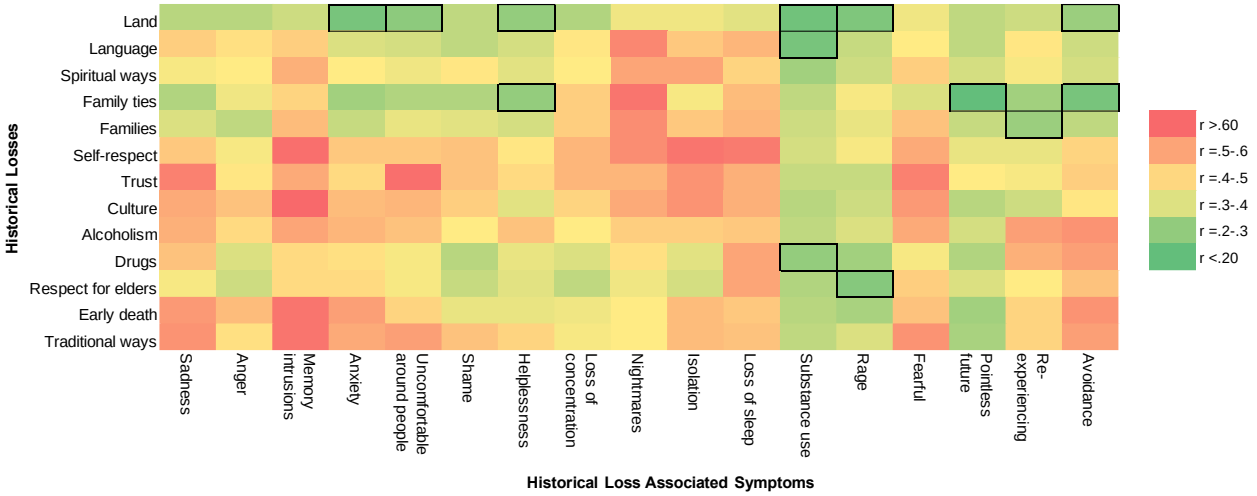
For Indigenous participants from Latin America, 32% thought about at least one historical loss weekly, daily, or several times a day. The top five historical losses thought about at least weekly included, "Loss of respect by our children and grandchildren for elders" (20%), "Loss of respect by our children for traditional ways" (19%), "The loss of our land due to the Spanish conquest or colonization" (14%), "The losses from the effects of alcoholism on our people" (12%), and "The losses from the effects of drugs on our people" (12%).

Most participants (62%) experienced one or more historical loss associated symptoms sometimes, often, or always. The most frequently experienced historical loss associated symptoms were "sadness or depression" (45%), "anger" (38%), "remembering these losses when you don't want to" (30%), "anxiety or nervousness" (29%), and "weakness or helplessness" (27%).

Figures 1 and 2 graphically depict correlations between HLS and HLAS scores for both ancestry groups. For the US/Canadian ancestry group (Figure 1), losses related to trust, self-respect, traditional ways, and the impacts of alcoholism had highest correlations with the HLAS. HLAS items most strongly associated with historical losses included memory intrusions, nightmares, loss of sleep, and feeling fearful. For participants with Latin American ancestry (Figure 2), losses related to trust, alcoholism, and self-respect (due to immigration or migration) had the highest correlations with HLAS items. Other items with high correlations include losses related to early death, drugs, and loss of culture. HLAS items most strongly associated with historical losses in this group included, in order of decreasing frequency, memory intrusions, feeling anger, and sadness.

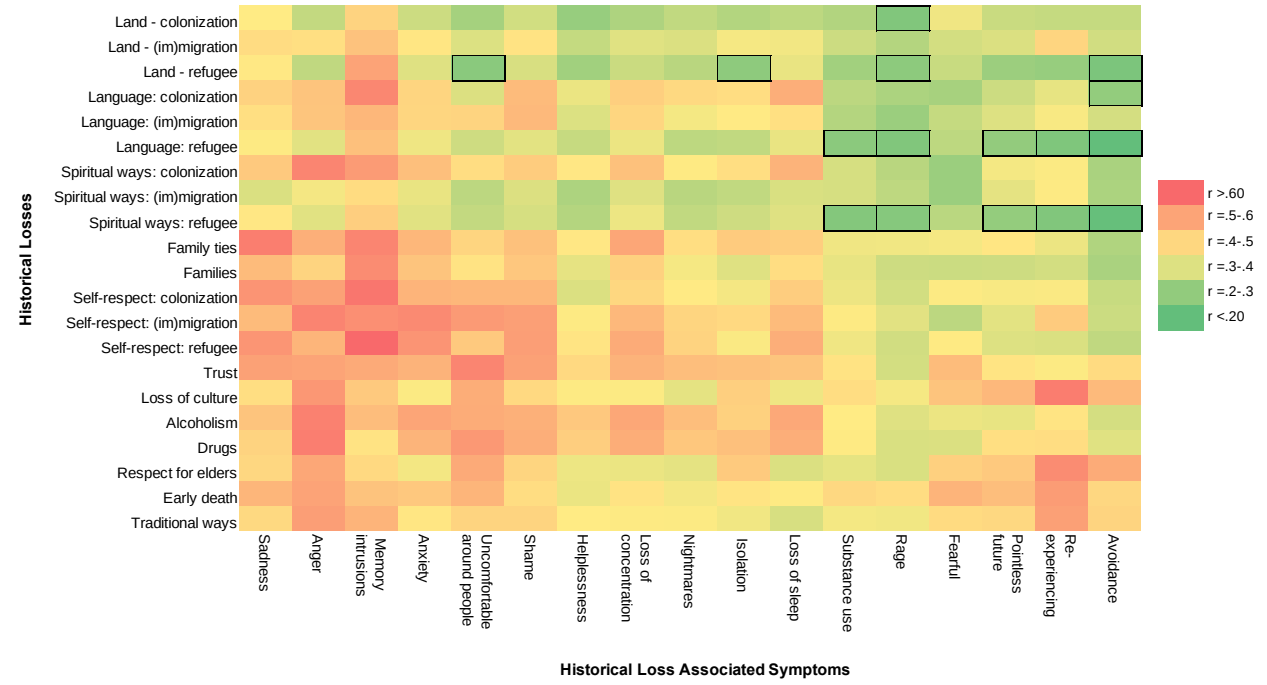
In bivariate analyses, Indigenous ancestry from the United States or Canada ($p < .001$), depression (< .001), greater participation in cultural ($p < .001$) and spiritual ($p < .01$) activities, and stronger identification with Indigenous identity ($p < 0.001$) were associated with greater average HLS scores (Table 2). An inverse association was observed between food security and average HLS ($p < .05$) and HLAS ($p < .01$) scores. Similarly, US or Canadian Indigenous ancestry ($p < .01$), depression ($p < .001$), greater participation in cultural ($p < .001$) and spiritual ($p < .05$) activities, and stronger Indigenous identity ($p < .01$) were associated with greater average HLAS scores.

Figure 1. Associations between historical losses and historical loss associated symptoms for Indigenous participants with US/Canadian ancestry



Note. **Cells with a border indicate non-significant correlations. All other correlations were significant at least at the $p < .05$ level.**

Figure 2. Associations between historical losses and historical loss associated symptoms for Indigenous participants with Latin American ancestry



Note. **Cells with a border indicate non-significant correlations. All other correlations were significant at least at the $p < .05$ level.**

Table 2

Median average historical loss and historical loss associated symptom scores, associations with participant characteristics, and multivariable logistic regression results

	Historical Loss Scale				Historical Loss Associated Symptoms			
			Odds of HLS Score >2				Odds of HLAS Score >2	
	Median (IQR)	p[1,2]	OR	95% CI[2]	Median (IQR)	p	OR	95% CI[2]
Demographic characteristics								
Gender		0.89	N/A			0.48	N/A	
Female	2.0 (1.6)				1.5 (0.9)			
Male	2.0 (1.6)				1.4 (0.9)			
Age		0.39	N/A			0.70	N/A	
18 - 39	2.1 (1.5)				1.5 (1.0)			
40 - 59	2.1 (1.5)				1.5 (0.9)			
60+	1.9 (1.3)				1.4 (1.1)			
Household income[3]		0.62	N/A			0.79	N/A	
0 - 200% FPL	2.1 (1.7)				1.4 (0.9)			
200% - 400% FPL	2.0 (1.0)				1.6 (0.9)			
400%+FPL	2.0 (1.3)				1.6 (0.9)			
Education		0.49	N/A			0.73	N/A	
<High school	1.7 (1.9)				1.4 (0.7)			
High school graduate	1.9 (1.5)				1.5 (1.0)			
Some college	2.1 (1.5)				1.5 (1.0)			
College or more	2.0 (1.5)				1.6 (0.9)			
Ancestry		<0.001				0.002		
US, Canada	2.2 (1.5)		2.88	(1.40 – 5.95)	1.6 (1.1)		3.82	(1.43 – 12.9)
MX, CA, SA	1.4 (1.1)		Ref		1.4 (1.0)		Ref	
Behavioral & psychosocial characteristics								
Alcohol		0.95	N/A			0.52	N/A	
High-risk drinker	2.2 (1.5)				1.7 (1.1)			
Normal-risk drinker	2.0 (1.5)				1.5 (0.9)			
Smoking		0.12	N/A			0.65	N/A	
Non-smoker	2.0 (1.5)				1.5 (1.0)			
Smoker	2.3 (1.6)				1.3 (1.6)			
Physical activity (MET-minutes/week)		0.14	N/A			0.39	N/A	
<500	1.8 (1.3)				1.4 (0.9)			
500 - 1000	1.8 (1.1)				1.3 (1.1)			
>1000	2.1 (1.6)				1.6 (0.9)			
Healthy food score		0.35	N/A			0.06		
First tertile (9-21)	1.9 (1.6)				1.5 (0.9)			
Second tertile (22-26)	2.1 (1.6)				1.6 (1.0)			
Third tertile (27-32)	1.8 (1.1)				1.4 (0.9)			
Unhealthy food score		0.15	N/A			0.28		
First Tertile (14-31)	1.7 (1.4)				1.4 (0.9)			
Second Tertile (32-39)	2.0 (1.7)				1.5 (1.0)			
Third Tertile (40-58)	2.1 (1.3)				1.6 (0.9)			

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Table 2 Continued
Median average historical loss and historical loss associated symptom scores, associations with participant characteristics, and multivariable logistic regression results

	Historical Loss Scale				Historical Loss Associated Symptoms			
			Odds of HLS Score >2				Odds of HLAS Score >2	
	Median (IQR)	p[1,2]	OR	95% CI[2]	Median (IQR)	p	OR	95% CI[2]
Depression (CES-D)		<0.001				<0.001		
Low depression risk	1.8 (1.2)		Ref		1.4 (0.8)		Ref	
High depression risk	2.5 (1.2)		3.77	(1.71 – 8.32)	2.0 (1.2)		8.86	(3.69 – 21.3)
Food security		0.013				0.003		
High security	1.8 (1.5)		Ref		1.4 (0.9)		Ref	
Low security	2.1 (1.4)		1.17	(0.51 – 2.69)	1.5 (0.9)		0.72	(0.27 – 1.95)
Very low security	2.4 (1.9)		0.77	(0.28 – 2.08)	2.0 (1.3)		0.79	(0.27 – 2.35)
Indigenous identity score		<0.001				0.002		
First tertile (15-33)	1.3 (1.3)		Ref		1.2 (1.0)		Ref	
Second tertile (34-39)	1.9 (1.3)		1.25	(0.55 – 2.86)	1.5 (0.8)		1.02	(0.36 – 2.85)
Third tertile (40-49)	2.3 (1.1)		2.13	(0.88 – 5.18)	1.7 (1.0)		1.47	(0.52 – 4.20)
Cultural activity participation (per year)		<0.001				<0.001		
None	1.3 (1.2)		Ref		1.1 (0.6)		Ref	
One	1.3 (1.2)		1.25	(0.39 – 3.99)	1.1 (0.9)		2.51	(0.57 – 11.0)
Two	1.9 (1.4)		2.09	(0.67 – 6.48)	1.5 (0.9)		2.98	(0.69 – 12.8)
Three or more	2.3 (1.1)		6.20	(1.96 – 19.6)	1.8 (0.9)		4.13	(0.99 – 17.2)
Spiritual activity participation (per year)		0.003				0.02		
None	1.8 (1.2)		Ref		1.4 (0.9)		Ref	
One	1.6 (1.6)		0.31	(0.11 – 0.89)	1.4 (0.9)		0.66	(0.19 – 2.24)
Two	2.5 (1.8)		0.95	(0.33 – 2.72)	1.8 (1.0)		1.91	(0.59 – 6.17)
Three or more	2.2 (1.1)		0.75	(0.26 – 2.22)	1.7 (0.9)		0.90	(0.25 – 3.21)

[1]p-value for the Wilcoxon Rank Sum Test for categorical variables with two levels and the Kruskal-Wallis Test for variables with three or more levels. [2]Boldface indicates statistical significance, $p<0.05$. [3]Household income was classified using poverty level (FPL) guidelines.

In the multivariable analysis, Indigenous ancestry, depression, and engagement in cultural activities were significantly associated with HLS scores, after controlling for all other variables with significant associations in the bivariate analysis. The odds of reporting a HLS score >2 were more than two times greater for Indigenous persons from the United States or Canada compared to Indigenous adults from Latin America (Odds Ratio [OR] = 2.88; 95% Confidence Interval [CI]: 1.71, 8.32). The odds of reporting an HLS score >2 were almost four times greater for participants endorsing symptoms consistent with high risk of depression compared to participants with low depression risk (OR = 3.77, 95% CI: 1.71, 8.32) and more than six times greater for participants who engaged in cultural activities three or more times during the last year compared to participants who did not participate in any cultural activities (OR = 6.20, 95% CI: 1.96, 19.6).

Similarly, the odds of reporting a HLAS score >2 were over three times greater for Indigenous persons from the United States or Canada compared to Indigenous adults from Latin America (OR = 3.82; 95% CI: 1.43, 12.9), and more than eight times greater in participants endorsing symptoms consistent with high risk of depression compared to participants with low depression risk (OR = 8.86, 95% CI: 3.69, 21.3).

DISCUSSION

To our knowledge, this is the first study to describe historical losses and their associated symptoms in an urban population of Indigenous adults at risk for diabetes. Nearly half (49%) of participants with Indigenous ancestry from the United States or Canada and a third (32%) of participants with Indigenous ancestry from Latin America thought about one or more historical losses at least weekly. In addition, 62% of all participants experienced at least one symptom associated with historical losses sometimes, often, or always. These findings illustrate that historical trauma, as measured by the HLS and HLAS scales, was frequently experienced in this sample of Indigenous adults living in an urban area.

In 2004, Whitbeck et al. reported HLS and HLAS data for 143 Indigenous adults recruited from two reservations in the American Midwest. Weekly or more often, over half of these adults thought about various losses, and some items from the HLAS were endorsed by over 60% of respondents. Indigenous adults in our sample, recruited from an urban area, experienced similar historical losses and associated symptoms as their reservation-based counterparts but at slightly lower levels. It is possible that individuals residing in tribal reservations face additional stressors such as deep poverty, unemployment, and other socioeconomic barriers (Krogstad, 2014), which may exacerbate symptoms associated with historical trauma.

The literature comparing historical trauma and associated symptoms among Indigenous groups with diverse ancestry is scarce (Brave Heart et al., 2011). Findings from the present study further the extant literature on differences in experiences and magnitude of historical loss and trauma by ancestry. We found that a higher proportion of participants with Indigenous ancestry from the United States or Canada endorsed thinking about one or more historical losses weekly, daily, or several times a day, compared to their counterparts with Latin American ancestry. This was also shown in our multivariate analysis where participants who were Indigenous to the United States or Canada had higher scores in the HLS and HLAS, even after controlling for other covariates. Observed differences may reflect group differences in historical experiences with

colonization, assimilation, and acculturation. Such differences may reflect the importance of place in contextualizing historical trauma, in particularly histories and experiences of displacement and land loss (Walters, Beltran et al., 2011). Indigenous participants of Latin American descent could also be experiencing other, and perhaps more, salient discrimination events related to assumptions of foreign-born status and current anti-immigrant sentiment across the country. Given the diversity of Indigenous populations, it may be important to consider ancestry differences in HLS and HLAS when designing and delivering interventions in this context.

The finding that participants who more frequently engaged in cultural practices may be particularly vulnerable to experiences of historical trauma is a complex finding requiring further exploration. It is important to emphasize that, in general, the literature supports a buffering effect of engagement in traditional cultural and spiritual practices in combating negative impacts of environmental insults and are generally recommended for diabetes programs (Brave Heart et al., 2011; Mitchell, 2012; Shaw et al., 2013). It is possible that participation in cultural and religious practices may have increased awareness of historical trauma and its sequelae. This experience may result in an increased need for support and opportunities to process. Interventions could provide support and opportunities to heal and develop culturally congruent and appropriate coping or cultural revitalization strategies. This may be particularly relevant for urban communities that may lack or have more intermittent cultural sources of support and racial socialization available to them. It is also possible that the positive association of participation in cultural activities and historical losses does not account for other important variables. Prior research has shown that stronger ethnic identification and less comfort in mainstream society were associated with increased thoughts of historical loss among AI college students (Tucker et al., 2016). Additionally, systematic reviews have identified engagement in traditional Indigenous ways of life to be associated with lower adherence to self-management recommendations, in part due to mistrust in providers (Scarton & de Groot, 2016). These studies point to the potential role of additional variables—such as discrimination and mistrust—in explaining findings. Thus, findings not accounting for these additional variables should be interpreted with caution.

Positive bivariate associations observed in this study between depression and food insecurity with HLS and HLAS scores may elucidate how historical trauma could compromise diabetes prevention efforts, in particular by negatively influencing health behaviors. For example, previous studies have shown that depression and food insecurity are negatively associated with physical activity (Cueva et al., 2020; Delahanty et al., 2006; To et al., 2014), positively associated

with obesity (Luppino et al., 2010; Pan et al., 2012), and independently associated with an increased risk of diabetes (Kahl et al., 2015; Gucciardi et al., 2014). Thus, incorporating interventions that address depression and food insecurity may be important adjunctive strategies for successful diabetes prevention in the context of historical trauma. Indeed, food is integrally connected to culture and traditional knowledge and practices (Alonso et al., 2019; DeBruyn et al., 2020; Satterfield et al., 2016). Discussions around traditional foods have been implemented as a way of discussing culture and history and promoting conversations around health and diabetes prevention in Indigenous communities (DeBruyn et al., 2020). These conversations and activities involve growing and preparing foods, storytelling, and talking circles. Moreover, the food sovereignty movement has received recent attention, particularly among tribes (DeBruyn et al., 2020), as a way to restore the local food environment, while incorporating elders and intergenerational knowledge sharing. An example of this traditional food movement can be found in Phoenix, AZ, where an urban garden ties sustainable food access with education, capacity building programs, and storytelling to connect food with health and well-being for urban Indigenous communities (Wesner, 2015).

Other urban Indigenous programs are also using holistic approaches to improve diabetes prevention and control. The Sogorea Te' Land Trust program[1] in Northern California incorporates food access and nutrition activities (urban gardens, cooking of culturally appropriate recipes, food distribution), mental health (activities aimed at increasing socialization and involving elders as role models), language revitalization programs, spirituality (via ceremonies), and promotion of physical activity (in part via working in the land). Other aspects involve leadership opportunities, creating a space to share and return to, and conducting advocacy around land rights and historical trauma. Additional research is needed to assess the efficacy of these types of programs as a different strategy for addressing diabetes and other chronic diseases in Indigenous communities.

Despite these promising efforts, a few limitations exist. First, the majority of research has been conducted in tribal communities (Alonso et al., 2019; DeBruyn et al., 2020; Satterfield et al., 2014), highlighting the need for similar programs in urban areas. Second, while traditional components of DPP interventions involve discussion and content around healthy eating and nutrition, our findings suggest a need to address food security as well. For example, programs adapted for urban medically underserved communities, including Indigenous ones, concentrate on promoting healthy food choices (Benyshek et al., 2013; Seidel et al., 2008); however, it is less

[1] https://sogoreate-landtrust.org

evident whether they discuss or address potentially underlying food insecurity. In fact, scholars have pointed to a lack of efforts to address underlying socioeconomic factors (including food insecurity, poverty) that can facilitate long lasting and systemic prevention of diabetes, obesity, and other comorbid conditions (Spencer et al., 2016). Finally, while DPP interventions include discussions around stress management and problem solving, discussions around depression or historical trauma associated symptoms (e.g., anxiety) are not typically included. Storytelling and talking circles appear to be the most common strategies used to incorporate historical trauma and incorporate cultural and traditional values into Indigenous diabetes programs (Rosas et al., 2016; Satterfield et al., 2014).

Research and Clinical Implications

A dearth of empirical research exists addressing the health of urban Indigenous communities in the context of diabetes and historical trauma. While limited research and interventions exist for urban Indigenous populations, some studies have successfully implemented culturally congruent strategies including talking circles, storytelling, and photovoice to engage Indigenous participants in a DDP (Rosas et al., 2016). Additional research providing data for different groups (e.g., urban vs. tribal communities, different ancestry groups), exploring nuances in cultural and demographic characteristics and their impact on chronic conditions, as well as exploring potential interventions is crucial.

Clinically, our results can increase awareness among primary care providers and other health care professionals of the prevalence of historical loss and associated symptoms among Indigenous adults at risk for diabetes. Clinical interventions such as the Historical Trauma and Unresolved Grief Intervention (Brave Heart, 1998) could potentially be integrated with diabetes prevention. The positive association observed between depression and historical loss and associated symptoms underscores the importance of integrating support for mental wellness. As such, culturally centered depression interventions may be important for effective diabetes prevention. Primary-care based brief low-intensity depression interventions have been shown to be effective with diverse populations (Lopez-Montoyo et al., 2019). Additionally, incorporating traditional medicine could be a potential strategy for ameliorating the impacts of trauma (Marsh et al., 2016) and positively influence health (Mainguy et al., 2013).

Given the complexity of historical trauma and its associated symptoms, which can include symptoms of anxiety, depression, substance use, and post-traumatic stress (Sotero, 2006), holistic

approaches to addressing mental health are needed. Moreover, providers must be educated on the multiple ways in which historical trauma can be experienced by current generations. For example, via experiences as children (e.g., exposure to relatives who were direct victims of trauma and subjugation), behavioral and social problems in the community (e.g., suicides, substance use), collective memory and oral traditions (e.g., accounts of trauma shared via storytelling), and through direct experiences of ongoing trauma and marginalization (e.g., deep poverty and deprivation, discrimination, social inequities) over the individuals' lifetime (Sotero, 2006). This complexity also calls for new paradigms and programs (Duran et al., 1998; 2019) and the need to connect the past with the present in the case conceptualization and in treatment planning.

Study Limitations and Future Directions

The present study has limitations to consider. First, experiences of historical loss and trauma captured in this study may not be generalizable to Indigenous populations living on reservations or in other urban areas. In addition, the cross-sectional design of this study limits the ability to ascertain causal relationships between historical loss and trauma and participant characteristics. Future studies using longitudinal designs should examine direction of associations and test whether intervening in certain psycho-social variables (e.g., depression) can reduce the endorsement and impacts of historical trauma-associated symptoms. Longitudinal research is also needed for understanding complex relationships between historical losses, associated symptoms, and health behaviors. Moreover, we employed HLS and HLAS as our primary measures of historical trauma, which conceptualize a complex phenomenon mostly within the spectrum of emotional distress. Although we adapted some of the content for our population, it is possible that other measures might be better able to capture specific stressors faced by urban Indigenous populations. Additionally, it is possible that participants and community members may have different conceptualizations of and reactions to historical trauma compared to those measures by Whitbeck and others. As the empirical literature surrounding historical trauma continues to grow, psychometric refinement of measures and population specific data is needed. We hope our data contributes to this effort and can be used by future metanalysis or other cross-study synthesis efforts. Finally, future studies should consider other factors that also contribute to diabetes and other chronic conditions. For instance, exposure to pollutants (e.g., polychlorinated biphenyls, pesticides) has been associated with diabetes and obesity in Indigenous communities (Aminov &

Carpenter, 2020; Codru et al., 2007). Thus, future studies should assess key environmental and social factors that can further illuminate risk and areas for additional intervention.

The results of this study suggest that historical trauma and associated symptoms are prevalent among urban Indigenous adults at risk for diabetes, particularly Indigenous adults from the United States and Canada. Strategies that address these challenges may improve engagement and success in prevention programs for Indigenous individuals in urban areas. Additionally, observed associations between HLS and HLAS with frequent participation in cultural activities deserves more attention to understand how this cultural asset could be leveraged to improve diabetes prevention for this population.

CONCLUSION

The prevalence of diabetes in the United States calls for reinvigorated efforts to attenuate this public health crisis. The results of this study highlight the needs of urban Indigenous adults, which are distinct from the significant public health efforts needed on U.S. reservations. These findings suggest that as preventive efforts serving Indigenous adults expand in urban environments, behavioral interventions must incorporate strategies that address community-identified barriers to success. For our community partner and in this study, historical trauma was identified as a challenge that manifested as comorbid depression and low food security, which could decrease the likelihood of successful diabetes prevention efforts. Identifying and addressing the unique challenges specific to distinct communities and unique to urban settings has the greatest potential for successful program implementation and diabetes prevention.

List of Abbreviations

AI/AN: American Indian, Alaska Native; DPP: Diabetes Prevention Program; HLS: Historical Loss Scale; HLAS: Historical Loss Associated Symptom Scale.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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APPENDIX

Table A1

Frequencies of historical losses among Indigenous persons from the US and Canada (n = 126)

	Never, Yearly, Only special times (%)	Monthly (%)	Weekly, Daily, Several times a day (%)
The loss of our land	66.7	13.3	20.0
The loss of our Indigenous language	67.5	15.5	17.0
Losing our traditional spiritual ways	59.4	19.5	21.1
The loss of our family ties because of boarding or residential schools	73.0	13.9	13.1
The loss of families from the reservation to government relocation	76.9	10.7	12.4
The loss of self-respect from poor treatment by government officials	71.5	11.4	17.1
The loss of trust in whites from broken treaties	68.6	12.4	19.0
Losing our culture	60.7	15.5	23.8
The losses from the effects of alcoholism on our people	53.7	17.1	29.2
The losses from the effects of drugs on our people	54.6	14.0	31.4
Loss of respect by our children and grandchildren for elders	54.0	17.0	29.0
Loss of our Indigenous people through early death	62.3	15.6	22.1
Loss of respect by our children for traditional ways	58.2	18.8	23.0

Table A2
Frequencies of Historical Losses Among Indigenous Persons from Mexico and Central and South America (n = 67)

	Never, Yearly, Only special times (%)	Monthly (%)	Weekly, Daily, Several times a day (%)
The loss of our land due to the Spanish conquest or colonization	79.5	6.9	13.7
The loss of our land due to immigration or migration to the US	78.7	9.3	12.0
The loss of our land due to being a refugee	91.7	5.6	2.8
The loss of our Indigenous language due to the Spanish conquest or colonization	82.2	11.0	6.8
The loss of our Indigenous language due to immigration or migration to the US	83.6	6.9	9.6
The loss of our Indigenous language due to being a refugee	94.3	4.3	1.4
Losing our traditional spiritual ways due to the Spanish conquest or colonization	82.4	9.5	8.1
Losing our traditional spiritual ways due to immigration or migration to the US	87.8	6.8	5.4
Losing our traditional spiritual ways due to being a refugee	92.9	5.7	1.4
The loss of our family ties because of boarding or residential schools	87.3	7.0	5.6
The loss of families from the reservation to government relocation	91.4	5.7	2.9
The loss of self-respect from poor treatment by government officials due to the Spanish conquest or colonization	86.0	7.0	7.0
The loss of self-respect from poor treatment by government officials due to immigration or migration to the US	88.7	7.0	4.2
The loss of self-respect from poor treatment by government officials due to being a refugee	92.9	5.7	1.4
The loss of trust in whites from broken treaties	86.3	11.0	2.7
Losing our culture	70.7	18.7	10.7
The losses from the effects of alcoholism on our people	78.4	9.5	12.2
The losses from the effects of drugs on our people	77.0	10.8	12.2
Loss of respect by our children and grandchildren for elders	60.5	19.7	19.7
Loss of our Indigenous people through early death	73.7	14.5	11.8
Loss of respect by our children for traditional ways	69.3	12.0	18.7

Table A3
Frequencies of emotional responses to historical losses (n = 205)[1]

	Never (%)	Seldom (%)	Sometimes (%)	Often (%)	Always (%)
How often do you feel sadness or depression?	31.9	22.9	34.6	7.9	2.7
How often do you feel anger?	37.6	24.3	26.9	7.9	3.2
How often do you feel like you are remembering these losses when you don't want to?	44.1	25.8	20.9	4.3	4.8
How often do you feel anxiety or nervousness?	54.7	16.3	23.2	3.7	2.1
How often do you feel uncomfortable around white people when you think about these losses?	56.6	20.6	15.3	4.8	2.7
How often do you feel shame when you think of these losses?	66.7	15.9	10.6	4.8	2.1
How often do you feel a sense of weakness or helplessness?	58.7	14.8	19.6	4.2	2.7
How often do you feel a loss of concentration?	64.6	17.5	12.2	5.3	0.5
How often do you have bad dreams or nightmares?	66.7	17.5	12.7	3.2	0.0
How often do you feel isolated or distant from other people when you think of these losses?	62.8	16.5	14.4	3.7	2.7
How often do you have a loss of sleep?	62.6	18.4	14.2	4.2	0.5
How often do you feel the need to drink or take drugs when you think of these losses?	87.4	8.4	3.1	1.1	0.0
How often do you feel rage?	78.0	11.0	8.4	2.6	0.0
How often do you feel fearful or distrustful of the intentions of white people?	62.9	13.8	16.9	3.7	2.7
How often do you feel there is no point in thinking about the future?	74.7	14.7	7.4	1.6	1.6
How often do you feel like it is happening again?	63.5	15.3	17.5	2.7	1.1
How often do you feel like avoiding places or people that remind you of these losses?	69.8	13.8	7.9	5.8	2.7

[1] Some participants completed this questionnaire, but not the HLS scale reported in Tables A1 and A2. Both Indigenous participants to the US or Canada or to Mexico, South, or Central America completed the same HLAS scale reported here.

RETENTION IN A 6-MONTH SMOKING CESSATION STUDY AMONG ALASKA NATIVE AND AMERICAN INDIAN PEOPLE

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Abstract: Participant retention in longitudinal health research is necessary for generalizable results. Understanding factors that correlate with increased retention could improve retention in future studies. Here, we describe how participant and study process measures are associated with retention in a longitudinal tobacco cessation research study performed in Anchorage, Alaska. Specifically, we conducted a secondary analysis exploring retention among 151 Alaska Native and American Indian (ANAI) people and described our study processes using study retention categories from a recent meta-analysis. We found that our study processes influence retention among ANAI urban residents more than measures collected about the participant. For study process measures, calls where a participant answered and calls participants placed to the study team were associated with higher retention. Calls where the participant did not answer were associated with lower retention. For participant measures, only lower annual income was associated with lower retention at 6 weeks. Promoting communication from participants to the study team could improve retention, and alternative communication methods could be used after unsuccessful calls. Finally, categorizing our study retention strategies demonstrated that additional barrier-reduction strategies might be warranted.

INTRODUCTION

High participant retention between study enrollment and conclusion is often needed to ensure sufficient power and unbiased results (Young et al., 2006; Redwood et al., 2010; Robinson et al., 2007; Singh et al., 2018; Teague et al., 2018). Characteristics of those who participate consistently and are retained in longitudinal cohort studies often differ in important ways from those who miss follow-up appointments, leading to lower generalizability of findings (Young et al., 2006; Redwood, 2010; Odierna & Schmidt, 2009; Robinson et al., 2007).

Strategies to maximize participant retention, especially among underserved and minority populations, must be considered when researchers design and implement longitudinal studies. Doing so will ensure generalizability of findings, account for population-specific differences, and promote equitable provision of health services—including health research. A tumultuous relationship with the United States government and health care systems, as well as health research misconduct, have led to a legacy of mistrust in health research among many minority communities (Kennedy et al., 2007; Dillard et al., 2019). This, along with other factors, may contribute to the reported difficulty of retaining study participants from diverse and often under-represented populations (Clark, 2012; Nicholson et al., 2015). The effectiveness and reproducibility of retention strategies that work well for one population might not be as effective in another. Importantly, geographic considerations, such as those found in Alaska, may necessitate different retention strategies and support efforts (Beans et al., 2019; Clark, 2012).

One area where retention is of consistently great concern is tobacco cessation research. Research in this area is critically needed because tobacco cessation is extremely difficult for most people, with low annual quit rates and many attempts needed, on average, before tobacco cessation success (Chaiton et al., 2016; Kotz et al., 2014; Hensel et al., 1995; Borland et al., 2011; Kealey et al., 2007). Research on such programs is often impaired by relatively high numbers of participants leaving the tobacco cessation program before the program end date. The proportion of participants who fully complete these programs is often low; for instance, Daley et al. (2018) report that slightly less than three-quarters of participants who began a tobacco cessation program implementation study completed a 24-week follow-up. This proportion is actually quite good, as Smith et al. (2017) report that the proportion of participants who complete studies is "often in the low-to-moderate range, from under half up to three-quarters of the original sample" (p. 171). Improving tobacco cessation research by adopting strategies that increase retention could increase the generalizability of results and accordingly improve tobacco cessation program outcomes.

There is also a strong need for dissemination of information regarding retention practices used in longitudinal studies, as the retention literature is limited and sometimes contradictory in its findings (Robinson et al., 2007; Teague et al., 2018). For instance, a systematic review from 2007 and an updated review in 2015 found that a higher number of retention strategies (e.g., alternative contacts or having a dedicated research phone number) correlated with higher overall retention, while a recent meta-analysis found the association non-significant (Robinson et al, 2015; Robinson et al., 2007; Teague et. al, 2018). Varying recruitment settings and populations may

contribute to these seemingly contradictory findings. Recent work by Teague et al. (2018) recommended using a systematic approach to report retention strategies and resulting outcomes. The Teague classification system has four domains of study retention strategies: barrier-reduction, community-building, follow up and reminder, and tracing (Teague et al., 2018).

In this paper we identify participant and study process measures associated with participant retention in a six-month, observational study of urban Alaska Native and American Indian people (ANAI) who smoke, a group rarely described in the retention literature (Redwood et al., 2010; Teague et al., 2018). In addition, we used Teague et al.'s categorization scheme to classify the retention strategies employed in this longitudinal study and identify areas for improvement. Framing our study processes in a standardized way, evaluating which measures correlate with study retention, and identifying which retention strategies were helpful could improve participant retention and increase the generalizability of longitudinal tobacco cessation research.

METHODS

Setting

The study was conducted at Southcentral Foundation (SCF), a nonprofit, tribally-owned and operated health care organization that provides pre-paid primary care services to over 65,000 ANAI people living in southcentral Alaska. SCF's vision is "a Native Community that enjoys physical, mental, emotional and spiritual wellness"; its mission is "working together with the Native Community to achieve wellness through health and related services" (Gottlieb, 2013).

Participants were recruited directly from SCF's Quit Tobacco Program, which started in 2004 in response to the relatively high rate of smoking among ANAI people (Fenn et al., 2007; Hensel et al., 1995; Dilley et al., 2013). The Quit Tobacco Program is a comprehensive, multidisciplinary health service option that provides tobacco cessation, pharmacological, and counseling services to eligible ANAI individuals according to evidence-based guidelines, including the U.S. Public Health Service Clinical Practice Guideline (Fenn et al., 2007).

Study Design

This exploratory, secondary data analysis focused on measures that correlated with participant retention in a tobacco cessation study. The six-month, observational tobacco cessation study was conducted to identify the relative contributions of sociodemographic, clinical, and

genetic factors affecting pharmacological interventions to help ANAI people successfully quit smoking tobacco. The cessation study consisted of three data collection study visits: baseline (before quitting tobacco), 6-weeks post quit date, and 26-weeks post quit date. At baseline, participants were asked to answer a series of surveys related to tobacco use and sociodemographic characteristics. The 6- and 26-week study visits involved surveys about tobacco use. Blood draws, an expelled carbon monoxide test, and urine sample collection were conducted at each study visit to measure several genetic and metabolic parameters pertaining to smoking cessation. Participants were given a $20 incentive at the completion of each study visit, for a potential total of $60.

At the end of each of the first two study visits, participants scheduled their next visit, unless participants asked to schedule it later. The study team provided standard business hours during which participants could schedule a study visit (8:00 A.M. to 5:00 P.M., Monday to Friday). The project also provided a specific telephone number that study participants could call or text to reach the study team. The team scheduled two participants simultaneously if the participants requested it. A reminder letter was sent approximately three weeks before the scheduled study visit. Letters were also sent to participants if they missed a study visit. Two reminder calls were made to participants, one week before and one day before the scheduled study visit. Study staff would either confirm the study visit, reschedule, or leave a voicemail. If the participant could not be reached, study staff called an alternative contact person, provided by most participants at baseline. Up to three phone call reminders were made for each scheduled study visit. When a participant missed a study visit, study staff would attempt to reschedule the visit with up to three separate contacts (two calls to the participant and one to the alternative contact). In total, study staff contacted participants up to 6 times and alternative contacts up to 2 times between each study visit. Each contact was logged in a contact database. Emails and texts were only sent to participants if they requested these communication methods.

An advisory group helped ensure that the project was acceptable to the ANAI community prior to any data collection. Regular feedback reports were sent to research partners to keep track of study data such as the number of people scheduled for study visits in the upcoming week. This project was reviewed and approved by the Alaska Area Institutional Review Board (AAIRB# 2015-10-037). In addition, this study and manuscript was reviewed and approved by SCF and the Alaska Native Tribal Health Consortium Research Review Boards prior to journal submission (Hiratsuka et al., 2017).

Participants

Individuals were eligible to participate in the tobacco cessation study if they were enrolled in SCF's Quit Tobacco Program, self-identified as ANAI, were 18 years of age or older, smoked at least 100 cigarettes to date, and smoked in the last 24 hours. Exclusion criteria were simultaneous use of other tobacco products which included chew, electronic cigarettes, pipes, cigars, or iqmik—a smokeless tobacco used among AN people (Renner et al., 2005). Additionally, potential participants were ineligible to participate if they were being treated for cancer, had hemophilia, or were pregnant.

Informed Consent

Participants in the tobacco cessation study provided informed consent before any data were collected. The informed consent included an overview of the study and potential risks and benefits of participation in the study. Participants were informed throughout the study that participation was voluntary.

Measures and Materials

Participant measures were collected via in-person surveys and from a de-identified dataset of electronic medical record information. Study process and retention measures were recorded by study staff in a Microsoft Access® database.

Participant Measures

Participant measures included gender, age, residence type, number of people in residence, number of children in residence, number of tobacco users in residence who are trying to quit tobacco, highest level of education, annual household income, number of cigarettes smoked per day, Fagerström test for tobacco dependence, reported readiness to stop smoking, and the reported main reason to stop smoking. A proxy variable for employment was constructed from multiple self-report variables (i.e., 'Yes' to 'do you or others smoke at work', 'Yes' to 'works nights or swing shift', or 'Yes' to 'current member of the armed forces').

Study Process Measures

Study process measures included the number of contact attempts made to a participant or alternative contact after baseline; the number of successful calls made by research staff to a

participant or alternative contact (i.e., if a researcher successfully conversed with the participant); and the number of unsuccessful call attempts made by research staff to a participant or alternative contact (i.e., participant missed call, a voicemail was left, or phone number was no longer working). Each of these types of calls were categorized to increase the statistical power by grouping the larger number of calls together (i.e., categories are 0 calls, 1 call, 2 calls, 3 calls, or 4 or more calls). Other variables included whether emails, letters, or texts were sent to a participant and whether the participant contacted the study team.

Retention Measures

The primary outcome of interest was whether a participant attended or missed follow-up study visits. In each of three intervals (e.g., baseline to 6-weeks, 6-weeks to 26-weeks, and baseline to 26-weeks), participants were stratified into 'retained' or 'not-retained' groups before tests of comparison were conducted. The baseline to 26-week interval reflects retention irrespective of attendance of the 6-week study visits.

Data Collection

Data collection for the tobacco cessation study took place between July 2016 and October 2018. Participant measures were collected by surveys during the study visit and an electronic medical record query. Study process measures were queried from the Microsoft Access® database and reviewed manually to ensure accurate data extraction for texts, calls, emails, and mailing letters. For number of calls, and their sub-distinctions, data were created through an iterative manual process by reviewing the call logs. Calls were documented for each participant, and a random sample of 20% of the extracted call data were reviewed by a second study team member to ensure inter-reviewer consistency and definitional agreement. In cases of ambiguity, two team members discussed the data until consensus was reached. A final review was conducted on the call logs to reduce the possibility of error.

Analysis

Descriptive statistics on participant and study process measures were calculated as percentages for categorical variables and median with interquartile range (IQR) for continuous variables.

We assessed the association of participant and study process measures with retention between the three intervals: baseline to 6-weeks, 6-weeks to 26-weeks, and baseline to 26-weeks. We fit separate regression models for each independent variable. Significance of association was assessed with a chi-square test for categorical data and a t-test for continuous data. Odds ratio (OR) are reported with 95% confidence intervals (CI). We emphasize ORs and CIs, rather than *p*-values, for interpretation of results since this is an exploratory analysis (Goodman, 2008). All analyses were conducted using R software version 3.5.3 (R Core Team, 2020).

Participant retention strategies used in this study were categorized in accordance with Teague et al. (2018). This method of reporting processes adds to the transparency in research methodology, may provide a useful tool with pragmatic examples for others to incorporate, and allowed us to identify retention strategies that worked well and areas needing improvement. Retention strategies were grouped into four main domains: barrier-reduction, community-building, follow-up and reminder, and tracing.

RESULTS

Participant Description

Participants enrolled at baseline (N = 151) included more women (58%), and the median age was 45 (Table 1). Most participants lived in a single-family home (45%) or an apartment/condominium (49%). Within a participants' residence, over half had 3 or more people and around 20% lived by themselves. Over half did not have a child living in the residence, and around 30% of participants had another person in the residence trying to quit smoking. The majority (83%) of participants were currently employed. Most graduated high school/earned a GED (37%) or had some college education (44%). Over half (52%) had an annual household income below $30,000.

The median number of cigarettes smoked per day was 10. Fagerström scores for nicotine dependence were 'Low' (58%), 'Moderate' (25%), and 'High' (17%). The most common self-reported reason to stop smoking was 'general health' (46%), followed by 'cost' (20%), 'reduce risk of cancer' (8%), among other reasons.

From baseline to the next study appointment 6 weeks after the quit date, 86 (57%) participants attended. Forty-eight attended both the 6- and 26-week appointments; accordingly, complete study retention was 32%. Independent of attending the 6-week appointment, 54 (36%) participants attended the 26-week appointment.

Table 1
Distribution of participant and study process measures

	Baseline ***N* = 151**	Baseline to 6-weeks Retained ***N* = 86**	6-weeks to 26-weeks Retained ***N* = 48**	Baseline to 26-weeks Retained ***N* = 54**
Participant Measures	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Gender				
Female	87 (58)	50 (58)	27 (56)	30 (56)
Male	64 (42)	36 (42)	21 (44)	24 (44)
Age, median (IQR)	45 (35-54)	47 (35-54)	48 (36-54)	48 (35-54)
Residence				
Single family home	68 (45)	45 (52)	22 (46)	23 (43)
Apartment/Condo	74 (49)	38 (44)	24 (50)	29 (54)
Other[a]	8 (5)	2 (2)	2 (4)	2 (4)
People in residence				
1	29 (19)	14 (16)	10 (21)	11 (20)
2	40 (26)	24 (28)	14 (29)	15 (28)
3+	82 (54)	48 (56)	24 (50)	28 (52)
Children in residence				
0	86 (57)	45 (52)	29 (60)	32 (59)
1+	65 (43)	41 (48)	19 (40)	22 (41)
Residents trying to quit				
1 (self)	107 (71)	58 (67)	35 (73)	41 (76)
2+	44 (29)	28 (33)	13 (27)	13 (24)
Employment status				
Working	125 (83)	68 (79)	38 (79)	44 (81)
Education				
Some high school	19 (13)	9 (10)	5 (10)	5 (9)
High school graduate/GED	56 (37)	32 (37)	18 (38)	22 (41)
Some college	66 (44)	40 (47)	23 (48)	24 (44)
College graduate or more	10 (7)	5 (6)	2 (4)	3 (6)
Annual household income				
<$9,999	40 (26)	16 (19)	8 (17)	10 (19)
$10,000-29,999	40 (26)	21 (24)	15 (31)	16 (30)
$30,000 – 49,999	25 (17)	19 (22)	10 (21)	11 (20)
$50,000 – 69,999	23 (15)	12 (14)	8 (17)	10 (19)
$70,000+	23 (15)	18 (21)	7 (15)	7 (13)
Cigarettes[b] per day, median (IQR)	10 (7-15)	10 (7-15)	10 (7-15)	10 (7-15)
Fagerström test for nicotine dependence				
Low (0-4)	88 (58)	53 (62)	34 (71)	35 (65)
Moderate (5-6)	37 (25)	20 (23)	8 (17)	11 (20)
High (7-10)	26 (17)	13 (15)	6 (13)	8 (15)
Reason to stop smoking				
General health	69 (46)	39 (45)	23 (48)	26 (48)
Cost	30 (20)	16 (19)	10 (21)	12 (22)
Risk of cancer	12 (8)	5 (6)	2 (4)	3 (6)
Other[c]	30 (20)	26 (30)	13 (27)	13 (24)

continued on next page

Table 1 continued
Distribution of participant and study process measures

	Baseline ***N* = 151**	Baseline to 6-weeks Retained ***N* = 86**	6-weeks to 26-weeks Retained ***N* = 48**	Baseline to 26-weeks Retained ***N* = 54**
Study Process Measures	n (%)	n (%)	n (%)	n (%)
Successful calls made to participant				
0	29 (19)	5 (6)	2 (4)	2 (4)
1	26 (17)	11 (13)	4 (8)	6 (11)
2	33 (22)	23 (27)	12 (25)	13 (24)
3	22 (15)	18 (21)	12 (25)	12 (22)
4+	41 (27)	29 (34)	18 (38)	21 (39)
Unsuccessful calls to participant				
0	17 (11)	11 (13)	9 (19)	10 (19)
1	27 (18)	17 (20)	11 (23)	13 (24)
2	28 (19)	17 (20)	11 (23)	12 (22)
3	24 (16)	15 (17)	8 (17)	10 (19)
4+	55 (36)	26 (30)	9 (19)	9 (17)
Participant contacted study team				
0	94 (62)	44 (51)	23 (48)	27 (50)
1	35 (23)	28 (33)	15 (31)	16 (30)
2+	22 (15)	14 (16)	10 (21)	11 (20)
Study team emailed participant	21 (14)	9 (10)	2 (4)	2 (4)
Study team texted participant	5 (3)	2 (2)	1 (2)	1 (2)
Study team mailed letter to participant	115 (76)	65 (76)	32 (67)	37 (69)

Note. Numbers rounded to nearest whole number.
[a]Other = halfway house, mobile home, shelter, rooming, or boarding house
[b]Menthol and non-menthol cigarettes
[c]Bad breath, ability to be physically active, reduce risk of heart disease, role model for family, health of family in the home

Study Process Description

The study team made many calls (Table 1); 80% of participants spoke with the study team, with 27% having four or more calls. Only 11% of participants had zero unsuccessful calls – meaning the study team connected with the participant on every call attempt. Over a third (36%) had four or more unsuccessful calls, meaning the participant did not answer, the phone number was not a working number, or the study team left a voicemail. While most participants (62%) did not call the study team, 23% called once, and 15% called twice or more. The study team emailed 14% of participants, texted 3%, and sent letters to 76%.

Participant Measures and Retention

There were very few statistically significant participant measures associated with retention across different time intervals of the study (Table 2). Given this caution to interpretation, some trends appeared in this exploratory analysis. A positive trend in attending the 6-week and a negative trend in attending the 26-week appointments can be seen with number of children in the residence and number of tobacco users trying to quit.

An annual household income of <$9,999 had a decreased odds of retention with an OR of 0.19 (95% CI [0.05, 0.57]) for baseline to 6-weeks compared to those in the highest income group (>$70,000). All low-income groups were less likely to attend the 6-week study visit compared to the highest income group. In contrast, almost all the low-income groups had higher odds of attending the 26-week study visit, though this was not significant, suggesting those with an annual income in this range were more likely to be retained in the later stage of the study compared to the highest income group.

Study Process Measures and Retention

Successful calls made by the study team to participants significantly correlated with increased retention, with two successful calls having an OR of 3.14 (95% CI [1.09, 9.50]) compared to one successful call (Table 2). This trend appeared between all study visit intervals. Correspondingly, if the call was unsuccessful, participants were less likely to attend follow-up study visits, but this was not significant. With more unsuccessful calls, the participant was even less likely to attend the study visit (OR = 0.81 for 2 vs. 1 unsuccessful call; OR = 0.77 for 3 vs. 1 unsuccessful call; and OR = 0.21 for 4+ vs. 1 unsuccessful call).

When participants contacted the study team for any reason, they were more likely to attend follow-up study visits (OR = 4.55, 95% CI [1.89, 12.2] for baseline to 6-weeks for 1 participant call compared to none; OR = 2.09, 95% CI [0.93, 4.67] for baseline to 26-weeks for 1 participant call compared to none).

Sending any email to a participant had a very low odds for the participant attending follow-up study visits (OR = 0.52, 0.19, and 0.16 for baseline to 6-weeks, 6-weeks to 26-weeks, and baseline to 26-weeks, respectively), though only 21 participants were sent emails. Sending any text or letter to a participant had low odds of them attending follow-up study visits, but these results were not significant.

Table 2

Bivariate logistic regression for the odds ratio of retention between baseline and 6-week appointment, 6-week appointment and 26-week appointment, and baseline and 26-week appointment

Participant Measures	OR [a]	(95% CI)	*p*	OR [a]	(95% CI)	*p*	OR [a]	(95% CI)	*p*
Gender			0.88			0.69			0.70
Female	1.05	(0.55, 2.02)		0.84	(0.35, 1.99)		0.88	(0.45, 1.72)	
Male	Ref			Ref			Ref		
Age			0.14			0.17			0.10
1 year increase	1.02	(0.99, 1.05)		1.02	(0.99, 1.06)		1.02	(1.00, 1.05)	
People in residence			0.57			0.36			0.90
1	Ref			Ref			Ref		
2	1.61	(0.61, 4.27)		0.56	(0.12, 2.22)		0.98	(0.37, 2.67)	
3+	1.51	(0.65, 3.57)		0.40	(0.10, 1.38)		0.85	(0.36, 2.08)	
Children in residence			0.19			0.10			0.67
0	Ref			Ref			Ref		
1+	1.56	(0.81, 3.03)		0.48	(0.20, 1.12)		0.86	(0.44, 1.69)	
Residents trying to quit			0.29			0.23			0.31
1	Ref			Ref			Ref		
2+	1.48	(0.72, 3.09)		0.57	(0.23, 1.41)		0.68	(0.31, 1.42)	
Employment status			0.17			0.98			0.75
Working	0.53	(0.20, 1.27)		1.01	(0.35, 2.88)		0.87	(0.37, 2.13)	
Not working	Ref			Ref			Ref		
Education			0.74			0.91			0.76
Some high school	0.67	(0.23, 1.92)		0.97	(0.22, 4.57)		0.55	(0.16, 1.67)	
High school/GED	Ref			Ref			Ref		
Some college	1.15	(0.56, 2.39)		1.05	(0.41, 2.70)		0.88	(0.42, 1.85)	
College or more	0.75	(0.19, 2.98)		0.52	(0.06, 3.54)		0.66	(0.13, 2.66)	
Annual household income			0.02			0.31			0.43
<$9,999	0.19	(0.05, 0.57)		1.57	(0.40, 6.33)		0.76	(0.24, 2.45)	
$10,000-29,999	0.31	(0.09, 0.94)		3.93	(1.07, 16.0)		1.52	(0.52, 4.73)	
$30,000 – 49,999	0.88	(0.22, 3.42)		1.75	(0.48, 6.67)		1.80	(0.55, 6.11)	
$50,000 – 69,999	0.30	(0.08, 1.05)		3.14	(0.71, 15.8)		1.76	(0.53, 6.11)	
$70,000+	Ref			Ref			Ref		
Cigarettes per day			0.76			0.57			0.85
1 cig increase	0.99	(0.95, 1.03)		0.98	(0.93, 1.04)		1.00	(0.95, 1.04)	
Fagerström test for nicotine dependence			0.60			0.15			0.48
Low	1.51	(0.63, 3.68)		2.09	(0.61, 7.37)		1.49	(0.60, 3.96)	
Moderate	1.18	(0.43, 3.24)		0.78	(0.19, 3.24)		0.95	(0.32, 2.90)	
High	Ref			Ref			Ref		
Reason to stop smoking			0.51			0.73			0.77
General health	Ref			Ref			Ref		
Cost	0.88	(0.37, 2.09)		1.16	(0.36, 4.01)		1.10	(0.45, 2.64)	
Risk of cancer	0.55	(0.15, 1.89)		0.46	(0.06, 3.10)		0.55	(0.11, 2.04)	
Other	1.43	(0.64, 3.25)		0.70	(0.25, 1.89)		0.80	(0.34, 1.79)	

continued on next page

Table 2 continued

Bivariate logistic regression for the odds ratio of retention between baseline and 6-week appointment, 6-week appointment and 26-week appointment, and baseline and 26-week appointment

Study Process Measures	OR [a]	(95% CI)	*p*	OR [a]	(95% CI)	*p*	OR [a]	(95% CI)	*p*
Successful calls made to participant			<0.01			0.48			<0.01
0	0.28	(0.08, 0.94)		1.17	(0.11, 10.5)		0.25	(0.03, 1.20)	
1	Ref			Ref			Ref		
2	3.14	(1.09, 9.50)		1.91	(0.45, 9.03)		2.17	(0.71, 7.23)	
3	6.14	(1.73, 26.1)		3.50	(0.76, 18.4)		4.00	(1.20, 14.7)	
4+	3.30	(1.20, 9.49)		2.86	(0.70, 13.2)		3.50	(1.21, 11.2)	
Unsuccessful calls to participant			0.50			0.10			0.01
0	1.08	(0.31, 3.96)		2.45	(0.44, 19.7)		1.54	(0.45, 5.41)	
1	Ref			Ref			Ref		
2	0.91	(0.30, 2.71)		1.00	(0.24, 4.16)		0.81	(0.28, 2.34)	
3	0.98	(0.31, 3.09)		0.62	(0.15, 2.58)		0.77	(0.25, 2.33)	
4+	0.53	(0.20, 1.34)		0.29	(0.08, 1.01)		0.21	(0.07, 0.59)	
Participant contacted study team			<0.01			0.45			0.07
0	Ref			Ref			Ref		
1	4.55	(1.89, 12.2)		1.05	(0.41, 2,75)		2.09	(0.93, 4.67)	
2+	1.99	(0.78, 5.40)		2.28	(0.65, 9.34)		2.48	(0.96, 6.48)	
Study team emailed participant [b]			0.16			0.05			0.02
	0.52	(0.20, 1.30)		0.19	(0.03, 0.86)		0.16	(0.02, 0.58)	
Study team texted participant [b]			0.44			0.87			0.47
	0.49	(0.06, 3.05)		0.79	(0.03, 20.4)		0.44	(0.02, 3.06)	
Study team mailed letter to participant [b]			0.85			0.04			0.10
	0.93	(0.43, 1.97)		0.30	(0.09, 0.88)		0.53	(0.25, 1.14)	

Note. OR = odds ratio; CI = confidence interval.

[a] Each OR is for a model with one independent variable included

[b] Reference group: no emails, texts, or letters

DISCUSSION

This study assessed associations between participant and study process measures with retention in a tobacco cessation study among urban ANAI people. We found that study process measures were associated with study retention more than participant measures. One participant measure, annual income, significantly correlated with differential retention from baseline to 6-week appointment. Several study process measures correlated with differential retention, including successful calls to participants, unsuccessful calls to participants, a participant contacting the study

team, and sending emails. These findings suggest that the characteristics of the participants in this tobacco cessation study were less important in determining retention than the specific retention strategies used. This emphasizes the importance of considering techniques and strategies to improve retention when designing study procedures.

We retrospectively organized the retention strategies used in this study according to the retention domains used by Teague et al. (2018).

Barrier-Reduction Strategies

First, encouraging participants to schedule follow-up study visits in-person at the baseline visit reduced the burden of scheduling on both participant and study team. Flexible scheduling from the study team, during business hours, allowed participants to fit study visit times into their personal schedule. When possible, the team scheduled two participants within the same household simultaneously if requested by the participants. Finally, the project had a specific telephone number that study participants could call or text to reach the study team during business hours, though it was not toll free.

Social determinants of health may influence tobacco cessation efforts, as transportation barriers or the fact that study visits were conducted during normal business hours may have limited access for many individuals, especially those with fewer resources or inflexibility associated with lower wage employment. Reducing these barriers to participation might help, especially as Teague et al. (2018) reported that the cumulation of barrier-reduction strategies correlated with improved study retention. Further efforts to reduce barriers to participation could be explored. Hirchak et al. (2018) recently described the popularity of gasoline vouchers and bus passes in ANAI populations during a series of focus groups with ANAI participants. Implementing barrier-reduction strategies such as providing transportation vouchers may increase retention in future studies.

Community-Building Strategies

The research study was conducted at SCF, a tribally-owned and operated health care organization familiar to community members. SCF has a strong and consistent organizational brand that was used throughout the study. The study team collaborated with an existing program, the Quit Tobacco Program, to recruit for the study. In addition, the study addressed a community-identified health priority, tobacco use. Last, an advisory group ensured project acceptability to the ANAI community before and during data collection.

Follow-Up and Reminder Strategies

The tobacco cessation study planned for multiple contact attempts from the inception of the study. Phone call reminders were placed one week before and the business day prior to each scheduled study visit (or at another time based on a communicated participant preference). Email and text reminders were used in a small number of cases if the participant requested them. Study team limited the number of calls made to each participant based on participant preference. Financial incentives were given ($20 for each appointment).

We found that increasing the number of calls to participants did not significantly correlate with higher or lower retention. This is in contrast to a recent meta-analysis examining call frequency, which found a negative association between reminder calls and study retention (Teague et al., 2018). In fact, as the number of unsuccessful calls to participants increased, the odds of a participant attending a study appointment decreased. From this finding, we might infer that continuing to call participants after an unsuccessful call may not be a worthwhile effort and different communication strategies should be employed. Higher retention was noted amongst participants who contacted the study team, suggesting study teams could explore other types of incentives for responding to calls or texts or how to make Teague et al.'s community building and tracing strategies for retention a more engaging process. For example, for longitudinal studies providing a one-page newsletter, or similar type of communication updating enrolled participants between study visits, may help to keep participants engaged in the study and, in turn, increase retention. Moreover, this strategy addresses ANAI community members requests for engagement throughout research studies (Beans et al., 2018).

Tracing Strategies

Participants were encouraged to list an alternative contact, who was called if contact to the participant was unsuccessful. Overall, to increase the success of tracing using alternative contacts, participants could be asked to provide more individuals at the outset and these alternative contacts could be called earlier after unsuccessful calls, texts, or emails.

Strengths

This study had several strengths. First, various communication strategies were used, including calls, texts, emails, and letters. This allowed for more in-depth exploration of which

communication strategies were associated with increased retention. Second, we explored measures associated with retention in an understudied population and improving processes could lead to increased participation among ANAI people in future research. In turn, this could lead to more statistical power and generalizable longitudinal study findings, making research more meaningful to the broader ANAI community. Finally, we identified several actionable suggestions by categorizing retention strategies into domains that may improve future research efforts, such as utilizing alternative communication methods after an unsuccessful call to a participant, increasing communication to participants via study update newsletters, encouraging participants to call study staff, or attempting to reduce barriers to participation via transportation assistance. Even though our findings with alternative communication strategies (i.e., texts, emails, and letters) were inconclusive, the fact that additional unsuccessful calls are correlated with lower study retention suggests a need to explore innovative contact strategies, with further research on their efficacy.

Limitations

There were several limitations to this study. First, the study process measures have inherent limitations. Many staff were involved in data recording during the study, which made extracting data from communication logs challenging. Second, the study was observational and used data not intended for the examination of strategies of retention, so ascertaining causal relationships is challenging. This is especially true for many participant measures like employment. Third, the study did not recruit or conduct follow-up visits during Saturday clinic hours, which may have prevented participants who work during the workweek (M-F) from participating as most study participants were employed. Fourth, participants were not asked why they were unable to attend or what resources they would need in order to keep an appointment.

CONCLUSION

These findings suggests that study teams should carefully consider strategies to improve retention in future longitudinal research studies, especially when it involves ANAI participants. Employing the four domains in Teague's classification system should not just be a retrospective assessment, but a prospective tool to design study processes. Our findings indicate that when participants contact the study team, retention was significantly higher. Improving participant engagement, such as incorporating study update communication, could increase participant-driven

contact with the study team and should be explored. Overall, these findings could inform future tobacco cessation research strategies, increasing retention and making studies more generalizable to the broader ANAI community.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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DIET QUALITY AND DEPRESSION IN A COHORT OF AMERICAN INDIANS: THE STRONG HEART FAMILY STUDY

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Abstract: Diet quality has been shown to be inversely associated with depression, but this has not been studied in American Indians (AIs). We examined the prospective association of diet quality and probable depression in a family-based cohort of rural AIs. Using data from the Strong Heart Family Study, we included 1,100 AIs ≥14 years old who were free of probable depression at baseline. We defined probable depression as the presence of moderate or severe depressive symptoms on the Center for Epidemiologic Studies Depression Scale or current use of antidepressant medications. We calculated baseline diet quality from food frequency questionnaires using the Alternative Healthy Eating Index-2010 (AHEI). We used GEE-based multivariate logistic regression to estimate the odds ratio of probable depression at follow up associated with a 10-point higher AHEI score at baseline, adjusted for demographic, psychosocial, and health factors. At follow up, 19% (n = 207) of the sample reported probable depression. Diet quality was not associated with report of probable depression at follow up (OR = 1.16, 95% CI [0.96, 1.39]). Research is needed to examine other temporal dimensions of this relationship and unique aspects of rural AI diets and psychosocial factors that may influence depression.

INTRODUCTION

Rural American Indian (AI) communities experience some of the highest rates of diet-related cardiometabolic diseases in the United States (Benjamin et al., 2019; Hutchinson & Shin, 2014; Breathett et al., 2020). Colonization, loss of land, subsequent food insecurity, and federal food assistance programs led to a rapid transition from traditional to "Western" diets for many AI communities (Compher, 2006; Howard et al., 1999; Kuhnlein & Receveur, 1996; Warne &

Wescott, 2019). Before this nutrition transition, cardiometabolic diseases such as diabetes and coronary heart disease were largely absent in AIs (Howard et al., 1999; Welty et al., 2002).

Traditional or subsistence diets consist of nutrient-dense, minimally processed foods such as wild game, berries, squash, legumes, and whole grains. Hunting, gathering, and harvesting practices of traditional diets are intrinsically linked with physically active lifestyles and spiritual and cultural well-being (Conti, 2006). In contrast, a "Western" dietary pattern is characterized by frequent consumption of highly processed, energy-dense, and nutrient-poor food, and accompanies a sedentary lifestyle and cardiovascular disease risk factors (Eilat-Adar et al., 2013). Commonly consumed foods in rural AI communities, like soda and processed meat, align with this dietary pattern (Fretts et al., 2012; Taylor et al., 2006). Other common foods that have been historically consumed, but differ from pre-colonial, traditional diets, such as hydrogenated vegetable fats for frying, are also associated with similar risk profiles to that of the "Western" dietary pattern (Eilat-Adar et al., 2013).

There is growing interest in understanding how dietary patterns that prevent cardiometabolic diseases may additionally reduce the risk of common mental health conditions (Jacka et al., 2012). While depression is attributable to biological, environmental, and social factors (Lopresti et al., 2013; Urban Indian Health Institute, Seattle Indian Health Board, 2012), some evidence from non-AI populations suggests that healthy diet quality may protect against the development of depression. Dietary patterns characterized by high consumption of vegetables, fruits, whole grains, and healthy fats are associated with reduced risk of depression in recent meta-analyses (Lassale et al., 2019; Molendijk et al., 2018; Nicolaou et al., 2019; Opie et al., 2017). Diets high in ultra-processed foods and red and processed meat may increase the risk (Bear et al., 2020; Lopresti et al., 2013; Marx et al., 2017). Nutritional quality of the diet influences systemic inflammation, oxidative stress, insulin resistance, and gut microbiota, which are related to neuronal health and cognitive functioning (Bear et al., 2020; Opie et al., 2017; Sánchez-Villegas et al., 2013), and could lead to onset or persistence of depressive symptoms. Dietary sources of antioxidants, fiber, omega-3 fatty acids, and folate, consumed in higher amounts in healthy dietary patterns, are thought to play protective, beneficial roles in these mechanisms (Bear et al., 2020; Opie et al., 2017).

However, further investigation of the prospective relationship between diet quality and depression is warranted. Studies that examined adherence to a Mediterranean dietary pattern produced the most robust evidence (Lassale et al., 2019), but this pattern does not reflect a culturally appropriate diet for all populations. While other healthy dietary patterns have produced

generally consistent evidence, the associations are weaker (Nicolaou et al., 2019), and most occurred in cohorts of majority-white populations in Europe, Australia, and North America (Lassale et al., 2019). Additionally, it has been difficult to control for psychosocial factors like social support and environmental stress that influence diet quality and depression (Bear et al., 2020; Molendijk et al., 2018).

To our knowledge, no prior studies have focused on AI populations. Diets of AI populations on reservations and in rural areas differ substantially from populations in the existing literature (Zamora-Kapoor et al., 2019). The prevalence of depression in rural AI populations varies across communities and tribal settings (Asdigian et al., 2018; Beals et al., 2005; Brave Heart et al., 2016; Finkbonner & Kaiser, 2002; Urban Indian Health Institute, 2012). In an earlier analysis of the Strong Heart Family Study, nearly 28% of the population reported current moderate or severe depressive symptoms (Zhao et al., 2016). Importantly, depression has been linked with poor glucose control and higher diabetes mortality in AI communities (Calhoun et al., 2010; Goins et al., 2019; Knaster et al., 2015; Sahota et al., 2008). Efforts to prevent depression can help address disparities in diabetes risk (CDC, 2020). The Strong Heart Family Study is an opportunity to investigate the relationship between diet quality and depression in rural AI communities and identify implications for cardiometabolic and mental health interventions.

Objectives

The primary objective of this study was to determine whether baseline diet quality was associated with the presence of depressive symptoms or antidepressant use after five years of follow up among AIs from primarily rural AI communities. Our secondary, exploratory objectives were to assess for interactions between diet quality and age, and diet quality and sex in this population because susceptibility to depressive symptoms can vary over the life course and differ by sex (Abrams & Mehta, 2019; Akbaraly et al., 2013; Brave Heart et al., 2016; Rice et al., 2015). We additionally conducted sensitivity analyses to assess the robustness of our findings with narrower definitions of depression and, separately, within a more restricted baseline population.

We hypothesized that higher diet quality is associated with lower odds of reporting depressive symptoms and/or antidepressant use at follow up, and secondarily, that the association is stronger among younger individuals and females. Since we aimed to estimate an unbiased association between diet quality and depression, we adjusted for demographic characteristics, measures of physical health, and psychosocial factors in all analyses.

METHODS

Study Design

We analyzed data from the Strong Heart Family Study, a prospective, family-based cohort study designed to identify risk factors for cardiovascular disease among AIs from 12 tribal communities in Arizona, Oklahoma, North Dakota, and South Dakota. Details on the original study are described elsewhere (Lee et al., 1990; North et al., 2003).

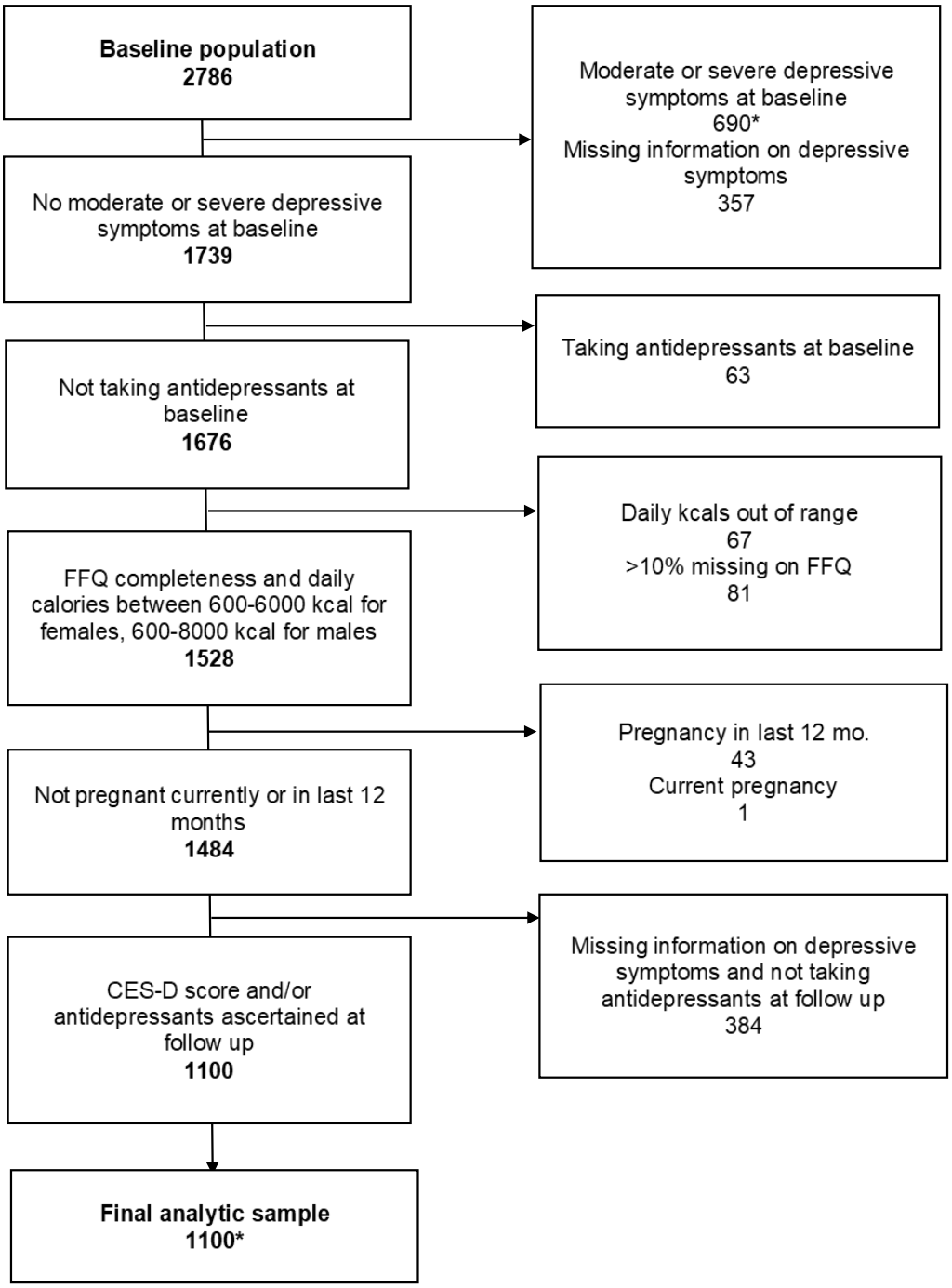
Our study involved two assessments: baseline (2001-2003) and follow up (2007-2009). We selected these assessments because they collected the most recent data on diet and psychosocial measures available in the cohort. Both assessments included a physical examination, detailed personal interview, and one-week pedometer log. The examination consisted of a general physical assessment for overall health, fasting blood glucose testing, pregnancy testing if suspected, and a review of all medications taken in the past two weeks (Lee et al., 1990; North et al., 2003). The personal interview collected information on medical history, demographics, health behaviors, and psychosocial factors. The food frequency questionnaire was only administered at the baseline assessment personal interview. All participants provided written, informed consent at each assessment.

Population

We included 1,100 individuals who completed baseline and follow-up assessments and were free of probable depression at baseline (Figure 1). Participants were ≥14 years old and from 83 large families in 12 tribal communities in Arizona, Oklahoma, North Dakota, and South Dakota. From the initial population of 2,786, we excluded participants from our analysis who, at baseline, had moderate or severe depressive symptoms (n = 690), missing information on depressive symptoms (n = 357), or were taking antidepressant medications (n = 124, 61 of whom also had moderate/severe depressive symptoms). We additionally excluded those with unreliable diet information, defined as reporting daily energy intake outside the bounds of 600-6,000 kcal for females or 600-8,000 kcal for males (Eilat-Adar et al., 2013; Kauffman et al., 2019) or failing to answer >10% of items on the food frequency questionnaire (n = 148). Those with a pregnancy ≤12 months before the baseline assessment were also excluded (n = 44). Finally, we excluded participants who were missing depressive symptom information and not taking antidepressants at follow up (n = 384). Individuals with missing information at follow up were more likely to be

male, older, and have less than a high school education, known diabetes, and slightly higher diet quality compared to the analytic sample (see Appendix Table A1).

Figure 1. Strong Heart Family Study population inclusion and exclusion criteria for the analytic sample



Participants were ≥14 years old at baseline (2001-2003) and from 83 large families in 12 tribal communities in Arizona, Oklahoma, North Dakota, and South Dakota. The follow-up exam occurred in 2007-2009. Depressive symptoms were assessed using the Center for Epidemiologic Studies Depression Scale (CES-D); scores reflect depressive symptoms: none = <10; mild = 10-15; moderate = 16-24; severe = >24. Diet quality and caloric intake were assessed using a Block Food Frequency Questionnaire (FFQ). *321 individuals were additionally excluded in the sensitivity analysis with a baseline population restricted to those with a CES-D score <10 (no depressive symptoms).

Assessment of Diet Quality

The validated Block 1998 Food Frequency Questionnaire (FFQ) was used to estimate the usual dietary intake during the previous year at the baseline assessment (Block et al., 1986; (Boucher et al., 2006). The FFQ food list included 110 items that reflected the most common nutrient sources and food groups in American diets based on National Health and Nutrition Examination Survey dietary recall data (Block et al., 1986). Nine additional items that are commonly consumed in AI communities were added to the FFQ (Strong Heart Study Coordinating Center, 2001). The items were selected by community-based study staff and community members in consultation with local dieticians to represent a non-exhaustive list of popular AI foods that may contribute meaningfully to usual dietary intake. The items were Spam, menudo, pazole, guysava, red/green chili stew, Indian taco, frybread, and corn and flour tortillas. For all food items on the FFQ, participants estimated a frequency of consumption (seasonally, never, few times per year, 1x/month, 2-3x/month, 1x/week, 2x/week, 5-6x/week, daily), and quantity (small, medium, large portion size).

Using standard Block FFQ analysis methods with a Block Dietary Database, average daily intakes of food groups, nutrients, and energy were calculated for each participant (Block et al., 1986). We used the Alternative Healthy Eating Index-2010 (AHEI) to determine diet quality from these average daily intakes. The AHEI is based on 11 nutrients and food groups that are associated with risk of cardiometabolic disease: vegetables, fruits, whole grains, sugar-sweetened beverages and fruit juice, nuts and legumes, red and processed meat, *trans* fat, long-chain n-3 fatty acids (EPA + DHA), polyunsaturated fatty acids, sodium, and alcohol (Chiuve et al., 2012). Absolute intake of each nutrient or food item was scored 0 (worst) to 10 (best) using standardized serving sizes and cut points known to influence disease risk (Appendix Table A2) (Chiuve et al., 2012; Kauffman et al., 2019). AHEI scores can range from 0 (least healthy) to 110 (most healthy). We did not include alcohol intake in the AHEI score; therefore, the maximum possible AHEI score in this study was 100. Since the relationship between alcohol use and depression is complex (Boden & Fergusson, 2011), we did not consider alcohol use in the characterization of diet quality. We included categorical, self-reported alcohol use (current, former, never) as a covariate in our statistical analysis instead.

Measurement of Depression

The primary outcome was the presence of moderate or severe depressive symptoms or initiation of antidepressant medications at follow up, which we defined collectively as probable

depression (APA, 2011; Ferrari et al., 2013; Zhao et al., 2016). Depressive symptoms were assessed using the validated Center for Epidemiologic Studies Depression Scale (CES-D) for nonclinical measures of depressive symptomology (Radloff, 1977), which has been used and validated in AI populations (Calhoun et al., 2010; Zhao et al., 2016; Schure & Goins, 2017; Dick et al., 1994; Somervell et al., 1993). The CES-D has also been used in prospective studies of diet quality and depression in other populations (Adjibade et al., 2018; Akbaraly et al., 2013; Le Port et al., 2012; Vermeulen et al., 2018). Participants rated 20 items on a 4-point Likert scale indicating how often in the past week they experienced symptoms associated with depression (Radloff, 1977). Items were summed to produce an overall CES-D score (0-60) to create four categories of depressive symptoms: none = <10, mild = 10-15, moderate = 16-24, severe = >24 (APA, 2011). We considered a participant's overall score missing if they failed to respond to > 4 items (Radloff, 1977).

Participants with any of the following current medications documented in their review were classified as taking antidepressants: Amitriptylin, Bupropion, Buproprion SR, Celexa, Citalopram, Cymbalta, Desipramine, Effexor, Effexor XR, Elavil, Escitalopram, Fluoxetine, Fluvoxamine, Imipramine, Lexapro, Nortriptylin, Paroxetine, Paroxetine HC, Paxil, Prozac, Remeron, Sertraline, Trazodone, Venlafaxine, Wellbutrin, Wellbutrin SR, or Zoloft.

Measurement of Covariates

We selected covariates *a priori* based on their potential to confound the relationship between baseline diet quality and presence of depression and/or use of antidepressants at follow up. Dietary habits and depression are known to vary by age, sex, and tribal community (Beals et al., 2005; Finkbonner & Kaiser, 2002). We used educational attainment as a proxy for socioeconomic status, which is known to influence diet quality and depression (Darmon & Drewnowski, 2008; Lorant et al., 2003). Smoking, smokeless tobacco use, and alcohol use are associated with diet quality and depression (Boden & Fergusson, 2011; Breslow et al., 2010; Liu et al., 2017; Noble et al., 2015). Body size and physical activity are also known correlates of diet quality and depression (Liu et al., 2017). Diabetes status influences diet quality and depression (Al-Ibrahim & Jackson, 2019; Calhoun et al., 2010; Sahota et al., 2008). We hypothesized that the psychosocial measures of self-reported social support, health locus of control, and identification with one's tribal traditions would also influence diet quality and depression through potential

pathways related to health behavior norms, coping, and cultural buffers to environmental stressors (Berk et al., 2013; Roh et al., 2015; Walters & Simoni, 2002).

At the baseline assessment personal interview, participants' field center location (Arizona, Oklahoma, and South Dakota), sex (male, female), age (years), and education (years) were collected in the personal interview. Participants also reported their status for smoking (never, former, current), smokeless tobacco use (current, no), and alcohol use (never, former, current). Body mass index (BMI) was calculated from height and weight measurements at the baseline physical examination.

Daily step counts were measured over seven days immediately following the baseline assessment using Accusplit AE120 pedometers (Yamax, Japan). We calculated average steps per day after excluding the minimum and maximum step counts for each participant; all observations were included if more than two observation days were missing (Fretts, Howard, McKnight, Duncan, Beresford, Calhoun, et al., 2012).

Diabetes status was assessed with blood glucose testing as part of the physical examination at baseline. Known diabetes was defined as ≥126 mg/dL fasting blood glucose at baseline or reported history of diabetes and any of the following: on insulin treatment, hypoglycemic agent, renal dialysis, or had kidney transplantation. Impaired glucose tolerance was defined as fasting blood glucose 110-125 mg/dL and no diabetes treatment. Normal glucose tolerance was <110 mg/dL at baseline and no diabetes treatment (Strong Heart Study Coordinating Center, 2001).

The following psychosocial measures were ascertained during the baseline personal interview. A social support questionnaire measured perceived emotional support, social networks, tangible social support, and negative social support on a Likert scale and produced a summary score of 0-40 (Roh et al., 2015; Strong Heart Study Coordinating Center, 2001). The Multidimensional Health Locus of Control Scale measured beliefs about internal versus external determinants of health, and thus, tendencies towards healthy behaviors and reactions to health outcomes (Strong Heart Study Coordinating Center, 2001; Wallston, 2005). We calculated summary scores of 0-18 for participants' agreement with each construct (internal, external: chance, and external: powerful others); only internal scores were included in the model due to weak inter-construct correlations (Wallston, 2005). Self-identification with tribal traditions was measured by asking, "How much do you identify yourself with your own tribal tradition?" Responses were dichotomized as "a little" (not at all or a little) and "a lot" (some or a lot).

Analyses

For the primary analysis, our objective was to determine whether baseline diet quality was associated with report of probable depression at follow up in a population free of probable depression at baseline. To achieve this, we estimated the population odds ratio and 95% confidence interval for probable depression at follow up associated with baseline AHEI score. We fit a multivariate logistic regression model using generalized estimating equations with an independence working correlation and robust standard errors. The use of generalized estimating equations accounts for clustering of the data at the family level. We estimated the odds ratio for a ten-point AHEI score difference because this was similar to AHEI score comparisons made in other populations, and standard cut points are not specified (Akbaraly et al., 2013; Miller et al., 2020; Sánchez-Villegas et al., 2015).

We imputed missing observations for covariates using multiple imputation by chained equations (Schafer, 1999) to adjust for potential confounders in our primary analysis. Missing observations for covariates did not exceed 7% for any one variable. The imputation model included all variables in the primary analysis model and produced ten imputations with 100 iterations per round. We evaluated convergence with trace plots of means and standard deviations for each imputed variable and compared distributions of imputed versus observed values to assess whether the imputed variable distributions were realistic.

We conducted two exploratory analyses to evaluate whether the association between diet quality and probable depression differed by baseline age and sex. For age, we added an interaction term for age (years) and AHEI score in the primary model. Due to statistical power limitations, we qualitatively examined the exponentiated interaction term and 95% confidence interval for a deviance from one, meaning we did not evaluate the term based on it being statistically significantly different from one. To explore differences by sex, we stratified the primary model by sex and qualitatively assessed whether the AHEI score coefficient for males differed meaningfully from the coefficient for females.

We conducted several sensitivity analyses to assess the robustness of our findings. First, we repeated the primary analysis with a narrower definition of the outcome: severe depressive symptoms or antidepressants (instead of moderate/severe depressive symptoms or antidepressants). Second, we repeated the primary analysis with a baseline population restricted to participants with less than mild depressive symptoms (instead of less than moderate symptoms). We did this to try to rule out a bidirectional effect of depressive symptoms on diet, since subclinical

(i.e., mild) depressive symptoms at baseline may influence diet quality at baseline and progress to clinical depression at follow up (Le Port et al., 2012). Third, we regressed the primary outcome on AHEI components hypothesized to be most strongly associated with depression (vegetables, fruit, red and processed meat, sugar-sweetened beverages and fruit juice, *trans* fats, and long-chain n-3 fatty acids) to examine whether certain components were driving the association in the primary model (Molendijk et al., 2018; Opie et al., 2017). Fourth, we estimated the mean change in depressive symptoms at follow-up associated with baseline diet quality. We did this to assess whether our findings were materially different with a continuous outcome and omission of antidepressants from the outcome definition.

Finally, to investigate possible selection bias due to the exclusion of individuals with missing depression outcome information, we imputed such values using the approach for missing covariates and included these individuals in the analytic sample. All analyses were performed using Stata 15 (StataCorp LLC, 2017).

Ethics Approvals

This study was approved by the Strong Heart Study Publications and Presentations Committee (under reference numbers T28 and SHS641) and institutional review boards (IRB) from all participating tribes and each Indian Health Service (IHS) region serving the participating tribes, including the Phoenix Area IHS IRB, Great Plains Area IHS IRB, and Oklahoma City Area IHS IRB. This study was not considered human subjects research by the University of Washington IRB because the authors exclusively used deidentified, secondary data from the Strong Heart Family Study and did not have access to any identifying information.

RESULTS

In the analytic sample of 1,100 individuals, AHEI scores ranged from 19.6 to 74.0 with a median of 39.6 (inter-quartile range [IQR]: 34.2-46.1; Table 1). Compared to the highest AHEI quartile, individuals with scores in the lowest quartile were more likely to be male and younger; have less than a high school education; report current smoking, smokeless tobacco use, and alcohol use; have normal BMI; and report mild depressive symptoms. Individuals in the lowest quartile were less likely to report sedentary levels of physical activity, have known diabetes, and identify

with their own tribal traditions. Social support and health locus of control scores were similar across AHEI quartiles.

Table 1
Baseline characteristics of the analytic sample population by quartiles of AHEI diet quality score

	AHEI Score Quartiles				
	Q1 (19.6-34.2)	**Q2 (34.3-39.6)**	**Q3 (39.7-46.1)**	**Q4 (46.1-74.0)**	**Total *N* = 1100**
	N (column %) or mean (SD)				
Male	152 (55)	118 (43)	105 (38)	94 (34)	469 (43)
Age, years					
15-25	104 (38)	72 (26)	44 (16)	32 (12)	252 (23)
26-45	129 (47)	116 (42)	120 (44)	111 (40)	476 (43)
46-65	35 (13)	70 (25)	89 (32)	96 (35)	290 (26)
66-90	7 (3)	17 (6)	22 (8)	36 (13)	82 (7)
Education, years					
0-11	84 (31)	65 (24)	62 (23)	47 (17)	258 (23)
12-15	168 (61)	176 (64)	172 (63)	185 (67)	701 (64)
16-20	23 (8)	33 (12)	40 (15)	41 (15)	137 (12)
Missing	0	1 (<1)	1 (<1)	2 (1)	4 (<1)
Smoking status					
Never	112 (41)	112 (41)	130 (47)	120 (43)	474 (43)
Former	44 (16)	72 (26)	55 (20)	79 (29)	250 (23)
Current	119 (43)	91 (33)	90 (33)	76 (28)	376 (34)
Smokeless tobacco use, current	31 (11)	20 (7)	15 (5)	14 (5)	80 (7)
Missing	0	2 (1)	5 (2)	5 (2)	12 (1)
Alcohol use status					
Never	30 (11)	38 (14)	36 (13)	32 (12)	136 (12)
Former	55 (20)	87 (32)	81 (29)	102 (37)	325 (30)
Current	190 (69)	150 (55)	157 (57)	141 (51)	638 (58)
Missing	0	0	1 (<1)	0	1 (<1)
BMI category[a]					
Underweight	4 (1)	6 (2)	1 (1)	1 (<1)	13 (1)
Normal	68 (25)	44 (16)	46 (17)	39 (14)	197 (18)
Overweight	75 (27)	76 (28)	79 (29)	95 (35)	325 (30)
Obese	126 (46)	148 (54)	146 (53)	140 (51)	560 (51)
Missing	2 (1)	1 (<1)	2 (1)	0	5 (<1)
Pedometer average steps/day					
<5,000	105 (38)	100 (36)	124 (45)	133 (48)	462 (42)
5,000-9,999	115 (42)	119 (43)	102 (37)	99 (36)	435 (40)
≥10,000	40 (15)	38 (14)	31 (11)	32 (12)	141 (13)
Missing	15 (5)	18 (7)	18 (7)	11 (4)	62 (6)

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Table 1 continued
Baseline characteristics of the analytic sample population by quartiles of AHEI diet quality score

	AHEI Score Quartiles				
	Q1 (19.6-34.2)	**Q2 (34.3-39.6)**	**Q3 (39.7-46.1)**	**Q4 (46.1-74.0)**	**Total *N* = 1100**
	N (column %) or mean (SD)				
Diabetes diagnosis[b]					
Known diabetes	22 (8)	38 (14)	53 (19)	57 (21)	170 (15)
Impaired glucose tolerance	53 (19)	53 (19)	69 (25)	66 (24)	241 (22)
Normal glucose tolerance	199 (72)	183 (67)	151 (55)	152 (55)	685 (62)
Missing	1 (<1)	1 (<1)	2 (1)	0	4 (<1)
Social support score (0-49)	40.0 (5.7)	40.6 (5.1)	41.6 (4.8)	41.4 (4.9)	40.9 (5.2)
Health Locus of Control scores					
Internal (0-18)	12.6 (2.2)	12.7 (2.4)	12.4 (2.4)	12.8 (2.4)	12.6 (2.4)
External: Chance (0-18)	8.2 (2.5)	7.6 (2.5)	7.7 (2.3)	7.2 (2.8)	7.7 (2.5)
External: Powerful others (0-18)	8.4 (2.5)	8.2 (2.9)	8.5 (2.8)	8.4 (3.0)	8.4 (2.8)
Identify with tribal traditions (yes)	184 (67)	197 (72)	194 (71)	207 (75)	782 (71)
Missing	0	8 (3)	12 (4)	5 (2)	25 (2)
Depressive symptoms (CES-D scale)					
None	183 (67)	198 (72)	202 (73)	196 (71)	779 (71)
Mild	92 (33)	77 (28)	73 (27)	79 (29)	321 (29)

Note: Data are pooled across three field centers in Arizona, Oklahoma, and North and South Dakota.

[a]Body mass index (BMI): underweight <18.5 kg/m^2; normal 18.5-24.9 kg/m^2; overweight 25-29.9 kg/m^2; obese ≥30 kg/m^2.

[b]Known diabetes (DM) defined as ≥126 mg/dL fasting blood glucose, or reported history of DM and any of the following: on insulin treatment, hypoglycemic agent, renal dialysis, or had kidney transplantation. Impaired glucose tolerance: fasting blood glucose 110-125mg/dL and no DM treatment. Normal glucose tolerance: fasting blood glucose <110mg/dL and no DM treatment.

AHEI: Alternative Healthy Eating Index; a dietary index based on absolute intake of 10 nutrients and foods each scored 0-10 using standardized serving sizes (excluding alcohol). Total AHEI score ranges from 0 (least healthy) to 100 (most healthy).

CES-D: Center for Epidemiologic Studies Depression Scale. Scores reflect depressive symptoms: none = <10; mild = 10-15; moderate = 16-24; severe = >24.

The mean follow-up period was 5.35 years (*SD* = 1.13). At follow up, 15% (*n* = 166) of the analytic sample reported moderate or severe depressive symptoms, and 5% (*n* = 58) reported current use of antidepressant medications, which included 17 individuals who reported both outcomes. Altogether, 19% of the sample reported probable depression (*n* = 207). The median baseline AHEI score for those who later reported probable depression was 39.6 (IQR = 33.4-46.8) and for those who did not, 39.7 (IQR = 34.3-45.8; see Figure 2). Mean AHEI scores for those who did and did not report probable depression are presented in Appendix Table A3.

Results from our primary analysis indicate that diet quality at baseline was not associated with report of probable depression at follow up (Table 2). The unadjusted OR associated with a 10-point higher AHEI score was 1.04, 95% CI [0.88, 1.23], and the adjusted OR was 1.16, 95% CI [0.96, 1.39]. We did not find evidence of interaction with age or sex. The exponentiated age interaction term was 1.00, 95% CI [0.99, 1.01], and stratified estimates were similar for males (OR = 1.04, 95% CI [0.78, 1.37]) and females (OR = 1.22, 95% CI [0.94, 1.56]).

Sensitivity analyses echoed the primary results. We did not find evidence of an association after restricting the outcome to only severe depressive symptoms or taking antidepressants. The association appeared more strongly positive, though still non-significant, when estimated among those who reported no depressive symptoms at baseline. We did not detect any associations with specific AHEI components, nor with changes in depressive symptoms as a continuous outcome variable. Imputing values for individuals with missing outcome information (n = 384) and including them in the sample, to investigate potential influences of loss-to-follow-up, did not materially change the estimate for AHEI score and probable depression (adjusted OR = 1.15, 95% CI [0.95, 1.41]).

Table 2

Association between diet quality as measured with the AHEI-2010 and onset of probable depression and alternative definitions of probable depression in sensitivity analyses

Outcome definition, analytic sample	Crude OR[a] (95% CI)	Adjusted OR[a] (95% CI)
Probable depression (moderate/severe depressive symptoms and/or antidepressant use), N = 1100[b]	1.04 (0.88, 1.23)	1.16 (0.96, 1.39)
Probable depression (severe depressive symptoms and/or antidepressant use), N = 1100[c]	1.04 (0.82, 1.33)	1.12 (0.86, 1.46)
Probable depression (moderate/severe depressive symptoms and/or antidepressant use, excluding those with mild depressive symptoms at baseline), N = 779[c]	1.18 (0.94, 1.48)	1.23 (0.96, 1.59)

[a]The OR for each 10-point increase in the AHEI-2010 score.

[b]Primary analysis.

[c]Sensitivity analysis.

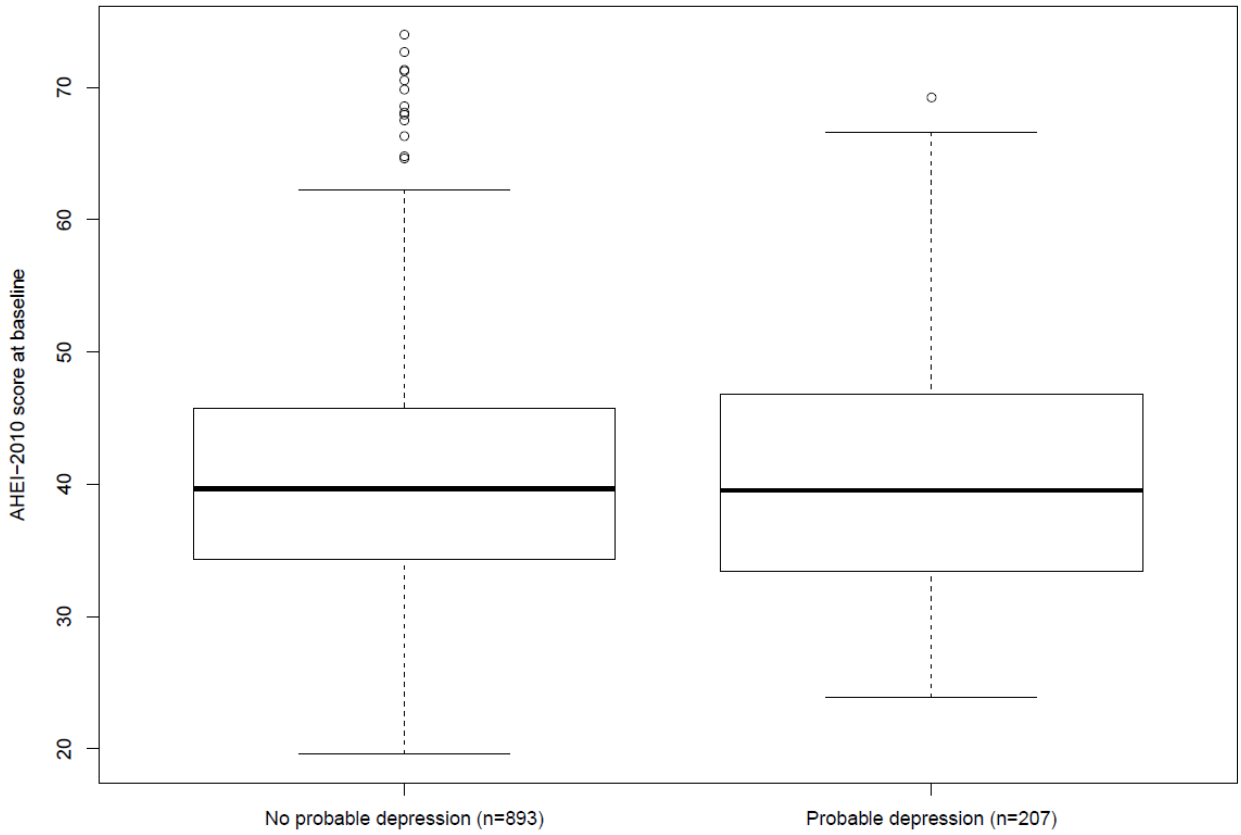
Moderate or severe depressive symptoms were measured with the Center for Epidemiologic Studies Depression Scale. Scores reflect depressive symptoms: none = <10; mild = 10-15; moderate = 16-24; severe = >24.

All participants were free of probable depression at baseline.

Adjusted models included baseline measures of field center, sex, age, education, smoking status, smokeless tobacco use, alcohol use, body mass index, physical activity, diabetes diagnosis, social support score, internal health locus of control score, and self-identification with tribal traditions.

AHEI: Alternative Healthy Eating Index; a dietary index based on absolute intake of 10 nutrients and foods; the total AHEI score ranges from 0 (least healthy) to 100 (most healthy).

Figure 2. Baseline AHEI-2010 scores comparing those who did and did not develop probable depression at follow up



The sample included 1,100 individuals ≥14 years old from 83 large families in 12 tribal communities in Arizona, Oklahoma, North Dakota, and South Dakota who were free from probable depression at baseline (2001-2003). Past year diet was collected with a Block Food Frequency Questionnaire and diet quality was determined using the Alternative Healthy Eating Index-2010 (AHEI), a dietary index based on absolute intake of 10 nutrients and foods each scored 0-10 using standardized serving sizes (excluding alcohol). Total AHEI score ranges from 0 (least healthy) to 100 (most healthy). Probable depression was assessed at follow up (2007-2009) and was defined as having moderate or severe depressive symptoms based on the Center for Epidemiologic Studies Depression Scale score (none = <10; mild = 10-15; moderate = 16-24; severe = >24) or taking antidepressant medications. Note: Points outside of the box and whiskers are values greater than 1.5 times the interquartile range.

DISCUSSION

The purpose of this study was to determine whether diet quality was associated with report of probable depression after five years of follow up in a large, family-based cohort of AIs. After adjusting for baseline demographic characteristics, family-level clustering, indicators of health status, and psychosocial factors that may also influence diet and depressive symptoms, our results do not provide evidence of an association. Our overall conclusion did not change in secondary analyses that restricted the population to those with extreme values, nor stratified by age and sex.

Our primary results are inconsistent with much of the literature, as meta-analyses have concluded generally that diet quality is prospectively associated with depression. Dietary patterns such as the AHEI-2010, Healthy Eating Index, Mediterranean Diet Score, Dietary Inflammatory Index, and the Dietary Approaches to Stop Hypertension score are associated with depression symptoms in other studies, including those that used the CES-D as an outcome measure (Lassale et al., 2019; Molendijk et al., 2018; Nicolaou et al., 2019; Opie et al., 2015). Most studies involved large cohorts from majority-white populations in Western Europe, Australia, Canada, and the United States with follow-up periods that were similar to or longer than the follow up in our study (Lassale et al., 2019; Molendijk et al., 2018; Nicolaou et al., 2019). The evidence for interactions between diet quality and sex and age is less consistent in the literature, and in our exploratory analyses, we did not find evidence of either interaction. A harmonized meta-analysis of diet quality and depression found that associations differed by sex for some diet quality scores in some cohorts, but there was not a consistent pattern (Nicolaou et al., 2019). Other studies only observed an association among females (Akbaraly et al., 2013; Wang et al., 2019). Fewer diet-depression studies have investigated interaction with age, despite literature supporting that depression can express differently over the life course (Mirowsky & Ross, 1992). One meta-analysis of diet and depression analyzed studies with and without adolescents and did not find evidence of differing associations (Lassale et al., 2019).

Several inconsistencies in the literature are worth noting in the context of our unexpected findings. Some cohort studies did not find evidence of an association between diet quality and depression. These included the Japan Public Health Center cohort, which assessed adherence to the Japan food guide, and the Whitehall II British cohort, which assessed high intakes of sugar and saturated fats (Okubo et al., 2019; Vermeulen et al., 2018). A meta-analysis found that adjusting for baseline depressive symptoms removed previous associations, suggesting that a bidirectional effect may contribute to mixed findings, since baseline depressive symptoms may influence baseline diet quality (Molendijk et al., 2018). This meta-analysis also found that associations were weaker in studies that assessed clinical diagnosis of depression as the outcome (Molendijk et al., 2018), raising the question of whether other psychosocial factors confound associations with depressive symptoms.

We offer several potential reasons for our null findings. First, we consider unique aspects of diet quality in our study population. Most Strong Heart Family Study participants report fairly simple diets, and there is little variation across individuals due in part to the limited food retail

environment in rural AI communities (Chodur et al., 2016; Eilat-Adar et al., 2013; Fretts et al., 2014, 2018). Having little dietary variety in our sample may have limited our power to detect an association with depression. Further, the AHEI was not designed to directly measure aspects of the diet that are linked with depression, such as antioxidants, fiber, folate, and healthy gut microbiota (Bear et al., 2020; Chiuve et al., 2012; Hébert et al., 2019); limited variety in the diet may have complicated this. Additionally, diet quality is lower, on average, in this AI population compared to other populations in the literature on diet and depression. The median AHEI score in our study was 40 (IRQ: 12). In other studies, median scores range from 45 to 59 (IQRs: 12-16), with the exception of 38 (IQR: 12) in an Italian adult cohort (Nicolaou et al., 2019), though it is unclear whether our exclusion of alcohol from the AHEI explains these differences. If there is a threshold effect of diet quality on depression, diet quality may be too low in our population to observe an association. While there is some suggestive evidence of a threshold effect at the higher end of diet quality (Sánchez-Villegas et al., 2015), it is unknown whether a lower threshold exists.

Another potential explanation is selection bias due to bidirectional effects of diet and depression. Excluding individuals with probable depression at baseline may have biased the sample towards people less susceptible to depression to begin with (Bear et al., 2020), which could be related to past and current diet. A French cohort study found that the influence of diet on depressive symptoms was attenuated when they excluded symptomatic individuals at baseline; the authors hypothesized that those with depressive symptoms are less likely to eat healthily (Le Port et al., 2012). The large body of evidence for cross-sectional associations between diet quality and depression supports this possibility (Lai et al., 2014; Lassale et al., 2019; Nicolaou et al., 2019). A cohort study of Dutch adults found that past and current depressive symptoms were associated with poorer diet quality among men (Elstgeest et al., 2019), providing additional evidence for an inverse association of depression and future diet quality. Other evidence suggests that individuals with subclinical depression (mild symptoms), who are more likely to later report clinical depression, may improve their diets in an attempt to improve symptoms (Bear et al., 2020; Jacka et al., 2015). Indeed, a meta-analysis found that studies that adjusted for baseline subclinical depressive symptoms did not find prospective associations between diet quality and depression, though this adjustment raises concerns for overcorrection (Molendijk et al., 2018). In our study, we were interested in the unidirectional influence of diet as a potential modifiable risk factor for depression. Using a sampling approach common in other diet-depression cohort studies (Nicolaou et al., 2019), we excluded individuals at baseline who reported depression. We did this to limit

potential effects of depressive symptoms on diet quality at baseline. However, we were unable to control for previous depression that resolved before the baseline assessment and possibly influenced current diet quality.

Finally, residual confounding may be present. We adjusted for social support and identification with tribal traditions because we hypothesized that social and cultural factors co-occur with dietary habits that confound the association between diet quality and depression. For example, cultural activities and social gatherings can involve foods that are scored poorly on the AHEI. These foods may confer positive social experiences and mental well-being that contribute to lower odds of reporting depression over time and a lower diet quality score. It is possible the psychosocial measures we included in the model did not fully control for this confounding.

This study has several limitations. First, in contrast to a clinical diagnosis, the CES-D measures past-week depressive symptoms which may vary over time due to the scale's sensitivity to reactions to life events and individual-level cycles of symptomology (Radloff, 1977). However, the CES-D has shown adequate test-retest validity for intervals of up to 12 months (Radloff, 1977) which supports its use in longitudinal studies conducted previously on this topic (Adjibade et al., 2018; Akbaraly et al., 2013; Le Port et al., 2012; Vermeulen et al., 2018). Second, while we included current use of antidepressants in the outcome to indicate depression in the absence of symptoms, there are important limitations to this measure. Some antidepressant medications are prescribed for other conditions like chronic pain and anxiety, and we were unable to distinguish these indications from clinical depression. Additionally, prescribing practices may have changed over time, so data on antidepressant use may not reflect the underlying presence of depression in the population. However, antidepressant use has been included in previous studies of the diet-depression relationship (Chocano-Bedoya et al., 2013; Sánchez-Villegas et al., 2015), and our sensitivity analysis that omitted antidepressants from the outcome did not produce materially different results from our primary analysis. Third, the study is limited by two assessments periods, necessitating our assumption that AHEI scores represented the usual diet before and after the baseline assessment. Diets of the Strong Heart Family Study population are known to be relatively consistent over time (Chodur et al., 2016; Fretts et al., 2018; Kauffman et al., 2019; Kumar et al., 2016), so this may be a reasonable assumption. Additionally, the single follow-up assessment prevents us from estimating time of depression onset and time-varying confounding. Fourth, loss-to-follow-up was greater among male participants. Compared to females, males tend to have poorer diet quality and health

behaviors and are less likely to report depression symptoms (Brave Heart et al., 2016; Noble et al., 2015). In our study, on average, those who were lost to follow up had fewer depressive symptoms at baseline and a slightly higher AHEI score than those with complete data (Appendix Table A1). Although this could have induced a positive, non-significant association between diet quality and reporting depressive symptoms, our sensitivity analysis using imputed outcomes did not offer evidence of this. Fifth, we were unable to exclude participants with possible postpartum depression because we did not have pregnancy information at follow up.

Our study also has numerous strengths. We used standardized, *a priori* measures of diet quality and depression to test for a prospective association in AI communities—a population unique to the literature on this topic yet known to experience higher burdens of related health outcomes. The Strong Heart Family Study is a large, multi-tribal study of risk factors for cardiovascular disease in an underserved and rural population of AIs. We leveraged comprehensive data collected at each assessment to control for potential confounders, including psychosocial factors that have been difficult to control for in previous studies. We were also able to explore interactions by age and sex and impute missing values.

We did not find evidence of a relationship between diet quality and depression after a mean follow up of five years in a population of rural AIs. While nearly one-fifth of our sample reported probable depression at follow up, our findings do not support that past diet quality is an important risk factor. Additional research is needed to confirm this initial interpretation. Future studies with longer follow-up periods and repeated measures of diet and depression will help determine whether a longer-term and bidirectional relationship exists. Further, other aspects of rural AI diets and dietary determinants that may influence depression should be assessed in future studies, such as food insecurity, stress and coping, and social connectedness. Finally, research on possible threshold effects of diet quality and depression in warranted. While current implications for public health and clinical practice are limited without additional research, our results reinforce the need to address low diet quality and high prevalence of depression in rural AI communities represented in this study.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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APPENDIX

Table A1
Characteristics of individuals included in the analytic sample versus those excluded due to missing information on depressive symptoms at follow up

	Analytic Sample ***N* = 1100**	Missing CES-D score and not taking antidepressants at follow up[a] ***n* = 384**
	n (%) or mean (SD)	
Male	469 (43)	206 (54)
Age, years		
15-25	252 (23)	96 (25)
26-45	476 (43)	138 (36)
46-65	290 (26)	100 (26)
66-90	82 (7)	49 (13)
Missing	0	1 (<1)
Education, years		
0-11	258 (23)	108 (28)
12-15	701 (64)	235 (61)
16-20	137 (12)	39 (10)
Missing	4 (<1)	2 (1)
Smoking status		
Never	474 (43)	141 (37)
Former	250 (23)	110 (29)
Current	376 (34)	133 (35)
Smokeless tobacco use, current	80 (7)	28 (7)
Missing	12 (1)	5 (1)
Alcohol use status		
Never	136 (12)	41 (11)
Former	325 (30)	124 (32)
Current	638 (58)	219 (57)
Missing	1 (<1)	0
BMI category[b]		
Underweight	13 (1)	4 (1)
Normal	197 (17)	73 (19)
Overweight	325 (30)	118 (31)
Obese	560 (50)	186 (48)
Missing	5 (<1)	3 (1)
Pedometer average steps/day		
<5,000	462 (42)	173 (45)
5,000-9,999	435 (40)	129 (34)
≥10,000	141 (13)	50 (13)
Missing	62 (6)	32 (8)

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Table A1
Characteristics of individuals included in the analytic sample versus those excluded due to missing information on depressive symptoms at follow up

	Analytic Sample ***N* = 1100**	Missing CES-D score and not taking antidepressants at follow up[a] ***n* = 384**
	n (%) or mean (SD)	
Diabetes diagnosis[c]		
Known diabetes	170 (15)	79 (21)
Impaired glucose tolerance	241 (22)	84 (22)
Normal glucose tolerance	685 (62)	215 (56)
Missing	4 (<1)	6 (2)
Social support score (0-49)	40.9 (5.2)	38.1 (6.8)
Health Locus of Control scores		
Internal (0-18)	12.6 (2.4)	12.8 (2.3)
External: Chance (0-18)	7.7 (2.5)	8.0 (2.5)
External: Powerful others (0-18)	8.4 (2.8)	8.9 (2.9)
Identify with own tribal traditions (yes)	782 (71)	260 (68)
Missing	25 (2)	7 (2)
AHEI score (no alcohol), quartiles		
1st: 19.6-34.2	275 (25)	96 (25)
2nd: 34.3-39.6	291 (26)	80 (21)
3rd: 39.7-46.1	261 (24)	110 (29)
4th: 46.1-74.0	273 (25)	98 (26)
Depressive symptoms (CES-D scale, baseline)		
None	779 (71)	279 (73)
Mild	321 (29)	105 (27)

[a]Individuals who did not answer any questions on the CES-D questionnaire: *n* = 262; individuals who skipped >4 questions on the CES-D questionnaire: *n* = 122. Individuals with missing CES-D scores, but who were taking antidepressants at follow up are included in the study population (*n* = 13). Individuals not shown in this table are those who, at baseline, had current or recent (≤12 months) pregnancies, CES-D scores ≥16 or missing CES-D scores, or reported taking antidepressants.

[b]Body mass index (BMI): underweight <18.5 kg/m^2; normal 18.5-24.9 kg/m^2; overweight 25-29.9 kg/m^2; obese ≥30 kg/m^2.

[c]Known diabetes (DM) defined as ≥126 mg/dL fasting blood glucose, or reported history of DM and any of the following: on insulin treatment, hypoglycemic agent, renal dialysis or had kidney transplantation. Impaired glucose tolerance: fasting blood glucose 110-125mg/dL and no DM treatment. Normal glucose tolerance: fasting blood glucose <110mg/dL and no DM treatment.

Data are pooled across three field centers in Arizona, Oklahoma, and South Dakota.

AHEI: Alternative Healthy Eating Index; a dietary index based on absolute intake of 10 nutrients and foods; the total AHEI score ranges from 0 (least healthy) to 100 (most healthy).

CES-D: Center for Epidemiologic Studies Depression Scale. Scores reflect depressive symptoms: none = <10; mild = 10-15; moderate = 16-24; severe = >24.

Table A2
The Alternative Health Eating Index-2010 (AHEI) scoring method (Chiuve et al. 2012, Kauffman et al. 2019, Jacobs et al. 2017)

Component	Criteria for Min. Score (0)	Criteria for Max. Score (10)
Vegetables (serv/day)	0	≥5
Fruit (serv/day)	0	≥4
Whole grains (grams/day)		
Males	0	90
Females	0	75
Sugar-sweetened beverages and fruit juice (serv/day)	≥1	0
Nuts and legumes (serv/day)	0	≥1
Red/processed meat (serv/day)	≥1.5	0
trans fat (% of energy)	≥4	≤0.5
Long-chain n-3 fats (EPA and DHA) (mg/d)	0	250
Polyunsaturated fatty acids (% of energy)	≤2	≥10
Sodium (mg/d)	Highest decile	Lowest decile
Total	0	100

Alcohol use was excluded from the AHEI score calculations and was instead included as a separate covariate in analyses. Therefore, the maximum score possible was 100, not 110.

Table A3

Baseline AHEI diet quality scores overall and for each component stratified by those who did and did not develop probable depression at follow up

	Outcome at follow up	
	No probable depression[a] ***n* = 893**	**Probable depression[a]** ***n* = 207**
AHEI components	mean (SD)	
Vegetables (serv/day)	2.6 (2.1)	2.7 (2.2)
Fruit (serv/day)	0.9 (1.0)	1.0 (1.3)
Whole grains (g/day)		
Males	19.9 (25.2)	20.8 (30.6)
Females	20.0 (26.2)	18.2 (19.0)
Sugar-sweetened beverages and fruit juice (serv/day)	2.9 (2.6)	3.0 (2.9)
Nuts and legumes (serv/day)	0.7 (1.0)	0.8 (1.1)
Red/processed meat (serv/day)	1.4 (1.1)	1.4 (1.1)
trans fat (% of energy)	1.6 (0.5)	1.6 (0.6)
Long-chain n-3 fatty acids (EPA and DHA) (mg/d)	67.7 (113.6)	65.0 (104.0)
Polyunsaturated fatty acids (% of energy)	8.6 (2.6)	8.8 (2.7)
Sodium (mg/d)	3114 (1891)	3230 (1892)
Total calories[b]	2322 (1254)	2436 (1327)
AHEI score	40.5 (9.0)	40.8 (9.4)

AHEI: Alternative Healthy Eating Index; a dietary index based on absolute intake of 10 nutrients and foods each scored 0-10 using standardized serving sizes and cut points associated with increased or decreased chronic disease risk. Alcohol use was excluded from the AHEI score calculations and was included as a separate covariate in analyses.

CES-D: Center for Epidemiologic Studies Depression Scale. Scores reflect depressive symptoms: none = <10; mild = 10-15; moderate = 16-24; severe = >24.

[a]Probable depression is defined as having a CES-D score ≥16 or taking antidepressants. All participants were free of probable depression at baseline.

[b]Total calories are not included in AHEI score calculation; shown for descriptive purposes only.

EVALUATING THE IMPACT OF A TRIBAL NALOXONE PROGRAM THROUGH PRE AND POST SURVEYS FROM FIRST RESPONDERS

Samantha McGee, CADC, Morgan Greutman, PharmD, BCPS, Grace Cua, MSW, and Barbara Plested, PhD

Abstract: The Choctaw Nation Health Care Center established a first responder naloxone program in 2015. Limited data is available on community naloxone programs specific to tribal communities and the opinions of first responders who may utilize naloxone in the field. The purpose of this article is to highlight the model of a tribal first responder naloxone program in Talihina, Oklahoma and present analysis of the impact of program trainings on first responders' understanding and willingness to administer intranasal naloxone through pre- and post-surveys (n = 758) collected from May 2018 to November 2019. Descriptive analyses were conducted to compare first responders' rating of their support, willingness, and confidence in using naloxone. Overall, 95.1% of first responders reported learning something new from the training. However, the most significant changes in pre- to post-test results were among first responders that had never been at the scene of an overdose. Almost 77% of trainees who reported they never were at a scene of an overdose and responded "not very willing" in administering naloxone at pre-test, responded that they were "very willing" to administer naloxone at post-test.

INTRODUCTION

The Centers for Disease Control and Prevention (CDC) reports almost 450,000 people died from an opioid overdose from 1999-2018 in the United States (CDC, 2020). In the state of Oklahoma, data show that over 6,500 people died from opioid overdose from 1999-2016 (ODMHSAS, 2021). Data available on the CDC website shows a statistically significant decrease in opioid overdose deaths from 2018-2019 (172 deaths in 2018, 133 deaths in 2019; CDC, 2021). However, in late 2020 the CDC issued a health advisory stating that an increase in opioid overdose deaths was observed during the pandemic across the United States. Provisional data in this report

showed overdoses involving synthetic opioids in the state of Oklahoma had more than a 50% increase from June 2019 to May 2020 (CDC, 2020).

In Southeastern Oklahoma, it is common for first responders such as police or firefighters to be the first at the scene of a medical emergency due to the rural nature of the area. The Choctaw Nation jurisdiction spans over approximately 11,000 square miles in Southeastern Oklahoma with an average population per square mile of 23.9 (CNO, 2021). The most populated county per square mile is Le Flore County at 54.5 versus Pushmataha County at 8.3. Seven out of the eleven total counties have a population per square mile of less than 20 people (US Census, 2010). Equipping these professionals with Narcan (naloxone) can lead to faster administration of the lifesaving medication to reverse an opioid overdose, without having to wait on an ambulance.

Because of compelling data and the rural nature of the Choctaw Nation jurisdiction, the Talihina pharmacy department started a small naloxone program that began by training and equipping tribal police with naloxone in 2015 (35 tribal officers trained). Due to positive feedback and community impact, the team applied for and received SAMHSA's First Responders – Comprehensive Addiction and Recovery Act (FR-CARA) grant in 2017, a program created to provide funding to equip first responders with naloxone to administer for emergency treatment of an opioid overdose while also initiating appropriate processes for referral to treatment and recovery (SAMHSA, 2017). Receiving this award allowed the existing program to hire an additional full-time employee and expand naloxone access to all first responders within the 10 ½ counties of the Choctaw Nation jurisdiction.

Staff for the Addressing Opioid Overdose Death (AOOD) program consists of a pharmacist that serves as the Project Director with 25% effort and a Certified Alcohol and Drug Counselor (CADC) with 100% effort that serves as the Project Coordinator. The director is responsible for overall program management, budget, naloxone inventory, and sustainability efforts. The Project Coordinator provides naloxone trainings to first responders, tracks naloxone kit utilization, meets local and federal grant reporting deadlines, and is available to provide information on treatment resources to tribal and community members.

The objective of this article is to describe the AOOD program model and to determine if AOOD naloxone trainings impacted first responder's understanding and willingness to administer naloxone in the field through pre- and post-surveys.

METHODS

Participants

All participants were first responders that worked within the 10 ½ counties of the Choctaw Nation jurisdiction. The first responders worked at a variety of agencies including fire departments, police departments, tribal police and security, state parks, schools, college universities, and emergency medical services (EMS). A total of 901 first responders received the AOOD First Responder naloxone training. The majority of trainees agreed to complete surveys (n = 758, 84.13%) with 714 trainees completing most items on the pre- and post-training surveys. On average, trainees worked as first responders for 10.55 years (SD = 9.52 years, range = 0.00 years to 44.00 years).

Procedure

Before the training started and prior to providing any information, first responders were given a pre-training survey that included assessing the first responders' opinion on being authorized to administer naloxone, willingness to administer naloxone on a victim, and confidence in utilizing the lifesaving medication. Once the pre-training surveys were completed, the project coordinator began the training utilizing a PowerPoint in a traditional classroom style. The training consisted of opioid education, tribal impact of opioid epidemic, overdose identification, Good Samaritan law review, use of intranasal naloxone, appropriate response to an opioid overdose, and actions to take after they use an intranasal naloxone device. After the training was completed, a group verbal competency is reviewed to assess basic knowledge of naloxone use. After the competency, first responders were given a post-training survey to determine their opinion on authorization to administer, willingness, confidence, and if they learned new information or skills as a result of the training.

At the end of each quarter, the project coordinator submitted all pre- and post-surveys to Council Oak Training and Evaluation (COTE), the contracted evaluation services for data analyses. COTE compiled all data from matching pre- and post-surveys, entered anonymous information into database, and provided reports and presentations as needed. This information was shared with the staff, AOOD Advisory Board, and SAMHSA. On a monthly basis AOOD staff completed an Excel tracking log on the number of trainings, number in attendance, number of naloxone kits distributed, and number of kits used. This log was sent to COTE for data analysis.

The data from the pre- and post-surveys used in this publication were completed during an 18-month period from May 2018 to November 2019.

Pre-Training Survey

A 7-item survey was administered prior to receiving the training. Items included questions on their experiences at a scene of an overdose, attitudes towards first responders' authorization to administer naloxone, and being present at a scene of an overdose.

Time Since Last Scene of Overdose

Trainees identified the last time they were present at the scene of a serious heroin or opiate pain medication overdose: (1) within the past 12 months, (2) more than a year ago, or (3) never.

Presence of First Responders at Scene of Overdose

Trainees were asked to identify how often first responders were present at the scene of an overdose based on their experience on a five-point Likert scale (1 = always, 2 = usually, 3 = sometimes, 4= rarely, 5 = never).

Importance of First Responders' Presence at Scene of Overdose

Trainees were asked to rate first responders' importance at a scene of an overdose for the purpose of keeping medical personnel safe and enforcing laws. Each were rated on a four-point scale (1= very important, 2 = somewhat important, 3 = not very important, 4 = not important at all).

Support First Responders' Authorization to Use Naloxone

Trainees were asked to rate their support for first responders' authorization to use naloxone on a five-point Likert scale (1 = strongly support, 2 = somewhat support, 3 = neutral, 4 = somewhat against, 5 = strongly against). This item was reversed scored to reflect higher scores meaning more support. Trainees (n = 71) who reported "don't know" or did not respond were excluded from analyses.

Willingness to Administer Naloxone

Trainees were asked to rate their willingness to administer naloxone to an overdose victim on a four-point Likert scale (1 = very willing, 2 = somewhat willing, 3 = not very willing, 4 = definitely would not). This item was reversed scored to reflect higher scores meaning more

willingness. Trainees (n = 86) who reported "don't know" or did not respond were excluded from analyses.

Confidence in Using Naloxone

Trainees were asked to rate their confidence in using naloxone on a four-point Likert scale (1 = very confident, 2 = somewhat confident, 3 = not very confident, 4 = not confident at all). This item was reversed scored to reflect higher scores meaning more confidence. Trainees (n = 146) who reported "don't know" or did not respond were excluded from analyses.

Post-Training Survey

A four-item survey was administered after the training. Trainees were asked again to rate their support for first responders' authorization to use naloxone, willingness to administer naloxone, and confidence in using naloxone. In addition, trainees identified if they learned new information and/or skills as a result of this training (0 = yes, 1 = no).

Analytical Plan

First, descriptive analyses were conducted on all survey items. Next, the endorsement of pre- to post-response categories for trainees' rating of their support, willingness, and confidence in using naloxone was examined to determine movement in ratings from pre- to post-test. Then, the endorsement of pre- to post-response categories for trainees' rating of their support, willingness, and confidence in using naloxone by time since last scene of serious overdose (never, within the past 12 months, more than a year) was examined to determine movement in ratings from pre- to post-test.

Ethics Approvals

The Choctaw Nation Institutional Review Board (CNO IRB) exists to protect the rights of people who are or could potentially be research participants. The CNO IRB reviewed and approved the project and deemed it appropriate for continuation.

RESULTS

Last Time at the Scene During an Overdose

Approximately half reported that they had never been at a scene of a serious heroin or opiate pain medication overdose (*n* = 391, 51.6%). About 25% of trainees reported the last time they were at a scene of an overdose was more than a year ago (*n* = 191, 25.2%) and about 23% reported the last time was within the past 12 months (*n* = 171, 22.6%). Five trainees did not respond (0.7%).

Presence of First Responders at Scene of Overdose

Overall, trainees reported that in their experience, first responders were present at the scene of an overdose "always" or "usually" (*n* = 132, 17.4%; *n* = 288, 38.0%, respectively), followed by "sometimes" (*n* = 221, 29.2%), "rarely" (*n* = 65, 8.6%), and "never" (*n* = 40, 5.3%). Twelve trainees did not respond (1.6%).

Importance of First Responders

The majority of trainees reported that first responders are "very important" for the purpose of keeping medical personnel safe at the scene of an overdose (*n* = 569, 75.1%), followed by "somewhat important" (*n* = 130, 17.2%), "not very important" (*n* = 10, 1.3%), and "not important at all" (*n* = 3, 0.4%). The remaining trainees (*n* = 46, 6.1%) reported "I don't know" or did not respond. In addition, trainees reported that first responders are "very important" for the purpose of enforcing the law at the scene of an overdose (*n* = 334, 44.1%), followed by "somewhat important" (*n* = 224, 29.6%), "not very important" (*n* = 75, 9.9%), and "not important at all" (*n* = 57, 7.5%). The remaining trainees (*n* = 68, 9.0%) reported "I don't know" or did not respond.

New Information

Overall, 95.1% of first responders reported learning something new from the AOOD training.

Support, Willingness, and Confidence Administering Naloxone

Means and standard deviations for pre- and post-test trainees' scores of support for first responders authorization to use naloxone, willingness to use naloxone in the field, and confidence in using naloxone in the field are provided in Table 1.

Endorsement of post-response categories by pre-response categories are provided in Table 2. Across the three domains (support, willingness, and confidence), the majority of trainees who reported they "strongly supported," were "very willing," or were "very confident" at pre-test maintained their endorsement at post-test (99.0%, 97.5%, and 97.4%, respectively). The majority of trainees who responded they were "neutral" in supporting naloxone administration at pre-test, responded that they "strongly support" administering naloxone at post-test. About 58% trainees who responded they were "not very willing" to administer naloxone to an overdose victim at pre-test responded "very willing" at post-test. The majority of trainees who responded "not very confident" or "not confident at all" at pre-test, reported they were "very confident" in administering naloxone to an overdose victim at post-test (70.5%, 69.0%, respectively).

Table 1
Pre- and post-training responses for trainees who have never used naloxone in the field, M(SD)

Pre	Post	
Support	4.58 (0.74)	4.87 (0.44)
Willingness	3.68 (0.55)	3.89 (0.33)
Confidence	3.18 (0.90)	3.85 (0.40)

Table 2
Support, willingness, and confidence endorsement of post-test response categories by pre-test response

		Post-Test				
	Support	Strongly Support	Somewhat Support	Neutral	Somewhat Against	Strongly Against
Pre-Test	Strongly Support	490 (99.0%)	4 (0.8%)	0 (0.0%)	1 (0.2%)	0 (0.0%)
	Somewhat Support	73 (74.5%)	23 (23.5%)	2 (2.0%)	0 (0.0%)	0 (0.0%)
	Neutral	56 (63.6%)	18 (20.5%)	14 (15.9%)	0 (0.0%)	0 (0.0%)
	Somewhat Against	2 (50.0%)	0 (0.0%)	2 (50.0%)	0 (0.0%)	0 (0.0%)
	Strongly Against	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)

continued on next page

Table 2 continued

Support, willingness, and confidence endorsement of post-test response categories by pre-test response

		Post-Test			
	Willingness	Very Willing	Somewhat Willing	Not Very Willing	Definitely Would Not
Pre-Test	Very Willing	470 (97.5%)	12 (2.5%)	0 (0.0%)	0 (0.0%)
	Somewhat Willing	120 (72.3%)	46 (27.7%)	0 (0.0%)	0 (0.0%)
	Not Very Willing	11 (57.9%)	7 (36.8%)	1 (5.3%)	0 (0.0%)
	Definitely Would Not	1 (33.3%)	1 (33.3%)	0 (0.0%)	1 (33.3%)
		Post-Test			
	Confidence	Very Confident	Somewhat Confident	Not Very Confident	Not Confident at All
Pre-Test	Very Confident	263 (97.4%)	7 (2.6%)	0 (0.0%)	0 (0.0%)
	Somewhat Confident	179 (81.7%)	40 (18.3%)	0 (0.0%)	0 (0.0%)
	Not Very Confident	55 (70.5%)	20 (25.6%)	1 (1.3%)	2 (2.6%)
	Not Confident at All	29 (69.0%)	10 (23.3%)	3 (7.1%)	0 (0.0%)

Table 3

Pre and post training descriptives by time since last experience at overdose scene, M(SD)

	Within the past 12 months		**More than 1 year**		**Never**	
	Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**
Support	4.69 (0.63)	4.89 (0.36)	4.61 (0.69)	4.90 (0.34)	4.50 (0.81)	4.81 (0.59)
Willingness	3.85 (0.37)	3.95 (0.21)	3.71 (0.51)	3.86 (0.36)	3.58 (0.62)	3.82 (0.42)
Confidence	3.46 (0.73)	3.90 (0.36)	3.27 (0.80)	3.84 (0.37)	2.96 (1.00)	3.79 (0.46)

By Time Since Last Experience at Scene of an Overdose

Means and standard deviations for pre- and post-test trainees' scores of support for first responders' authorization to use naloxone, willingness to use naloxone in the field, and confidence in using naloxone in the field by trainees' reported time since last experience at scene of an overdose are provided in Table 3.

Support

Post-response categories on support for first responders' authorization to use naloxone by pre-response categories are provided in Table 4. Majority of trainees who reported they "strongly supported" naloxone use at pre-test maintained their endorsement at post-test across the three categories of time since last at overdose scene (never: 97.8%, within the last 12 months: 100.0%,

more than one year: 100.0%). The majority of trainees (68.0%) who reported they never were at a scene of an overdose and responded "neutral" in supporting naloxone administration at pre-test, responded that they "strongly support" administering naloxone at post-test.

Table 4
Support: Endorsement of post-test response categories by pre-test response and by time since last at overdose scene

		Post-Test				
	Never	Strongly Support	Somewhat Support	Neutral	Somewhat Against	Strongly Against
Pre-Test	Strongly Support	223 (97.8%)	4 (1.8%)	0 (0.0%)	1 (0.4%)	0 (0.0%)
	Somewhat Support	38 (79.2%)	9 (18.8%)	1 (2.1%)	0 (0.0%)	0 (0.0%)
	Neutral	34 (68.0%)	5 (10.0%)	11 (22.0%)	0 (0.0%)	0 (0.0%)
	Somewhat Against	2 (50.0%)	0 (0.0%)	2 (50.0%)	0 (0.0%)	0 (0.0%)
	Strongly Against	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)
		Post-Test				
	Within the last 12 months	Strongly Support	Somewhat Support	Neutral	Somewhat Against	Strongly Against
Pre-Test	Strongly Support	130 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Somewhat Support	13 (61.9%)	7 (33.3%)	1 (4.8%)	0 (0.0%)	0 (0.0%)
	Neutral	10 (66.7%)	4 (26.7%)	1 (6.7%)	0 (0.0%)	0 (0.0%)
	Somewhat Against	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Strongly Against	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
		Post-Test				
	More than one year	Strongly Support	Somewhat Support	Neutral	Somewhat Against	Strongly Against
Pre-Test	Strongly Support	136 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Somewhat Support	21 (75.0%)	7 (25.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Neutral	11 (50.0%)	9 (40.9%)	2 (9.1%)	0 (0.0%)	0 (0.0%)
	Somewhat Against	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Strongly Against	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Willingness

Post-response categories on willingness to administer naloxone by pre-response categories are provided in Table 5. Majority of trainees who reported they were "very willing" at pre-test maintained their endorsement at post-test among trainees across the three categories of time since last at overdose scene (never: 95.7%, within the last 12 months: 98.6%, more than one year:

99.3%). Almost 77% of trainees who reported they never were at a scene of an overdose and responded "not very willing" to administer naloxone at pre-test responded that they were "very willing" to administer naloxone at post-test.

Confidence

Post-response categories on confidence in administering naloxone by pre-response categories are provided in Table 6. The majority of trainees who reported they were "very confident" at pre-test maintained their endorsement at post-test among trainees across the three categories of time since last at overdose scene (never: 98.0%, within the last 12 months: 96.6%, more than one year: 97.5%). The majority of trainees who reported they were "not very confident" at pre-test responded that they were "very confident" in administering naloxone at post-test across the three categories of time since last at overdose scene (never: 66.7%, within the last 12 months: 86.7%, more than one year: 66.7%).

Table 5

Willingness: Endorsement of post-test response categories by pre-test response and by time since last at overdose scene

		Post-Test			
	Never	Very Willing	Somewhat Willing	Not Very Willing	Definitely Would Not
Pre-Test	Very Willing	198 (95.7%)	9 (4.3%)	0 (0.0%)	0 (0.0%)
	Somewhat Willing	73 (73.7%)	26 (26.3%)	0 (0.0%)	0 (0.0%)
	Not Very Willing	10 (76.9%)	3 (23.1%)	0 (0.0%)	0 (0.0%)
	Definitely Would Not	1 (33.3%)	1 (33.3%)	0 (0.0%)	1 (33.3%)
		Post-Test			
	Within the last 12 months	Very Willing	Somewhat Willing	Not Very Willing	Definitely Would Not
Pre-Test	Very Willing	136 (98.6%)	2 (1.4%)	0 (0.0%)	0 (0.0%)
	Somewhat Willing	19 (86.4%)	3 (13.6%)	0 (0.0%)	0 (0.0%)
	Not Very Willing	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)
	Definitely Would Not	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
		Post-Test			
	More than one year	Very Willing	Somewhat Willing	Not Very Willing	Definitely Would Not
Pre-Test	Very Willing	134 (99.3%)	1 (0.7%)	0 (0.0%)	0 (0.0%)
	Somewhat Willing	27 (61.4%)	17 (38.6%)	0 (0.0%)	0 (0.0%)
	Not Very Willing	1 (20.0%)	3 (60.0%)	1 (20.0%)	0 (0.0%)
	Definitely Would Not	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 6
Confidence: Endorsement of post-test response categories by pre-test response and by time since last at overdose scene

		Post-Test			
	Never	Very Confident	Somewhat Confident	Not Very Confident	Not Confident at All
Pre-Test	Very Confident	98 (98.0%)	2 (2.0%)	0 (0.0%)	0 (0.0%)
	Somewhat Confident	88 (82.2%)	18 (16.8%)	0 (0.0%)	0 (0.0%)
	Not Very Confident	28 (66.7%)	12 (28.6%)	1 (2.4%)	1 (2.4%)
	Not Confident at All	25 (71.4%)	6 (17.1%)	3 (8.6%)	0 (0.0%)
		Post-Test			
	Within the last 12 months	Very Confident	Somewhat Confident	Not Very Confident	Not Confident at All
Pre-Test	Very Confident	85 (96.6%)	3 (3.4%)	0 (0.0%)	0 (0.0%)
	Somewhat Confident	38 (86.4%)	6 (13.6%)	0 (0.0%)	0 (0.0%)
	Not Very Confident	13 (86.7%)	1 (6.7%)	0 (0.0%)	1 (6.7%)
	Not Confident at All	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
		Post-Test			
	More than one year	Very Confident	Somewhat Confident	Not Very Confident	Not Confident at All
Pre-Test	Very Confident	79 (97.5%)	2 (2.5%)	0 (0.0%)	0 (0.0%)
	Somewhat Confident	52 (76.5%)	16 (23.5%)	0 (0.0%)	0 (0.0%)
	Not Very Confident	14 (66.7%)	7 (33.3%)	0 (0.0%)	0 (0.0%)
	Not Confident at All	2 (33.3%)	4 (66.7%)	0 (0.0%)	0 (0.0%)

DISCUSSION

Overall, the AOOD naloxone training increased the confidence to administer naloxone among first responders that reported "not confident at all" on the pre-test (69%). Across the three domains (support, willingness, and confidence), the majority of trainees who reported they "strongly supported," were "very willing," or were "very confident" at pre-test maintained their endorsement at post-test (99.0%, 97.5%, and 97.4%, respectively). According to the first responder's last experience at the scene of an overdose, trainees who were never at a scene of an overdose and reported that they "somewhat support," were "neutral," or were "somewhat against" at pre-test collectively changed their endorsement to strongly support (79.2%, 68%, and 50% respectively) post-test. Based on this data, it could be inferred that first responders who have never been at the scene of an overdose may benefit more from naloxone training than those who have responded to an opioid overdose previously. However, the overall data shows that 95.1% of first

responders reported learning something new because of the training. Overall pre- and post-survey results show that very few trainees were unsupportive or unwilling to use naloxone in the field after completing the training. Post-survey evaluations indicate that most first responders are supportive, willing, and confident to use naloxone in the field.

This program showcases a model that could be easily replicated at other health systems and pharmacies. Naloxone educational resources are plentiful online, and pharmacies are uniquely positioned to provide opioid overdose training and naloxone distribution to communities from an inventory and medication knowledge standpoint. Pharmacy staff can manage naloxone ordering and storage within their current processes. Pharmacy staff are also well versed in proper medication storage, use, and side effects. Limitations to starting a program of this nature in the health system or pharmacy setting could be the additional staffing requirements due to time required to train and maintain appropriate records of community naloxone kits. Another constraint may be the funding of additional staff members and the naloxone kits. Applying for grants can be a solution to the potential financial and staffing restrictions.

Some limitations of this study include a small data set that includes first responders from the same regional area. Due to this, results may not be generalizable to other first responders across the nation. First responders may have also responded to the pre- and post-survey questions the way they thought was correct due to the desire to give the "right" answer. More studies from similar naloxone programs are needed to assess the opinion of first responders utilizing naloxone more accurately on a broader scale.

CONCLUSION

The AOOD program showcases a first responder naloxone program in a rural, tribal jurisdiction aiming to increase access to naloxone through community trainings. Since the beginning of the AOOD program, staff have trained 1,932 first responders and have 24 documented lives saved. The program demonstrates the impact that grant programs, like SAMHSA's FR-CARA grant, can have on communities. Post-hoc analysis showed that first responders that had never responded to an opioid overdose situation showed a greater change in willingness and confidence to administer naloxone than those who had been at an overdose within the past year. The AOOD program has proven to be especially beneficial to first responders that have never been at the scene of an opioid overdose. Greater access to naloxone is still needed

despite progress being made over the past several years, particularly due to increased opioid overdoses since the onset of the COVID-19 pandemic.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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AN UPDATED SYSTEMATIC REVIEW OF RISK AND PROTECTIVE FACTORS RELATED TO THE RESILIENCE AND WELL-BEING OF INDIGENOUS YOUTH IN THE UNITED STATES AND CANADA

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Abstract: Indigenous youth in North America experience mental health inequities compared to White peers, including a higher prevalence of depression, anxiety, suicide, and substance use. This systematic review of culturally specific risk and protective factors related to resilience and mental health in Indigenous youth aimed to synthesize the recent evidence and update a systematic review of evidence prior to 2013 (Burnette & Figley, 2016). Following PRISMA guidelines, seven academic databases were searched for peer-reviewed qualitative and quantitative resilience research with Indigenous youth (age 19 and under) in the United States and Canada published from 2014 to 2021. Seventy-eight studies met inclusion criteria and provided ample knowledge about risk and protective factors for the resilience of Indigenous youth across the Social Ecology of Resilience theory: individual (86%), family (53%), community (60%), cultural (50%), and societal (19%). A plethora of recent interventions serve as examples of context and culture-specific responses to the mental health needs of Indigenous youth. Further attention to younger children, urban populations, and Indigenous knowledge systems is needed. In particular, the influence of racism, settler colonialism, and cultural resurgence efforts on the well-being of Indigenous youth are areas for future research.

INTRODUCTION

Indigenous youth experience more health inequities compared to White peers, including a higher prevalence of depression, anxiety, suicide, and substance use behaviors (Indian Health Service, 2017; Subica & Wu, 2018; Walker et al., 2018; Wong et al., 2014). Factors related to these disparities include historical and contemporary trauma, forced assimilation practices, family fragmentation, poverty, and loss of land, language, and culture (Goodkind et al., 2010; Lewis et al., 2018; Whitbeck, 2006). Mainstream treatments for improving physical and mental health are often

suboptimal in Indigenous populations (Goodkind et al., 2015) due to most traditional Indigenous philosophies being holistic and including an interconnected view of mind, body, spirit, and environment, instead of the Euro-American traditional medical model that aims to cure disease (Barker et al., 2017). Additionally, Indigenous communities may prefer a strength-based approach to a deficit-based approach when addressing mental health, which does not align with the Euro-American medical model (Jumper-Reeves et al., 2014). Culturally relevant practices and interventions promoting resilience are desired outcomes of research with Indigenous youth (Jongen et al., 2019; Wexler et al., 2015). A collective view of the recent advances in community-based and culturally relevant research about the resilience and mental health needs of North American Indigenous youth is needed.

Literature from 1988-2013

Burnette and Figley (2016) conducted a systematic review of risk and protective factors related to wellness of American Indian and Alaska Native (AI/AN) youth that included research from 1988 through 2013. Burnette and Figley's search resulted in 51 peer-reviewed articles, of which findings were organized into the Social Ecology of Resilience theory (Ungar, 2008, 2011a, 2011b), as shown in Figure 1. The three most important empirical domains involved relationships, which suggested that interventions aimed at strengthening the relationships with family, culture, and community resilience were essential. Burnette and Figley's review also uncovered gaps in the literature of AI/AN resilience. For example, few studies involved children younger than 10 years old, only three studies adopted a qualitative methodology, there was a paucity of resilience intervention studies, and they identified a pervasive lack of holistic and culturally relevant definitions of resilience (Burnette & Figley, 2016).

Figure 1. Risk and protective factors for AI/AN youth within the Social Ecology of Resilience theory

Note: Re-printed with permission from Burnette & Figley (2016).

Theoretical Framework of Resilience

Decades of resilience research have evolved the concept of resilience and identified relationships of resilience to health and well-being (Masten & Barnes, 2018). Ungar (2013) defined resilience as both a trait of an individual or group as well as a set of processes and mechanisms through which internal and external strengths are harnessed in response to adversity. The present systematic review continued with Ungar's theory of Social Ecology of Resilience (Ungar, 2008, 2011a, 2011b) that is based on four principles. First, one must *decentralize* the child from the focus of resilience and instead realize that availability and accessibility of culturally relevant resources affect the resilience of the child. Second, resilience is *complex* and context specific. Third, resilience is not representative across contexts and thus is *atypical*. Fourth, resilience is *culturally*, historically, and temporally *relative* and may not be congruent with dominant cultural norms. Resilience does not merely involve a return to a previous state but is a dynamic process of growth and transformation (Kirmayer et al., 2012). Resilience research must account for three important things: risk exposure, promotive processes, and desired outcomes based on the culture and context (Ungar, 2019). Concepts within the Social Ecology of Resilience theory (Ungar, 2008, 2011a, 2011b) include the domains of individual, family, community, cultural, and societal, which represent antecedents of adaptive growth. Examples of individual resilience traits are temperament or coping skills, while family resilience might include parent or caregiver attachment and economic security. Community resilience resources may be a quality day care program or safe and effective schools. Cultural resilience may be drawn from spirituality or ethnic identity, while the societal domain draws from historical oppression and discrimination (Burnette & Figley, 2016, Ungar, 2011a, 2011b). The child's mechanism of resilience includes activating their individual strengths while navigating resources and negotiating for these resources to be provided to them. Therefore, resilience is a process of resource provision (Ungar, 2011a).

The construct of resilience is pertinent to youth particularly around the stressful transition to adolescence when they must rely on patterns and strategies acquired throughout life to adapt to changing environmental conditions (Ungar, 2011b, p. 47). Resilience theory provides a positive adaptation view congruent with many overarching Indigenous traditions and beliefs among AI/AN and Canadian Aboriginal communities, who share histories of settler colonization, genocide, and intentional loss of culture (O'Neil et al., 2018). Before colonization, the Indigenous peoples of the United States and Canada lived and interacted with one another without the boundaries we know

today (Gone et al., 2019). Some researchers consider North American Indigenous communities collectively when addressing health equity, excluding those populations south of the U.S. border. The United States and Canada experienced dominant British and French influence in colonization, including such experiences such as signing treaties, having to use the English language, being forced into assimilating boarding schools, and having land decimated to a system of reservations or reserves (Whitbeck et al., 2004). Native Hawaiian youth were originally included in this review but later excluded; please refer to the methods section. For simplicity, "Indigenous" youth in this paper refers to Canada First Nations, Métis, Inuit (FNMI), American Indian (AI), and Alaska Native (AN) youth under age 19.

There are more than 630 First Nation communities in Canada (Government of Canada, 2021) and 574 federally recognized tribal nations in the United States (National Congress of American Indians, 2021), each with unique histories, languages, cultural practices, and spiritual beliefs. For example, the Métis people currently live across a wide geographical area of Canada, often in urban environments, hold values of autonomy, self-reliance, and a need to maintain their identity (Kirmayer et al., 2012). Alternatively, the Inuit people who have lived in small groups in the challenging environment of the Arctic, have developed resourcefulness, hope, and a connection to the land and environment (Kirmayer et al., 2012). Brave Heart et al. (2011) described how differences exist across Indigenous regions in North America in how psychological distress related to historical trauma are experienced and addressed. Health prevention programs and health interventions must acknowledge these cultural differences. Findings regarding Indigenous youth resilience from research with diverse study populations can be *generally* mapped using the Social Ecology of Resilience theory (Ungar, 2008, 2011a, 2011b), but when developing local and culturally relevant community programs and interventions, the findings of individual studies can offer context-specific examples. The systematic review aims to evaluate culturally specific risk and protective factors related to well-being, resilience, and mental health in Indigenous youth in literature published since 2013. Like the original review by Burnette and Figley (2016), this study was guided by the Social Ecology of Resilience theory (Ungar, 2008, 2011a, 2011b).

METHODS

The systematic review was recorded in Prospero in March 2021 and used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). The authors also consulted guidelines regarding updating systematic reviews (Garner et al.,

2016) and corresponded by e-mail with Catherine Burnette McKinley, who granted permission to update the original systematic review. A literature search was conducted in the following academic databases: Academic Search Ultimate, CINAHL, Embase, Google Scholar, PsychINFO, PubMed, and Sociological Abstracts. The authors supplemented the search with further searching of personal libraries and reference lists in published articles. Each of the seven databases was searched using a combination of MeSH terms and keywords or subject headings and keywords, when possible. Search strategies by Burnette and Figley (2016) were enhanced to capture the relevant current literature in this review (see Table 1). Of note, the term "Indigenous" was not included as numerous attempts to refine the search including the word "Indigenous" produced unwieldy results due to the global applicability of the term. Instead, the search specifically named the Indigenous groups in Canada along with AI/AN and Native Hawaiian.

Table 1
Search strategies

Original search terms used by Burnette & Figley (2016) (Data collection until 2014):	**Updated search terms**
("American Indian," OR "Alaska Native," OR "Native American,") AND ("mental health," OR "substance abuse,") AND ("risk factor," OR "protective factor," OR "resilience," OR "resiliency,") AND ("youth," OR "adolescent")	("American Indian," OR "Alaska Native," OR "Native American," OR "Inuit" OR "First Nation" OR "Native Hawaiian") AND ("mental health," OR "substance*," OR "risk*" OR "vulnerability" OR "suicide*" OR "risk factors" OR "health risk behaviors) AND ("resilience*" OR "adaptation, psychological" OR "resilience, psychological" OR "coping" OR "adapt*" OR "protect*" OR "wellness" OR "wellbeing" OR "well being" OR "well-being" OR "asset-based") AND ("child*" OR "adolescent*" OR "juvenile" OR "teen*" OR "youth")

Table 2
Inclusion and exclusion criteria

Inclusion	**Exclusion**
American Indian, Alaska Native, Native Hawaiian, Indigenous Canadian (Inuit, First Nations, Métis)	Indigenous populations outside the U.S. or Canada. Other Pacific Islanders. Non-indigenous populations.
Age 19 and under, high schoolers up to grade 12	Adults, college populations
Focus on resilience, well-being, pro-social outcomes, risk or protective factors, mental health outcomes, substance use, suicide	Results that do not include knowledge about the stated inclusion factors (such as instrument or protocol development without results relating to the sample)
Published 2014 or later, data collection prior is acceptable	Published prior to 2014
Articles in peer-reviewed journals	Abstract only, commentary, dissertation, book, conference proceeding, literature reviews, systematic reviews

Eligibility Criteria

Inclusion and exclusion criteria are shown in Table 2. Studies involving mixed samples of Indigenous/non-Indigenous youth, locations within/outside North America, or adults/children were reviewed only if findings for the specified population were reported separately.

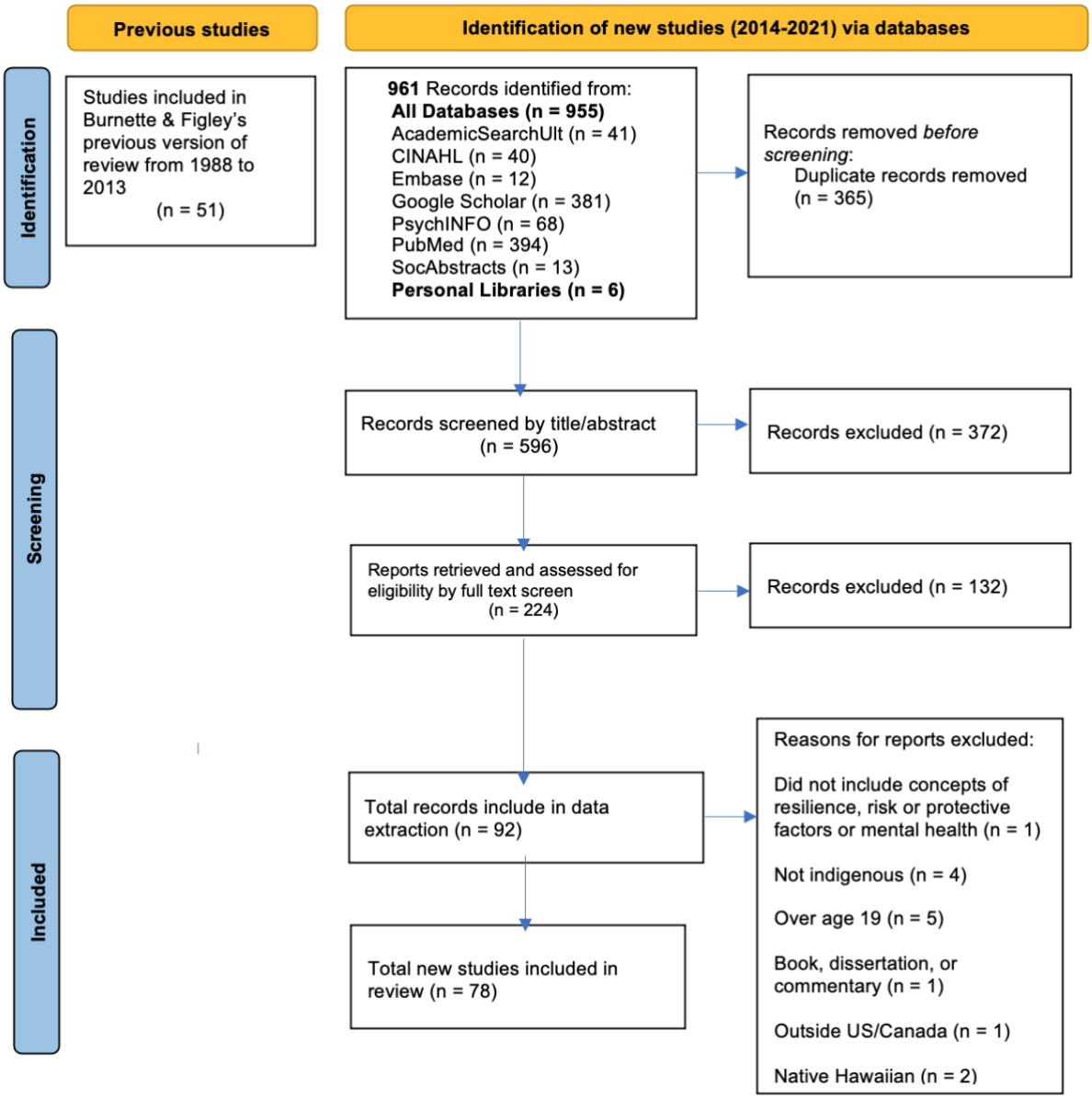
Study Selection

The article selection process is depicted in a PRISMA flow diagram (see Figure 2). After searching the seven databases, duplicate articles (n = 365) were discarded, and the remainder were screened for relevance by title and abstract by authors C.H., T.G., and R.D. Each author did a title/abstract screen for 398 of the 596 original articles so that two authors screened each article. Ties were broken by the author who did not originally screen the title/abstract. For the qualifying title/abstracts, full text articles were acquired. At this point in the project a qualified fourth author, J.A.B., joined the study due to the volume of articles obtained. Each full text article was screened by two authors and ties were broken by an author who did not originally screen the full text in question. Data from each article was extracted by one of three authors (C.H., R.D., or T.G.) using a codebook they developed, with reliability checks by the team on several randomly selected articles and as needed. The authors performed norming exercises at three points during the systematic review process. The original search was done in January 2021 resulting in 72 articles. The search was repeated in October 2021 and the procedures were repeated, resulting in an additional 8 articles which made the total 80.

The original search included Native Hawaiian youth based on one author's interpretation of recent literature that described Indigenous knowledge-based health promotion strategies that grouped American Indian, Alaska Native, and Native Hawaiian populations together (Walters et al., 2018). The authors engaged in extensive conversations about the relevance of Native Hawaiian youth to other Indigenous North American youth throughout the systematic review process. Finally, reviewers' feedback was considered and ultimately two articles focusing on Native Hawaiian youth were eliminated due to being less relevant to the context of Indigenous youth in the United States and Canada. For example, Native Hawaiians are grouped with "Other Pacific Islanders" by the United States Census Bureau (HHS.gov, 2021, October 12), which broadens the population characteristics to other cultures and histories. The October 2021 search results and the late exclusion of articles were merged into the PRISMA flowchart (Figure 2) to show the final 78 articles.

All four researchers reflected on their own backgrounds and potential bias they brought to the project. For example, the first author is White, and the other three authors are American Indian from three different tribal nations. Each resides in a different state in the Western United States. Each author viewed the data collected through a different lens and addressed this by collaborating and coming to agreement about including or excluding articles to minimize selection bias, along with the group norming exercises that were performed before each screening phase.

Figure 2. Modified PRISMA diagram



Note: From Page et al. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews.

Strength of Evidence

In the protocol, every article was evaluated for bias and quality with GRADES of evidence (BMJ Best Practice, 2021) for quantitative studies and the JBI Checklist (Joanna Briggs Institute, 2020) for qualitative studies. For comparison purposes in this study, the JBI criteria of "include," "seek further," or "exclude," was equated to high, medium, or low quality, respectively. No articles were excluded based on quality alone. Of the quantitative studies or quantitative strands from mixed methods studies, GRADES were rated as very low (n = 7), low (n = 32), moderate (n = 20), and high (n = 1). Of the qualitative studies or strands, research articles ranked low (n = 4), moderate (n = 15), high (n = 5), and unable to evaluate (n = 1).

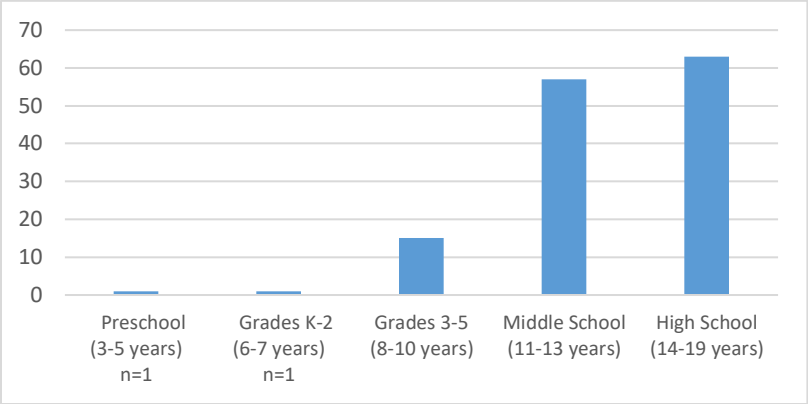
Characteristics of Studies

The most common ages of Indigenous youth in the present review were 11-19 years (see Figure 3), geographic locations were in the continental United States (see Figure 4), and in rural/reservation settings (see Figure 5). The methodology of studies is depicted in Figure 6. Thirty-two studies reported on interventions (see Figure 7).

RESULTS

Mental health outcomes measured in the final 78 studies were numerous and heterogeneous, but the most common positive outcomes were related to resilience (n = 16), ethnic/cultural identity (n = 14), well-being (n = 10), social support (n = 10), parent relationships (n = 9), self-esteem (n = 5), and cultural connectedness (n = 5). The most common negative mental health outcomes were related to substance use (n = 35), suicidal ideation or behavior (n = 12), depression (n = 10), anxiety (n = 8), historical trauma symptoms (n = 6), discrimination (n = 5), and bullying (n = 2). Factors of resilience across theoretical domains are shown in Figure 8. More details about each study can be found in Appendix Table A1.

Figure 3. Ages of youth in studies (2014-2021)



Note: Ages were not reported in earlier review other than "the majority of articles described ages 10-18."

Figure 4. Geographic location of studies

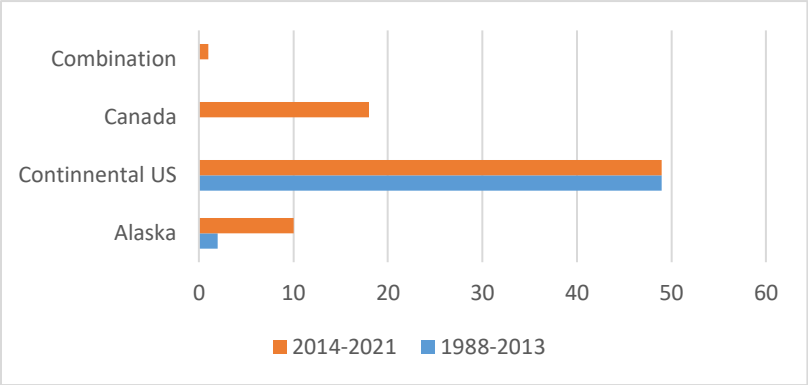


Figure 5. Reservation/rural versus urban sample

Figure 6. Methodology of studies

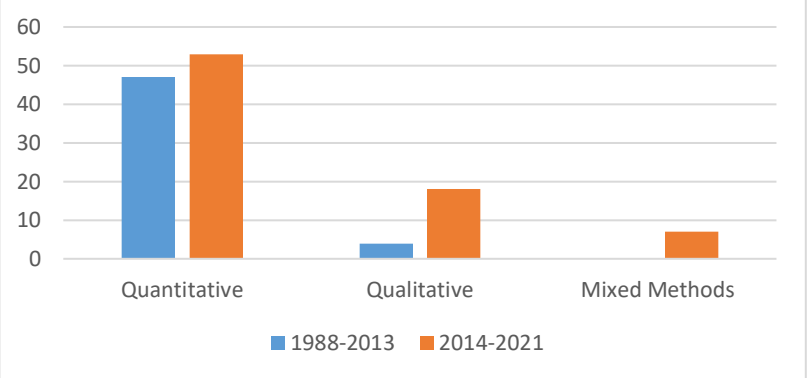
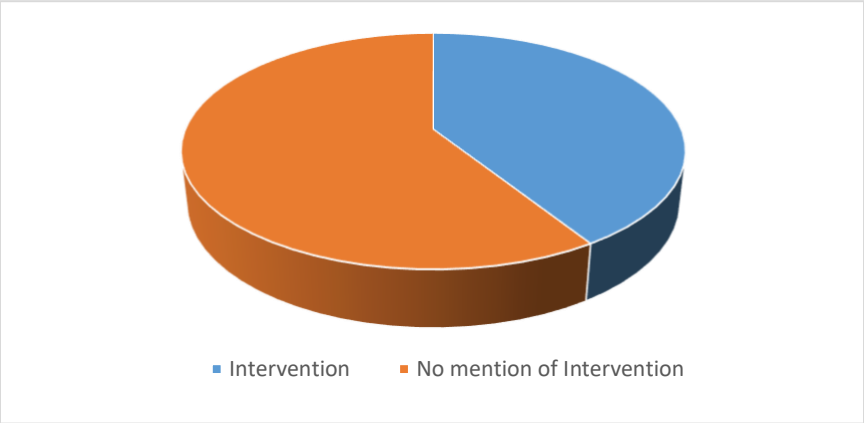
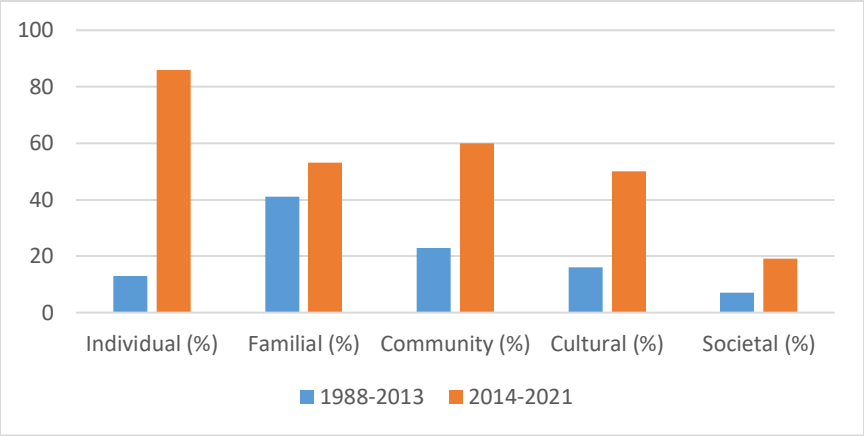


Figure 7. Intervention studies (2014-2021)



Note: The original review did not specify the number of intervention studies but stated, "Clearly, more culturally relevant and culturally specific prevention and interventions are needed" (Burnette & Figley, 2016, p. 149).

Figure 8. Factors of resilience across domains of the Social Ecology of Resilience theory (Ungar, 2011a)



Note: Original review identified one factor per article, while the updated review identified multiple factors per article.

Individual Factors of Resilience

Individual protective factors for suicidal ideation among Indigenous youth included Reasons for Life, a multidimensional construct that draws from one's cultural and spiritual beliefs about meaning in life (Allen et al., 2019). Individual risk factors for suicidal ideation included depression and the use of substances (Cwik et al., 2015) and shame (Crooks et al., 2015). Individual protective factors for substance use included social skills that help resist peer pressure (Nuño & Herrera, 2020), self-compassion (Spillane, Schick, Goldstein, et al., 2021), life skills (Baydala et al., 2014), future orientation, self-determination, and a perception of negative consequences of substance use (Crabtree et al., 2020). Additionally, the construct of Reflective Processes, which includes the potential culturally specific negative consequences of drinking was found to be protective (Allen et al., 2014). Individual risk factors for substance use included age of first use of alcohol and illicit drugs (Nuño & Herrera, 2020), sensation-seeking, poor school performance (Morrell et al., 2018), and impulsivity (binge drinking; Cwik et al., 2017). Individual protective factors for other outcomes

included Connecting to Self for resilience and well-being (Ritchie et al., 2015), ego strengths and racial/ethnic identity for personal adjustment and well-being (Gfellner, 2016), social supports, extracurricular activities, and healthy eating and sleeping for mental distress (Ersan & Rodriguez, 2021). Individual risk factors for other outcomes included having experienced trauma, substance use, skipping school for mental distress (Ersan & Rodriguez, 2021), polysubstance use for antisocial and oppositional behaviors and being bullied (Kulis et al., 2016), and substance use and early dating for aggressive offenses (Sittner & Hautala, 2016).

Familial Factors of Resilience

Familial protective factors for suicidal ideation included interpersonal factors, social support (Bush & Qeadan, 2020), and positive relationships with adults in the home (Fullerton et al., 2019). Familial risk factors for suicidal ideation included exposure to suicide or attempts in loved ones and substance use disorders in caregivers (Cwik et al., 2015). Familial protective factors for substance use included living with both parents as protective from marijuana use (Swaim & Stanley, 2021). Familial risk factors for substance use were poor family functioning (binge drinking; Cwik et al., 2015), family's own substance use, youth's access to substances, parental favorable attitudes towards substance use (Morrell et al., 2020), family history of antisocial behaviors, and favorable attitudes towards substances (Nuño & Herrera, 2020). Familial risk factors for other outcomes included parent rejection for aggressive offenses (Sittner & Hautala, 2016).

Community Factors of Resilience

Schools were a common place for data collection among AI/AN and FNMI youth (55%), often drawing from research on existing state, regional, or national surveillance data. Some authors evaluated culturally adapted school-based curricula, such as that of 3-8 grade FNMI children (Baydala et al., 2014) or AN adolescents in a school leadership program (Wexler et al., 2017). Community protective factors for suicidal ideation included connections to adults and Elders (Philip et al. 2016). Community risk factors for suicidal ideation included bullying perpetration and victimization (Gloppen et al., 2018) and overlap with binge-drinking (Cwik et al., 2017). Community protective factors for substance use were extracurricular activities (Moilanen et al., 2014; Spillane, Schick, Nalven, et al., 2021) and peer norms against substances (Martinez et al., 2015; Nuño & Herrera, 2020). Community risk factors for substance use were peer norms and use

of substances (Nalven et al., 2020; Nuño & Herrera, 2020; Whitesell et al., 2014) and connections to adults and Elders (Philip et al., 2016). Specific to binge drinking, risks were peer pressure, fights with boyfriend/girlfriend, and a lower cultural identity (Cwik et al., 2017). Community protective factors for other outcomes included a community mentoring program for improving emotional problems and anxiety symptoms (DeWit et al., 2017), youth-driven and solution-focused programs (Rasmus et al., 2014), and community activities and stable peer relationships (Kral et al., 2014). Community risk factors for other outcomes were bullying perpetration and victimization for suicidal ideation and anxiety symptoms (Gloppen et al., 2018).

Cultural Factors of Resilience

Cultural protective factors for suicidal ideation included cultural participation (Cwik et al., 2015). There were no reported cultural risk factors for suicide. Cultural protective factors for substance use included cultural identity (Belone et al., 2017) and cultural participation (West et al., 2021). Spirituality and religiosity were mostly protective factors but had mixed effects across substances (Nuño & Herrera, 2020; Unger et al., 2020). Cultural risk factors for substance use (binge drinking) included lower cultural identity (Cwik et al., 2015). Cultural protective factors for other outcomes included cultural identity for depressive symptoms (Tyser et al., 2014). Cultural connectedness (Crooks et al., 2015; Tyser et al., 2014), culturally relevant mentoring (Crooks et al., 2017), "connecting to Creation," and "connection to God and Christianity" (Lys, 2018) were protective for well-being. Cultural knowledge was protective for anxiety symptoms and relationships with caregivers (Chambers et al., 2021). There were no reports of cultural risk factors for other outcomes.

Societal Factors of Resilience

The historical and sociopolitical experiences of Indigenous peoples since colonization contribute to the complexity of Indigenous youth well-being. Historical trauma refers to the brutal treatment and subjugation of Indigenous people, leading to social determinants that undermine health in the population (Gone et al., 2019). Societal protective factors for substance use were not identified in this review. Societal risk factors for substance use were historical trauma (Soto et al., 2015) and discrimination (Davis et al., 2019). Societal protective factors for other outcomes included a high sense of coherence (comprehensibility, manageability, and meaningfulness) and

AI/AN culture, sports, arts, music, and family for Historical Loss Associated Symptoms (Whitbeck et al., 2004), including anxiety/depression and anger/avoidance (Evans & Davis, 2018). Harm-reduction and self-determination (Cooper et al., 2019), cultural camps (Barnett et al., 2020), and parental cultural socialization (Yasui et al., 2015) were protective for resilience in the context of historical trauma. Societal risk factors for other outcomes included family conflict, loss, school stress, and isolation for Historical Loss Associated Symptoms (Evans & Davis, 2018). Discrimination was a risk factor for depression (Yasui et al., 2015).

Interventional Resilience Research

Intervention research in the present review ranged from small feasibility studies to decade-long, multilevel, longitudinal studies. Most prevention interventions addressed the outcomes of suicide and substance use. Suicide prevention interventions included a community-driven and culturally adapted brief intervention named "New Hope" in Arizona that was found to decrease negative thinking, depression, and suicidal ideation and increase use of psychological services in a sample of 13 AI adolescents (Cwik et al., 2016). The cultural adaptation of a substance use prevention program for Indigenous 3rd-8th grade children living on reserve in Canada was used in a mixed methods intervention study (Baydala et al., 2014). Qualitative data about the effects of the intervention were positive across all ages. In the intervention group of middle school children, quantitative data showed significant differences from the control group. These differences included more knowledge about the negative effects of alcohol and more knowledge/decreased behavior in terms of drug use or intent (Baydala et al., 2014). In rural southwest United States, the "Respecting the Circle of Life" program, an AI/AN substance use prevention program, measured co-occurring substance use and sexual health behaviors in an interventional trial during an 8-day summer camp (Tingey et al., 2021). The Respecting the Circle of Life intervention was statistically significant in lowering intention to use substances for southwest AI/AN adolescents, as was the "Be Under Your Own Influence" intervention for Northern Plains AI/AN 7th-graders (Crabtree et al., 2021). Equine-assisted therapy at a residential inhalant treatment center for FN adolescents was beneficial, especially through cultural knowledge sharing (Adams et al., 2015). Utilizing longstanding community-based participatory research (CBPR) partnerships, researchers in Alaska were able to develop and test a suicide and substance use prevention intervention (Allen et al., 2018; Mohatt et al., 2014).

Interventions focused on other mental health outcomes as well. An intervention in Canadian aboriginal youth showed that mentored youth had less social anxiety and emotional problems than youth without a mentor, a finding not shared with non-aboriginal youth (DeWit et al., 2017). Similarly, Crooks et al. (2017) found that a culturally relevant mentoring program improved intra/interpersonal skills and the cultural and health knowledge base of youth. The "Fostering Open eXpression among Youth (FOXY)" intervention, including body mapping for 41 female youth, led to qualitative themes about coping mechanisms (Lys, 2018). In another study, a decolonizing framework guided the intergenerational participatory workshop for urban, Indigenous females in Canada that provided qualitative data regarding historical trauma effects (Cooper et al., 2019). Barnett et al. (2020) conducted a pilot study of culture camps in Alaska and found improved psychosocial outcomes in adolescents. Ritchie et al. (2014) found that adolescents attending a 10-day outdoor camp intervention in Canada had higher resilience scores than controls after the camp; however, resilience scores returned to baseline after one-year, leading Ritchie and colleagues to hypothesize that intervening historical events may have contributed.

DISCUSSION

The most impressive change in the Indigenous youth resilience literature found through systematic reviews from 1988-2013 and 2014-2021 is the volume of peer-reviewed articles; the prior 25-year period accounted for 51 articles (Burnette & Figley, 2016) and the latter seven-year period for 78 articles. The expansion of the population to Canada accounted for 18 of the 78 articles. Not only the volume but the complexity of research studies has increased, consistent with Social Ecology of Resilience theory. Large, longitudinal, and multi-site studies in the present review allowed for multiple research articles to be published from one study. Shared authorship was noted across several studies or interventions, which demonstrated the challenge of summarizing resilience research. Most studies used quantitative research designs that contributed objectivity, generalization, and prediction to the literature base for Indigenous youth resilience (Slevitch, 2011). The current search resulted in substantially more qualitative studies than the original (Burnette & Figley, 2016). Qualitative research allows for rich data that is passed verbally, more like Indigenous knowledge transmission than traditional Euro-American quantitative metrics (Auger, 2016). Qualitative themes can provide deeper understanding of resilience factors and how resilience may be atypical and context specific. Similarly, the present review had a representation of mixed methods studies that was not identified in the prior review. Mixed methods research pairs

well with emancipatory theories such as postcolonial and Indigenous theory (Creswell & Plano Clark, 2018, p. 45) and mixed methods were the foundation for the Social Ecology of Resilience theory (Ungar, 2008, 2011a, 2011b). Through multiple methodologies, researchers are accessing new and relevant findings about resilience in Indigenous youth.

Interventional Research

The examples of current and ongoing culturally relevant interventions from the present review suggest a plethora of meaningful work across Indigenous populations that is closing this gap. Slightly more than half of the articles (n = 41) followed a CBPR approach. CBPR is a partnership between researchers and the community through every stage of research design that addresses health equity by empowering the communities (Wallerstein & Duran, 2010). Although not a specific methodology, the CBPR approach is recommended for research with Indigenous populations (Jernigan et al., 2015; Jumper-Reeves et al., 2014). Burnette and Figley (2016) did not report on the use of CBPR, but the past decade has seen a surge of the use of CBPR studies and evidence that CBPR can improve health equity outcomes (Oetzel et al., 2018). Some use of CBPR may have been missed due to articles reporting on secondary analysis. The increased use of CBPR, qualitative methodology, and mixed methods are encouraging advances of rigor in the field of Indigenous youth resilience. If research about Indigenous youth continues along a trajectory like that of the past seven years, the resulting cultural prevention and intervention programs for Indigenous youth will enhance health equity.

Comparison of Updated Review to the Original

In the original systematic review by Burnette and Figley (2016), each article was organized into one domain of the Social Ecology of Resilience theory so that the sum of individual factors (13%), familial factors (41%), community factors (23%), cultural factors (16%), and societal factors (7%) totaled 100% (see Figure 8). The present review's breadth and depth of research findings made selecting one overarching domain infeasible. Risk and protective factors are complex and interactive (Ungar, 2019), so the compilation of findings from each study was organized into categories that were not mutually exclusive. This updated systematic review revealed individual factors (86%), familial factors (53%), community factors (61%), cultural factors (50%), and societal factors (19%). Most studies had resilience findings that interacted across multiple domains. Although there is limited ability to compare these factors to the review

by Burnette and Figley, the following discussion by theoretical domain considers changes over time and other current research. Referring again to the Social Ecology of Resilience theory, the empirical risk and protective factors of resilience found in this review represent the promotive processes needed in resilience research (Ungar, 2019).

Individual Domain

Individual-level factors, which ranked first among the ecosystem domains in the present review, were more highly represented than in the original review by Burnette and Figley (2016), where the individual level was the fourth most common domain. The protective and risk factors found across both reviews were consistent. Additional protective factors in the present review were the constructs of Reasons for Life (Allen et al., 2019), and Reflective Processes (Allen et al., 2014), belonging, help-seeking, life skills, and hope. The increased use of qualitative methodology, which often involves one-on-one interviews, may reflect the increased data about individual-level factors of resilience. Another reason for increased individual factors in the present review may be the expanded search terms used ("adaptation, psychological"; "resilience, psychological"; "coping"; "vulnerability"; "suicide"; and "health risk behaviors"). These terms are conceptually related to the individual domain and therefore may have filtered more studies with individual resilience factors.

Individual protective factors found in a published literature review of AI/AN adolescent well-being (Henson et al., 2017) included current and/or future aspirations, personal wellness, positive self-image, and self-efficacy. The present review extends this evidence to a larger group of Indigenous youth using rigorous methods of a systematic review protocol. What remains lacking for Indigenous youth is research about the relationship of individual stress, trauma, and resilience (Zahradnik et al., 2010). The emerging science of physiological and immune markers of psychological resilience including cortisol, DHEA, cytokines, and heart rate variability (Daruna, 2012; Walker et al., 2017) may hold promise for knowledge about individual factors of Indigenous youth. For example, John-Henderson et al. (2019) created a biomedical program of research in the Blackfeet tribal community and used biomarkers to measure the effects of trauma in young AI/AN adults. It is critical to find culturally centered and acceptable approaches to using new scientific technologies such as that of John-Henderson et al. to address health disparities.

Familial Domain

Decentralizing the individual with respect to Social Ecology of Resilience theory (Ungar, 2011a, 2011b) begins with the familial domain. Familial factors ranked first among the five ecosystem domains in the original review, yet the familial domain was ranked third in the present review. The present review had a larger number of intervention studies which may not have been directed towards families, as youth are more accessible in school-based or youth service programs. Despite less emphasis in current research on the family, risk and protective factor findings were consistent. Positive relationships with adults were protective in the present review but had more evidence in the earlier review in relation to family caring, support, warmth, sanctions, disapproval, and communication (Burnette & Figley, 2016). Future research about substance use and suicide prevention for Indigenous youth needs to investigate how modifiable familial-level risk and protective factors can be incorporated into resilience interventions. Other relevant research by Oré et al. (2016) demonstrated through the life course framework of resilience that intergenerational knowledge sharing within families through stories and narratives could increase AI/AN youth resilience.

Community Domain

The earlier systematic review by Burnette and Figley (2016) included findings congruent with the present review for most of the community-level factors, which ranked second in both systematic reviews. A few differences were noted. For example, the earlier review included evidence related to community safety that was not emphasized in the present review, while the current literature introduced new research on mentoring programs (Crooks et al., 2017; DeWit et al., 2017), youth leadership programs (Saskamoose et al., 2016; Wexler et al., 2016), and bullying (Gloppen et al., 2018; Kral et al., 2014). The original review found that peer factors offered more protection than risk, while most of the recent evidence suggested that peer influence had negative effects on resilience. School-based prevention interventions were present in the earlier review but more common in the updated review, suggesting continued attention to community-level health promotion strategies. Novel interventions for Indigenous youth have been reported in the literature that did not meet our inclusion criteria, such as an effective text messaging intervention for mental health wellness in AI/AN youth ages 15-24 (Craig Rushing et al., 2021). It is imperative to consider

the community-level resilience factors when developing, adapting, implementing, and evaluating new interventions to promote Indigenous youth resilience.

Cultural Domain

Cultural-level factors of resilience were represented in more than half of the articles in the present review and ranked fourth among the five ecosystem domains. The cultural domain evidence was third most prevalent in the review by Burnette and Figley (2016). The earlier review found mixed evidence for the role of ethnic identity in resilience of AI/AN youth, while the present review found overall more support for ethnic identity as a protective factor than as a risk for Indigenous youth. New evidence was found in the present review for the protective themes of Indigenous identity as being fluid (Jette & Roberts, 2016), grounded via nature (Lys et al., 2018), and expressed using the arts (Evans et al., 2018; Lys et al., 2018). Religion and/or spirituality was reported by Burnette and Figley to be a context-dependent protective factor of mental health and substance use problems, and this was sustained in the present review. Current literature showed mixed findings regarding the protective effects of spirituality for resilience in Indigenous youth, but the positive findings outnumbered the negative. As an example of the complexity of resilience across domains, Indigenous spirituality was associated with negative mental health symptoms but observed effects were attenuated when historical loss and discrimination were added into statistical models (Walls et al., 2016). The relationships between cultural factors and resilience were also compounded when some studies lacked consistent definitions of spirituality and religion or failed to distinguish between the two.

Outside of the present review, recent literature suggests the future of interventions for resilience may include a return to traditional healing (Freeman et al., 2016). Freeman and colleagues provided an average of 13 varied traditional Lakota ceremonies to children with emotional problems and their caregivers. The traditional intervention led to statistically significant improvements in family functioning and child resilience. A review of literature on Inuit suicide prevention programs offered compelling evidence for including the restoration of cultural pride as a priority (Morris & Crooks, 2015). Others provided concrete advice for health providers treating depression and suicidal ideation in AI/AN youth with guidance on balancing Indigenous values in the postcolonial world (Livingston et al., 2019). A new AI/AN cultural resilience scale was developed by Kelley and Lowe (2018) to measure community cultural knowledge and connections,

language usage, sense of community and attachment, and intergenerational connections. Current literature places a strong emphasis on the role of culture in resilience of Indigenous youth.

Societal Domain

Societal factors of resilience had the least reporting in both Burnette and Figley's (2016) review and the present review. However, there was meaningful literature among both reviews that demonstrated the association of historical loss and trauma with mental health symptoms in Indigenous youth. The older review only identified a few societal risk factors while the present review summarized several risk factors and several protective factors at the societal level. Most studies in the earlier review called for more empirical research about societal factors, a call that was partially addressed in the subsequent research studies of the present review. Aside from more empirical evidence, the present review found the use of decolonizing theoretical frameworks to ground the methodology (Cooper et al., 2019; Jette & Robets, 2016), something not noted in the earlier review. Decolonizing theories strengthen research with Indigenous peoples because they challenge the dominant Euro-American research methodologies and unveil power systems that sustain health disparities (Smith, 2012).

Other current research supports the review findings regarding the societal factors of resilience. Gone et al. (2019) conducted a systematic review of Indigenous historical trauma related to health outcomes of adults and provided sound evidence for historical trauma as an explanation for contemporary health disparities. A scoping review by Toombs et al. (2016) of resilience in Indigenous Canadian youth emphasized the need to incorporate Indigenous models into research. Similarly, Walters et al. (2018) called for Indigenous CBPR processes in research, which prioritize local knowledge, health positive messages, and culturally grounded designs. Future research of Indigenous youth resilience at the societal level is likely to follow the emerging themes of climate change as a risk factor. For example, MacDonald et al. (2015) demonstrated how changing sea ice and weather conditions compromised safe access to being on the land for the Nunatsiavut (Inuit) youth ages 15-25 in Canada.

A Comparison to Other Reviews of AI/AN Youth Resilience and Risk

Several other systematic reviews about resilience in AI/AN youth have been conducted since 2014, each smaller and with slightly different objectives and findings than those of Burnette

and Figley (2016). Teufel-Shone et al. (2018) reviewed three adolescent studies along with five adult studies and called for less focus on deficits and more on ecological strengths, assets, and resilience. Oré et al. (2016) also performed a systematic review of AI/AN resilience as related to the life course framework and concluded that resilience is a dynamic process, is developed intergenerationally and collectively, and gained from cultural wisdom and practice. A scoping review of resilience interventions in the school setting for international Indigenous adolescents found 16 moderate-to-high quality studies but a lack of validated resilience measurements (Jongen et al., 2019). Jongen et al. (2019) highlighted the need for a balance between culturally tailored and relevant instruments and standardized measures that can be generalized to other Indigenous populations. Meanwhile, Rountree and Smith (2016) searched the international literature to produce a cumulative qualitative dataset of well-being measures that aligned with Indigenous beliefs and were useful in promoting Indigenous youth's health. Henson et al. (2017) synthesized the evidence base for protective factors of AI/AN adolescents that increased desirable health and social outcomes or prevented undesirable outcomes such as substance abuse. Henson et al. (2017) called for better measurement tools to focus more on promotive and protective factors for AI/AN adolescent well-being. The present systematic review adds to these smaller reviews by capturing the developing knowledge base of resilience in Indigenous youth and categorizes findings across the Social Ecology of Resilience theory (Ungar, 2008, 2011a). Furthermore, the theory-driven updated review demonstrates how resilience is a trait as well as a mechanism through which youth can utilize their strengths in response to adversity.

Strengths of this Systematic Review

A major strength of this systematic review was the team of authors who collaborated to conduct the review and explore the challenges in measuring resilience amongst Indigenous youth. The first author is White, and the other authors are members of the Diné (Navajo) Nation, Acoma Pueblo, and Turtle Mountain Band of Chippewa Indians. With increasing diversity in academia, there is a dire need to include the perspectives of the communities being researched. This type of collaboration allows for a theory-driven and culturally centered process of reviewing the literature. This review was guided by the Social Ecology of Resilience theory (Ungar, 2008, 2011a, 2011b), which allowed for a structured means of presenting findings and encouraged a deliberative process of critical reflection on the findings and interpretation of studies.

Limitations of this Systematic Review

An important limitation of this review is the inability to generalize findings from specific Indigenous populations to others. Different Indigenous peoples have unique histories, languages, cultures, and spiritual beliefs that affect resilience and risk factors in their youth. A concise list of resilience factors was presented within theoretical domains despite being from vastly different sample populations. Findings from any given study do not necessarily apply to other Indigenous youth populations. Another weakness of this review is that the studies had differences in theoretical and methodological approaches to resilience across 78 studies (Ungar, 2011, p. 45). Because the search was limited to peer-reviewed journals in the English language, pertinent information that captured Indigenous knowledge may have been omitted. Evaluation of the quality of studies was done using rigorous criteria (GRADES and JBI), but meta-analysis on quantitative data was not possible due to the heterogeneity of study design and methodology. The quantitative studies reviewed were mostly low to moderate quality. Many studies were rated lower for methodologies, such as cross-sectional designs that do not allow for analysis of causation or an understanding of the dynamic mechanisms of resilience. However, strong CBPR partnerships allowing for Indigenous peoples' participation throughout the studies increased rigor and were considerations in quality evaluations (Page et al., 2021).

Implications for Clinical Practice and Future Research

The present review is a source for aggregated findings about resilience factors and research programs for Indigenous youth in the United States and Canada. Multidisciplinary professionals can draw from the Social Ecology of Resilience theory (Ungar, 2008, 2011a) domains when providing care or creating prevention interventions. For example, counselors and educators could provide a culturally tailored curriculum on peer relations and peer pressure to optimize individual- and community-level influences. Public health nurses could provide parenting classes based on the needs of their community to address familial-level factors of resilience. Physicians and health care providers could incorporate traditional healing and ceremonies as a cultural-level intervention. Community activists, public health leaders, and all health care workers could identify and remedy societal-level systems within an Indigenous community that sustain systemic racism practices in health care.

This body of knowledge will likely lead to more interdisciplinary and creative research to inform health prevention strategies and upstream programs to enhance well-being for Indigenous children and adolescents. The diversity in the way resilience was being studied across studies indicated that the definition of resilience amongst Indigenous communities is vast and may require frequent re-evaluation and defining. Additionally, the updated literature continues to show that effects of historical trauma on mental health outcomes warrant more research (Cooper et al., 2019; Evans & Davis, 2018). Another persisting gap in the literature is resilience research with urban populations of Indigenous youth (Brown et al., 2021; Bush & Qeadan, 2020). In addition to attention to empirical societal-level factors of resilience for Indigenous youth, the authors propose an expansion of the Social Ecology of Resilience theory (Ungar, 2008, 2011a) to include more cultural and societal details within the domains.

CONCLUSION

This updated systematic review of risk and resilience factors for the mental health of Indigenous youth in North America resulted in an abundance of research; the number of studies retrieved from the past seven years far exceeded that of the previous 25 years. Risk and protective factors of mental health in Indigenous youth in the United States and Canada have a meaningful literature base with the potential to improve the mental health and well-being of Indigenous youth. Ample literature concerning individual, familial, community, cultural, and societal factors of resilience is available to contribute to developing resilience-enhancing programs for Indigenous youth in the United States and Canada. Increasingly, researchers are using the CBPR approach, conducting more experimental studies, and are evaluating interventions for improving mental health for Indigenous youth. Interrelated forms of knowledge are being produced by quantitative, qualitative, and mixed methods research of resilience of Indigenous youth. Meanwhile, the theoretical foundations of research are met with the construct of resilience. Further attention is needed to understand Indigenous knowledge systems and the influence of racism, settler colonialism, and cultural resurgence efforts related to Indigenous youth well-being.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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APPENDIX

Table A1
Characteristics of included research, summary of results, critical appraisal/quality assessment

First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Adams (2015)	*Study design:* Exploratory case study; 6 months per participant *Methodology:* Qualitative *Sample:* Females ages 12-18 years (n=26)	*Setting:* Canada, HC *Indigenous Population:* First Nations	*Theory:* Medicine wheel; bio-psycho-social-spiritual CBPR *SER:* I, F, C, Cu	Substance use prevention, well-being	Equine assisted therapy at a residential inhalant treatment center was found to be useful, especially through cultural knowledge sharing. Of 28 themes that emerged, the most important were: safe touch, physical health improvements, learning about anatomy.	JBI: Moderate
Allen (2014)	*Study design:* Cross sectional strand of a mixed methods study; empirically testing a model *Methodology:* Quantitative *Sample:* Ages 12-17 years (n=61)	*Setting:* Alaska, RR, Sc *Indigenous Population:* Yup'ik	*Theory:* Ecological theory CBPR *SER:* I, F, C, Cu	Suicide and substance use prevention, Reflective Processes, and Reasons for Life	The first empirical test of a model of protective factors of AN people for alcohol use and suicide. Reasons for Life and Reflective Processes were found to be appropriate intermediate prevention strategy target variables in a multilevel intervention.	GRADES: Low
Allen (2018)	*Study design:* Nonrandomized comparative intervention; 1 year *Methodology:* Quantitative *Sample:* Ages 12-18 years (n=413)	*Setting:* Alaska, RR, C *Indigenous Population*: Yup'ik	*Theory:* Yup'ik Indigenous Theory of Change CBPR *SER:* I, F, C	Substance use prevention, peer influences, Reflective Processes, Reasons for Life	Culture as intervention: The intensive Qungasvik version of the intervention compared to less intense Qungasvik version of the intervention had significant effects on suicide protective factors. The intervention had significant effects on Reasons for Life but not Reflective Processes.	GRADES: Moderate

Table A1
Characteristics of included research, summary of results, critical appraisal/quality assessment

First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Allen (2019)	*Study design:* Measurement development and instrument validation *Methodology:* Quantitative *Sample:* Ages 12-18 years (male= 141; female=161; n=302)	*Setting*: Alaska, RR, C *Indigenous Population*: Yup'ik, Inupiat, Athabascan, Aleut, Tlingit/Haida, and Tsimshian	*Theory:* Not specified CBPR *SER:* I, F, C, Cu	Suicide prevention, resilience, social connectedness	Findings demonstrate Reasons for Life as a protective factor from suicide and can be measured as a complex, multidimensional construct. Protection is associated with a) beliefs in ability to surmount life's greatest difficulties, b) cultural and spiritual beliefs about the value of one's life, and c) perceptions that people in one's social network view them as making positive contributions to others.	GRADES: Very Low
Barnett (2020)	*Study design:* Quasi-experimental, pre-post survey, 5-day camp *Methodology:* Quantitative *Sample:* Ages 13-18 years (n=69); 81 completed pre-survey; 69 completed post-survey	*Setting:* Alaska, RR, Camp *Indigenous Population:* Iñupiaq, Central Yup'ik, St. Lawrence Island Yup'ik	*Theory:* Not specified *SER:* Cu	Suicide prevention, positive and negative affect, problem-focused coping	A pilot evaluation of a 5-day culture camp in remote Alaska. Subsistence activities, developing relationships and life skills, and learning traditional knowledge and values were emphasized. Significant improvements after the camp were shown in in mood scores, sense of belonging, and ability to cope.	GRADES: Low

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Characteristics of included research, summary of results, critical appraisal/quality assessment

First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Baydala (2014)	*Study design:* Quasi-experimental, 3-year longitudinal pre-test/posttest with comparison group *Methodology:* Mixed methods *Sample:* ages 9-19 years (n= 16 for high schoolers; n ranged from 13-19 for elementary age intervention groups)	*Setting:* Canada, RR, Sc *Indigenous Population:* Alexis Nakota Sioux Nation	*Theory:* Not specified CBPR *SER:* I, F, C, Cu, S	Substance use prevention	Cultural adaptation of alcohol and substance abuse program (life skills training). Qualitative results: the adapted program was highly valued especially due to the inclusion of Isga language, history, and culture. Quantitative results: poor attendance affected the analysis. Results of the Piers-Harris self-concept scale and the life skills training questionnaire were mixed.	GRADES: Moderate JBI: Moderate
Belone (2017)	*Study design:* Pilot study, 5 months *Methodology:* Mixed methods *Sample:* Grades 3-5 (n=11)	*Setting:* Contiguous US/WEST, RR, C *Indigenous Population:* Mescalero Apache	*Theory:* Not specified CBPR *SER:* I, C	Substance use prevention, well-being, cultural identity	Family listening/family circle program. Qualitative: participants learned how to trust and give support, and new skills related to problem solving, ways of listening, anger control and ways of supporting their community. Quantitative: Significant improvements in cultural identity and problem-solving and decreased depression and anxiety symptoms after intervention. Positive coping skills and strong cultural identity were identified as protective factors.	GRADES: Moderate JBI: Moderate

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Brockie (2015)	*Study design:* Cross sectional *Methodology:* Quantitative *Sample:* Ages 15-19 years (n=166)	*Setting:* Contiguous US/WEST, RR, Sc *Indigenous Population:* Northern Plains	*Theory:* Not specified *SER:* I, F, S	Depression, suicide, substance use, risk behaviors, depression, poly drug use, suicide attempt, posttraumatic stress disorder, ACEs, historical loss, discrimination	78% percent of the sample reported at least one Adverse Childhood Experience (ACE) and 40% reported at least two. The cumulative impact of the ACEs was significant for the four outcomes with each additional ACE increasing the odds of suicide attempt (37 %), poly-drug use (51 %), posttraumatic stress disorder symptoms (55 %), and depression symptoms (57 %).	GRADES: Low
Brown (2016)	*Study design:* Longitudinal instrument development study with focus groups *Methodology:* Qualitative *Sample:* Ages 14-18 years (n=30)	*Setting:* Contiguous US/WEST, Urban, C *Indigenous Population:* Not specified	*Theory:* Not specified CBPR *SER:* I, F, C, Cu, S	Substance use prevention, cultural identity	Risk factors for youth alcohol and drug use by themes: intergenerational stressors, cultural disconnection, pan-tribal identity, mixed racial-ethnic identity, rural and urban environments are two different worlds, stereotypes and harassment, risks of being AI/AN, and mainstream culture clash. Protective factors: AI/AN identity, the importance of AI/AN institutions.	JBI: High
Brown (2021)	*Study design:* 3-year longitudinal *Methodology:* Quantitative *Sample:* Ages 14-18 years (n=185)	*Setting:* Contiguous US/WEST, Urban, C *Indigenous Population:* Urban AIs in California	*Theory:* Not specified CBPR *SER:* I, C, Cu	Substance use, risk behaviors, well-being	Adolescents self-identifying as AI/AN were compared with adolescents of other racial-ethnic identities. Adolescents who identified as AI/AN on their survey reported better mental health, less alcohol and marijuana use, lower rates of delinquency, and increased happiness and spiritual health.	GRADES: Moderate

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Bush (2020)	*Study design:* Retrospective, descriptive cross sectional (3 time points) *Methodology:* Quantitative *Sample:* Grades 9-12 (N=53,773: 2011=18,763; 2013=19,080; 2015=15,930)	*Setting:* Contiguous US/WEST, RR and Urban, Sc *Indigenous Population:* Not specified	*Theory:* Interpersonal-psychological theory of suicidal behavior by Thomas Joiner *SER:* I, F, C	Suicide attempt, social support	New Mexico Youth Risk and Resiliency Survey 2015 results were analyzed. A reduction in the likelihood of suicide attempt was associated with interpersonal-level protective factors among AI/AN adolescents. Low social support was a risk factor for youth on reservations or rural but not for youth in urban areas.	GRADES: Low
Chambers (2021)	*Study design:* Pre/post intervention *Methodology:* Quantitative *Sample:* Females. Ages 8-11 (n=47) plus female caregiver (n=47)	*Setting:* Contiguous US/WEST, RR,C *Indigenous Population:* Navajo, 2 communities	*Theory:* Not specified CBPR *SER:* I, F, Cu	Depression, anxiety, substance use, language, cultural knowledge, self-esteem	Preliminary results from the Asdzáán Be'eená (Female Pathways) intervention included: higher cultural Navajo knowledge and language knowledge reported by the girls after the program. Self-esteem, self-efficacy, and social support were increased post-intervention. The program was associated with lower internalizing behaviors (anxious/depressed, withdrawn, somatic complaints) and improved relationship with caregiver.	GRADES: Moderate

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Cooper (2019)	*Study design:* Intergenerational participatory workshops; 2-3 hours per week over 7 weeks *Methodology:* Qualitative *Sample:* Females grades 8-12 (n=36 girls plus n=24 women)	*Setting:* Canada, Urban, C *Indigenous Population:* First Nations and Métis	*Theory:* Decolonization framework CBPR *SER:* I, F, Cu, S	Well-being, historical trauma	A 7-week participatory workshop for First Nations and Métis women and girls was conducted three times following a decolonizing framework. Qualitative findings about safety, wellbeing, and historical trauma found harm-reduction and self-determination as important themes.	JBI: Moderate
Crabtree (2020)	*Study design:* Descriptive cross sectional, two cohorts *Methodology:* Quantitative *Sample:* 7th graders (n=379)	*Setting:* Contiguous US/WEST, RR, Sc *Indigenous Population:* Northern Plains	*Theory:* Theory of reasoned action and self-determination theory *SER:* I	Substance use, future orientation, and self-determination	Future orientation and self-determination were both predictive of intention to use alcohol or marijuana in the next 3 months. Negative consequences of alcohol/marijuana use for future goals and autonomy were moderators.	GRADES: Low
Crabtree (2021)	*Study design:* RCT with 6 middle schools *Methodology:* *Sample: 7th graders (n=445)*	*Setting:* Continuous US/WEST, RR, Sc *Indigenous Population:* Northern Plains	*Theory:* Self-determination theory CBPR *SER:* I, C, Cu	Alcohol and marijuana use	The culturally adapted "Be Under Your Own Influence" intervention was associated with a lower risk of initiating alcohol use (34% reduction) and lower first-time alcohol intoxication (36% reduction) but had no effect on marijuana use.	GRADES: High

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Crooks (2015)	*Study design:* Case study *Methodology:* Qualitative *Sample:* Adults (n=12)	*Setting:* Canada, RR and Urban, Sc *Indigenous Population:* First Nations, Métis, Inuit	*Theory:* Not specified *SER:* I, Cu	Cultural identity, connectedness	Thematic content analysis of adult stakeholder's perspectives on youth's response to the Fourth R intervention. Themes of improvement were found after intervention and reviewed in detail: 1) identity and belonging and 2) cultural connectedness. Other themes included leadership of students and shame.	JBI: Low
Crooks (2017)	*Study design:* Exploratory, 3 years longitudinal *Methodology:* Mixed methods *Sample:* Elementary and secondary school age (n=133)	*Setting:* Canada, Sc *Indigenous Population*: First Nations, Métis, Inuit (FNMI)	*Theory:* Medicine Wheel life cycles CBPR *SER:* I, C, Cu	Well-being, cultural identity	A mentoring program helped youth develop intrapersonal and interpersonal skills and enhanced their knowledge base of culture and healthy relationships. Multiple years of culturally relevant mentoring is a promising approach for promoting well-being among FNMI youth.	GRADES: Moderate JBI: Moderate
Cwik (2015)	*Study design:* Cross sectional *Methodology:* Quantitative *Sample:* Ages 10-19 years (n=71)	*Setting:* Contiguous US/WEST, RR, C *Indigenous Population:* White Mountain Apache	*Theory:* Not specified CBPR *SER:* I, F, C, Cu	Depression, suicide, substance use, risk behaviors, social and adaptive functioning, problem solving skills, cognitive processing	AI youth who had attempted suicide completed surveys. More than half had a loved one attempt suicide within 6 months prior. Nearly half lost a loved one to suicide death in their lifetime. Risks were suicide behaviors in peers or family, caregivers with substance use disorders, and personal use of alcohol or marijuana. Resilience factors included cultural participation and lower depression scores.	GRADES: Low

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Cwik (2016)	*Study design:* Pilot study of an open trial design (1-, 2-, and 3-months post-emergency department visit) *Methodology:* Quantitative *Sample:* Ages 10-19 years (n=13)	*Setting:* Contiguous US/WEST, RR, HC, C *Indigenous Population:* White Mountain Apache	*Theory:* Not specified CBPR *SER:* I, C, Cu	Trial of a brief intervention for suicide prevention	New Hope intervention identified youth who visited the emergency department for suicide attempt within a 90-day timeframe to pilot test a brief evidence-based intervention adapted to the culture. Preliminary findings suggest decreases in negative thinking, depression, and suicidal ideation after the intervention. There was also an increased use of psychological service use.	GRADES: Low
Cwik, (2017)	*Study design:* Cross sectional and case control (10 months) *Methodology:* Quantitative *Sample:* Ages 10-19 years (n=68 plus n=55 controls)	*Setting:* Contiguous US/WEST, RR, C *Indigenous Population:* White Mountain Apache	*Theory:* Not specified CBPR *SER:* I	Risk behaviors, protective factors, exploration of pathways to binge drinking, cultural identity	Stressful life events were related to family functioning and peer relationships. Family functioning affected peer relationships and adolescent impulsivity which were both associated with greater risk of binge drinking. Path between peer relationship and engaging in binge drinking was statistically significant for those expressing lower cultural identity.	GRADES: Moderate

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Cwik, (2018)	*Study design:* Cross sectional case control with ACASA (Audio Computer Assisted Self-Interview) *Methodology:* Quantitative *Sample:* Ages 10-19 years (n=69)	*Setting:* Contiguous US/WEST, RR, H *Indigenous Population:* White Mountain Apache	*Theory:* Not specified CBPR *SER:* I, F, C	Suicide, substance use, characteristics of AI youth who recently engaged in binge drinking	Adolescents who had a serious incident of binge drinking in the past 90 days were surveyed. 47% reported lifetime suicide thoughts. 53.7% used alcohol alone or with marijuana (31.3%). Median age of first suicide thoughts was 14.0. Median age first alcohol use was 13.0; marijuana was also 13.0. Reasons for substance use included stress, family problems, fight with girlfriend/boyfriend or peers, and "can't remember" or "no reason in particular."	GRADES: Low
D'Amico (2019)	*Study design:* Longitudinal 4 years *Methodology:* Quantitative *Sample:* Ages 14-18 years (n=185)	*Setting:* Contiguous US/WEST, Urban, C *Indigenous Population:* AIs in northern, central, and southern California	*Theory:* Not specified CBPR *SER:* I	Substance use, risk behaviors, well-being, discrimination, mental health status, cultural pride, traditional practices	Marijuana was the most frequently reported substance used followed by alcohol and e-cigarettes. Very few adolescents reported lifetime use of prescription drugs or stimulants; some reported that spirituality, religion, or beliefs affected their health. 68% indicated that they felt good about their cultural background and were happy with being a member of the AI tribal group. Most frequent traditional practices were powwow, learning tribal history, eating Native foods, and prayer.	GRADES: Moderate

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Davis (2019)	*Study design:* Exploratory, descriptive *Methodology:* Quantitative *Sample:* Grades 7-12 (n=1,934)	*Setting:* Contiguous US/WEST, Contiguous US/EAST, RR, Sc *Indigenous Population:* AI students in seven regions across the US	*Theory:* Not specified *SER:* I, Cu, S	Ethnic identity, religious importance, ethnic pride, and perceived discrimination	Among AI youth, the class with strong motives to drink for coping or enhancement had higher ethnic identity, greater risk of heavy episodic drinking, and greater perceived discrimination compared with the class with low motives.	GRADES: Low
DeWit (2017)	*Study design:* Quasi-experimental, pre-post design (baseline and 18 months) *Methodology:* Quantitative *Sample:* Aboriginal and non-aboriginal children in the Big Brothers Big Sisters of Canada program, ages 6-17 (n=125)	*Setting:* Canada, RR and U, C, H *Indigenous Population:* First Nations, Métis, Inuit	*Theory:* Not specified *SER:* C	Anxiety, conduct problems, ADHD symptoms, emotional problems, peer-related problems, prosocial behavior, and social anxiety	Structural equation modeling found that mentored aboriginal youth had significantly less emotional problems and social anxiety after the mentorship than non-mentored youth. This relationship was not found for mentored non-aboriginal youth.	GRADES: High

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Eitle (2014)	*Study design:* Cross sectional *Methodology*: Quantitative *Sample*: Ages 12-19 years (n= 568; American Indian= 125; Caucasian= 443)	*Setting:* Contiguous US/WEST, Contiguous US/EAST, RR, Sc *Indigenous Population:* Not specified	*Theory*: Stress-coping model *SER:* I	Substance use, past year alcohol/marijuana use and coping strategies	No significant differences in AI and white students' use of types of coping strategies, however some risk behaviors differed. Being AI was not a risk factor for alcohol use, but it was a risk factor for marijuana use. Self-distraction (an avoidant coping strategy) was associated with more marijuana use in AI, but less marijuana uses in white students.	GRADES: Low
Ersan (2021)	*Study design:* Cross sectional *Methodology:* Quantitative *Sample*: 8th, 9th, and 11th graders (n=3,736)	*Setting:* Contiguous US/WEST, U, Sc *Indigenous Population:* Anishinaabe/ Ojibwe, Dakota/Lakota and other tribal affiliations	*Theory*: Positive Youth Development theory and Circle of Courage *SER:* I, F,C	Mental distress, ACEs, being bullied, family/community support, sense of empowerment, out of school time activity	Risk factors in the study included having experienced trauma, being bullied by peers, substance use, and skipping school. Protective factors were social supports, out-of-school-time activities, healthy eating, and healthy sleeping behaviors. The protective factors moderated the effects of risk behaviors on mental distress.	GRADES: Low

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Evans (2018)	*Study design:* Cross sectional and semi-structured, arts-based interview 40+ minutes per child *Methodology*: Mixed methods *Sample*: Ages 14-18 years (n=57; survey n=30 and interviews n=27)	*Setting:* Contiguous US/WEST, RR, Sc *Indigenous Population:* Unidentified Western US tribal community	*Theory:* Sense of Coherence - Salutogenesis, (Antonovsky, 1987) *SER:* I, S	Historical trauma	Quantitative: higher levels of sense of coherence significantly predicted lower levels of historical trauma symptoms. Qualitative: Stress themes included: family conflict, loss, school stress and isolation. Coping themes included: AI culture, sports, art and music, and family.	GRADES: Low JBI: Moderate
FitzGerald (2017)	*Study design:* Cross sectional *Methodology*: Quantitative *Sample*: Grades 9-12 (n=2,792)	*Setting:* Contiguous US/WEST, RR and Urban, Sc *Indigenous Population:* Not specified	*Theory:* Not specified *SER:* I, F, C	Suicide, relationships with adults, cultural connectedness	Relationships at home, school and in the community were protective for suicide attempt. Language spoken at home (proxy for cultural connectedness) was not statistically associated with suicide attempt.	GRADES: Low
Fullerton (2019)	*Study design:* Cross sectional, exploratory, descriptive, 3 months *Methodology*: Quantitative *Sample*: Grades 9-12 (n=15,930)	*Setting:* Contiguous US/WEST, Sc *Indigenous Population:* Not specified	*Theory:* Not specified *SER:* I, F	Suicide, resilience	Positive relationships with parents, teachers, and other adults can greatly reduce the odds of suicide attempt in AI/AN, Hispanic, and Anglo adolescents. The final multivariable model for AI/AN youth included only positive relationships with adults in the home.	GRADES: Moderate

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Gfellner (2016)	*Study design:* Cross sectional *Methodology*: Quantitative *Sample*: Grades 6-12 (n=178)	*Setting:* Canada, RR, Sc *Indigenous Population:* First Nations	*Theory*: Social Identity theory by Erikson CBPR *SER:* I, Cu	Well-being, ego strengths, ethnic and racial identity, adjustment variables (self-esteem, superior adjustment, mastery and coping, emotional tone)	Ego strengths related directly with centrality, private regard and the adjustment measures. The moderation of ego strengths for exploration, commitment, and private regard reflected adverse functioning for those with less than advanced ego strengths. Ego strengths mediated associations between centrality and private regard with personal well-being.	GRADES: Low
Gloppen (2018)	*Study design:* Cross sectional *Methodology*: Quantitative *Sample*: Grades 5, 8, 9, 11 (n=1,409)	*Setting:* Contiguous US/EAST, RR and Urban, Sc *Indigenous Population:* Tribal community in Minnesota	*Theory:* Not specified *SER:* I, C	Depression, anxiety, protective factors, bullying involvement	All forms of bullying perpetration and victimization were associated with increased risk for mental health problems (odds ratio [OR]: 1.57–2.87). AI youth who reported higher levels of protective factors were less likely to report internalizing symptoms and suicidality even in the presence of bullying involvement.	GRADES: Low
Jette (2016)	*Study design:* Data collection over 2 months, two meetings then one interview *Methodology*: Qualitative *Sample*: Females, ages 11-17 years (n=14)	*Setting:* Contiguous US/EAST, Urban, C *Indigenous Population:* Not specified	*Theory*: Poststructural-ist Theory. Decolonization framework. CBPR *SER:* I, C, Cu, S	Constructions of health and the body, dominant social discourse and role of AI culture and identity	Three themes emerged: 1) Learning about health and bodily norms and negotiating wellness happened mostly at school, and was complex and often contradictory, 2) Participants did not perceive their AI status as conferring risk for health and, 3) AI identity is fluid in nature.	JBI: High

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Komro (2016)	*Study design*: Longitudinal survey 3 surveys each about 3 months apart *Methodology*: Quantitative *Sample*: Females, ages 14-19 years all (n=952); AI youth (n=422)	*Setting:* Contiguous US/WEST, RR, Sc *Indigenous Population:* Cherokee	*Theory:* Not specified *SER:* I, F, C	Substance use Individual and community level factors	AI and non-native responses were mostly similar. Alcohol access, parent communication, and best friend's alcohol use were statistically significant risk factors for past-month alcohol use among AI and non-native females. Depression and exposure to a parent's alcohol problem were not identified as risks for either AI or non-native females.	GRADES: Moderate
Kral (2014)	*Study design*: Ethnography, one interview *Methodology*: Qualitative *Sample*: Ages 12-19 years (n=23)	*Setting:* Canada, RR, Sc *Indigenous Population:* Igloolik, Nunavut	*Theory:* Not specified CBPR *SER:* F, C	Familial relationships, resilience	Thematic findings: stressors included bullying, school, substance misuse, domestic violence, romance. Talking, mostly with friends, was a primary means of coping. Talking with family, being on the land and community activities were also sources of strength.	JBI: Moderate
Kulis (2016)	*Study design*: Cross sectional *Methodology*: Quantitative *Sample*: Ages 12-19 years (n=2,407)	*Setting:* Contiguous US/WEST, U, Sc, C *Indigenous Population:* Tribal community in Arizona	*Theory:* Not specified *SER:* I, F	Substance use, risk behaviors by latent class analysis	Four latent classes emerged: a large group of "nonusers" (69%); a substantial minority using alcohol, tobacco, and/or marijuana (17%); a smaller group of polysubstance users consuming, alcohol, tobacco, marijuana, other illicit drugs, and prescription or over-the-counter drugs in combination (6%); and a "not alcohol" group reporting combinations of tobacco and drug use, but rarely alcohol use (4%). Polysubstance users had the highest risk of problematic behavior. Early adolescent nonusers had fewer problematic behaviors.	GRADES: Low

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Lys (2018)	*Study design*: Semi-structured interviews *Methodology*: Qualitative *Sample*: Females, ages 13-17 years (n= 36)	*Setting:* Canada, RR, Sc *Indigenous Population:* Not specified	*Theory:* Social Ecological Theory by Sallis et al. (2008) *SER:* I, F, C, Cu	Strategies to cope with mental health issues	Fostering Open Expression among Youth (FOXY) intervention included body mapping workshops for 41 female participants followed by an interview. Thematic analysis identified five themes related to coping strategies: grounding via nature, strength through indigenous cultures, connection with God and Christian beliefs, expression using the arts, and relationship with social supports.	JBI: Moderate
Martinez (2015)	*Study design*: Cross sectional *Methodology*: Quantitative *Sample*: Grades 7-8 (n=148)	*Setting:* Contiguous US/WEST, U, Sc *Indigenous Population:* Not specified	*Theory:* Theory of Social Norms *SER:* F, C	Substance use, risk behaviors, social norms	Overall, AI youth had very low substance use intentions. Strong peer and grandparent injunctive norms were associated with less intention to use. Parent injunctive norms, school lunch status and grades in school were not significantly associated with intention to use.	GRADES: Low
Mileviciute (2014)	*Study design*: Self-report survey with path analysis *Methodology*: Quantitative *Sample*: Ages 13-18 (n=146)	*Setting:* Contiguous US/WEST, RR, Camp *Indigenous Population:* Northern Plains	*Theory:* Not specified *SER:* I	Depression, substance use, self-efficacy, externalizing behavior, alcohol	High self-efficacy for resisting negative peer pressure predicted both lower rates of alcohol use and fewer externalizing behaviors. High levels of both academic and social self-efficacy predicted fewer depressive symptoms. Being female was a predictor of depressive symptoms.	GRADES: Low

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Mohatt (2014)	*Study design*: Feasibility intervention study; 1 year in one community; 2 years in another community *Methodology*: Quantitative *Sample*: Ages 12-17 (n=52)	*Setting:* Alaska, RR, C *Indigenous Population:* Yup'ik	*Theory:* Not specified CBPR *SER:* I, F, C, Cu	Community mastery, family characteristics, community characteristics, peer influences, Reflective Processes, Reasons for Life	A suicide and substance use prevention intervention was implemented through two remote community programs: Elluam Tungiinun (Toward Wellness) and Yupiucimta Asvairtuumallerkaawas (Strengthening our Yup'ik Identity). The intervention was found effective with medium dose effects for suicide and alcohol prevention in the community with more intervention resources and small dose effects in the community with less intervention resources.	GRADES: Moderate
Moilanen (2014)	*Study design*: Retrospective, cross sectional *Methodology*: Quantitative *Sample*: Grades 8, 10, 12 (n=5,709)	*Setting*: Contiguous US/EAST, RR and U, Sc *Indigenous Population*: Not specified	*Theory*: Routine Activity theory; Social Control theory; Positive Youth Development and Resilience theory *SER:* I, F, C, Cu	Substance use, drunk or high at school, driving or having a driver intoxicated, selling drugs	High levels of extracurricular availability and intensity predicted low levels of all outcomes (substance use, drunk or high at school, driving or having a driver intoxicated, selling drugs). Some of the associations were moderated by demographics with unique patterns for each behavior.	GRADES: Low

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Morrell (2020)	*Study design*: Retrospective, cross sectional secondary data analysis *Methodology*: Quantitative *Sample*: Grades 6-12 (n=5,912)	*Setting:* Contiguous US/WEST, Contiguous US/EAST, RR and U, Sc *Indigenous Population:* Not specified	*Theory:* Betancourt's Integrative Model of Culture, Psychological Processes and Behavior *SER:* I, F, C, Cu	Risk and protective factors of substance use	Sensation-seeking behavior was the only significant predictor of lifetime use of all five substances measured. Overall, peer and family substance use, more favorable attitudes towards substance use, greater sensation-seeking, easier to access substances and poor school performance were associated with increased odds of substance use. Gender, religion, peer delinquent behavior, perceived maternal warmth, and school resources were inconsistently related to substance use.	GRADES: Low
Nalven (2020)	*Study design*: Retrospective, cross sectional secondary data analysis *Methodology*: Quantitative *Sample*: Grades 7-12 (n=3,498)	*Setting:* Contiguous US/WEST, Contiguous US/EAST, RR, Sc *Indigenous Population:* AI reservations across 6 US regions	*Theory:* Not specified *SER:* I, F, C	Substance use, including heroin and opioids, peer, school, and family attitudes	Colorado State's Tri-ethnic Center for Prevention Research study. Risks for opioid use included peer substance use, lower family disapproval, lower school performance. For heroin in specific, greater peer use was the only significant indicator of lifetime or past month heroin use.	GRADES: Low

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Nuño (2020)	*Study design*: Cross sectional *Methodology*: Quantitative *Sample*: Grades 11-19 (n=2,912)	*Setting:* Contiguous US/WEST, RR, Sc *Indigenous Population:* Tribal communities in Arizona	*Theory:* Social Development Theory *SER:* I, F, C	Risk and protective factors of substance use	The most powerful indicator of alcohol and drug was use age of onset. Peer and family use of substances interacted to increase risk of alcohol and drugs use in participants. However, peers with pro-social behaviors were a protective factor. Social skills, specifically the ability to resist peer pressure were protective. Religiosity was not related to alcohol use, but it was related to a decreased likelihood of drug use. Overall, a scarce number of significant protective factors were found.	GRADES: Low
Patchell (2015)	*Study design*: Quasi-experimental; pre-posttest, 8.5 weeks *Methodology*: Quantitative *Sample*: Ages 16-19 years (n=44)	*Setting:* Contiguous US/WEST, RR, Sc *Indigenous Population:* Comanche, Kiowa, Apache in Oklahoma	*Theory:* Not specified CBPR *SER:* C, Cu	Substance use, self-reliance, life problems including mental/emotional health	Native American Talking Circle Intervention incorporated tribal specific cultural beliefs into a 10-hour school-based prevention program. Self-reliance significantly increased from baseline to post intervention. Substance abuse/use showed a significant decrease from baseline to post intervention.	GRADES: High
Philip (2015)	*Study design*: Cross sectional *Methodology*: Quantitative *Sample*: Ages 12-19 years (n=50)	*Setting:* Alaska, RR, Sc *Indigenous Population:* Yup'ik	*Theory:* Not specified CBPR *SER:* F, C	Suicide, substance use, social network factors	Connection to adults and elders, but not peers, emerged as predictors of family and community level protection. Minimal effects of social network on individual level protective factors were found.	GRADES: Low

Table A1
Characteristics of included research, summary of results, critical appraisal/quality assessment

First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Rasmus (2014)	*Study design*: Semi-structured interviews in 2-3 sessions over 2 weeks *Methodology*: Qualitative *Sample*: Ages 11-18 years (n=25)	*Setting:* Alaska, RR, Sc *Indigenous Population:* Yup'ik	*Theory:* colonial stress, cultural continuity, and indigenous and community resilience CBPR *SER:* F, C, Cu	Strengths and resilience of remote indigenous youth	Two composite youth narratives about resilience were shared with the community. Findings included important connections between local stressors, community-level protective resources, and youth-driven, solution-focused strategies for overcoming hardships.	JBI: Low
Rees (2014)	*Study design*: Longitudinal; mean =230.57 days between surveys; extended consequence model for interactive effects *Methodology*: Quantitative *Sample*: High school age (n=3,426)	*Setting:* Contiguous US/WEST, Contiguous US/EAST, RR and U, Sc, H *Indigenous Population:* Not specified	*Theory:* Social Network Theory *SER:* I, C	Alcohol use school hierarchies, ethnicity differences	School social hierarchies were similar for AI adolescents and adolescents of other ethnicities, but AIs had fewer reciprocated friendships, smaller number of in-school friends, less cohesive friend groups than Caucasians. AI youth were no more likely to report their personal drinking as being detrimental to social relationships.	GRADES: Low

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Ritchie (2014)	*Study design*: Quasi-experimental, survey with open-ended questions, 3 time points (baseline, 1 month, and 1 year post intervention) *Methodology*: Mixed methods *Sample*: Ages 12-18 years (n=73)	*Setting:* Canada, RR, Camp *Indigenous Population:* Wikwemikong Unceded Indian Reserve	*Theory:* Resilience definition by Wagnild *SER:* I	Resilience, well-being, mental, physical, and emotional factors	Outdoor adventure leadership experience. Resilience scores were significantly higher after the 10-day camp intervention compared to the control group but returned to baseline at one year. Intervening events may have contributed to the return to baseline scores.	GRADES: High JBI: Low
Ritchie (2015)	*Study design*: Critical ethnography, 10 days *Methodology*: Qualitative *Sample*: Ages 11.9-18.7 years (n=43)	*Setting:* Canada, RR, Camp *Indigenous Population:* Wikwemikong Unceded Indian Reserve	*Theory:* Medicine Wheel, Connecting to the Good Life, Resilience CBPR *SER:* I, F, C, Cu, S	Resilience, well-being guided by Indigenous ways of knowing	Outdoor adventure leadership experience. Central themes of connecting to creation and connecting to self were discovered to promote resilience and well-being. Connecting to the Good Life" and "Waking up to the Good Life" were themes that helped understand the impact of the camp.	JBI: High
Saskamoose (2016)	*Study design*: Youth sharing circles; multiple data sources including photographs, transcripts, video recordings; 3 days *Methodology*: Qualitative *Sample*: ages 14-17 years (n=13)	*Setting:* Canada, RR and U, C *Indigenous Population:* First Nations, Métis, and Inuit	*Theory:* Literature review for definitions of resilience CBPR *SER:* I, F, C, Cu, S	Resilience Neurodecolon-ization, identity	Fred Saskamoose Aboriginal Youth Leadership and Wellness Program. Themes of overcoming adversity in personal lives and communities, efforts to be healthy. Subthemes included holistic health, culture (spirituality, traditions, identity), sports and wellness, and navigating addictions.	JBI: High

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Shadlow (2018)	*Study design*: Descriptive *Methodology*: Quantitative *Sample*: Ages 10-13 years (n=31)	*Setting:* Contiguous US/EAST, C *Indigenous Population:* AIs in Oklahoma and Kansas	*Theory:* Not specified *SER:* I	Resilience, repressive adaptive style (reporting low distress while having high distress)	Across ethnicities, differences in repressive style category did not reach statistical significance. European descent and African American children identified themselves as repressors 3x more than AI youth. Findings did not support that AI and African American children would be overrepresented in the repressor group.	GRADES: Low
Sittner (2016)	*Study design*: Longitudinal study, analysis with latent class growth model 7 waves of data collection *Methodology*: Quantitative *Sample*: Ages 10-19 years (n=646)	*Setting:* Contiguous US/WEST, RR, Sc, H *Indigenous Population:* a northern Midwest tribal nation	*Theory:* Social development model of antisocial behavior *SER:* I, F, C	Substance use, risk behaviors, aggression, and delinquency	Five aggression trajectory groups were identified: non-offenders, moderate desistors, adolescent-limited offenders, high desistors, chronic offenders. Risk factors for being a high desistor or chronic offender were parent rejection, delinquent peers, substance use and early dating. The only significant protective factor was positive school adjustment.	GRADES: Moderate
Smokowski (2014)	*Study design*: Longitudinal with two waves of self-reported data *Methodology*: Quantitative *Sample*: Middle school students from 28 public schools, ages 10-19 years Total: (n=4714), AI (n=1358)	*Setting:* Contiguous US/EAST, RR, Sc *Indigenous Population:* Lumbee AIs	*Theory:* Not specified *SER:* I	Depression, anxiety, ethnic identity, self-esteem	Self-esteem mediated the relationship between ethnic identity and anxiety/depression/externalizing behaviors for entire sample. Future optimism mediated the relationship between ethnic identity and externalizing behaviors for the entire sample and mediated ethnic identity and depressive symptoms for AIs.	GRADES: Moderate

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Snowshoe (2017)	*Study design*: Cross sectional *Methodology*: Quantitative *Sample*: Ages 11-24 years Total: (n=290) under age 18 (n= 261)	*Setting:* Canada, RR and Urban, Sc *Indigenous Population:* First Nations, Métis, and Inuit	*Theory:* Not specified CBPR *SER:* I, C, Cu	Stressful life events, cultural connectedness	All significant relationships between mental health outcomes and the cultural connectedness scale (CCS) and subscales were in the expected direction. Age, gender and stressful events were not predictive of self-efficacy, however, when the CCS subscales were added to the model the variance of self-efficacy significantly increased. Spirituality and cultural connectedness were found to contribute to the youth's well-being.	GRADES: Low
Soto (2015)	*Study design*: Cross sectional *Methodology*: Quantitative *Sample*: Ages 13-19 years (n=969)	*Setting:* Contiguous US/WEST, RR and U, Sc *Indigenous Population:* Not specified	*Theory:* Not specified CBPR *SER:* I, Cu, S	Substance use, historical trauma, ethnic identity	Historical trauma had a positive and direct effect on smoking behaviors and historical trauma also mediated the association of cultural activities and stressful life events with past month smoking. Ethnic identity was negatively related to past month smoking.	GRADES: Low
Spillane (2020)	*Study design*: Focus groups and one-to-one interviews; modified grounded theory *Methodology*: Qualitative *Sample*: Ages 14-17 years (n=15)	*Setting:* Canada, RR, *Indigenous Population:* First Nations	*Theory:* Behavioral Theories of Choice CBPR *SER:* I, F, C, Cu	Substance use, alternatives, and access to substances	Risk factors identified were peer influences, family influences and community influences. Six protective factors were found: future goals, peer influences, family influences, community influences, alternative activities, and culture. Discrimination and stereotyping were not common themes as predicted by the authors.	JBI: Moderate

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Spillane, Schick, Goldstein (2021)	*Study design:* Cross sectional *Methodology:* Quantitative *Sample:* Ages 11-18 (n=106)	*Setting:* Canada, RR, C *Indigenous Population:* First Nations	*Theory:* Framework of historical trauma, CBPR *SER:* I, S	Alcohol use, self-compassion	Self-compassion (the ability to be kind and accepting to oneself) was related to less alcohol use, fewer alcohol problems, and lower risk of alcohol use disorder. Self-compassion also moderated the risks of alcohol use.	GRADES: Low
Spillane, Schick, Nalven (2021)	*Study design:* Cross sectional *Methodology:* Quantitative *Sample:* Ages 11-18 (n=106)	*Setting:* Canada, RR, C *Indigenous Population:* First Nations	*Theory:* Behavior Theories of Choice *SER:C, Cu*	Cultural and social reinforcers and extracurricular activities. Alcohol and marijuana use.	Youth who rated competing life reinforcers (CLRs) as having greater value had significantly less substance use. Specifically, cultural, and social reinforcers were associated with less drinking. Extracurricular activities were associated with less drinking and less marijuana use.	GRADES: Low
Stanley (2018)	*Study design*: Adaptation of intervention, one time focus group *Methodology:* Qualitative *Sample*: Study 1: Grade 7 (mean group size= 7; two groups). Study 2: Grade 11 (n=10)	*Setting:* Contiguous US/WEST, RR, Sc *Indigenous Population:* Two Northern Plains tribal nations, one Southwest tribal nation	*Theory:* Not specified CBPR *SER:* I, F, C, Cu, S	Substance use, resilience	AI youth reported having high future aspirations, involvement in activities, and influence from family and friends. There were important differences from non-indigenous youth, including emphasis on different types of activities, a more collectivist cultural orientation, tribal identity and pride, and the importance of extended families.	JBI: Moderate

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Swaim (2016)	*Study design*: Cross sectional *Methodology:* Quantitative *Sample*: Middle school and high school age (n=3,389)	*Setting:* Contiguous US/WEST, Contiguous US/EAST, RR, Sc *Indigenous Population:* Not specified	*Theory:* Not specified CBPR *SER:* I, F	Marijuana use, family factors	Strong effects were found for family structure, parental monitoring, family conflict, and family sanctions against marijuana use. Weaker effects were found for family participation in school events, and no relationship was found for family communication about marijuana. Findings regarding marijuana use were consistent across AI and white adolescents on reservations.	GRADES: Low
Swaim (2019)	*Study design*: Self-report survey, SEM analysis *Methodology*: Quantitative *Sample*: Grades 7-12 (N=3,375); middle school males (n=697), middle school females (n=767), high school females (n=975), high school males (n=936)	*Setting:* Contiguous US/WEST, Contiguous US/EAST, RR, Sc *Indigenous Population:* Not specified	*Theory:* Not specified *SER:* I, C	Substance use, self-esteem, cultural identification	Except for high school females, self-esteem was significantly positively related to both AI and white identification. Alcohol use was not directly related to cultural identification or self-esteem. A small mediating effect of self-esteem on marijuana use was found in high school females. No other mediating effects were found.	GRADES: Low

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Swaim (2021)	*Study design:* Latent class analysis *Methodology:* Quantitative *Sample:* Grades 9-12 (n=2,884)	*Setting:* Contiguous US/WEST, Contiguous US/EAST, RR *Indigenous Population:* Not specified	*Theory:* Not specified *SER*: I	Substance use, risk behaviors, well-being, self-esteem	Four classes of marijuana use were identified ranging from nonusers to regular users. Predictors of use differed in females and males. For females, protective factors were living with both parents, family sanctions against use, and self-esteem. Risks were peer use and coping motive for marijuana use. For males, protective factors were parental monitoring and family sanctions against use. Risks for males were peer use.	GRADES: Low
Tingey (2014)	*Study design*: Descriptive, 1 year *Methodology*: Qualitative *Sample*: Ages 13-19 years (n=22)	*Setting:* Contiguous US/WEST, RR, C, H *Indigenous Population:* White Mountain Apache	*Theory:* White Mountain Apache Descriptive Model of Youth Suicide CBPR *SER:* I, F, C, S	Risk pathways for suicide	Four themes of suicide risk emerged including individual, family, community, and societal. Adjustments were made to the existing conceptual model and included removal of the following sub-themes: negative media messages, access to means. Added were the sub-themes of emotional dysregulation, substance use, and imitation.	JBI: High
Tingey (2016)	*Study design*: Cross-sectional, case control *Methodology*: Quantitative *Sample*: Ages 10-19 years, cases (n=66), controls (n=55)	*Setting:* Contiguous US/WEST, RR, C, H *Indigenous Population:* White Mountain Apache	*Theory:* Not specified CBPR *SER:* I, F, C, Cu	Depression, anxiety, binge alcohol use, risk behaviors	Risk factors for heavy binge drinking included aggressive or impulsive behaviors, having deviant peers, poor family functioning, more people living in the home. Protective factors were attending school, family closeness, residential stability, social problem-solving skills, traditional AI values, strong ethnic identity.	GRADES: Moderate

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Tingey (2021)	*Study design*: cross-sectional, secondary data analysis from an RCT *Methodology*: Quantitative *Sample*: Ages 11-19 (n=534)	*Setting:* Contiguous US/WEST, RR *Indigenous Population:* Southwest US tribe	*Theory:* Protection Motivation Theory CBPR *SER:* I, F, C	Co-occurring risk factors; substance use	Respecting the Circle of Life Program, an intervention shown to improve sexual health behaviors for AI/AN youth, was evaluated for the effect on substance use risk and protective factors. Youth completing the program reported lower intention to use substances through 12-month follow up. Peer and parent protective factors were improved.	GRADES: Low
Tolliver-Lynn (2020)	*Study design*: Cross sectional *Methodology*: Quantitative *Sample*: Parents (n=57) of children ages 3-5	*Setting:* Contiguous US/WEST, Contiguous US/EAST, RR and U, C *Indigenous Population:* Not specified	*Theory:* Family Resilience (Masten, 2015) *SER:* F	Risk behaviors, resilience, parental anxiety, depression, cultural identification, parent-child relationship	The quality of parent-child relationships moderated the association between parent anxiety symptoms and child internalizing symptoms. Strength of parent-child relationship buffered the effect of parent distress on child internalizing symptoms.	GRADES: Low
Tremblay (2018)	*Study design*: Photovoice with accompanying descriptions coded and analyzed for themes, 10 sessions *Methodology*: Qualitative *Sample*: Ages 15-19 years (n=11)	*Setting:* Canada, RR, Sc, H *Indigenous Population:* Maskwacis Tribal Community	*Theory:* Not specified CBPR *SER:* C, Cu	How youth view community strengths, reframing perceptions through photos	40 photos taken by 11 youth and 2 adults were analyzed to determine how youth viewed their community strengths. Themes included strong relationships, commitment to culture, beautiful natural world that is a part of Maskwacis, and ability to look to the future. 392 people who viewed the photo exhibit reported a positively changed perception of the community.	JBI: Moderate

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Tyser (2014)	*Study design*: Cross sectional *Methodology*: Quantitative *Sample*: Grades 5-12 (n=164)	*Setting:* Contiguous US/WEST, RR, Sc *Indigenous Population:* Northern Plains	*Theory:* Not specified *SER:* I, Cu	Depression, optimism, cultural identity	Results supported a model in which greater goal self-efficacy, AI cultural identity, grades, and dispositional optimism each significantly predicted fewer depressive symptoms. Grades and goal self-efficacy had both direct and indirect (through optimism) relationships with depressive symptoms.	GRADES: Low
Ulturgasheva (2014)	*Study design*: Grounded theory, multi-site comparative study *Methodology*: Qualitative *Sample*: Ages 11-19 years (n=20)	*Setting:* Alaska and Canada, RR *Indigenous Population:* Inuit, Yup'ik, Inupiaq	*Theory:* A new "sliding scale" youth resilience model CBPR *SER:* I, F, C, Cu	Resilience, vulnerability	Circumpolar indigenous pathways to adulthood study. Strategies for resilience among the Inuit: family, camping and hunting, being on the land. Yup'ik: relatives, peer support, land/river, sports, school, not thinking about things too much, helping someone else, prayer and God. Inupiaq: peers, relatives, self-reliance, emotional support networks, culture, time on land, subsistence, sense of competence, responsibilities and contributing to others.	JBI: Moderate
Unger (2020)	*Study design*: Cross sectional *Methodology*: Quantitative *Sample*: Ages 13-18 years (n=156)	*Setting:* Contiguous US/WEST, RR and U, Sc *Indigenous Population:* Unidentified tribal communities in California	*Theory:* Not specified *SER:* I, C	Substance use; ethnic identity, spirituality	Strong ethnic identity was protective against cigarette, marijuana, and alcohol use, but not protective of blunt or e-cigarette use. Spirituality was associated with increased risk of cigarette and marijuana use. Previous ceremonial tobacco use had no significant associations with past month substance use.	GRADES: Low

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Walls (2016)	*Study design*: Cross sectional, 7th wave data from an 8-year longitudinal study *Methodology*: Quantitative *Sample*: Enrolled at ages 10-12; Current mean age= 17.23 years (n=569)	*Setting:* Canada, Contiguous US/WEST, Contiguous US/EAST, RR *Indigenous Population:* Unspecified	*Theory:* Not specified CBPR *SER:* I, F, Cu, S	Resilience, spiritual activities, discrimination, historical loss	Indigenous spirituality was associated with depressive symptoms, anger, anxiety, somatization, and interpersonal difficulties, but observed effects were attenuated when historical loss and discrimination were added into statistical models. Consideration of cultural complexities changed the authors' original conclusions.	GRADES: Low
West (2021)	*Study design:* Culturally informed talking circle *Methodology:* Qualitative *Sample:* Ages 13-18 (n=83)	*Setting:* Contiguous US/WEST, RR,C *Indigenous Population:* California tribes	*Theory:* Not specified *SER:* I, F, C, Cu	Opioid use, risk behaviors, resilience	Study of AI/AN teens with opioid and other substance use disorders and their use of services. Barriers to care (risks) included shame, stigma, lack of trust. Risks for use were intergenerational substance use disorder. Protective factors included family cohesion, cultural traditions, and culturally based youth programs.	JBI: High
Wexler, Jernigan (2014)	*Study design*: Semi-structured interviews (one hour x 3), modified grounded theory analysis *Methodology*: Qualitative *Sample*: Ages 11-18 years (n=20)	*Setting:* Alaska, RR *Indigenous Population:* Inupiaq	*Theory:* Social Ecology of Resilience (Ungar, 2008, 2011) CBPR *SER:* I, F, C, Cu	Resilience, everyday struggles, and life challenges	Stressors by theme: relationship loss, "not being there for me," non-supportive/hostile experiences, transitioning to adulthood, and boredom. Resilience strategies by theme: relationships with others, being responsible, creating systems of reciprocity, subsistence living, and giving back to family and community.	JBI: Moderate

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First Author and Year	Study Design, Methodology, and Sample	Setting and Indigenous Population	Theory and SER Level	Mental Health Outcomes Assessed or Measured	Key/ Significant Findings	Quality Assessment
Wexler, Joule (2014)	*Study design:* Semi-structured interviews (one hour x 3) *Methodology*: Qualitative *Sample*: Ages 11-18 years (n=20)	*Setting:* Alaska, RR *Indigenous Population:* Inupiaq	*Theory*: Social Ecology of Resilience (Ungar, 2008, 2011) CBPR *SER:* I, F, C, Cu, S	Community resilience	Cultural grounding was related to more flexible patterns of resilience in youth. Kinship networks allowed for young peoples' access to cultural and material assets. Cultural and subsistence activities were important to most youth. Historical and political positioning influences access to cultural resources	JBI: Moderate
Wexler (2016)	*Study design*: Longitudinal, quasi-experimental, pre-posttest, 9 months Focus groups, interviews *Methodology*: Mixed methods *Sample*: Grades 8-11 (n=86); paired youth leaders (n=61)	*Setting:* Alaska, RR, Sc *Indigenous Population:* Inupiaq	*Theory:* Not specified CBPR *SER:* I, C	Resilience, risk behaviors	Intervention study of Youth Leaders Program (YLP). Quantitative: increased attendance and academic performance were found in program participants. Comparing matched pairs pre- and post-survey showed no significant changes; levels of positive feelings were high before and after. Qualitative: participants felt an increased sense of agency, responsibility, and confidence.	GRADES: High JBI: High
Whitesell (2014)	*Study design*: Longitudinal growth mixture modeling, 2 years *Methodology*: Quantitative *Sample*: Grades 6-7 (n=381)	*Setting:* Contiguous US/WEST, RR, Sc *Indigenous Population:* Northern Plains	*Theory:* Not specified *SER:* I, F, C	Substance use, patterns, and predictors	Across substances risk factors were stress, early puberty, and deviant peer relationships. Protective factors were strong relationship with parents and prosocial peers. Emergent cultural identity did not relate to substance use.	GRADES: Moderate

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Yasui (2015)	*Study design*: Longitudinal, quasi-experimental, pre-posttest (baseline and 1-year post-intervention) *Methodology*: Quantitative *Sample*: Ages 11-17 (n=92)	*Setting:* Contiguous US/WEST, RR, C, H *Indigenous Population:* Three Northwest US tribal nations	*Theory:* Not specified *SER:* I, F, S	Substance use, culture, and discrimination	Parents with high cultural socialization and socialization of coping with discrimination were predictive of lower youth depression scores and higher youth-reported ethnic identity. No relationship was found between discrimination and ethnic identity.	GRADES: High
Zapolski (2017)	*Study design*: Cross sectional *Methodology*: Quantitative *Sample*: Grades 4-12 Total (n=34,708); AI (n=474)	*Setting:* Contiguous US/WEST, U, Sc, C *Indigenous Population:* not specified from a large midwestern county	*Theory:* Social Ecology of Resilience (Ungar, 2008, 2011) *SER:* I, Cu	Substance use, ethnic identity across diverse youth	Compared African Americans, whites, multiracial, Hispanic and AI youth in measures of ethnic identity, drug attitude and drug use. Unlike other ethnic groups, AI ethnic identity was not significantly related to drug attitude or drug use.	GRADES: Low

CBPR: Community-Based Participatory Research
Cu: Cultural
F: Family
H: Participant's home
HC: Health care facility
I: Individual
RR: Reservation or rural
S: Societal
Sc: School
SER: Social Ecological Conceptualization of Resilience
U: Urban