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Indigenous knowledge and chronic disease prevention among the first people of north america

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Indigenous knowledge and chronic disease prevention among the first people of north america

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Editorial: Indigenous knowledge and chronic disease prevention among the first people of North America

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Indigenous health, Indigenous framework, Indigenous knowledge, community-based participatory research (CBPR), chronic disease treatment and prevention

Editorial on the Research Topic
Indigenous knowledge and chronic disease prevention among the first people of North America

Indigenous populations of North America face substantial health disparities, which have led to disproportionate rates of chronic diseases, compounded by elevated rates of poverty, lack of educational opportunities, and historical trauma (1, 2). The use of local Indigenous knowledge and culturally-anchored interventions have resulted in sustainable programs that support tribal sovereignty and self-determination (3–5). However, case studies illustrating the role of Indigenous knowledge in changing the course of chronic disease health disparities are limited.

This special topic issue titled *Indigenous Knowledge and Chronic Disease Prevention among the First People of North America*, presents a collection of original research and literature reviews illustrating the role of traditional frameworks and cultural assets to inform the development and implementation of programs and interventions addressing chronic disease prevention and health promotion in Indigenous communities. The ten articles include one mixed studies review, two random clinical trials (RCT) studies, and seven articles that present the development and/or results of culturally-anchored health programs. The mixed studies review included in this issue documents the identification and application of risk and protective factors to inform cancer surveillance and health promotion efforts in Indigenous communities. Some of the interventions described in this issue, engaged traditional knowledge holders in the training of Indigenous and non-Indigenous scholars and researchers. Engaging traditional knowledge holders is key to ensuring interventions are indeed culturally-anchored and support traditional values, beliefs, and practices (6, 7). Ivanich et al. describes an innovative scholar program intended to support the career development of Indigenous scholars. Dreifuss et al. provides an overview of a summer program aimed to expose Indigenous youth to the potential of a public health career through the integration of academic and cultural knowledge to understand and influence health behaviors and perspectives.

In addition to engaging traditional knowledge holders in training researchers and health care professionals, traditional knowledge holders were employed to guide the development of some of the programs and interventions described in this issue. Both Walls et al. and Wilson et al. emphasize that culturally-anchored diabetes programming yields a meaningful approach to disease management that aligns with patients' worldview of self-care. Rink et al. describe the development of a multi-level RCT that builds upon existing community strengths and traditional knowledge and values to reduce sexual and reproductive health disparities in a northwest Indigenous community. Richards et al. presents results from an Indigenous fatherhood health promotion program evaluation guided by a community workgroup that provided cultural expertise and local insight.

Another important emphasis of this issue is the use cultural assets and local resources to support chronic disease prevention. Margariti et al. shared results from their analysis of self-reported data from Indigenous adults enrolled in a sexually transmitted disease (STD) risk reduction program, that recognized the influence of colonizing stressors and used cultural assets as prevention buffers. With a comparable emphasis on cultural strengths, Blue Bird Jernigan et al. share their design and methods for a planned RCT to assess nutrition-related interventions intended to promote food sovereignty and security in an Indigenous community in Oklahoma. Lastly, Fernandez and Beltrán present their analysis of a qualitative health needs assessment that explores the role of participating in cultural dance as a means to strengthen Indigenous identity and understanding of traditional visions of health and wellbeing to ground substance abuse and HIV prevention efforts.

This issue celebrates the use of traditional knowledge and cultural assets in the development and implementation of programs and interventions to address chronic diseases in Indigenous communities. We are confident that this issue will be a valuable resource for public health professionals and researchers aiming to apply innovative strategies to reduce health inequities among Indigenous populations. This collection advocates for the use of Indigenous frameworks and perspectives to improve the health status of Indigenous communities.

Author contributions

MS and NT-S confirm shared responsibility for drafting, reviewing, and approving the final version of the editorial.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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"Wherever I Go, I Have It Inside of Me": Indigenous Cultural Dance Narratives as Substance Abuse and HIV Prevention in an Urban Danza Mexica Community

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Introduction: "Mexican American Indian" (MAI) is a large and diverse population for which little empirical research on alcohol and other drug (AOD) use and HIV is available, yet for which there is a disproportionate risk. Indigenous health narratives and participation in place- and settings-based cultural practices can be protective in chronic and co-occurring disease prevention and health promotion for Indigenous people. This study explores the role of participation in cultural dance in generating narratives of prevention and health promotion among a sample of MAIs from an Urban Danza Mexica Community (UDMC), framed within a decolonizing narratives of health (DNOH) model.

Methods: This secondary data analysis ($n = 9$) is drawn from a qualitative AOD and HIV health needs assessment of UDMC living in the Pacific Northwest and the Rocky Mountain West ($n = 21$). This study uses a community-based participatory research approach and employs narrative, Indigenized methods to analyze in-depth interviews from adult cisgender females ($n = 5$) and males ($n = 4$). The DNOH model is developed as a relational, analytic framework that contextualizes Indigenous stories in relationship to three distinct yet interconnected levels—the personal, the communal, and Indigeneity in the larger world. These levels of narrative analysis function as culturally grounded, relational pathways through which to articulate health education and promotion approaches.

Results: Narratives delve into the complex and nuanced relationships within participants' internal worlds (personal), between themselves and their Danza community (communal), and between themselves and their complex, intersectional Indigenous identities within society (Indigeneity). Stories of ancestral teachings about health and prevention shared within the Danza circle create spaces wherein participants navigate complex conversations that resist oppressive colonial narratives, reconnect with and strengthen their Indigenous identities, and strive toward ancestral visions of health and well-being.

Discussion: This study contributes to Indigenized theoretical and methodological expansion and the development of place/settings-based, narrative, cultural health interventions aimed at preventing chronic and co-occurring disease and promoting

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wellness among populations similar to the UDMC. Identifying cultural practices as Native Hubs (relational, socially constructed places) that foster decolonizing narratives helps increase understanding of their role in public health education and promotion through recognition of Indigenous knowledge systems and frameworks.

Keywords: transnational Indigenous, place, cultural dance, chronic disease prevention, narrative methods, community-based participatory research, substance abuse, HIV

INTRODUCTION

Indigenous peoples of North America have developed and maintained cultural and community-based health practices grounded in original teachings and knowledge systems that have been instrumental in maintaining health and resilience despite centuries of colonial oppression (1–3). A growing body of health intervention literature documents how Indigenous communities and scholars have successfully collaborated to design and implement chronic disease prevention interventions grounded in such practices (4–9). Most of this literature comes from Indigenous communities whose ancestral origins lie within what is now called the United States and Canada. This body of literature is seminal, with relevant implications to other Indigenous Peoples across North America and beyond. However, there is scarce literature documenting the health status, risk, and protective factors of transnational Indigenous Peoples of North America, who may experience both similar [e.g., racial discrimination, colonialism (10)] and unique [e.g., xenophobia (11)] stressors compared with American Indian/Alaska Natives (AIAN) in the U.S. or Canadian First Nations peoples (12, 13). One such group is Mexican American Indians (MAIs), a new U.S. Census (14) category that includes Indigenous peoples from Mexico living in the U.S. (15). A first-of-its-kind, culturally-anchored, community-based AOD and HIV needs assessment with a sample of MAIs found that AOD abuse and HIV are important health concerns, and that traditional knowledge, cultural practices, and teachings were promising as prevention and intervention strategies. The needs assessment's findings highlighted Danza Mexica (also called Danza Azteca or Aztec dance) as a central cultural practice and prevention and intervention strategy (16). Drawn from the needs assessment data, the present study is an in-depth analysis of the role of participation in Danza Mexica as a potential protective factor and prevention and intervention strategy, framed through development of a culturally-grounded decolonizing narratives of health (DNOH) model derived from participants' stories.

Mexican American Indians

Mexican American Indians represent the fourth largest Indigenous grouping in the United States, and their population has tripled since 2000 (15). Used as an umbrella term, MAIs include diverse groups of people with complex, intersectional identities who maintain affiliation or attachment with one or more Indigenous Peoples from Mexico. MAIs may self-identify with one or more racial or ethnic identities, may have been born in the United States, Mexico, or elsewhere, and may be U.S. citizens, residents, or undocumented (17–19). MAIs include diverse subgroups constituted around shared cultural experiences and identities (12). These groups may also share a history of Spanish colonization, oppression in Mexican society, and discrimination as immigrants in the United States [specifically non-U.S.-born MAIs (11)]. Spanish colonizers committed multiple acts of genocide and massacre and relentlessly attempted to annihilate their Indigenous ancestors' economic and social systems (20–23) as well as psychological, cultural, and spiritual well-being in order to subjugate the people into indebted servitude and Catholicism (20, 21, 24). Many people were forcefully compelled to adapt, adopt, and exchange their Indigenous traditions for those of the Catholic faith to preserve and protect their traditions from complete decimation. However, many also strategically continued their practices privately within their homes and communities, maintaining their cultural roots while surviving Spanish colonization (25) through the nineteenth-century independence of Mexico from Spain, as well as under continual and increasing Westernization and marginalization of Indigenous People through the twentieth century within the nation state (24).

AOD, HIV, and Social Determinants of Health

Similar cultural experiences of colonial-based historical and contemporary traumas, such as forced migration and displacement, discrimination, violence, and ongoing structural inequalities (26, 27), are major social determinants of health for MAIs (28). *Historical trauma,* defined as complex, cumulative, and collective traumas resulting from violent colonial acts targeted at specific communities and experienced throughout the life course and across multiple generations (10, 29–31), is a term used to conceptualize these traumas that may act as social determinants of health. Physiologically, historically traumatic events and resilience can become embodied or biologically incorporated, impacting health outcomes and disparities (32) for MAIs (10).

Epidemiological evidence points to AOD and HIV disparities among AIANs and Latinos—two groups in which MAIs may be categorized separately or simultaneously—and the use of alcohol or any other substance is closely associated with increased HIV risk for all populations (33). The AIAN mortality rates due to alcohol-induced causes and drug-induced causes are 6.6 and 1.5 higher than all U.S. races (34), and AIANs have twice the HIV infection and AIDS rate compared with Whites (35). Hispanics who drink are more likely to binge drink compared with non-Hispanic Whites (36), Hispanic males are three times as likely to have HIV or AIDS compared with White males, and Hispanic

females are three times as likely as non-Hispanic Whites to die of HIV infection (35). Findings from the first and only needs assessment with a sample of MAIs to date is consistent with these disparities—AOD and HIV were identified as significant community health concerns among 80 and 60% of participants, respectively (12).

This needs assessment not only identified risk factors for AOD and HIV rooted in historical trauma but also found cultural protective factors derived from traditional teachings and practices, one of which was an engagement in Danza Mexica. Danza teachings and practices were described as preventative and promotive of cultural identity, community support, and healing by participants (12). These findings are supported by the literature. Research on dance therapy across non-culturally specific dance forms (e.g., ballroom dancing) and other forms of movement (e.g., tai chi) demonstrate positive impacts on overall health, well-being, and social support (37–39). Cultural dance not only provides mental and physical health benefits for Indigenous and other communities (40–44), but may also increase the likelihood of intervention acceptability, by integrating aspects of mind, body, and spirit, which is linked to motivation and adherence (38).

Furthermore, as an expression of Indigeneity, Danza Mexica may serve as a means to re-create the connection to original tribal homelands and Indigenous identity (45–48). For members of the Urban Danza Mexica Community (UDMC), participation in Danza circles can be a way of cultural place-making to maintain connections to Indigenous identity and facilitate spaces for physical and emotional well-being (12, 24, 48). Native Hubs is a term used to describe relational place-making through Danza participation. Native Hubs can represent fixed or fluid places that may be geographical, socially constructed, or virtual. They can include engagement in a wide range of cultural practices such as pow-wows, storytelling, ceremonies, or other social or political activities that support Indigenous constructions of identity, culture, community and belonging apart from original land bases (16, 48, 49).

The Danza Mexica Community

The needs assessment sample comprised members of the Danza Mexica community (16). This community is found across North America and the world and is organized around traditional Indigenous dance originating from Mexica (Aztec) peoples, considered the predecessors of Nahuatl speaking peoples of Central Mexico. Danza Mexica communities come from multiple Indigenous Peoples that may or may not include Mexica but who follow Mexica traditions in Danza. In the needs assessment, almost all participants identified unique Indigenous or tribal heritage with only two identifying Mexica as their primary identity. Other tribal groups represented included a combination of Mexica and P'urhépecha, Yaqui, and Aztec. Huichol, Mixteco, Ñuu Savi, Raramuri, Tarahumara, Cora, Otomi, Apache, and Chichimeca were also represented in the sample (16). *Danzantes* (a general term that describes any dancer from the pre-Cuauhtémoc, Conchero, Aztec/Azteca, or Mexica traditions) share a strong history of resilience in the face of traumatic events resulting from Spanish colonization, Christianization, and Mexico's *mestizaje* project (12, 25, 50) as well as on-going discrimination in Mexico and structural inequality and xenophobia in the U.S. (16). These traditions are derived from four evolutionary periods of Danza, starting before (pre-Cuauhtémoc) and after (Conchero, Aztec/Azteca and Mexica, respectively) Spanish invasion through today (24, 25). For pre-Cuauhtémoc danzantes, dance was both a public and private obligation, with its role in prayers and ceremonies related to agricultural events, commemorations and celebrations of human and astronomical events, expression of gratitude, commerce, education, and commitment in social relations (24). Despite Spanish colonizers' attempts to annihilate Indigenous societies (20–22, 24), some danzantes strategically combined their traditions with Catholic rituals, which became the Concheros tradition. Others continued their original practices privately within their homes and communities (24, 25). Into the twentieth century, the Aztec/Azteca and Mexica movements arose and supported more decolonial processes (47). Of the variety of nuanced and dynamic Danza Mexica forms practiced across North America, participants in this sample primarily participate in the Mexicayotl tradition, a more recent tradition centering on decolonizing and Indigenizing practices. While danzantes today practice a variety of health-promoting cultural and ceremonial traditions (e.g., velacion/all-night vigil, temazcal/sweat lodges, and tipi ceremonies) alongside Danza Mexica (12), the present study builds on and deepens the parent study focus on Danza Mexica as a Native Hub (16, 48), in which participation can serve as a protective factor. Using secondary data analysis, it draws from the needs assessment (16) to specifically examine the role of participation in Danza Mexica as potentially protective, through generating narratives of prevention and health promotion, framed by the culturally-grounded DNOH model derived from participants' stories.

MATERIALS AND METHODS

Sample

The first author analyzed nine of the 21 full interviews from the dataset (12). This sample size is appropriate for capturing meaningful data in response to the research question, given the narrative case-based structure for analysis and similarity of the demographic diversity of this sample to the total sample [(51), p. 403]. The first author conducted seven of the interviews alone, and two together with the second author. Six participants were interviewed in Spanish and three in English (one participant occasionally used words in his Indigenous language). Participants were 18 and older [divided into younger (18–39) and older (40 & up) adult cohorts to add an additional layer of de-identification], and education levels ran from zero–eighth grade to graduate and professional degrees. In the study presented here, two participants did not report a particular tribal heritage, and the remaining seven participants identified ancestry from four specific Indigenous Peoples (one of which was Mexica). These Indigenous Peoples have geographic origins across the northern, central, and southern states of Mexico. Five participants self-identified as cisgender female, and four as cisgender male (see **Table 1**). One participant

TABLE 1 | Demographics of the participant sample.

Demographic area	Sample characteristics ($n = 9$)
Age cohorts	Younger adults: 18–39 ($n = 5$) Older adults: 40–60 ($n = 4$)
Genders	Cisgender female ($n = 5$) Cisgender male ($n = 4$)
Interview languages	Spanish ($n = 6$) English ($n = 3$)
Education levels	0-some college <1 year ($n = 3$) Some college >1 year ($n = 3$) Bachelor's-professional degree ($n = 3$)
Indigenous groups	4
Regions of Mexico	3 (northern, central, southern)

identified as two-spirit. Two-spirit is an umbrella term that can be used to describe lesbian, gay, bisexual, transgender, and queer (LGBTQ) American Indian/Alaska Native (AIAN) and other Indigenous peoples including participants in this study (52–54).

Procedure

This study is a secondary data analysis drawn from an in-depth qualitative community-based participatory research (CBPR) pilot study to gather data to inform an AOD and HIV needs assessment within the urban MAI community of the Pacific Northwest and the Rocky Mountain West (12). The pilot study used a purposive, snowball sampling strategy. Inclusion criteria were adults 18 years of age or older, identifying as men, women, and gender non-conforming (e.g., transgender, intersex, two-spirit, or other tribal-specific gender identity), and those who self-identified as having Indigenous ancestry of Mexico or Central/South America. In-depth interviews and focus groups in English and Spanish were conducted to explore participants' experiences, thoughts, and feelings related to AOD, HIV, and overall health within their communities. For the present study, the first author was invited by the second author (PI) and the project community advisory board to add a place and health theme to assess perceptions of the place relationship in MAI's health. Participants told stories of Danza and place in health throughout the interview question themes, in addition to their responses to the place-and-health set of questions. We took a fluid, narrative-style approach to interview participants that allowed us to follow a non-linear, Indigenized approach to the questionnaire. This enabled the participant's natural storytelling flow to lead the interview. To ensure data collection was responsive to community perceptions/needs, we presented a thematic analysis of the data and the DNOH model to the community for review and approval after data collection was completed (12). While the parent study focused on AOD and HIV risk and resilience perceptions, the analysis presented here focuses on narratives of participant perceptions of health and place relationships.

Analytic Strategy

Informed by narrative inquiry, the present study uses the DNOH model as an analytic framework and narrative thematic analysis (NTA) (55) as the specific analytic strategy used to identify story segments for analysis and interpretation of the data within the DNOH model. Aligned with Indigenous, relational worldviews, narrative inquiry posits that understanding of the whole sheds light on understanding the parts and uses the analysis of stories to explore and create meaning (56). This study conceptualizes participation in Danza as a Native Hub (48, 57), to explore the potential impacts of Danza participation on AOD, HIV, and other overall health-related prevention goals, which in turn expands the reader's knowledge of how such practices may be transferrable to similar situations (58). It also functions as a tool to move beyond theme identification into an analysis of the themes' interrelationships to uncover more nuanced processes within the context of conceptual ideas (56). Narrative, like storytelling, is also a primary medium of communication among many Indigenous nations and is an effective method to assess determinants of health (59).

This study uses the DNOH analytic framework to help guide the analysis and interpretation of the data. The DNOH model is inspired by the Kaupapa (Māori language: principles) Korero (Māori language: to talk, narrative) narrative analysis method (60, 61) as well as Danza Mexica epistemology (24). It delves into the complex and nuanced relationships within participants' internal worlds (personal), between themselves and their Danza community (communal), and between themselves and their overall Indigenous identity within society (Indigeneity)—contextualized within Danza as a Native Hub. Using the DNOH framework aligns with the circular formation of Danza, like a solar system within a universe, both a reflection of life and connection with Mother Earth (24).

The transformative role of Danza as a vehicle for decolonization can also be depicted by likening the DNOH to the structure of the Danza circle. Each danzante is like a planet that strives to move in balance and duality with other danzantes within and across the circles, honoring *Ometeotl* (the Nahuatl word often translated to mean "dual energy" also referred to as Higher Power, Great Spirit, or Creator/God, as dual feminine and masculine energies in one force to create life; sacred or divine duality) in word and action (47). Most novice dancers start on the outer rings of the circle and move closer to the center as they increase in knowledge, skills, and responsibilities within the Danza community—similar to the process of UDMC strengthening or returning to their identities as Indigenous people through decolonizing narratives while simultaneously remaining grounded in their Indigenous identity within the larger society.

Furthermore, the DNOH model demonstrates how knowledge, health, and decolonization is transmitted intergenerationally, through the Danza circle structure, in that those danzantes closer to the center function like elders, or more experienced persons who help the novice danzantes grow in knowledge and responsibilities of their own Indigenous identity (24) and within the group. No matter where danzantes

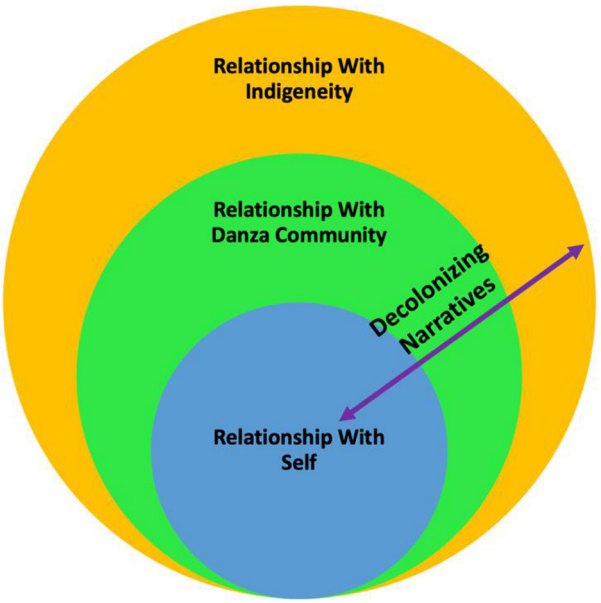

FIGURE 1 | Decolonizing narratives of the health analytic framework.

find themselves within the actual Danza Mexica circle or where individual narratives within this study are located within the DNOH analytic framework, each person plays a unique and equally valuable role that helps the entire group function as a *calpulli*—like a family [Nahuatl notion of a group; (46) p. 119].

The DNOH model (see **Figure 1**) in its entirety represents the Danza circle as a Native Hub (48) in which participants' stories function as decolonizing narratives (represented by the left-right double arrow) of connectedness to self, others, and Indigeneity within the larger society—narratives that may transmit Indigenous teachings of health and well-being. The three layers of relationships within the DNOH model—self, Danza community, and Indigeneity— are inextricably linked through the concept of connectedness. *Connectedness* refers to the interdependent well-being of self, family, community, and the natural environment (62), as well as the role the concept plays among Indigenous people in creating cultural places that are optimal for prevention and health promotion (63).

This study highlights this role for the UDMC as an urban, transnational diasporic community that sustains their overall connectedness to place—representing their ancestral origins and attachment to homelands—through participating in Danza as a Native Hub. The first layer, relationship with self, narrates Danza's role in place-making for participants' connectedness with their own emotional, mental, spiritual, and physical health. The second layer, relationship with the Danza community, narrates Danza's role in place-making through fostering health within the context of their connectedness to Danza as a family or community structure. The third layer, relationship with Indigeneity, narrates Danza's place-making role for cultivating health within the context of connectedness to their identities as Indigenous people in relation to one another and other groups in the larger society. The left-right double arrow that crosses all three layers represents how participants use narrative as a tool with which to decolonize beliefs and practices surrounding prevention and health promotion, engaging in Danza as a Native Hub that facilitates traditional health beliefs and practices, thereby "weakening the effects of colonialism" [(64), p. 65]. Such traditional health beliefs and practices may include (but are not mutually exclusive) community health-promoting traditions such as velacion/all-night vigil, temazcal/sweat lodges, or tipi ceremonies in addition to Danza Mexica. These practices are also integral to connectedness to Indigenous identity, and may additionally be practiced by danzantes across multiple levels of the DNOH. However, the present study is centered on Danza Mexica as a Native Hub within which traditional health beliefs and practices are engaged. The layers of the DNOH are not mutually exclusive in that participants often traverse within and across practices and layers several times within a single story.

Finally, we used NTA as a way of organizing and making meaning from the data about the role of Danza in participants' relationships to place and health. The primary purpose of the NTA in this article is to identify key participant stories relevant to the research question to highlight and magnify each participant's voice. The NTA emphasizes data content—what participants say—with the intact story as the unit of analysis from which to theorize, rather than smaller clusters of words or phrases (55, 65) through exploring the meanings within the stories as individual cases. The NTA can accommodate the large amount of data generated through qualitative data collection, making it a strategic foundational step that provides narrative material from which the remaining analytic strategies can be drawn.

This NTA generates themed, categorized stories from participants' narratives that draw on central concepts of the ISCM and highlight individual and collective meanings of UDMC experiences with health, place, and dance. These stories are the foundation for the DNOH analysis. The NTA was a preparatory mechanism used to identify and organize stories to conduct a more nuanced analysis. The first author developed the DNOH model to collate the stories and integrate them into an analytical framework of layers of contextual relationships to examine these connections across levels for each participant. The first author followed five steps: (1) summarization of participant background; (2) guided selection of story segments by the research question and DNOH layers; (3) summarizing interpretation of main story points; (4) using the DNOH model to guide placement of stories in layers; and (5) examining stories within and across themes and patterns (61, 66, 67).

Overall, our data analytic approach guided the selection, placement, and interpretation of these particular, salient stories within each participant's narrative. Each participant's story was treated as a case within a particular layer, in alignment with the methodological design, which favors lengthier excerpts over more brief, fragmented excerpts, to preserve interpretive essence better and serve as appropriate units of analysis [e.g., (55, 61, 65, 68)]. The section Results is organized according to the three DNOH levels, each containing the participant name (pseudonym) whose narrative is highlighted (**Figure 2**).

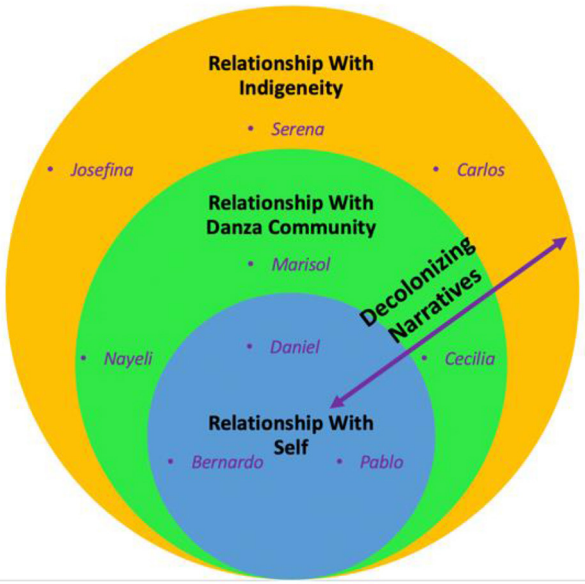

FIGURE 2 | Decolonizing narratives of the health analytic framework: placement of participant narratives.

RESULTS

Throughout these stories, participants engage both individually and collectively in the process of decolonization. The first author found an overarching theme of Danza as a Native Hub—a place wherein narrative is used to decolonize conceptions of identity, health, and well-being through the transmission of traditional health knowledge within the context of individual and collective Indigenous identities. Conceptualizing Danza as a Native Hub, specific subthemes embedded within the three layers of the DNOH model illuminate the pathways through which participants achieve the overarching theme. These include spiritual, mental, physical, and behavioral health and well-being, sense of family and belonging, community education and advocacy, and Indigenous identity and solidarity.

Layer 1: Relationship With Self

It Sets a Blueprint for You

Daniel, Bernardo, and Pablo tell the story of their personal journeys in confronting depression and anxiety, physical pain, addiction, and both internalized oppression and discrimination based on race. Each of their narratives portrays Danza as a space of healing whose teachings help them navigate their specific life challenges. They speak of embracing their Indigenous identities and unique roles within the *calpulli,* embodying the teachings of their own stories to honor their ancestors through self-love as well as through dedication to preventing illness and promoting health among future generations.

Daniel (Younger Adult Male)

Daniel's story frames Danza as a spiritual journey that provides a pathway through which members of the UDMC can find healing from mental stress through spirituality and Indigenous identity. Daniel describes Danza as a personal "outlet" to find his "inner peace," rooted in ancestral origins.

> You could go to Danza, and you can dance, and during that time... you can do some self-reflection... exclude yourself from the outside world and just find a connection with yourself... It's just another outlet for people to feel at peace with themselves.... You could do that with going to church, or... a temple. The differences is our ancestors.

According to Daniel, Danza "keeps a lot of people healthy," not just physically but also spiritually. For danzantes, he claims, Danza's teachings "set a blueprint for you to carry on those things through your everyday life." His story exemplifies that narrative helps danzantes find a sense of balance. The ceremonial practice of using *palabra* ("the word" in Spanish), a ritual process within which participants are given the opportunity to express themselves from their "mind/heart" [(24), p. 103]. This sacred process within Danza, usually enacted at the end of ensayos (practices) or formal ceremonies, serves as an expressive outlet through which one may find support for mental health:

> When we finish... we give everybody the opportunity to speak…one of the things that we focus on the most, is people being mentally healthy because there will be times where someone will feel like they want to give up; and so our group really focuses on trying to help them out... whether it be an elder or someone who has a high position that can help them out and talk to them... when it comes to mental health, I think that Danza is a very big pillar to my community.

Daniel's narrative speaks to the role of spirituality in Danza as a Native Hub to heal, transform, and empower oneself. Such spiritual teachings provide a guide for living a healthy life. According to Daniel, the spiritual consciousness Danza brings provides a sense of purpose and identity for both him and his community.

Bernardo (Older Adult Male)

Bernardo's story exemplifies the power of Danza as a decolonizing Native Hub wherein he learns Indigenous Danza teachings that his mother forbid as "despicable" during his childhood, giving him the spiritual strength to overcome addiction, regain a sense of self-worth and trust in others, and a sense of purpose. Now a dedicated member of a Danza circle himself, he shares that engaging in Danza weekly strengthens his spirit to handle the stressors of daily life. He reflects on the importance of his wellness in being able to support loved ones both in the United States and Mexico:

> Danza has also helped me quite a bit; it gives me spiritual strength. Asking for blessings to begin the week right, for our people that are over there and those that are here. When people depend on you, you have to be strong and take care of yourself.

Danza is a holistic, healthy space, according to Bernardo. It has "helped me to give up alcohol, drugs, to put into practice the

knowledge of what to do with our lives," and helped him learn "how to live":

> …the emotional problems that are most difficult. I was tired…but when I heard the drums…I arrived at my safe door…I can feel things differently…when you use drugs, you feel like you are worthless…when you begin to detoxify your body…you recuperate… to revive your trust in people…to believe in something…this type of health, this type of group…is what many people want…to return to feeling that you are alive, that you begin to act like a human being again.

Bernardo's story serves as a testament to resilience and strength in healing oneself to be a healing force for others. He credits Danza for playing a crucial role as a Native Hub wherein he has overcome addiction and wherein he came to embrace his Indigeneity. The passion he expresses for Danza's role as a place of healing in his own life translates into a dedication to promoting health and pride in Indigenous identity among youth and others within his community. Bernardo's words embody this mission for his people: "I keep identifying myself as a Mexican and as an Indigenous…wherever I go…I have it inside of me." Danza as a Native Hub is the place wherein his reconnection with ancestral origins is cultivated.

Pablo (Older Adult Male)

Like Bernardo, Pablo's story exemplifies the power of Danza as a Native Hub wherein he also has learned to cope with mental and physical health challenges. He has overcome addiction through learning traditional teachings about staying healthy, which give him hope for the future. He reflects on the initiation of his healing journey with family in Mexico and his Danza family after he arrived in the United States:

> I had a threat to my health, emotionally…I began to suffer from anxiety attacks. It was when I told the doctor that I…I began to live with these anxieties. I sought out someone who could listen to me because I had a lot of things going on…and I entered into a depression. And my [specific family members] helped me so much…speaking with me. They took care of everything. I started going to see psychologists, and I learned a lot from them.… I was going to therapy daily…and this was when they told me about [support group for addictions]…and they helped me a lot.… I began to take out all of my frustrations…and my anxieties began to lessen, and so did my blood pressure. I came here, and I had this depression, and through Danza…I have learned how to endure it.

Grounded in his culture, Pablo talks about the traditional teachings and holistic health benefits of Danza participation that make his pain "vanish."

> [F]or us, it is medicine. We should be eating well first because we have to be healthy, this is the base of everything.… And after this, we utilize Danza…when we are physically unwell, we use traditional medicine…but we also utilize the spirit of the Creator.… We ask that he help us with Danza, if we are physically unwell…the medicine enters through the spiritual, and it enters through the physical. But before all of this, we ask the spirit…we arrive with pain, and when we are dancing, it all vanishes.

Since his arrival to the United States, he explains that Danza has provided a healing and empowering Native Hub. Therein, he finds holistic "medicine" to support his recovery from addiction and physical and mental health conditions. Pablo's narrative tells how he has learned to become a healthier person through traditional teachings and Danza's practice.

Layer 2: Relationships With the Danza Community

We Take Care of Each Other

Marisol, Nayeli, and Cecilia tell the story of Danza as a Native Hub that fosters a sense of family and community, a *calpulli* through which they give and receive social support to face health challenges, addiction, and emotional stress. Each of these participants traverses unique and challenging territory as they seek and create a sense of belonging within (and at times beyond) the Danza community. Within this support system, participants share their knowledge, skills, and advocacy in risk prevention and health promotion, making the Danza *calpulli* into a place where "warriors"—young and old—can emerge.

Marisol (Older Adult Female)

Marisol's story reflects the central role of family that Danza as a Native Hub creates and the role of advocacy and outreach in creating community. She explains how the sense of family connectedness cultivated within Danza can create a sense of belonging, purpose, and identity that can help danzantes overcome addiction and mental illness and promote physical and mental wellness:

> …those that have gotten involved in the group…the benefits of belonging to a group, a *calpulli*, a family, to transform their lives and leave behind alcohol and drugs, to have a purpose in life and identify with knowing where you come from, knowing that you have a past and that you have a group that has your back and makes you feel that you have a future.

Marisol emphasizes the important role of advocacy for the prevention of health risks through passing on traditional knowledge and health practices to young people as the "seeds" of the future. She and her fellow danzantes provide outreach to the Mexican-origin community, expanding Danza as a Native Hub to welcome others beyond their circle. At school and community events, they present as a family, sharing messages of prevention and health promotion, awakening consciousness and pride in Indigenous identity through connectedness to one another in their common ancestral roots. Marisol's description of the group's message emphasizes the key role that Danza plays as a protective factor from stressors—a Native Hub through which connections to community, homelands, and identity are maintained wherever they go.

> [W]hen we give presentations, as a group, as a community, as a *calpulli*, what we bring isn't just Danza, to the schools, the community events, what we bring…is…the image of Danza

> and what the culture is. And it makes them feel…that you are not alone. That they have this identity that even though they are living here in this country, they see themselves reflected in the Danza group, their past, the family that they left in their countries, or in Mexico.… That even though they are far from their country, they can as a community keep recovering their values and traditions…medicine, the food, the traditions as well as the culture. That they can keep maintaining the unity of the community…to the children in the schools that suffer from bullying, that suffer from discrimination, that they see that the culture of their family, of their parents and grandparents, with this traditional garb, this coordination and these dances, it gives them, it awakens their pride. Which is to say they are my culture or the culture of my father or mother or my grandparents. It is this connection that awakens them.… I belong to this community, I belong to this town, to this culture, to this tradition.

Belonging extends beyond collective gatherings. For those who cannot attend a Danza circle, Marisol describes Danza as a transportable Native Hub: "And if you are not able to go to Danza, you have your altar in your home…all of this heals you." Marisol's story portrays that connection to Danza as a Native Hub can be expansive, fluid, and flexible beyond the Danza circle itself, to the home or community, facilitating a commitment to caring for self and community no matter where one goes: "is healing, it is medicine." Ultimately, Marisol's story is an example of how Native Hubs can help participants stay connected to spiritual well-being no matter where they are, through sharing its healing message of belonging with all MAIs and their descendants—the "seeds" and "future" of her community.

Nayeli (Younger Adult Woman)

Nayeli's story exemplifies how Danza is an ideal Native Hub for fostering a sense of *calpulli* (family), especially for youth. Within Danza, she shares her journey of reconnecting with and embracing her Indigenous heritage, giving her a sense of belonging that serves as a platform for developing coping strategies for stress management and sharing ideas about prevention and health promotion among youth. Her story begins with her search for a positive community with which to connect, as part of her motivation to join Danza, whose teachings have taught her "how to cope with myself."

Nayeli shares creative ideas for how her *calpulli* can facilitate dialogue on many health-related issues through intergenerational communication. She suggests one-on-one mentorship and advocacy, from older to younger danzantes, regarding such "sensitive subjects" related to health. For example, Nayeli shares that if she is "having this issue and I needed someone to take me to a clinic, they could take me. They might want to sit me down in front of my mom and talk about it, but they'll always take me."

For AOD and HIV education, Nayeli gives specific recommendations for organizing small groups or one-on-one meetings, which has been helpful for her in facilitating more effective communication and support:

> [M]aybe they have questions that they don't really have answered. Say, we're, like, after practice. We can sit down and, like, whatever's on their mind, we can then talk about; and, say they're having an issue drinking, we could tell them, like, what it is going to lead to, what could potentially happen…what the alcohol is actually meant for…like the spiritual meanings behind it.

Nayeli also expresses her belief that leaders should be educated about other health-related topics like mental and health and interpersonal violence:

> It could just be any topic…spiritual needs, substance abuse maybe, they're in a[n] abusive relationship, they're…maybe it's like me that I need emotional support, they can then tell me why I'm feeling a certain way. They can find out the reasons for what triggered it and help me come out of it.

Nayeli's story demonstrates how Danza as a Native Hub on the community level has provided her with not only a sense of belonging within her individual *calpulli* but also within the larger Indigenous community. Within the positive, familial space of the Danza circle, she learns about her history and culture, develops coping skills that help her achieve her goals, and shares her ideas about prevention for youth. With the support of her *calpulli*, Nayeli's story exemplifies how Danza is a Native Hub for fostering leadership.

Cecilia (Older Adult Woman)

Cecilia's narrative speaks of the familial space that Danza provides as a Native Hub wherein she plays a role as a protector, nurturer, and healer in educating young "warriors" to avoid substance abuse and gang involvement and mentors them toward health leadership. To facilitate this positive space for healing and growth, Cecilia explains her sense of responsibility as a role model, "pure of my mind and of my heart," through choosing not to use alcohol and pursuing spiritual growth—in alignment with her Danza circle's values as "a spiritual group."

Cecilia provides an example in which she chose permanent abstinence from alcohol to make a statement as a role model for her community—her decision based on Indigenous traditions. Her story demonstrates her dedication to taking care of herself, her family, loved ones, and fellow danzantes by assuming the role of protector and healer for youth, families, and other women. She believes that this is part of her role as a woman—to support the emergence of healthy, sober young "warriors" from the group.

> I want that my heart and my prayer, because my heart and my prayer are what I give in the Danza, for our people, for our children, for my [partner], for my family in Mexico, for our women, our children, all of the little ones that don't know the situation we are in and how it is changing the world, no? And so for this reason, I am on this path…if in some way I can save a child from getting into drugs or help a mother to not fall into depression because her husband abandoned her or because she doesn't have anyone to watch her kids, for these reasons, we are in the Danza group. To help our women. I feel very proud because we are protecting our community. It is a big responsibility to be taking care of this whole family. But we take care of each other. I believe that good warriors are going to come out of this Danza group, and more little warriors are going to come out of it, from these men and women that we are educating well, to not use drugs, no gangs, no alcohol.

Cecilia's narrative depicts Danza as a Native Hub for community-building—a large intergenerational family where danzantes can feel a sense of belonging and protection—and a place for prevention, health promotion, and education.

> We are supporting not only our community but our children. . . . I feel that we put a lot of energy into it, and we do the best that we can to bring our people in. For many of our youth, it is very important to keep them in Danza, to give them this guidance, education, that having Danza in your life. . . you're not going to get in trouble because all of us elders, since I am the [order in age group] in the Danza group, we all protect them, we are all their mothers, their fathers, for these young people to the youngest ones, it is a blessing to have the children there, even more so when we have the women with their babies in their womb still, and they hear the rhythm of the Danza, and for this reason, we dance in the schools, in the community spaces.

The overarching theme in Cecilia's narrative is her role in cultivating a sense of family within Danza as a Native Hub. Her story reflects her pride in being a role model of traditional health teachings to play her role as a woman to love, heal, protect, and support her Danza family. She particularly emphasizes her efforts to make Danza a positive space for youth—both in preventing substance abuse and health promotion through pride in identity, belonging, and connection.

Layer 3: Relationship With Indigeneity

We're Always Connected to the Universe and the Galaxy and Our Ancestor[s]

Josefina, Serena, and Carlos tell how, within the Native Hub of Danza, they reconnect with their identities as Indigenous people in the world, finding pride and a sense of solidarity with other Indigenous communities. Through decolonizing narratives, they not only learned coping strategies but also ancestral teachings that enable them to confront the structural oppression that drives many of the health challenges among their people. Within the Native Hub of Danza, they are positioned as leaders—from emerging to seasoned—to resist oppression, build community among other UDMC and Indigenous peoples, reconnect with Mother Earth, and thrive.

Josefina (Younger Adult Woman)

Josefina's story documents the beginning of her journey as she finds healing and connection to her Indigenous identity through her engagement in Danza as a Native Hub. She reflects on her new consciousness of and pride in her Indigenous identity here in the United States as well as her initial dissonance and disconnection with Indigeneity while living in Mexico: "At first, it caused me conflict or harm. . . I am still learning. . . about defending my roots. . . . I didn't know my culture. . . and now that I am beginning to see it, it really interests me. . . ."

Josefina recalls witnessing discrimination toward Indigenous people in Mexico for speaking their languages, and she reflects on her disconnection from Indigeneity at that time. Danza as a Native Hub has provided a space wherein she has begun to explore her identity and express her desire for a greater understanding of her Indigenous roots:

> In the people with whom we can share what we really are, what it feels like to be proud of what we are. And so that they can learn to value the things that one can make possible. And that we shouldn't devalue people because they don't speak a dialect. . . . I think that we are like this when we do not know; sometimes, we judge people who speak a different dialect or because they are different.

Josefina also shares observations about how ceremonial practices tied to Danza support recovery from addiction—something she has witnessed personally within her family. She speaks of how balance is learned through the ceremonial use of Peyote as part of recovery.

> . . . they come to the group because they want to avoid this, and for example, using Peyote. . . they see it as a medicine. And if really they don't need it, they don't consume it. . . a ceremony is a question of if one earns it. . . this requires time, and I think. . . it helps them a lot. And the discipline that one is learning is, they start distancing themselves from all of this. Peyote, when they use it like this, they try to make sure that people don't confuse it with a drug. And that they don't make it into a necessity.

Within Danza as a Native Hub, Josefina has learned about the spiritual use of Peyote used in specific ceremonies as a respected plant relative. Based on what she has learned, she suggests those struggling with addictions be invited to participate in Danza to experience the healing that comes from dancing and the teachings on connectedness with Mother Earth: "I would invite them to come because the simple act of dancing helps a lot. To feel oneself connected with the earth, with the environment, this has helped me a lot personally."

Josefina's story is a testament to the power of Danza as a Native Hub to foster decolonization of colonial beliefs about Indigenous inferiority, to question colonial narratives, and to foster healing and connection with ancestral roots. Not only does she share how Danza participation gave her a sense of pride in her identity, but also how it has helped educate her about healthy relationships with substances, their connection with Mother Earth as plant relatives, all within an Indigenous worldview.

Serena (Younger Adult Woman)

Through Serena's participation in Danza as a Native Hub, starting in Mexico and now in the United States, she shares how her pride in ancestral roots and connection to Mother Earth continues to grow and strengthens her resistance to both internalized oppression and structural oppression toward of Indigenous people of Mexico. Her story exemplifies that whereas Danza and other Indigenous ceremonies often originate in specific geographical locations, over time, they may evolve and migrate, as do many Indigenous peoples. They may be transported to urban spaces and shared across national and transnational Indigenous Peoples, yet always maintain songs, practices, and teachings derived from their connectedness to Mother Earth and all creation.

> [I]n Mexico, many tourists try to encounter. . . cultural aspects of the traditions, while the. . . Mexican people do not value it, and we try to avoid it. Or we do not recognize that we are natives, that we

> are Indigenous…even in Mexico not only here, people…aren't proud to be Indigenous. They prefer to hide it, but there are things one cannot hide …. So, instead of speaking to the government and the institutions telling them to support them and telling them that you are Indigenous and this is important, that you have knowledge, you have tradition, they try to make them less valuable…as if it had less value, that I am Indigenous…and my way of being is entirely the opposite. I am super proud of being Indigenous, and I show it…speaking about the cultural Danza group that we are in, we are all proud, and the people see that we are proud.

Although the UDMC as a Native Hub is far from participants' diverse, geographical homelands from which Danza originated, each Danza remains connected to these lands. Danza practices and ceremonies are packed with multiple teachings on how traditional health knowledge promotes healthy nutrition among danzantes, as part of a relationship of reverence to Mother Earth for all she provides. Serena explains:

> All of the dances have something to do with the elements. *Tonantzín* is the name that we give to our Mother Earth…that provides our nourishment, that enabled us to walk. The earth is where we come from and where we will return…when you are in the circle of Danza, you learn to recognize the importance of all living things…you don't take more than you need…they have arrived to cure themselves there, and they give up drugs or alcohol or other things that they use because they are not necessary…there are foods that are not good for you and your body knows it, and somehow it communicates to your mind, and you just don't want it anymore…. And you want to just do all-natural things, and you want to grow your own garden …. You feel that connection with the earth.

Serena's narrative demonstrates how Danza as a Native Hub brings her "home" to her Indigenous identity, no matter how far she now lives from her homelands. According to Serena, Danza is a place of health that grounds her in her Indigenous identity. It enables her to be part of a larger group of Indigenous peoples within and beyond the Danza community. Within Danza as a Native Hub, Serena speaks of learning traditional health knowledge that guides her choices about substances and foods in reverence of her relationship to Mother Earth.

Carlos (Younger Adult Man)

Carlos's story exemplifies how Danza as a Native Hub can be used as a decolonizing tool to reconnect to Indigenous identity and strengthen solidarity among people with Indigenous ancestry of Mexico. Born in his Indigenous community's homelands in Mexico, his connection to his Indigenous identity was disrupted: "…because of NAFTA [North American Free Trade Agreement]…we were forced to move out of our village," making it "hard for us to practice our language." Like many other Indigenous and mestizo Mexican families, Carlos's family could no longer afford to produce their own corn, driving them to northern Mexico to work in agribusiness, where "it's about exploitation," and later to the United States where they continued to work in agriculture. Carlos shares how joining Danza in college helped him peel back layers of colonization to return to his Indigenous identity in college:

> You got to understand where you're going, where your people stand in order to keep going and fight for what is right for you and your people. And so [danza] philosophy is all about reconnecting to Indigenous roots. That's when I started identifying myself more as [Indigenous]. I was doing more research, talking, introducing myself now as an Indigenous person. Before then, in high school, it was just…a Mexicano…

Carlos's story demonstrates how joining Danza was the catalyst for helping him re-embrace his Indigenous identity. As a transitional Indigenous migrant youth, he experienced racial discrimination first in Mexico and then in the United States, facing pressures to conform with nationalist identities in both countries, yet considered "not Mexican enough" or "not American enough." He was "changing my identity now…from [name of participant's Indigenous group] kid to Mexican American to…Chicano." He speaks of his commitment to passing on his Indigenous identity to his future children: "I have to pass on to…my next generation, and make sure… we go as deep as…we can in the culture."

Carlos's narrative relates a cultural dance specific to his Indigenous group to Danza. He highlights the connectedness that cultural dance, in general, brings to intergenerational, ancestral, and intergalactic relationships, facilitating a sense of balance that ushers in physical and emotional health and well-being.

> Like the spirit or yourself fills with proudness and happiness…in [name of Mexican province] we danced…[name of local cultural dance]…. Every time we…dance [name of dance]…we shout, we scream…happiness…whenever you dance, you're doing, like, exercise…We have to have like music…we hold proudness. We love ourself…. It's like a healing of us…we just feel the moment…and feel our bodies…. And relating that to health, I feel like that's how our people [have] always done it…. We dance to fulfill ourself spiritually and emotionally, and also to learn…about balance…with Danza, we always start on the left—because that's our heart. We always close the circle. We open the circle too. And we're always connected to the universe and the galaxy and our ancestor[s], and so that's a very deep-rooted thing.

Carlos's narrative speaks to Danza participation as the catalyst that initiated his journey toward peeling back the layers of nationalist, colonially imposed identities. Through sharing songs, dance, stories, and teachings with other people in the UDMC and even within the larger Mexican community, Carlos speaks of his connectedness to his original tribal heritage as a gift he will pass on to his future children.

DISCUSSION

Across all nine participants' narratives, each layer of the DNOH model contained important themes that speak to the multilevel role Danza can play as a Native Hub in risk prevention and health promotion. Within Layer 1 (relationship with self) of the DNOH model were narratives of how participants found

strategies to manage individual spiritual, mental, behavioral, and physical health challenges through their participation in Danza as a Native Hub. Narratives in Layer 2 (relationship with the Danza community) spoke to collective issues of belonging, nurturance, and protection, both within and beyond the Danza circle, as well as community-level health education and outreach—demonstrating the role that the UDMC plays in the health of the larger Latinx, Mexican, and Indigenous communities. Finally, Layer 3 (relationship with Indigeneity) centered on reconnecting with and embracing Indigenous identity as resistance to Indigenous erasure in solidarity with other Indigenous Peoples and within the context of the larger society, through narratives that remind us of the origins of Native Hubs—as connections to ancestral lands, synonymous with connections to Indigenous identities.

Native Hubs are created and transported wherever Danza is practiced. Narratives are used as specific decolonial tools with which participants reconnect, remember, and recreate traditional health practices and beliefs at the individual, communal, and societal levels. For members of the UDMC, Danza participation is making place—a Native Hub away from ancestral homelands. Living in urban spaces as largely diasporic, transnational populations enables them to maintain their land-based ancestral ties through decolonizing oppressive, colonial narratives within Danza as a transportable Native Hub that they can take with them wherever they go. Within this Native Hub, the UDMCs honor their ancestral origins and the lands from which their identities are borne, and they are charged with setting the stage for future generations to thrive.

Beyond demographic differences, each of these nine participants represents a diversity of lived experiences that shape their perceptions within and beyond the Danza circle and enrich the findings of this study. Across unique differences, narrative served overall as a decolonizing mechanism. Participants shared how Danza has created a Native Hub wherein healing and returning to individual and collective Indigenous identity is nurtured. This Native Hub provides a place of healing for body, mind, and spirit, as well as for finding a sense of belonging and community for members of the UDMC, whether U.S.- or Mexican-born, living in the United States far from their ancestral homelands. Furthermore, it is a place where consciousness is raised, stereotypes and racism are challenged, resisted, and debunked, and intergenerational wisdom, healing, and liberation are transmitted (69).

This analysis represents the highly complex, intersectional, and nuanced experiences of nine diverse individuals with a common confluence of lineage and culture, whose resilience speaks volumes to the power of Indigenous people to survive and thrive despite structural oppression created by settler colonialism. The challenges that Danza groups face now are not only the health disparities and inequities that are common to many other marginalized groups in the larger society. Countering the racist stereotypes imposed on their ancestors, as well as contemporary Indigenous communities in Mexico, participants share stories of traditions that their elders had to hide to keep alive. Identifying Native Hubs as protective places that foster distinct pathways for decolonization helps increase understanding of how they can serve as optimal, culturally grounded place/settings-based interventions for preventing health risk behaviors and promoting overall health and well-being. Similar to the findings from the MAI needs assessment parent study that 80% of participants identified AOD as a significant risk factor and 60% perceived HIV to be a heath concern, the sample in the present study spoke more frequently of concerns about AOD than HIV risk. Furthermore, the present study builds upon and deepens the original MAI needs assessment through its development of the DNOH as a general health model which not only encompasses potential for prevention of AOD and HIV risk, but also includes additional protective benefits such as improved mental health, physical activity and nutrition.

Practice, Research, and Policy Implications

An AOD and HIV community needs assessment with a sample of Mexican American Indians found that AOD and HIV are important health concerns and that traditional knowledge, cultural practices, and teachings were instrumental to prevention and intervention (12). Using secondary data analysis, the present study draws from this needs assessment to investigate the role of participation in Danza Mexica as a potential protective factor in generating narratives of prevention and health promotion, framed by a culturally-grounded DNOH model derived from participants' stories.

The findings suggest several implications for practice, research, and policy. First, the results of the analysis point to the need for practitioners working with UDMC (or similar populations) to include questions about client participation in cultural practices in their assessments. Should clients express interest or participate in such practices, practitioners should support client engagement and include such culturally grounded interventions in developing treatment plans. It is crucial that practitioners recognize that "many of the culturally grounded approaches proposed are actually a return to traditional worldviews and practices that were part of everyday life for Indigenous communities and a source of their well-being prior to Western intrusion" [(70), p. 250]. Native Hubs like the UDMC in this sample may also serve as places for community organizing and social movements—which may be included as part of a client's treatment plan, based on that person's priorities and interest.

It is also crucial that health care practitioners strive to remain conscious of the great diversity among Indigenous Peoples, their distinct affiliations, definitions of culture, and proximity to particular identities and practices—important factors unique to each patient that will help shape assessments, treatments, and intervention. The results of this study's analysis are particularly crucial to populations similar to the UDMC. The UDMC is a highly diverse population in terms of language, Indigenous grouping, national origin, immigration status, gender, sexual identities, and lived experience.

Researchers working with populations such as the UDMC should take a similarly supportive, engaged, and collaborative Indigenist approach to their work. This approach is found within the body of critical theories of race, intentionally de-legitimizing

racism in research and promoting liberation through self-determination and empowerment. It is based on three related, foundational principles: resistance as a tool for liberation (i.e., Indigenous resilience and empowerment despite colonization); political integrity (i.e., research by Indigenous scholars); and privileging Indigenous voices (i.e., research with Indigenous participants); (71). Researchers should support Indigenized methods to privilege Indigenous voices that tell stories of resilience despite the multiple, multi-generational forms of structural oppression within which they live.

This study exemplifies the use of such Indigenized methods to uncover opportunities to expand the current literature on culture- and place/settings-based health interventions. Within Danza as a Native Hub, we learn that decolonizing oppressive colonial narratives through reconnecting with ancestral teachings and practices help danzantes learn, internalize, practice, and pass on knowledge and strategies for risk prevention and health promotion at individual, communal, and societal levels. In a sense, by sharing and maintaining these threads of attachment to homeland/Indigenous identity in narratives, identity is kept alive. It can thrive no matter where Indigenous people go. Taking the lead from the participants' use of narratives as a decolonizing tool, this study enhances mainstream understandings of place/settings- and culture-based interventions within public health and other related fields by conceptualizing them as transportable and socially relationally constructed. Although perspectives that emphasize physical presence and contact with such geographically bound definitions of place and land are most commonly recognized in both mainstream (72) and Indigenous literature (73), this current study adds an additional dimensionality that is relevant to increasing diverse, intersectional, and transnational (e.g., urban to rural or national to international) Indigenous populations around the world. Thus, these findings further articulate and add to the extant Indigenous literature to envision the broad possibilities of relational place-making as interventive spaces, much like the Native Hubs of Danza described in this article.

This study also warrants further investigation into understanding what other Native Hubs look like for populations like the UDMC across the world. Such research can inform policy initiatives that recognize the unique and crucial role that culture and place play in addressing Indigenous health disparities and inequities. With ever-increasing urbanization and migration of all peoples across the globe—Indigenous included—it is essential that policymakers recognize the importance of making funding streams available that accommodate the considerable financial resources and time needed to support the development of cultural and place/settings-based, community-based interventions as Native Hubs.

Future Directions

This study illuminates pathways for culturally grounded intervention research development with the UDMC and similar populations. Its findings point to the potential of culturally grounded practices as proactive, primary prevention interventions to address risk for adverse health outcomes before they take root, thereby mitigating the health and fiscal consequences involved in rendering secondary- and tertiary-focused prevention interventions for those already exposed to risk or those who have become ill (74). Taking strengths-based, primary prevention approaches aligns with Indigenous communities' efforts to reduce stigmatizing narratives believed to be primarily reinforced by much of the extant research on risk factors within Native communities. Such culturally grounded interventions counter pathologizing narratives through promoting decolonizing narratives that draw on traditional health knowledge and practices. For participants in the UDMC, these go beyond the physical health benefits of participating in cultural dance to include other benefits that "can build connectedness, model positive social norms, personal wellness, and contribute to other positive outcomes" [(75) p. 2, (76, 77)] and have potential to serve as multilevel, community-level interventions that can positively impact overall community health and well-being in a sustainable way (78). Given the results from this study, in particular, publications highlighting the theoretical and methodological innovations and the substantive findings surrounding Danza as a Native Hub will help build the body of literature in this area for which there has previously been little empirical work.

The findings of this study translate into important future directions for developing prevention research in several ways. First, they shed light on the potential for theoretical development in recognizing Danza as a place to other, similar populations' unique cultural practices as potential, relationally constructed Native Hubs. Such theoretical development could provide a unique and innovative example of how culturally protective activities can be conceptualized as Native Hubs within a relational geography lens that builds on Indigenous principles of relationality and connectedness. Second, applying this study's qualitative, narrative methods approach to other UDMC samples would evaluate the transferability of the DNOH model as a general health model (see **Figure 1**) to other similar urban, transnational and diasporic Indigenous communities to determine its applicability. Furthermore, taking a qualitative and quantitative mixed-methods approach to conduct a longitudinal analysis of the impact of UDMC participation on changes in health attitudes and behaviors would additionally yield more robust data from which to assess its effectiveness among the sample populations. Third, these findings can be used to develop culturally appropriate measures to assess multilevel risk more accurately and protective factors appropriate for this vulnerable population (78). As tools for collecting data from larger samples, such measures could foreground the production of more generalizable findings that can be used to advocate for more funding toward culturally grounded interventions that serve urban, transnational, and diasporic Indigenous communities like the UDMC.

Second, the body of research on epigenetics is growing, particularly surrounding the transmission of intergenerational trauma (79). More work in this area with Indigenous populations could fill a critical gap in health research. Epigenetic and other scientists have also been calling for an increased investigation

of the intergenerational transmission of resilience (79). However, such work should be approached with caution, given both the harmful, exploitative history of genetic (e.g., eugenics) and other health research in Indigenous and other marginalized communities (80) and the potential for policymakers to shift "the responsibility away from societal factors," with awareness "that epigenetics could be used for racist agendas that work against Indigenous health and well-being" (81).

Third, there is also a clear need for greater integration and collaboration among more traditional, cultural practices. Such practices could include the use of *curanderos/as* (82) and/or other Indigenous healers. Furthermore, these practices can be integrated into and/or extend beyond the four walls of Western medical care facilities to therapeutic places and settings that are culturally relevant to marginalized communities, particularly for Indigenous and other communities whose identities and well-being are often intertwined with land and other than human relatives [e.g., plants, animals; (83)]. Practitioners, researchers, and policymakers should advocate for such collaborations and partnerships to build a more holistic, effective, and sustainable approach to care that aligns with the United Nations Permanent Forum on Indigenous Issues recommendations for governmental support of Indigenous health and resource centers (84). This study provides initial evidence that could support pathways toward additional qualitative, mixed-methods, and quantitative research that illuminates the impacts of place/settings-based, culturally grounded evidence on the prevention of health disparities and promotion of health and well-being.

Limitations

This study has three major limitations. First, Mexican American Indians (MAI) is a new U.S. Census subcategory representing a diverse, complex, and intersectional population for which there is limited empirical data (12). Thus, we review health literature among AIAN and Latinx as proxy demographic groups in which MAIs may have previously been categorized before the U.S. Census Bureau developed the MAI subcategory. These bodies of literature comprise great diversity within and across groups. They offer essential available empirical insight at this time as to the status of health among UDMC as a population with potentially similar colonial-based historical and contemporary determinants of health. Furthermore, the extant epidemiological literature reveals considerable similarities in AOD and HIV risk across these groups, highlighting the need for empirical investigation of health risks and protective factors among those who may identify as MAIs.

Second, the transferability of the findings of this study is limited due to the small sample size. However, we aimed to obtain rich, in-depth, qualitative, narrative data that reveals essential, culturally relevant, and meaningful health implications for UDMC. Furthermore, this sample of UDMC comprises participants whose origins come from four specific Indigenous Peoples originating from northern, central, and southern states of Mexico, with a diversity of ages, educational backgrounds, languages spoken, and genders. Although the sample is small, it is diverse in several arenas, strengthening the potential for transferability of findings to other groups of UDMC or similar communities. Furthermore, methodological integrity—a conceptual framework of criteria for trustworthiness in qualitative research—was used to evaluate whether the researcher achieved *fidelity to the subject matter* and *utility in achieving goals* (85, 86). This aligns with culturally appropriate standards of rigor that reinforce Indigenous principles of relational accountability between the researcher and the community who provide their stories as data, reflected in theoretical, methodological, and analytical choices in response to the research question and concerning the participant community.

Finally, although the needs assessment and this specific study analyzed participant narratives associated with AOD and HIV risk and several other areas of health experiences were discussed (e.g., mental health, spiritual health, and nutrition), authors did not evaluate for health outcomes related to these conditions so we cannot provide empirical evidence of the effectiveness of Danza as a prevention or intervention strategy. Rather, the data spoke to participant experiences and perceptions of AOD, HIV and other health risks, which is a first step in identifying promising prevention or intervention approaches. More research is needed to evaluate and measure the impact of Danza Mexica on these health outcomes.

CONCLUSION

This study illuminates how members of the UDMC are creating culturally grounded pathways for health and prevention for current and future generations through engaging in Danza Mexica as a Native Hub. Through innovative use of narrative methods to develop theory, shape methodological approaches, and synthesize stories as data, this study provides a unique opportunity to bear witness to the courage and strength of the UDMC to remember their ancestral pasts, shape their present, and envision their futures. The UDMC's narratives exemplify resilience despite historical and contemporary traumas, adapting to change in order to survive, and maintaining a continuous cultural thread to their past through current ceremonial practices. Indeed, their contemporary narratives *are* an expression of their emerging roots. For the UDMC, the practice of Danza Mexica creates community—a deep ancestral connection lived with ancestors (as both human and homelands) at the moment. Place becomes transportable and expands time and generations. The UDMC, like many complex, intersectional, marginalized communities, are actively defining their healing pathways within their Native Hubs, building on an ancient narrative that speaks to a challenging yet rich past and a rapidly evolving future. Their existence brings space, place, and time together in a way that ensures the health and well-being of future generations.

DATA AVAILABILITY STATEMENT

The raw de-identified data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Washington and University of Denver Internal Review Boards. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

This paper originates from AF's doctoral dissertation. AF developed the research question, conducted the analysis, and wrote the manuscript. RB is the principal investigator of the parent study, and served as a committee member for AF's dissertation. RB provided guidance, feedback, and edits to AF throughout the design, analysis, and writing of the article. All authors contributed to the article and approved the submitted version.

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METHODS
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Development of an American Indian Diabetes Education Cultural Supplement: A Qualitative Approach

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Objective: The purpose of this study was to culturally enhance a diabetes education program for Diné (Navajo) community members with Type 2 diabetes. Though the recommendation to culturally adapt health education curricula was meant to improve health education for American Indians and Alaskan Natives (AIANs), it has inadvertently created a "one size fits all" approach. This approach does not properly address the need for tribe-specific cultural health messaging, defined as incorporating cultural elements deemed relevant to the population. Tribe-specific health information and programming, such as integrating Diné worldviews and Indigenous knowledge among Diné people as described here, are essential to creating a culturally relevant and effective and meaningful approach to disease self-management.

Methods: A conversation guide, based on the Hózhó Resilience Model—a Diné framework on healthy living, was used to engage key cultural experts in interviews about traditional stories and teachings regarding health and wellness. Three specific self-care behaviors relevant to Type 2 diabetes self-management were discussed: (1) healthy eating, (2) physical activity, and (3) healthy coping. Interviews were audio-recorded, transcribed and analyzed using a qualitative thematic analysis method.

Results: Diné healers and cultural experts informed the development of an educational tool called Diné Health. Key themes that emerged from the data included the importance of discipline, positivity and mindfulness in the context of Hózhó.

Conclusion: Culturally safe and meaningful engagement with cultural leaders and the use of qualitative research methods can inform deep-level cultural adaptations essential to developing tribe-specific diabetes education programs. The approaches used here can guide the development, implementation, and testing of culturally-informed health education for AIAN populations.

Keywords: Indigenous knowledge, diabetes, CBPR, American Indians and Alaskan Native, health education, diabetes management, cultural adaptation

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INTRODUCTION

Although diabetes prevention and control efforts have increased in American Indian and Alaskan Native (AIAN) communities, AIAN people continue to experience disproportionality higher rates of diabetes-related morbidity and mortality (1). Diabetes is the fourth leading cause of death for the Navajo Nation (2), and is the seventh leading cause of death for the United States in general (US). The age-adjusted diabetes mortality rate for the Diné (Navajo) population is more than double (2.29 times higher) the US population rate (3). Poor glucose management may lead to diabetes complications and premature death, including vision loss, kidney failure, heart disease, limb amputation, and death (3–5). Promising approaches to diabetes management include nationally recognized guidance for self-care, medication management, diabetes education, regular check-ups, and ongoing support (6). The purpose of this study was to culturally adapt a standard diabetes education program originally designed to broadly address DM education needs for AIAN populations collectively. This cultural adapted program is designed specifically for Diné community members diagnosed with type 2 diabetes.

Cultural adaptation has been defined broadly as a modification of an evidence-based intervention by changing the curriculum's language and context in such a way that it is compatible with the client's cultural patterns, meanings, and values (7). To some, cultural adaptation is achieved by making surface-level adaptation such as changing the visual content or by adding AIAN created artwork (8). Deep-level cultural adaptation, on the other hand, has deeper levels of meaningfulness and includes adapting the language, metaphors, content, concepts, goals, methods, and framework to meet the needs of Indigenous communities (8). To optimize the impact of diabetes education for AIAN populations, deep-level cultural adaptations must be considered (9).

In 1997, in an effort to provide culturally competent health programs, Congress established the Special Diabetes Program for Indians (SDPI) to treat and prevent diabetes in AIAN communities (10). Currently 404 Indian Health Service (IHS), tribal and urban Indian health programs across the US receive SDPI funding (10). SDPI grantees recognize that culture and health are intertwined and inseparable concepts. They propose culturally adapted interventions are more acceptable, better understood, and more effective (11). For example, SDPI interventions that include AIAN language, traditional food demonstrations, and cultural activities (11) have demonstrated reduction in diabetes complications such as amputations and kidney failure (10, 12).

Despite well-intentioned efforts to culturally adapt and tailor health education curricula, diabetes programs have inadvertently created a "one size fits all" adaptation approach to health education programs (13) that is commonly used to prevent and manage diabetes among AIAN communities (14). Emergent research, however, suggests that AIAN community members prefer tailored and culturally adapted diabetes education programs that reflect their own cultures. The Native American Diabetes Project (NADP) conducted a participant satisfaction questionnaire regarding cultural competency with eight tribal communities (15). Results revealed that community input in co-developing the diabetes education sessions was an important factor in participant satisfaction and retention in the diabetes education series (15). Griffin et al. (15) highlighted that storytelling, a traditional communication strategy, was recommended by participants as a way to communicate information and provide diabetes education (15). Moreover, participants suggested that more culturally specific components, such as traditional foods, teachings and games could enhance participant satisfaction with educational sessions (15). Roubideaux found that 95% of participants preferred diabetes education materials relevant to their specific tribe or culture (16).

Several studies have shown a high prevalence (16.5%) of diabetes among the Diné (17) and 22.9% for adults (18) and an incidence rate of 2.78 per 1,000 for youth (19). Studies implicate the need for effective culturally relevant education for the Diné (20, 21) however, none of the prior diabetes prevention projects included tailored, deep-level, tribe-specific health information or cultural enhancement of diabetes education that were designed specifically for Diné communities. Efforts to apply surface-level cultural adaptations to the standard AIAN diabetes education curriculum may further perpetuate high program drop-out and may have limited effectiveness in promoting optimal diabetes self-management or glucose control in Diné communities. The purpose of this research was to use a community-based participatory research (CBPR) approach to engage Diné cultural experts and healers, to gain insights about cultural world views and Indigenous knowledge for the purpose of adapting an evidence-based diabetes management intervention for Diné adults diagnosed with Type 2 diabetes.

METHODS

Research Design

This study used a CBPR approach (22) to engage qualitative research methods and guide the collaborative production of a cultural tool, herein called Diné Health (DH), to be used in diabetes education classes in a Diné community. The lead author, a Diné researcher, met with members of the Diabetes Program a year prior to seeking approval from University and Tribal institutional review boards before engaging in the study. The director of the program helped obtained letters of support for the study from relevant tribal leaders and organization and also co-presented at meetings such as the Navajo Nation Human Research Review Board (NNHRRB) meeting to inform key tribal stakeholders about the study aims and objectives. The lead author applied Indigenous health research practices and Diné values of k'é (i.e., personal conduct, traditional etiquette to establish kinship) to establish respect and build positive relationships with Diné leaders and community members (23, 24). The NNHRRB and the University of Arizona Institutional Review Board approved this study in August 2018. The data and findings from this study belong to the Navajo Nation.

TABLE 1 | Community partnerships and roles in the Diné Health (DH) study.

Members	Role(s)
Diabetes Program	• Program director helped gain approval for study • Review DH drafts and materials monthly or as needed • Received training on DH • Implement DH into diabetes education classes
Community Advisory Board	• Attend CAB meetings and/or provide feedback via email • Reviewed transcript excerpts from key informant interviews • Approved cultural teachings and messages to be included in the DH
Diné Health Working Group	• Reviewed transcript excerpts from key informant interviews • Selected approved cultural messages to be included in DH classes • Reviewed DH drafts

TABLE 2 | Hózhó Resilience Model domains and attributes.

Domains	Attributes
Harmony (External factors)	Thinking–Remain positive in thought by practicing mindfulness
Respect (Internal factors)	Discipline–Remain respectful in all actions by having self-discipline
Spirituality (Existential factors)	Spirituality–Remain positive and harmonious through prayer

Community Engagement

The lead author collaborated with community partners to protect and properly apply only approved aspects of sacred Indigenous knowledge of the Diné (**Table 1**). When working with AIAN communities, it is important to recognize the aspects of protected and private cultural and traditional knowledge. Seeking consultation from cultural experts provides the opportunity to ensure that the research approach is ethical, culturally sensitive and does not disrespect, exploit or misinterpret cultural or traditional worldviews. It is also important to maintain the privacy of the more sacred traditional and cultural knowledge such as traditional stories or ceremonial knowledge which may be restricted to be known only by traditional healers. Some AIAN communities prohibit the recording of traditional knowledge so, it is important to seek the advice of cultural experts to safeguard the interpretation of research findings and to ensure the research approach is acceptable and respectful. Establishing good rapport, including reciprocal learning between researcher and partner, with the diabetes program before the study began was an important first step in this study and in line with CBPR approach (22, 25). The purpose of the initial meeting (held in January of 2018) with the Diabetes Program director was to determine whether the program would like to collaborate in a research study. The program expressed a concern that there was minimal Diné culture in their existing diabetes education classes and only one AIAN health educator who offered classes in the Diné language one time per month. At the time of this study implementation, the diabetes program was in the process of curriculum development. Therefore, the curriculum adaptation proposed in this study presented an opportunity to contribute to the development of a meaningful and sustainable product for the diabetes program.

The lead author purposefully sought guidance and consultation from a Community Advisory Board (CAB) established to support the current programming efforts. The CAB members included community and organizational representatives selected by the community for their professional, cultural and local knowledge. Inclusion criteria for the CAB were: must be an (18 years of age or older), must be a member of the Diné Nation, must possess expertise in Diné culture or Diné health, and Diné ceremony/healing. The CAB served to ensure that the research study respected the Diné people and culture. Lastly, a working group was established to lend expertise and experience in curriculum development. The working group consisted of three diabetes educators from the program and the lead author and met 5 times over 6 months.

Theoretical Framework

This study used the Hózhó Resilience Model (HRM) (26) as a framework to guide this study. The HRM is based on the Diné Philosophy of Hózhó—the ultimate state of health and wellness (27). Hózhó provides specific rules for a Diné person's behavior and emphasizes order, balance, and harmony in everyday life (26). The importance of order is reflected in a constant mindfulness and reverence with every thought, every word, and every step made in the journey of life (28). The concepts of balance and harmony are parallel to the notion of holistic health which emphasizes that there is a connection between the mind, body and spirit of an individual (23, 24, 29). For the Diné, there is an additional relationship with living elements i.e., water, air, earth and the cosmos (28). This relationship with the elements is driven by respect, specifically respect for plants, animals, and water. For this study, we used the HRM domains and attributes (**Table 2**) to identify key cultural concepts of the Diné health protective traditional teachings that can influence the self-care behaviors of our DH participants.

Balance Your Life With Diabetes Curriculum

The Balance Your Life with Diabetes (BYLD) (11) curriculum focuses on Type 2 diabetes and self-care and is the standard curriculum used in diabetes programs across Indian Country, including the program in this study (10). The BYLD curriculum was culturally adapted by the IHS Division of Diabetes Treatment and Prevention program. The IHS encourages programs to adapt their program's BYLD curriculum to reflect their participants culture, e.g., traditional food recipes, language, activities and traditional teachings (11). In some cases, however, program staff may not be familiar with the community's culture and therefore have difficulty offering tribe-specific adaptations to the BYLD. To close this gap in knowledge, the study investigators partnered with a diabetes program with a goal to adapt their BYLD curriculum by adding Diné-specific, meaningful and relevant cultural teachings to the BYLD lessons: healthy eating, being active, and healthy coping (**Table 3**).

TABLE 3 | Balance your life with diabetes (BYLD) and Diné Health (DH) supplemental curriculum content.

BYLD curriculum[a]	**DH supplemental curriculum[b]**
Lesson: Healthy Eating Knowledge • Effect of foods/beverages on metabolic parameters (including blood glucose, lipids, blood pressure, weight, etc) • Sources and distribution of nutrients (nutrient-dense carbohydrates, lean proteins, healthy fats) • Eating patterns (frequency of meals, timing, portions, etc) • Resources to assist in food • choices • • Macronutrient composition (quality, quantity, combination, substitutions) Skills • Meal planning • Portion awareness and management • Planning strategies (Carb Counting, Exchanges, Plate Method, Mindful Eating) • Nutrition Facts Label comprehension • Special situations and problem solving (planning, shopping, meal delivery/kits, eating away from home at work/school/ restaurants) Barriers • Environmental factors • Cultural and family influences • Food and health beliefs • Financial (food security) • Cognitive • Health literacy and numeracy • Emotional • Meal pattern sustainability	Supplemental Topic: Diné Food Practices Health Message(s) • T'óó bikiinígo (translation- eating for sustenance and nourishment) • Practicing portion control through self-discipline and mindfulness PowerPoint Presentation • Audio Recording: Practicing mindfulness during food preparation, cooking, serving and eating Supplemental Material(s) • DH Mindfulness Worksheet • DH Homemade Food and Meal Preparation Worksheet
Lesson: Being Active Knowledge • Planned exercise (type, duration, intensity, frequency, progression) • Daily movement • Breaking up sedentary time • Safety precautions, such as obtaining preparticipation medical clearance and/or exercise stress testing prior to unaccustomed vigorous activity • Special considerations, such as appropriate footwear Skills • Appropriate daily movement and physical activity plan • Adjustment of activity with food and medication to maintain glycemic balance • Monitoring of cardiometabolic parameters, data stream, and feedback Barriers • Physical (health conditions, injuries) • Perceived lack of time • Environment, facilities • Fear (hypoglycemia) • Self-efficacy • Lack of enjoyment • Lack of social support	Supplemental Topic: Establishing Self-discipline Health Message(s) • Diné teachings on having strong self-discipline in daily activities that foster good health physically and mentally PowerPoint Presentation • Audio Recording: T'aa hwo ajiteego (translation - be self-reliant and proactive) in your health Supplemental Material(s) • DH Discipline Worksheet • DH Daily Routines Worksheet
Lesson: Healthy Coping Knowledge • Internal and external motivators • Benefits of solution-focused problem solving • Active self-management • Value of nurturing support system (peers, online, family, friends) • Individual empowerment • Role as partner with other members of health care team Skills • Goal setting • Problem solving • Coping strategies • Self-efficacy Barriers • Physical	Supplemental Topic: Positive Thinking Health Message(s) • Diné teachings on carrying oneself in a mindful, respectful and positive manner in all aspects of life, especially through one's actions and thoughts PowerPoint Presentation • Audio Recording: Holistic Health and Są'áh Naagháí Bik'eh Hózhóo (Living a long healthy life) Supplemental Material(s) • DH Goal Setting Worksheet

(Continued)

TABLE 3 | Continued

BYLD curriculum[a]	DH supplemental curriculum[b]
• Financial • Emotional • Competing priorities • Lack of support network • Psychosocial distress including diabetes distress • Cognitive including mental health disorders	

[a] *Diabetes Self-Management Education and Support (DSMES) Core Outcome Measures (6).*
[b] *Diné-specific cultural teachings/topics added to the BYLD Group Classes.*

Cultural Expert Participation Selection and Interviews

Through a purposive sampling strategy, the lead author worked with leadership of a Diné healer association to identify well-respected healers and cultural experts who hold firsthand knowledge about the Diné traditional teachings and culture. The interview participants included five (n = 5) tribal members that spoke Diné and English, were distinguished healers within their respective communities and each resided on the Navajo Nation. The interviews were 60–90 min long and were conducted in a location most convenient to the healer, either at a central location or the healer's home. Data from the interviews guided the development of a tailored, tribe-specific educational tool for diabetes education—herein called Diné Health (DH). Each participant was provided a copy of the DH at the completion of the study. All participants provided informed consent and received an incentive to cover direct and indirect costs associated with participation in the study.

Interviews

Five in-depth interviews were conducted to elicit cultural health messages from the aforementioned Diné cultural experts. With consultation from a Diné researcher, the lead author developed a structured conversation guide (eight questions) to gather culturally grounded health messages regarding Hózhó. The questions asked about three diabetes self-management and education (DSME) self-care behaviors: (1) healthy eating, (2) physical activity and (3) healthy coping (6). Four questions focused on traditional food ways, self-discipline and mindfulness, e.g., "Based on Hózhó, what stories and teachings do you know about traditional food ways?" Two questions asked about physical activity and self-discipline, e.g., "Based on Hózhó, what stories and teachings do you know about being disciplined in physical activity?" The last two questions were asked about the importance of positive thinking and health, e.g., "Based on Hózhó, what stories and teachings do you know about thinking positively? As Diné, how do we show our respect to food and our health?" The CAB and diabetes working group reviewed the questions. The interviewer—a trained community researcher—is Diné who speaks, writes and understands the Diné language. Data from the interviews were audio recorded, transcribed verbatim and analyzed using a qualitative thematic analysis method.

TABLE 4 | Themes from key informant interviews.

Themes	Patterns
Relationship with food, family and culture	• Traditional food connects the Diné people to Mother Earth • T'óó bikiinígo (eat for sustenance and nourishment) • Diné custom to cook for all relatives • Having good thoughts while cooking ceremonial food
Self-discipline is needed for good health	• Engaging in physical activity shows self-discipline and strength • T'aa hwo ajiteego (being self-reliant and proactive) • Laziness is considered taboo in the Diné culture
Positive thinking is connected to health	• Thoughts can affect one's health • Belief in a holistic connection of Diné people's mind, body, spirit to Mother Earth and all living things • Mindfulness is needed in all aspects of life

Analysis

The lead author translated and transcribed audio recordings from Diné to English. To ensure accuracy and context, a consultant, who is Diné and holds cultural and linguistic knowledge, reviewed each of the transcripts. Although time-intensive, this process ensured complete and accurate transcripts. The lead author conducted deductive thematic analysis (30), driven by the researcher's theoretical interest in the context of the HRM and DSME. The aforementioned HRM domains served as the theme categories: harmony, respect and spirituality. The lead author read all transcripts independently while highlighting repetitive words and phrases which were coded as patterns. As a secondary step to review cultural alignment and interpretation and application of the HRM attributes in the DH, the lead study author also reviewed themes with the HRM developer. A thematic matrix was developed in Excel to organize and compare the themes and patterns from each transcript. This process helped the lead author identify common emergent themes and patterns. Once saturation -no new data—was reached, the lead author entered quotes into the Excel matrix. The themes identified in this by responses provided by the Diné cultural experts and healers were used to inform and guide the development of the DH (see **Table 4**).

RESULTS

Four Diné male healers and one female cultural expert were interviewed for a total of five cultural expert and/or healer

participants. Four participants were Diné healers knowledgeable about cultural teachings. One participant did not identify as a healer but was affiliated with the healer association as a cultural expert. Key themes from the data included the importance of the concepts and behaviors of discipline, positivity, and mindfulness—each attribute of Hózhó as outlined in the HRM, which were identified to be important aspects of wellness behaviors. When asked about health, participants discussed traditional Diné teachings and cultural activities that promote holistic health.

Participants also spoke about the importance and fundamental teachings of living in Hózhó, the ultimate state of health and wellness for the Diné. One healer explained, "As Diné we have a purpose for everything we do, so…we should think about what we put in our bodies and how we treat our bodies. How we think about things is important when we talk about Hózhó."

Another healer said,

> Hózhó means more than harmony, it is our whole life. We, the Diné, know what it means to live life in a good way. We've been instructed by our Holy People how to accomplish this…it requires a lot of hard work and discipline. It means to be healthy, happy, humble and be in harmony or balance with everything we encounter.

Three reoccurring culturally informed health promotion and self-management themes arose from the transcripts and were used to guide the development of DH:

Theme 1: *T'óó bikiiníigo* (translation—eating just enough). Some messages were central to healthy eating, e.g., being mindful of portion sizes is important to prevent overindulgence and wastefulness. Overindulgence is not the traditional way of eating for the Diné. One healer said,

> *T'óó bikiiníigo* (translation—I eat just enough to get by, not too much). We eat food when we are hungry, not when we are craving something. We shouldn't eat too much, we should eat just enough to sustain our bodies.

Wasting traditional food is disrespectful to the Diné people, it shows poor values. A healer explained,

> Ceremonial food should not be wasted, doing so is considered disrespectful to the plants, the Earth and to our mother, Changing Woman, [a holy deity]. She [Changing Woman] put food here [on Earth] for us, her children. She left us teachings to live life in a respectful way, not to do things without having a purpose.

Further, participants discussed key practices around food preparation were discussed (e.g., praying and having good thoughts while cooking). "Eating food that has been made by the fire in a hogan is the best medicine, because homemade chiyaan (food) is made with prayer and good thoughts…so when you eat it, you should feel better," said a Diné healer.

Theme 2: *T'aa hwo ajiteego*. (Translation—It is up to you to accomplish things in your life, no one is going to do it for you). For the Diné people, self-discipline is needed in every aspect of life from dawn to dusk (28). One strict disciplinary teaching is to offer a morning prayer and run in the east direction. The Diné believe that when a person adheres to this teaching, the individual will be blessed with a good life, including good health and wellness. A Diné healer said,

> If you are disciplined, you won't be lazy. This is *t'aa hwo ajiteego.* If you put your mind to something, you have to do it, it is up to you. We must have this type of mindset to have good things in life. This is the teaching of Hózhó.

All participants emphasized that this teaching is essential to living in Hózhó; self-discipline is needed to establish good physical, mental, and spiritual health.

Theme 3: Role of mindfulness is fundamental to health and wellbeing in the Diné culture. The Diné are told to have strong respect of the self through discipline and mindfulness (28). For the Diné, mindfulness means that all actions must have a purpose. They believe that the Holy People are watching over them, therefore they must carry themselves in a mindful, positive and respectful manner. Negative thoughts and behaviors are strongly discouraged. Doing so brings disharmony and imbalance. A healer explained,

> Ada *akooznizin'go nijigha* (translation—be mindful, have self–awareness and respect). Our people [the Diné] believe that a disciplined and positive mind keeps individuals from inviting *Téí'i'i* (translation—poverty) into their lives. It [positive thinking] shields us from the negative things in life, it is our protection. Having this kind of mindset is Hózhó, so I encourage people to keep striving and you will get there.

Healers also explained the Diné belief in the holistic connection of the mind, body, spirit to Mother Earth and all living things i.e., plants, animals, the elements.

Program Adaptation

The DH working group met four times to review the findings from the study (**Table 3**) and helped select key health messages to be included in the diabetes education class. The lead author developed four DH worksheets based on the group's selections. The DH worksheets were used as in-class handouts to supplement the BYLD PowerPoint, with the goal of adding more discussion around Diné culture and resilience to the BYLD. The CAB approved all DH materials with minor edits, e.g., Diné spelling and grammar.

The lead author provided a 1-day training on the DH supplemental curriculum for the Diabetes Program staff. This training took place 1 month prior to the implementation of the DH. The lead author attended the first few classes to observe and take notes on the implementation of the DH. The lead author used an observational checklist to identify the limits of the DH. Based on the lead author's notes and feedback from the health educators, several gaps to the DH were identified, such as the difficulty of reading the content written in the Diné language and the need for more cultural context behind the health messages. The lead author audio recorded all words, phrases and health messages written in the Diné language. The audio

clips were embedded into the PowerPoint presentations. Sample Diné phrases that were audio recorded include: (1) *T'óó bikiinígo*, meaning to eat just enough to live and not to overindulge in food consumption and (2) *T'aa hwo ajiteego*, meaning a person must rely on their own will and determination to achieve their goals. The DH was developed with the goal of utilizing culturally grounded teachings to teach patients with diabetes about diabetes self-care and management, thus enhancing the cultural relevancy of the current programming.

DISCUSSION

A key strategy to increasing diabetes education attendance and retention rates for AIANs is to implement culturally grounded, tribe-specific curriculums into community-based health programs (10). The main findings of this study include (1) CBPR approaches are feasible to inform development and adaptation of health programs in AIAN communities and (2) Indigenous health research practices and qualitative methods can be applied to strengthen existing curriculum, as in this case, in the form of the DH supplemental curriculum.

Researchers used CBPR to ensure that the results of the study can be used for action and sustained by the community (22, 25). In this study, several steps were essential to ensure that the Diabetes Program could implement and sustain the DH. First, the lead author established a relationship with the program before writing the study proposal. Establishing a reciprocal relationship with the community early in research is important in CBPR, especially in tribal communities. The diabetes program staff took initiative in all phases of the study by writing letters of support, attending leadership meetings, helping obtain IRB approvals from the university and tribe and co-developing the curriculum. Second, the lead author applied Indigenous health research practices and Diné values of k'é (i.e., personal conduct and kinship) to establish respect and build positive relationships with Diné leaders and community members (23, 24). Second, in addition to the program's contribution in the curriculum development, other key stakeholders, such as cultural experts and healers were actively involved. The integration of the Diné healers' and cultural expert's Indigenous knowledge certified and validated the cultural rigor that was used to inform the adapted DH content. This process used in the development of the DH supplement curriculum exemplifies consideration and respect for the integration and inclusion of Indigenous knowledge for the purpose of gathering information in a culturally appropriate and meaningful way (31).

Utilizing a qualitative approach to develop and inform a cultural curriculum is important for identifying health-protective and strength-based wisdom in AIAN communities. A qualitative voice enriches the curriculum and adds depth, richness, and meaning to the educational content. The Native American Diabetes Project (NADP) also used a qualitative approach to design culturally relevant education materials. In the NAPD, the community was an integral part of the project; they participated in the interviews, focus groups and community advisory board (32). A unique feature of our study was the rich cultural context and experience tribal scholars brought to the table. The Diné cultural experts' and lead author's cultural knowledge were imperative to understanding the depth and strength of the health messages. The qualitative approaches used in this study can guide the development and implementation of culturally-based, tribe-specific health education model tailored for AIAN populations, which can then be implemented for the Diné individuals diagnosed and living with diabetes. Outcomes of culturally informed and adapted health promotion programs should be studied further for outcomes and effectiveness within each tribal community that receives an adapted curriculum.

The study has a few limitations. First, there were only a handful of key informant interviews conducted due to time constraints and competing commitments such as work, expectations of both professional careers, and/or commitments to patient appointments for healing ceremonies. Despite the recruitment of five participants ($n = 5$), however, data saturation was achieved. Second, only one female participated in the key informant interviews. The Diné people are a matrilineal culture, therefore more insight from female healers could add to the curriculum, especially in regard to traditional food ways and healthy eating. Third, the community partners were not initially involved in the analysis of data, due to the training required to analyze qualitative data. In the hopes of mediating this limitation, the CAB and DH (many with expert cultural knowledge) working groups played vital roles in identifying culturally appropriate health messages for the curriculum.

A significant strength in this project was how the collective wealth and richness of authentic cultural knowledge shared by healers, CAB members and the diabetes program team members contributed to the study. Their willingness to share, learn and collaborate with the lead author on this study required additional work and time, but their dedication to properly honoring Indigenous health research was integral to developing a culturally grounded curriculum. This study could be used to guide the development and implementation of other culturally-based and tribe-specific health interventions for AIAN populations. Most important, the robustly tailored program will need to be tested to determine the impact on program enrollment, engagement, recidivism, and clinically relevant health outcomes such as diabetes self-management and glucose control. Lastly, the DH is not meant to serve as an independent diabetes curriculum, it is a supplemental curriculum that should be used in conjunction with a standard diabetes education curriculum specifically for the Diné people. The CAB members felt strongly about keeping and integrating the DH supplement in the existing DM program because it added authenticity and meaningfulness that countered the existing predominantly western based or mainstream diabetes education program.

CONCLUSION

Culturally safe and meaningful engagement with cultural leaders, along with the use of qualitative research methods can inform deep-level cultural adaptations essential to developing robust diabetes education programs at the individual tribe level. Such work can illuminate cultural relevance and may be important in identifying culturally related factors that influence engagement

and completion as well as health outcomes for participants in AIAN diabetes education programs. We recommend qualitative CBPR approaches and Indigenous research practices used here to guide the development and implementation of culturally tailored tribe-specific educational model that has been informed by the Diné cultural teachings.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the data belongs to the Navajo Nation, according to the Navajo Research Act and longstanding IRB policy.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Navajo Nation Human Research Review Board. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JW wrote the manuscript and made revisions to manuscript as part of her dissertation. CT, MK-J and SS provided comments on drafts and helped with final edits. All authors contributed to the article and approved the submitted version.

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Azhe'é Bidziil (Strong Fathers): Study Protocol for the Pilot Evaluation of an American Indian Fatherhood Program to Improve the Health and Wellbeing of Diné (Navajo) Fathers

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Introduction: Considering the critical role that American Indian and Alaska Native (Native) men play in family and child health, there is an urgent need to collaborate with Native communities in developing interventions and policies to improve Native men's health status. This study aims to address a significant gap in research by designing and implementing a culturally grounded health promotion program to increase economic stability, promote positive parenting, and build healthy relationships among Native fathers. The Azhe'é Bidziil ("Strong Fathers") study protocol, developed in response to community advisory board feedback, illustrates a community-engaged approach to developing and implementing a fatherhood program in two Diné (Navajo) communities.

Methods/Analysis: Azhe'é Bidziil was adapted from three evidence-based interventions developed in collaboration with Native communities. Intervention lessons were iteratively reviewed by a tribal working group to ensure that the content is culturally appropriate and relevant. A pre-post study will assess feasibility, acceptability, and satisfaction with the Azhe'é Bidziil intervention, as well as short-term impacts on positive parenting, economic stability, and healthy relationship outcomes. The intervention is composed of 12 weekly group sessions conducted with fathers ($n = 750$) that focus on developing knowledge and skills for positive father involvement, economic stability, and healthy relationships. Lesson content includes: honoring our roles as fathers, building healthy relationships, understanding the impact of historical trauma, goal-setting, and budgeting basics. Each of the 12 group lessons, consisting of 8–12 participants per group, last approximately 2 h. Eligible fathers or father figures are age $\geq$18 years, live within 50 miles of the participating Diné communities, and must be caregivers of at least one child $\leq$24 years. The outcomes for this study are acceptability, feasibility, and satisfaction with the intervention, as well as father involvement, quality of (co-) parenting communication, healthy relationships, fathers' engagement and communication with their children, protective factors (e.g., cultural connectedness and educational/career

aspirations), and economic empowerment and stability. Participants will complete an outcome assessment at pre- and post-intervention (12 weeks later).

Discussion: This study protocol presents one of the few evaluations of a fatherhood intervention to increase economic stability, promote positive parenting, and build healthy relationships among Native fathers in rural tribal communities. Such a study is sorely needed to address the health disparities perpetuated by social and Indigenous determinants of health that Native men experience today. If proven efficacious, this pre- post-study will inform a large scale randomized controlled trial to evaluate intervention impact, and if proven efficacious may be disseminated widely in tribal nations. Study findings may also deepen our understanding of peer mentoring, Native men's health status, involvement with their children, co-parenting relationships, family relationships, cultural connectedness, and economic status. The data collected may also inform strategies to ensure acceptability, feasibility, and satisfaction of an intervention designed specifically for Native fathers.

Keywords: fathers, fatherhood, American Indian, Indigenous, intervention, Native

INTRODUCTION

American Indian and Alaska Native (AIAN, Native) societies have been at the forefront of resistance against decades of land theft, colonization, and attempts at assimilation since time immemorial (1, 2). It is imperative to understand Native history, specifically the strength and health of Native men, as it stands in stark contrast to the health disparities that AIAN men face today. Native men have some of the highest rates of chronic diseases including diabetes (3), chronic liver disease (4), cardiovascular disease (5), and excessively high death rates for prostate, liver, and colon cancers (6). Despite projected national gains in life expectancy over the next few decades, Native men still have a disproportionately higher mortality rate compared to non-Hispanic white men (7) and are expected to live 6.6 years less than Hispanic/Latino men and 4.4 years less than non-Hispanic White men (8).

Many of the health disparities experienced by Native men today can be attributed to structural and social determinants of health that affect Native communities. Structural and social determinants of health are environmental conditions "where people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks" (9). Inequities in social determinants of health have been linked to poorer health outcomes and premature mortality across racial and ethnic groups (7, 10). Examples of these structural and social determinants of health include: safe housing and roads; access to healthy food; experiences with racism; access to quality education, job opportunities, and income (9). Native peoples experience disparities across these varying structural and social determinants of health, including high rates of unemployment (11) which is over 40% in some tribal communities (12), and over twice the poverty rate of non-Hispanic Whites (NHW) (11). Native people are less likely to attain a bachelor's degree than the general US population (21 vs. 37%) (11) and are often born into single-headed households (13). In 2019, over half (52%) of Native children were living with one parent (13) and in 2019, nearly 70% of Native babies were born to unmarried women (14).

Native men's health status has also been uniquely impacted by Indigenous determinants of health, which extend beyond the social and structural determinants described (15). These determinants, which are all influenced by colonialism, include historical trauma, federal assimilation policies, and racism, as well as protective factors such as cultural teachings, connection to land, sovereignty, language, and spirituality (15). For example, forced relocation of AIAN children into boarding schools disrupted Native parenting practices, cultural connectedness, kinship networks, and traditional language learning (16–19). This disruption to Native livelihood has manifested through the generations as substance abuse, domestic violence, mental health disorders, suicide, and poverty (16, 17). Assimilation policies were especially devastating for Native men as the forced removal of Native boys from their positive male role models disrupted intergenerational warrior teachings (20). Thus, scholars cite these policies as major contributing factors to the high rates of substance use (16, 18, 19, 21), parental absence (22), poverty (19, 23), accidents, suicide, violent victimization (5), and incarceration experienced by Native men today (24, 25).

With an enrolled population of approximately 399,500, the Navajo Nation is the largest tribe in the country (26). The Navajo Nation is also the largest AIAN land base in the United States, covering 27,425 miles of rural land in New Mexico, Arizona and Utah (27). Diné (Navajo) men experience the same health disparities and inequities in aforementioned structural and social determinants of health as AIAN men across the US. From 2006 to 2009, Diné men residing on the Nation had a slightly higher age-adjusted mortality rate than US White males in 2009 (876.7 vs. 875.9, respectively) (28, 29). For this same time period, the top 5 causes of Diné male mortality

were largely preventable conditions and included: unintentional injury, diabetes, suicide, alcohol dependence syndrome, and assault (29).

The Johns Hopkins Center for American Indian Health (JHU; "the Center") and the Navajo Nation have a 30-year community-academic partnership that addresses health disparities across the life span. Over the decades long partnership, the Center had implemented various family and child health interventions but had yet to implement one specifically targeting Native fathers. Community advisory boards, composed of organizational partners, health providers, traditional healers, and community members, voiced the need for a fatherhood empowerment intervention to holistically address family and community health. The formative work for the current protocol began as early as 2010 when a small ($N = 87$) descriptive study looking at fatherhood roles and substance use also identified risk factors to target for a future fatherhood intervention, including high unemployment status and low involvement in childcare (18). Recently, female youth participants in another study reinforced the supportive role that fathers and male relatives served during their rite of passage cultural events (30). Overall, with preliminary data and strong community support, the Navajo Nation's longstanding partnership with the Center provided a strong foundation to develop and pilot a fatherhood health intervention.

Considering the critical role that Native men play in family and child health, there is an urgent need to collaborate with tribal communities in identifying programs and policies to improve Native men's health status and increasing family involvement. Fatherhood involvement has a positive relationship with early childhood development (1) and has been shown to positively impact children's social and emotional health, as well as academic success during critical developmental years (31–34). This positive impact is especially pronounced for lower income children and for those who lack access to high quality educational systems, including Native youth (35–37). This finding is particularly relevant since Native children experience poverty and school dropout rates at higher rates than other racial and ethnic groups, as previously described. Recent studies have also demonstrated the positive impact of fatherhood involvement on child development at all stages (37) child academic performance (38) and overall child wellbeing (39).

Despite growing research on the benefits of fatherhood involvement and child development, there is a paucity of literature on research specific to fatherhood programming and its impact on the health status of Native men (39–41). Native culture has always known that community health is the sum of its parts, which includes healthy fathers and strong societies (20). Furthermore, it is critical to acknowledge how settler colonization of the Americas have impacted Indigenous masculinity and how this has led to toxic and unhealthy coping mechanisms. This study is an opportunity to engage Native fathers in leveraging their strengths to improve their parenting, economic stability, relationships and, by extension, their overall health status and that of their children. Ultimately this intervention is designed to support Native fathers in the restoration and strengthening of Native societies and the sacred bond between them and their children.

The social, structural, and Indigenous determinants of health affecting Native men and fatherhood serve as a conceptual framework for this study, which aims to: address the aforementioned gap in research by developing and implementing a culturally grounded health intervention to increase economic stability, promote positive parenting, and build healthy relationships among Native fathers. The program is called Azhe'é Bidziil ("Strong Fathers") and this study protocol illustrates a community-engaged approach to developing and implementing a fatherhood intervention with fathers in two Diné tribal communities. This study is also a direct result of a 30-year community-academic partnership between JHU and the Navajo Nation. Azhe'é Bidziil capitalizes on lessons learned from our family and child interventions, as well as best practices cited in the literature and a community-engaged approach to curriculum development (18, 39).

Study aims are to: 1) to assess the acceptability, feasibility, and satisfaction of Azhe'é Bidziil program among participating fathers; and 2) assess through a pre- post-study design the preliminary impact of the Azhe'é Bidziil program on father involvement, quality of (co-)parenting communication, healthy relationships, fathers' engagement and communication with their children, protective factors (i.e., cultural connectedness and educational/career aspirations), and economic empowerment and stability. The long-term goal of this study is to decrease the number of rural Native families living in poverty, increase the economic stability of Native fathers and their families, reduce violence in rural Native communities, promote positive parenting practices, and increase healthy relationships in Native communities. This study will be conducted with adult (18 years of age and older) Native fathers' and/or father figures (grandfathers, uncles, brothers, etc.) who have at least one child under 24 years of age and reside in or near the Navajo Nation.

Primary research questions are: Is the Azhe'é Bidziil intervention acceptable to Native fathers? Is it feasible to implement? and Are participants satisfied with intervention content and participation? Secondary research questions are: Does the Azhe'é Bidziil intervention have short-term impacts on father-child relationship, self-efficacy, self-esteem, cultural connectedness, psychosocial functioning, economic empowerment, co-parenting, coping skills, healthy relationships and communication, parenting practices, substance use behaviors, and program knowledge?

METHODS AND ANALYSIS

Overview and Hypotheses

We will conduct a pre- post-study to assess preliminary impacts of the Azhe'é Bidziil intervention on risk and protective factors associated with responsible parenting and, secondarily, the feasibility, acceptability, and satisfaction with the intervention. Azhe'é Bidziil consists of twelve sessions which aim to promote fatherhood involvement, responsible parenting, healthy relationships, and economic stability. Study aims and hypotheses are based on the extant literature presented and summarized

in the Introduction. Study aim 1 is to assess the acceptability, feasibility, and satisfaction of Azhe'é Bidziil program among participating fathers. The study team hypothesizes that fathers will report high rates of satisfaction with intervention content and their participation and that the intervention and facilitators are culturally and contextually acceptable. We also hypothesize that the intervention is feasible to implement. Study aim 2 is to assess the preliminary impact of the Azhe'é Bidziil program on father involvement, quality of (co-)parenting communication, healthy relationships, fathers' engagement and communication with their children, protective factors (i.e., cultural connectedness and educational/career aspirations), and economic empowerment and stability. The study team hypothesizes that there will be an increase in fathers' positive parenting practices, engagement and communication with their children, cultural connectedness, parenting self-efficacy, and economic empowerment. The study will be conducted in two Diné communities in partnership with JHU. The study was approved by the Navajo Nation Health Research Review Board, local tribal governments, as well as the JHU Institutional Review Board.

Intervention Adaptation and Development

Azhe'é Bidziil was adapted from three evidence-based interventions (EBI) developed and proven by the Center (**Figure 1**). These include: Respecting the Circle of Life (RCL), Arrowhead Business Group (ABG), and Asdzáán Be'eena' (AB). These interventions were selected because they are evidence-based, responsive to locally identified needs, exemplary of our tribal-academic partnership, and were developed by the Center in partnership with tribal communities to be culturally and contextually congruent. In addition, the three interventions have shown positive change in parents and fathers, and cumulatively, constitute the Azhe'é Bidziil curriculum focusing on responsible parenting, promoting and sustaining healthy relationships and marriage, and economic stability.

RCL is a sexual/reproductive health promotion program adapted for Native communities designed to promote general life skills such as goal setting and problem solving while teaching core concepts related to sexual and reproductive health including healthy relationships (42, 43). The program was developed for and evaluated with youth ages 11–19 and a trusted adult who is ≥18 years of age. The first 8 lessons are taught to Native youth in a peer-group camp-based format, and 1 follow-up lesson is taught one on one with youth and their trusted adult at home (42, 43). In a recent randomized controlled trial (RCT) of RCL conducted with $N = 1{,}064$ Native youth and trusted adults, 12 months after program completion, fathers randomized to the RCL group reported significantly more parent-child engagement ($p = 0.0163$) compared to fathers

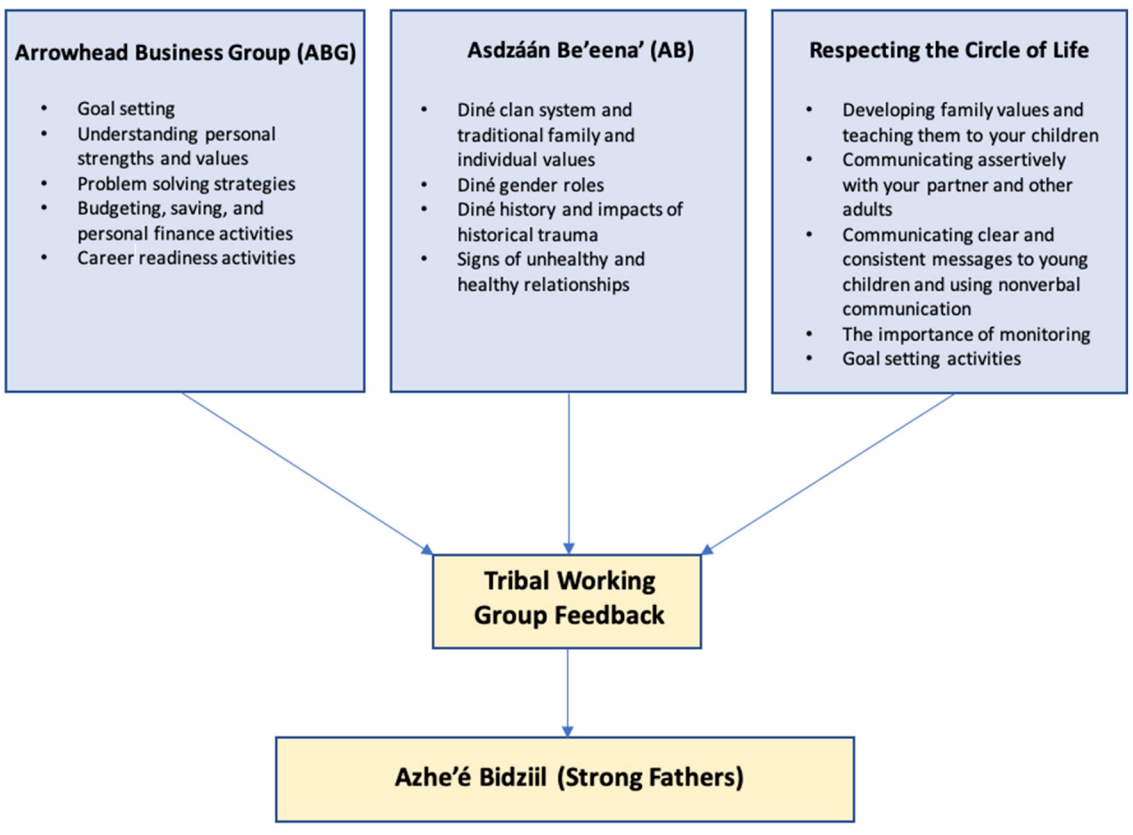

FIGURE 1 | Curricula adaptation process.

in the control group (43). Additionally, males receiving RCL reported significantly better partner communication/negotiation skills ($p = 0.032$), connection with their family ($p = 0.057$) and talking with their parent ($p < 0.001$) than those in the control (43). Further, over 85% of participants stated RCL "helps them make better decisions" and 70% reported it "made it easier to communicate with others" (43).

The ABG curriculum consists of 16 lessons and is designed for implementation in high school classrooms with youth ages 13–16. The ABG curriculum focuses on developing personal skills and providing opportunities for Native youth to achieve economic stability with a primary focus on entrepreneurship education and economic security (44–46). ABG teaches essential soft skills necessary for participants to be successful in their relationships (e.g., problem solving, communication, decision making, emotion regulation); provides job skills (e.g., resume building, public speaking, interviewing), training, and goal setting to prepare individuals for future employment; and teaches personal finance and entrepreneurship education to foster a sense of self and upward economic mobility (44). Previous trials of the ABG program indicate it reduces substance use and improves economic stability (45, 46). Specifically, ABG was evaluated through an RCT with N = 393 Native youth and young adults (45). Two years after program completion, ABG participants had significantly higher entrepreneurship knowledge and reported significantly more economic abilities ($p \leq 0.0001$), economic agency and participation ($p \leq 0.0001$) and economic confidence and security ($p = 0.013$) compared to controls. They also reported higher levels of future planning and aspiration ($p = 0.001$) as well as intentions to preserve health ($p = 0.006$) (45).

AB is a culturally-grounded program delivered to Native girls and their female caregivers. The overarching goal of the program is to reduce substance use and teen pregnancy by improving caregiver-youth relationships, promoting pride in girls' identity as Native women, improving support systems, and overall improving the psychosocial health of the girl and their caregiver (47). AB consists of 11 lessons, of which 6 are individual lessons taught to the female caregiver and youth, and 5 lessons are group-based lessons taught to all female caregivers and female youth enrolled (47). In a previous pre- post-trial of the AB program at 3 months post-program completion girls and mothers reported improved parent-child relationships compared to baseline ($p = 0.03$ and $p = 0.004$). Girls also had reduced internalizing and externalizing behaviors ($p \leq 0.001$ and $p = 0.05$), increased self-esteem ($p = 0.02$) and improved social support ($p = 0.04$) (47).

Several components of the RCL, ABG and AB programs were incorporated into Azhe'é Bidziil, but first adapted to fit the needs of Native fathers (**Table 1**). In addition to incorporating previous EBI content, we adapted the curricula according to best practices for teaching to an older, male-only population. Evidence suggests that adults learn best in more collaborative environments in which they have greater control over the content of the lessons (48). When it comes to learning about gender equity issues specifically, qualitative data from several studies have shown that adult males learn best when they are taught by facilitators who encourage questions and discussion about sensitive topics without judgement or fear of being ridiculed (49). In addition, adult learners show a higher retention rate when they are actively engaged in lessons and they have both extrinsic and intrinsic motivations for learning (48). Engagement in lessons can be achieved by limiting lessons to 2.5 h or less (49). Reflecting on this evidence, we ensured the following: (1) the tone of the curricula presents a conversational, discussion-driven style; (2) lessons were drafted that intentionally engage participants in discussions around sensitive topics like toxic masculinity, domestic violence, and child abuse; (3) to promote honest and direct dialogue, males from the community who have shared life experiences with the participants were recruited and trained to deliver the program; (4) to promote engagement, we limited dependence on technology and classroom-style instruction so the curricula can be facilitated in a variety of community settings (i.e., gymnasiums, outdoor recreational facilities); (5) the time allotted for each lesson was flexible to promote discussion while aiming to keep each lesson under 2 h; (6) finally, we designed lessons to be delivered to groups of men who would stay together for all lessons through a cohort to foster collaboration and peer-to-peer bonding.

To assist with adapting these curricula and to ensure relevance and engagement for fathers on the Navajo Nation, we formed a tribal working group consisting of 20 community leaders, local fathers, and researchers with experience working with Native adult males. This working group met 10 times from December 2020 to April 2021. The working group reviewed each of the 12 draft workshops in detail to ensure that the content is culturally appropriate, relevant, and that participants would engage with and understand the information (**Figure 1**). The members of the working group also proposed additional tailoring, such as providing examples of budgeting for different types of employment such as seasonal work, to strengthen the curriculum, as well as providing ideas to maximize engagement and incentives for participants. The working group also made a critical cultural adaptation by broadening the eligibility criteria to include grandfathers, uncles, stepfathers, and other father figures. This adaptation acknowledges that Native parenting expands beyond the biological parents to include other family caregivers and role models.

The working group was fundamental in helping the team incorporate cultural teachings into the curriculum. Working group members with deep cultural knowledge proposed integrating aspects of Diné culture such as the clan system and the impact of historical trauma to enhance engagement with the curriculum for participants (**Table 2**). During one working group meeting, one member remarked, "The way I look at it, if you want to have a watered-down curriculum you can focus on modern fatherhood. But I think if you focus on traditional values as the core base of your curriculum it can be an interesting intervention program." The feedback from the working group was incorporated by two curriculum writers into a comprehensive curriculum that is grounded in Diné values such as respect, reciprocity, discipline, and relationship (50).

TABLE 1 | Integration of content from previous EBI.

Azhe'é Bidziil workshop	Curricula used in adaptation	Parts of curricula adapted
1: Striving for a positive future	ABG	• Identifying personal strengths activity • Differentiating values and goals activity • Goal setting activity
	AB	• Diné clan characteristics • Identifying Diné clans activity • Values of the Diné Individual handout
2: Honoring our role as fathers	AB	• Milestones in a man's life in Diné culture • Important roles of men in Diné culture
	RCL	• How to develop family values and teaching them to your children
3: Effective communication and problem solving using the "SPIRIT" approach	ABG	• SPIRIT: A Problem Solving Technique activity
	RCL	• Being Assertive activity • How to communicate clear and consistent messages to young children • The importance of nonverbal communication when communicating with children
4: Boys to men	None	N/A
5: Love does not hurt	AB	• Incorporating the idea of Hózhó and domestic violence. Hózhó means living in balance (health, harmony and beauty). Violence can disrupt Hózhó, and we must take action to regain balance and harmony in our lives. • Traditional roles of women in Diné culture and content related to how Diné people have always held women as sacred.
6: Building healthy relationships	AB	• Signs of healthy and unhealthy relationships • Content on K'é, the Diné kinship system that also includes the idea that in being related to each other, we are responsible to each other, that it is a call to duty for us to respect one another in a loving way.
7: Our history, our future	AB	• Content on Diné history, specifically the Long Walk and boarding schools • Content on historical trauma
8: Monitoring and spending time with your children	RCL	• Content from the parent lesson about the importance of monitoring your children and strategies for communicating with children
9: Basics of budgeting	ABG	• Creating a monthly budget activity • Content about savings and debt, including how to set savings goals and tackle debt
10: Being me and establishing my career	ABG	• Content on the importance of education attainment and salary • Resume building activities and content
11: Career resources	ABG	• Editing a resume activity • Content on strategies for searching and applying for jobs
12: Bringing it all together	RCL	• Making Your Dream Come True goal setting activity • Content on overcoming obstacles on the way to our goals • Compliments and positive messages activity

Previous EBI: AB, Asdzáán Be'eena'; ABG, Arrowhead Business Group; RCL, Respecting the Circle of Life.

Azhe'é Bidziil Intervention

The Azhe'é Bidziil intervention is composed of 12 weekly group sessions (**Table 2**) conducted with fathers (or father figures such as grandfathers, uncles, stepfathers, and adult brothers) that focus on developing knowledge and skills for promoting positive father involvement, economic stability, and healthy relationships. Each of the 12 group lessons, consisting of 8–12 participants per group, lasts approximately 2 hours and is delivered by two trained Diné male facilitators. Facilitators use a curriculum manual to administer the program and participants receive workbooks. Sessions are taught using didactic techniques that includes lectures, games, role-playing, group bonding activities with corresponding materials, posters, videos and handouts. Group sessions take place either at the local JHU study office or in a communal location, such as outdoor fields, school classrooms, hiking trails, gyms, community centers and/or health facilities. Transportation to group sessions and child-care are provided upon request. Fathers enrolled in the program complete the 12, 2-h workshops over the course of 12 weeks for a total of 24 hours of workshop programming (**Table 2**). Additionally, social support will be provided to each participant while they are enrolled in the Azhe'é Bidziil program. Social support consists of providing referrals to necessary support services in the community based on identified needs and are conducted either by phone, Zoom, or in-person.

All research staff are Diné and employed/trained by the Center. Research staff complete a background check and are extensively trained in human subject's research and the study protocol, policies and procedures prior to any interaction with participants or study data. To ensure the Azhe'é Bidziil

TABLE 2 | Intervention lesson topics.

Lesson number	Delivery timepoint	Cumulative hours	Topic
1	Within 2 weeks of enrollment (week 1)	2	Striving for a positive future: Program introduction, K'é (discuss the meaning of the clan system and stablishing kinship/identity), defining values and goals.
2	Week 2	4	Honoring our role as fathers: Discussing various parenting styles and positive parenting practices, reflecting on cultural role as fathers, reflecting on how own childhood influences parenting style. Developing parenting values.
3	Week 3	6	Effective communication and problem solving: Learn and practice applying the SPIRIT model of problem solving
4	Week 4	8	Boys to men: Understanding masculinity and learning to take care of yourself so you can take care of others.
5	Week 5	10	Building healthy relationships: Foundations of a healthy relationship, enhancing family relationships, skills to strengthen and manage relationships with family members, the benefits of two-parent households (within Native context) and co-parenting strategies and skills.
6	Week 6	12	Our history, our future: Understanding the role of historical trauma, controlling aggressive behaviors and conflict resolution, causes of and addressing child abuse, and nurturing fatherhood practices
7	Week 7	14	Love Doesn't Hurt: Causes of domestic violence/intimate partner violence, understanding the cycle of abuse and seeking help
8	Week 8	16	Monitoring and spending time with your children: Understanding child development and behaviors, strategies to communicate with child throughout development phases, setting limits, and being an involved parent
9	Week 9	18	Basics of budgeting: Difference between wants and needs, building skills and knowledge to improve economic stability, finance management
10	Week 10	20	Being me and establishing my career: Career counseling/development, importance of education and an introduction/creating a resume
11	Week 11	22	Career resources: Resume workshop (continued), industries and opportunities for jobs in the local community, learning to search for and apply for jobs, guest speaker from local employment agency
12	Week 12	24	Bringing it all together: Staying on track and free from substances, how to readjust goals, making a difference in your community, group members give positive feedback to each other.

program is implemented with high quality and fidelity, all facilitators receive extensive training in curriculum and must pass a proficiency examination with a score $\geq$85% prior to delivery. In addition, fidelity monitoring of program implementation will be performed on $\geq$10% of all sessions conducted. Sessions will be randomly selected and observed in person, audio or video recorded. Staff performing fidelity monitoring will complete a feedback form and review it with the facilitator. Additional training will be conducted as necessary.

Study Site and Participants

Eligible fathers or father figures must be age 18 years or older and have a primary residence in or within approximately 50 miles of the participating Diné communities. Additionally, fathers must be caregivers of at least one child under the age of 24 years. Eligibility criteria was determined in collaboration with the working group to include all cultural definitions of fatherhood (e.g., uncles, grandfathers, stepfathers, etc.). Based on our eligibility criteria, an 18-year-old father of a newborn and an elderly grandfather who is helping to raise his grandchildren ($<$24 years old) would both be eligible for the intervention. All eligible participants are required to complete informed consent to participate. Participants who are unable to fully commit to the program (i.e., they are unable to complete all sessions and/or assessments or plan to move during the intervention period), unable to review and sign informed consent, or do not meet the criteria are deemed ineligible for participation.

Recruitment and Consent

Participants are recruited through a number of outlets using a combination of non-probability and snowball sampling. Participants are recruited by social media, word of mouth, community events, local community partners (e.g., family-based programs and services, schools, housing, and tribal college administration), the local tribal radio station and local newspapers. When a potential participant is identified, a study team member will set up an appointment to discuss the program using an approved recruitment script. Following the recruitment script, the study team member completes an eligibility form to determine if the individual meets the inclusion criteria. If the individual is deemed eligible and interested, a study team member will initiate the informed consent process. Study team members are trained to review the consent form section-by-section with the participant to ensure comprehension and to stop intermittently to answer any questions. Study team members

also ask the participant to explain the study in their own words to ensure that they understand the purpose of the study, their participation, and the risks and benefits associated with participation. Oral translation into the Diné language is available upon request.

Sample Size

Our primary outcome for sample size determination is the change in mean score between baseline and post-intervention in the global father responsibility and involvement scale. We will measure this using the Inventory of Father Involvement (IFI) which consists of 26 items and has been utilized in other studies with low-income, minority fathers. Responses are scored on a Likert scale from 0 to 6. The IFI will be collected at baseline and immediate post-assessment. We anticipate that an increase of 0.24 from baseline to the immediate follow-up time point is reasonable. We assume a baseline mean (SD) of 3.19 (1.25) based on findings reported by low-income fathers in a previous study (51). In order to detect a change in 0.24 between baseline and immediate follow-up timepoint, assuming alpha = 0.05, 90% power, we will need a final sample of 440 participants. Based on previous programs with Native adults that our team has conducted in the participating communities and other programs implemented with fathers (39, 43), we anticipate attrition rates of ∼40–45%. We will therefore recruit a total $n = 750$ Fathers.

Fatherhood education programs have high attrition rates, cited in the literature as ranging between one-third and one-half (or higher) of all participants (39–41). The study team has reviewed best practices in fatherhood program retention and are implementing community- and culturally-specific methods for addressing these barriers. Based on our experience with community-engaged research in Native communities, we aim to reduce the attrition rate by hiring and training male facilitators, building peer support, providing child-care during workshops as necessary and transportation to and from workshops (as needed), providing social support, providing gift card incentives for completion of assessments, and by offering flexible workshop schedules. We also plan to implement optional outdoor-based activities (including cultural activities) such as hiking, fishing, basic vehicle mechanics, and a men's sweat lodge to further promote participant retention.

Outcomes

The outcomes for this pre- post-study are acceptability, feasibility, and satisfaction with the intervention as well as father involvement, quality of (co-)parenting communication, healthy relationships, fathers' engagement and communication with their children, protective factors (i.e., cultural connectedness and educational/career aspirations), and economic empowerment and stability. Please (see **Table 3**) for a description of measures and key constructs to be utilized.

Data Collection

To assess the primary research question, participants will complete short surveys that ask about program acceptability, feasibility and satisfaction at the conclusion of each workshop session and again upon completion of the entire program. Surveys completed at the conclusion of each workshop session are completed via paper and entered by study staff team members into Research Electronic Data Capture (REDCap™). The survey completed at the completion of the program will be administered via REDCap™. Facilitators will also collect comprehensive process data including but not limited to workshop attendance and referrals provided.

To assess the second research question, data is collected at baseline and immediately (within one month) post-intervention completion through via an outcome assessment. All outcome assessment data are collected in participants' homes or another private location via a tablet using REDCap™. All measure items were selected based on their cross-cultural validity. When possible, selected measure items were drawn from studies that were implemented in Native communities and/or among Native men (**Table 3**). Selected measures were piloted with five Native fathers who provided written feedback on each question. Edits were made accordingly and outcome assessments finalized. See **Table 3** for a summary of measures.

Analysis

For the outcome evaluation data, we will conduct analyses using Stata, version 17 (58). Bivariate regression analyses using mixed effects models will be used to examine change from baseline to post-intervention in outcome measures. Mixed effects multivariate regression models adjusted for repeated measures with a random effect at the individual and group level will be used to examine significance between time points. We will examine whether the mixed effects multiple regression models also need to be adjusted for group levels.

We will review the session implementation assessments (i.e., Workshop Feedback Forms) for acceptability of each individual session, as well as examining the average scores on each item and outcome domain to determine which items and domains were particularly problematic. We will review overall program implementation assessments (i.e., Program Feedback Form) for acceptability of the entire program. Items or domains with average lower than the midpoint scores will be considered barriers to implementation and the focus of program improvement prior to a fully powered effectiveness trial. Finally, we will review all attendance and workshop session data reported by facilitators to understand average dosage and length of sessions.

DISCUSSION

This study protocol presents one of the few evaluations of a fatherhood intervention to increase economic stability, promote positive parenting, and build healthy relationships among fathers in rural Native communities. Such a study is sorely needed to address the disparate health disparities perpetuated by structural, social and Indigenous determinants of health that Native men experience today. In designing the Azhe'é Bidziil study, several strengths emerged early in the process. The Azhe'é Bidziil study innovatively drew upon evidence-based curricula, fatherhood program best practices, and cultural perspectives in developing an intervention that is tailored for Native men and their unique lived experiences. This would not have been

TABLE 3 | Azhe'é Bidziil evaluation measures.

Measures	Key Constructs	Description of measure	Timepoint				
			Pre	First	Every	Last	Post
Outcome assessment							
Demographics	NA	Questionnaire to assess age, gender, socioeconomic status and living situation	X				
Program Knowledge	RP, FI, HR, ES	24 questions to assess knowledge and comprehension of key curriculum topics. Developed by study team.	X				X
Healthy relationships and help-seeking	HR	4 questions to assess help-seeking, relationships, skills communication and confidence. Adapted from the Good Road of Life Training for Native Men (52).	X				X
Father involvement	FI	26-item scale to assess fatherhood involvement in the areas of discipline and teaching responsibility, school encouragement, maternal support, providing, time and talking together, praise and affection, academic support, and attentiveness. Adapted from the Inventory of Father Involvement (53).	X				X
Parenting and Co-Parenting	FI, HR, RP	20-item scale to assess the quality of co-parenting communication. Adapted from Coparenting Subscales: Parental Component and Quality of Coparental Communication (54).	X				X
Coping and Conflict Resolution	HR	4-item scale to assess brief resilient coping. Adapted from the Brief Resilience Coping Scale (55).	X				X
Skills, Communication, and Confidence	HR, RP	10 questions to assess perceived skills, communication, and confidence around fatherhood and parenting. Adapted from the Good Road of Life Training for Native Men (52).	X				X
Economic Empowerment and Stability	ES	26-item scale to assess economic empowerment in the areas of expansion of current economic abilities, economic agency and participation, and economic confidence and security. Adapted from a trial conducted with Apache youth (46).	X				X
Cultural Connectedness	NA	11 questions to assess degree of cultural connectedness. Adapted from the Culture is Prevention project (56).	X				X
Substance use	NA	8-item questionnaire used to screen for substance use (57).	X				X
Feasibility, acceptability, and satisfaction							
Workshop Feedback Form		Each form is 5 questions to assess the acceptability, feasibility, and satisfaction of individual workshops. Developed by study team.			X		
Program Feedback Form		12 questions to assess the acceptability, feasibility, and satisfaction of the overall program. Developed by study team.				X	
Workshop Session Summary and Attendance Forms		Each facilitator completes a Session Summary Form after each workshop. Forms ask about length, location, attendance and content covered for each workshop.			X		

Key Constructs: RP, Responsible Parenting; FI, Fatherhood Involvement; HR, Healthy Relationships; ES, Economic Stability; NA, Not applicable.

possible without the commitment and knowledge exchange from our tribal working group composed of community leaders, teachers, mental health providers, peacemaking court advocates, coaches, parents, grandparents, and a traditional healer. Each of these partners were dedicated to ensuring that the resulting intervention simultaneously addressed core lessons around economic empowerment, healthy relationships, and father involvement, while also recognizing the critical importance of anchoring the intervention in Native fathers' lived experiences.

Another strength is that the study incorporates a trauma-informed approach in addressing the determinants of Native men's health, such as helping facilitators to reflect on their own understanding of trauma, while also providing tools that aim to advance fathers' social and economic opportunities such as budgeting, career planning, and goal-setting. This

approach allows flexibility in gauging and responding to sensitive discussions. For example, in discussing trauma with participants, the facilitators often shift to land-based learning, which acknowledges that land plays "an integral role in Indigenous education" (59). Land-based learning reconnects participants to the land, promotes holistic perspectives, and encourages self-reflection, all of which can be transformative and healing processes (59). Other cultural elements such as Native parenting principles, revitalizing the kinship social support system, and Native gender roles are also unique cornerstones of this study that aim to reinvigorate Native fatherhood practices. The intended benefits of such efforts are 3-fold: cultural connectedness is a known buffer against high-risk behaviors, such as substance use and risky sexual behaviors (60, 61); cultural revitalization is advancement of Indigenous determinants of health which, in turn, promote holistic wellness (15) and cultural elements may promote program retention and enhance social support within groups. Perhaps most importantly, our study's trauma-informed approach to study design included the fundamental community need to have a safe space for Native men to learn, heal, and support one another.

A major limitation of the study is that this is a pre- post-study design and, without a control arm, it is not possible to detect causal relationships between the intervention and changes in key measures. However, it is common practice to have a pre- post-pilot study precede a larger RCT. This practice has its own strengths by allowing time to test curriculum content and to make adjustments prior to a larger scale study. Another limitation of the study is that all measures are self-report, including father involvement, quality of co-parenting relationship, and economic stability measures. Although self-report is commonly used with such study designs and in this specific population, biases are possible. The study employs the REDCap™ virtual data collection and management platform since a similar platform was shown to mitigate bias in another study conducted by JHU with a similar population (62). Another limitation is the piloting of the program in a single region, which means that results are specific to the Diné and nearby tribes and may not apply to other tribal nations. However, we are conscious of the widespread need for an intervention tailored for Native fathers. As such, our curriculum team has made efforts to embed cultural elements that are applicable to most Native nations, such as historical trauma, settler colonialism and masculinity, and extended kinship networks. This includes actively working to bring in Indigenous knowledge systems that focus on gender equality, gender socialization, and traditional gender roles.

If positive results are demonstrated, results from this pre-post-study will inform a large scale RCT of the intervention. Current study findings may also deepen our understanding of peer mentoring, Native men's health status, involvement with their children (especially if they are non-residential), co-parenting relationships, family relationships, cultural connectedness, and economic status. The data collected throughout study implementation may also inform strategies to ensure acceptability, feasibility, and satisfaction of a program designed specifically for Native fathers. Many fatherhood programs experience high attrition and dropout rate, thus if we experience high retention utilizing the aforementioned strategies, our study design could be used to inform other fatherhood program evaluations (39). This study may also provide additional insight into facilitators' proficiencies and trainings needed for program acceptability, feasibility, satisfaction and impact. Our team is consistently working to identify and address training needs in order for male facilitators to teach the curriculum and lead challenging conversations with study participants. Thus, far, this has included providing additional training on toxic masculinity, intersectionality, sexuality, cultural gender roles and responsibilities, and land-based learning strategies. This component has been found to be essential in helping male participants to understand how critical they are to addressing health inequity and restoring cultural practices.

Overall, results from this study may be used to inform future Native fatherhood and Native men's health initiatives and may have far reaching practice, research, and policy implications. It is our hope that this study is a catalyst for future community-academic partnerships that support Native fathers in the strengthening of Native societies and incorporating cultural knowledge to restore the sacred bond between Native fathers and their children. Balance across genders in Native communities is essential for harmony and community mastery. This study presents a unique public health approach that directly addresses the harmful effects of settler colonialism and toxic masculinity amongst Native men while also contributing to the cultural resurgence of Native gender systems.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Johns Hopkins University IRB, Navajo Nation Health Research and Review Board. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JR, LT, RC, HP, and JM contributed to the conception and design of the study. LG, NT, JB, LS, and BH implemented the study. JR wrote the first draft of the manuscript. LT, TB, HP, and JM wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.790024/full#supplementary-material

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Design and Methods of a Participatory Healthy Eating Intervention for Indigenous Children: The FRESH Study

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Objective: To increase vegetable and fruit intake, reduce body mass index (BMI), and improve parental blood pressure among American Indian families.

Design: Randomized, wait-list controlled trial testing a multi-level (environmental, community, family, and individual) multi-component intervention with data collection at baseline and 6 months post-intervention.

Setting: Tribally owned and operated Early Childhood Education (ECE) programs in the Osage Nation in Oklahoma.

Participants: American Indian families (at least one adult and one child in a ECE program). A sample size of 168 per group will provide power to detect differences in fruit and vegetable intake.

Intervention: The 6-month intervention consisted of a (1) ECE-based nutrition and gardening curriculum; (2) nutrition education and food sovereignty curriculum for adults; and (3) ECE program menu modifications.

Main Outcome Measures: The primary outcome is increase in fruit and vegetable intake, assessed with a 24-h recall for adults and plate weight assessments for children. Secondary outcomes included objective measures of BMI among adults and children and blood pressure among adults.

Keywords: American Indian, Indigenous knowledge, early childhood intervention, nutrition intervention, gardening intervention, vegetable and fruit intake, community-based participatory research, Indigenous food sovereignty

INTRODUCTION

In the United States, American Indians (AIs) experience significant and pervasive diet-related health disparities including obesity, diabetes, and hypertension (1–7), for which risk factors begin early in life. Recent publications on children enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children reported that in 2016, AIs and Alaska Native children aged two to four years experienced the highest rates for obesity among all racial/ethnic groups (36.7 vs. 29.1% combined) (8). Higher prevalence of excess body weight has serious implications for both the acute and chronic health of AI youth (9), and these health consequences extend into and persist throughout adulthood. Thus, strategies for reducing overweight and obesity risk in early childhood may have lasting benefits for long-term health. However, despite persisting disparities, few interventions have been developed and implemented with AI children (10, 11), and even fewer have intervened upon the environmental, community, family, and individual levels of the social-ecological model (12).

While individual-level obesity prevention efforts have been implemented with AIs (13–15), few studies have addressed community-level barriers to access nutritious foods in rural tribal reservations (16–19), or the forced historical reliance on government-subsidized foods that has led to unhealthy food preferences across multiple generations (20, 21). Since the causes of child and adult obesity disparities among AIs are multi-factorial, strategies to promote health equity within tribal communities requires simultaneous intervention across multiple levels and domains of influence (22).

Multi-level, multi-domain strategies for obesity prevention should involve healthy food access at the community, organizational, household, and individual levels, particularly access to fresh fruits and vegetables that are low in calories and rich in nutrients. Such strategies may involve community-level production of locally grown produce by the agricultural sector, that can then be purchased by food distributors, prepared by meal suppliers, and consumed by individuals. Tribally-owned and operated Early Childhood and Education (ECE) programs, which provide children with up to two meals and two snacks per school day, represent a critical domain of organizational influence in childhood obesity disparities, and thus can serve as a central location to deliver healthy eating interventions. Teaching gardens are increasingly used as interactive, tangible teaching aids across all grades (23), including in ECE programs (24). However, few teaching gardens have been rigorously designed and assessed for their impact on eating preferences, behaviors, and health outcomes. The single published study using a pre/post study design to evaluate a gardening intervention with elementary school-aged, First Nations youth found significant increases in preferences for vegetables and fruit, but not intake (25). The authors concluded that future gardening interventions must involve the entire family and must increase the availability of fresh produce (25–30).

The Food Resource Equity and Sustainability for Health (FRESH) study is a randomized, wait-list controlled trial of a multi-level, multi-component intervention designed to increase vegetable and fruit consumption of preschool-aged children and their families conducted in partnership with Osage Nation in Oklahoma. This manuscript describes the FRESH study design, including an overview of its multi-level, multi-domain components, study timeline, and measures collected to assess behavior and health change among participants.

Abbreviations: NA, Native American; ECE, Early Childhood Education; CBPR, community-based participatory research; FRESH, Food Resource Equity and Sustainability for Health; HS, Head Start; WELA, WahZhaZhi Early Learning Academy; LI, Language Immersion; PI, principal investigator.

MATERIALS AND METHODS

Theoretical Framework

The FRESH study is guided by an ecological framework that conceptualizes the many food environments and conditions that influence food choices, emphasizing policy, environmental, and individual contributors to eating patterns (**Figure 1**) (31). The FRESH intervention components further align with the National Institute of Minority Health and Health Disparities recommendations for multi-level, multi-domain strategies to address health disparities (22). Individual-level factors related to food choices and eating behaviors include behavioral and biological factors that can impact food choices through characteristics such as self-efficacy, behavioral capability, and learned food preferences. Environmental-level factors related to eating behaviors include social environments and physical environments. The social environment includes interactions with family, friends, peers, and others in the community and may impact food choices through mechanisms such as role modeling, social support, and social norms. The physical environment includes the multiple settings where people eat or procure food such as at home and in childcare settings. Lastly, policy-level factors include community food production and distribution systems, and changes in practices and legislation can influence this sector. These four levels interact directly and indirectly to influence eating behaviors.

The FRESH study was implemented using the principles of community-based participatory research (CBPR) within the context of the Indigenous food sovereignty movement. CBPR is a research approach that unifies education and social action to reduce health disparities and improve health (32). Rather than a specific set of research methods, CBPR focuses on relationships between research partners and the goals of societal shift (32). The Indigenous food sovereignty movement seeks to revitalize traditional growing and gathering practices and reverse the tide of unhealthy eating caused by the historical loss of tribal lands (33). Although other studies have developed multi-level, multi-component interventions to address diet-related health disparities in AI communities, such as the American Indian Healthy Eating Project (19), few or none have incorporated Indigenous food sovereignty, an orientation to research and practice that emphasizes AI communities' right to define their food environment and promotes their reconnection to culturally significant ways of life (34). Indigenous food sovereignty mirrors many public health initiatives to address diet-related disparities

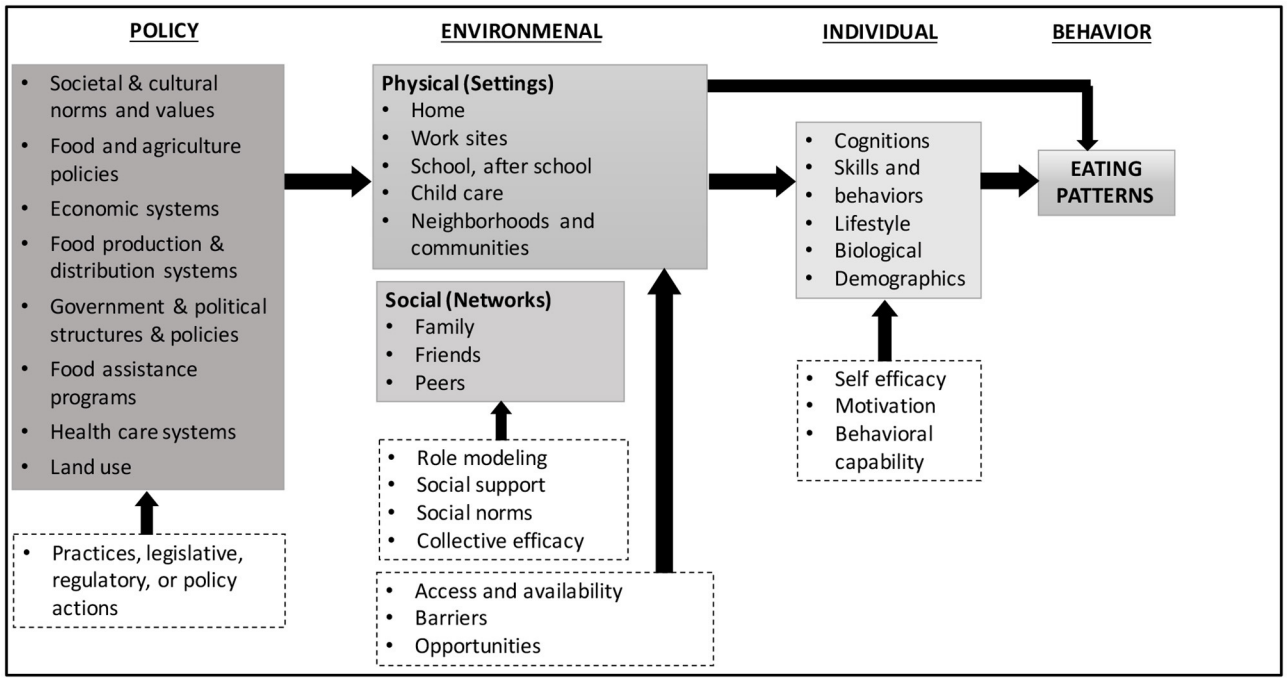

FIGURE 1 | Ecological framework depicting multiple influences on what people eat [adapted from Story et al. (31)].

through food system changes while also being a culturally centered model of health, making it an important area of focus for public health research (16, 35). The approach recognizes the loss of tribal lands and forced removal and restriction to reservations as a cause of chronic diseases among Indigenous people and centers the restoration of Indigenous food systems and food practices (e.g. fishing, hunting, farming, and foraging) in the promotion of emotional balance, mental clarity, and physical and spiritual health (36).

Study Setting and Partnership Development

The Osage Nation reservation is located in the northeastern part of Oklahoma (OK) and occupies the only federally recognized reservation in the state. The total tribal membership is 11,394, of whom nearly 7,000 reside in the reservation. The tribal government, led by Principal Chief Geoffrey M. Standing Bear and Assistant Chief Raymond Redcorn, is headquartered in Pawhuska, OK and has jurisdiction over Osage County. The Osage Nation has an extensive offering of health, wellness, and social service programs for adults and children. Services and operations include Child Support Services; a Community Health Representative Program; tribal schools and daycares; tribal ECE centers; a comprehensive health care center, the Wah-Zha-Zhi Health Center, two satellite clinics providing primary care; a diabetes program through which Osage citizens can receive free diabetes, fitness, and nutritional education as well as basic supplies (e.g., free glucose and blood pressure monitors, diabetic socks, eye glasses, dentures, and shoes); an education department; an Elder Nutrition Program; the Special Supplemental Nutrition Program for Women, Infants, and Children; and several other services.

In 2013, the Osage Nation launched its own farm, Bird Creek Farm, which is designed to be a sustainable community agricultural resource serving Osage youth, elders, and future generations. The farm is located on 29 acres in Pawhuska, OK with three large greenhouses, an aquaponics center, and a business office equipped with computing facilities, secure networks, and telephones. Bird Creek Farm provides fresh fruits, vegetables, herbs, and other products to the Osage Nation programs, such as the Elder Nutrition Program, Osage Nation Head Starts, Osage schools, cultural events, and traditional ceremonies. The farm operates with 12 full-time staff as well as additional seasonal volunteers.

The tribal-university partnership that developed the FRESH study began in 2013 with conversations between the university-based study principal investigator (PI) and the Director of Communities of Excellence at Osage Nation, who indicated that Osage sought to align tribal agricultural policies with health goals and simultaneously address healthy food production, access, and preferences to strengthen food sovereignty (37). More frequent tribal-university meetings led to the development of a multidisciplinary Executive Committee comprised of university researchers ($n = 4$) as well as Osage citizens who were also employees from the health ($n = 2$), education ($n = 4$), language ($n = 1$), agriculture ($n = 4$), and leadership ($n = 2$) divisions of the Osage Nation. The Executive Committee, comprising these 17 people, began meeting monthly in 2015 and guided all phases of the research. Memoranda of agreements were established at the beginning of the partnership between the

academic institution and Osage Nation, which included financial agreements as well as research agreements. The study was reviewed and approved by the Osage Nation Congress, which serves as the governing body for all research conducted within Osage Nation, as well as Oklahoma State University Center for Health Sciences Institutional Review Board.

Osage Nation owns and operates nine ECE programs, which were identified by the FRESH Executive Committee as the primary settings for the FRESH study. These nine ECE programs included four Osage Nation Head Start (HS) programs, four WahZhaZhi Early Learning Academies (WELAs), and one Osage Nation Language Immersion (LI) school. The Osage Nation HS programs have been operating since 1979 and have students ranging in age from three to seven years old. The WELAs first opened in 2012, and the Osage Nation LI School opened in 2015, specifically focusing on incorporating Osage language and culture into the classrooms and have children ranging in age from six weeks to 12 years old.

Participants, Recruitment, Eligibility, and Timeline

Participating ECE Programs

Osage Nation has central administration of Osage Nation HS programs and a separate, central administration for WELAs. Both administrative groups, as well as the LI school administration, agreed that all programs would participate in this study and were key collaborators in the development of the intervention. Of the nine Osage Nation ECE programs, one Head Start and one WELA are located in each of the four Osage Nation communities (Pawhuska, Fairfax, Hominy, and Skiatook), while the LI school is located in Pawhuska.

Randomization

To avoid contamination and due to the proximity of the ECE programs within the same community, we used the community as the unit of randomization to assign ECE programs to the intervention or wait-list control group (**Figure 2**). Five schools in two communities were randomized to the intervention group, while the other four schools in two other communities were randomized to the wait-list control group.

Recruitment of Families

Recruitment of families with children enrolled at the nine ECE programs began in August 2017 and continued through January 2018. Multiple recruitment strategies were implemented to maximize study recruitment at each program, as advised by the Executive Committee. First, study staff set up booths in the school lobbies during parent orientation and back-to-school nights, as well as drop-off and pick-up times to share information about the FRESH study and invite parents to enroll. Staff contacted remaining eligible adults via telephone to inform them about the study and invite them to participate. Promotional study materials, such as a letter signed by the Principal Chief, were distributed via children's backpacks and parent mailings, as well as posted on bulletin boards at the schools. Parents that were deemed eligible and indicated an interest in participating were scheduled for a study enrollment appointment, which included screening and, if eligible, baseline data collection after written informed consent. Based on retention rates of the research team's prior intervention research with AIs, it was expected that about 70% of potential families would participate (17, 38). A recruitment goal of 250 families (parent/child dyads) was set in order to retain 176 families.

Eligibility and Enrollment

Families were eligible to participate in the study if all of the following criteria were met: (1) at least one household family member identified as AI; (2) the family had at least one child aged three to six years old enrolled at a participating Osage Nation ECE program; (3) the family planned to remain in Osage Nation for at least nine months; (4) at least one family member was willing to participate in the monthly in-person family nights; and (5) the consenting adult was willing to follow study procedures. Children were eligible if they were a member of an eligible family and were enrolled in a participating ECE program. Adults were eligible if they were a member of an eligible family and were the parent or guardian of the eligible child(ren). Eligible adults (parents or guardians), were invited to participate in the study and were asked to provide consent for themselves and assent for their child(ren). Up to two adults per family and all eligible children were enrolled in the study. Baseline data collection occurred at the ECE programs or at another convenient location (e.g., place of work) at a scheduled date and time chosen by each participating adult. After consent and baseline data collection was obtained, study parents/guardians were told whether their community was in the intervention group or the wait-list control group.

Timeline

ECE programs assigned to the intervention group received the intervention during the Spring 2018 semester (January to May), while ECE programs assigned to the wait-list control group received the intervention during the Fall 2018 semester (August to December) after all post-intervention data collection was completed.

Intervention Components

This multi-level intervention consisted of three main components: (1) a preschool curriculum, a 15-week nutrition and gardening curriculum at the nine ECE programs designed to increase vegetable knowledge, willingness-to-try, and taste preference; (2) a parent curriculum, a 16-week hybrid nutrition education and food sovereignty curriculum for parents/guardians, including online and in-person components; and (3) ECE program menu modifications. We developed an initial plan for the preschool and parent curriculum, with input from the Executive Committee. Since no evidence-based multi-component, multi-level gardening curricula existed, we drew from theory, best evidence in these areas, and recommendations from the Executive Committee, who provided guidance on specific local, traditional, and preferred foods as well as food gathering and preparation practices. We also found the Center

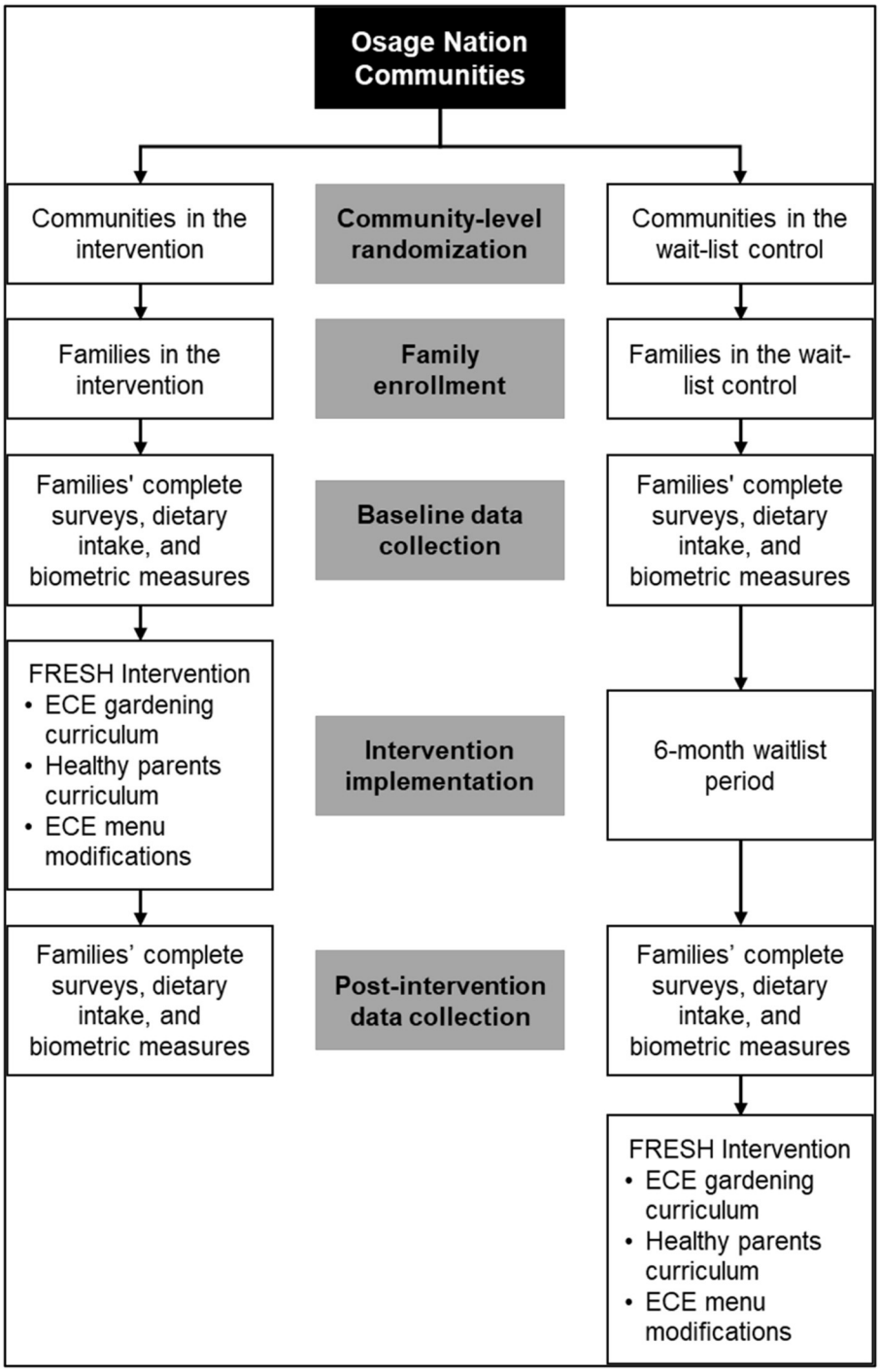

FIGURE 2 | Study design for the Food Resource Equity and Sustainability for Health (FRESH) randomized, wait-list controlled trial.

for Disease Control and Prevention's Traditional Foods Program to be an important resource as this program describes previous family (39) and school (25, 40) gardening programs and materials developed by Indigenous communities who participated in this initiative (41).

Preschool Curriculum

The FRESH preschool curriculum was adapted for AI families from the Early Sprouts™ nutrition curriculum (42) and the Watch Me Grow curriculum (43). The structured, weekly FRESH curriculum included knowledge, gardening, reading, and sensory

activities, comprised of three themes taught for five weeks each: (1) Harvest; (2) Explore; and (3) Sprout. The curriculum focused on six target vegetables (tomatoes, bell peppers, spinach, squash, butter beans, and carrots). For repeated exposure to the vegetables and the introduction of gardening concepts, each vegetable was taught three separate times corresponding with each of the three gardening curriculum themes. The weekly curriculum for each of the three themes included an introductory activity (e.g., circle time or reading a book), sensory exploration, cooking in the classroom, and a take-home family recipe kit. The planned duration of the activities varied depending on the activity; 5–30 min for introductory activities, 30–60 min for sensory exploration, and 20–75 min for cooking activities. All lessons were compiled in a teacher's user manual. Each child also received a take-home family recipe kit containing a recipe with ingredients for children to replicate the classroom snack with their family to reinforce exposure to the vegetable introduced at school that week. Take-home recipe kits were assembled by research staff and delivered to intervention ECE programs each week. Garden beds were built at each ECE program and managed by Osage Nation Bird Creek Farm staff during the time each group received the intervention. More information regarding the development and adaptation of the FRESH kids curriculum can be found elsewhere (44).

Parent Curriculum

In order to support parents/guardians in building healthful nutrition skills, we adapted the Choose Health LA Kid's Healthy Parenting Workshops curriculum (45), a series of six interactive 90-min workshops, for online, on-demand delivery over 12 learning modules. Online modules included nutrition, healthy lifestyle, and family topics. The information was condensed into short videos with local AI families from Osage Nation and Tulsa demonstrating the behaviors being discussed within the videos. For example, one of the modules discusses how to encourage "picky eaters" to try new vegetables. In this video, filmed in the kitchen of one of the members of the Executive Committee, a narrator describes the behavior of a picky eater and recommended strategies to address the behavior as an AI mother and child act out the scene. In the video the AI mother uses the Osage word for the vegetable to incorporate Osage language into the curriculum.

The 12 online modules were complemented by four in-person family nights during the intervention period that focused on Indigenous food sovereignty and its meaning and practice within the context of the Osage Nation. While the First Nations Development Institute's Food Sovereignty Assessment Tool (46) and Grassroots International's Food for Thought and Action curriculum (47) were used to prompt discussions, the community members were centered as the experts on this topic and thus took the lead in guiding the discussion, which focused on building community capacity to create a more sustainable Indigenous food system within the Nation. Each of the in-person meetings included a healthy meal prepared by a local chef using Indigenous and foraged ingredients identified by the Executive Committee. Additionally, some of the recipes used came from "The Sioux Chef's Indigenous Kitchen," (48) modified with local ingredients, such as paw paws, walnuts, acorns, prairie turnips, and yonkapins. The recipes included traditionally hunted meats such as bison, deer, and elk, and Osage harvested vegetables including the three sisters- beans, corn, and squash. The foods were served and described in English and the Osage language.

Childcare was provided at each in-person family night and incentives were given to parents/guardians in the intervention group who attended the in-person parent nights. The incentives included cooking utensils, such as pots and pans, cutting boards, blenders, measuring cups, etc. Intervention families were also given weekly take-home kits specific to each lesson, which included a healthy recipe and ingredients to make the recipe. More information regarding the FRESH parent curriculum can be found elsewhere (49).

ECE Program Menu Modifications

A menu was developed for all of the ECE programs moving the community toward best practices identified by the Child and Adult Care Food Program (CACFP) (50) and has been described in detail elsewhere (51). In short, menus were designed to add fruits and vegetables as snacks, replace refined grains with whole grains, serve lean meats, nuts, and legumes, reduce fried foods, and eliminate sugary beverages and juices. In addition to the CACFP best practices, menus aimed to include the six target vegetables from the preschool curriculum two times each week in meals or snacks within each six-week cycle menu rotation. The research team met monthly with Osage Nation ECE program leaders during the one-year study planning phase to understand current challenges and food procurement processes. Using CBPR practices, iterative cycles of draft menus were co-developed with the Osage Nation ECE cooks and farm staff using foods grown at the Bird Creek farm. The menu changes were determined based on the amounts of produce Bird Creek Farm could grow and deliver regularly and the ECE staffing and space needs. Once the menu was finalized the teachers and cooks participated in a three-hour interactive training session to introduce the menu modifications (51), discuss the importance of the CACFP best practices, and address any challenges raised during the interactive session.

Teacher Trainings

Teachers at the ECE programs completed two trainings prior to the intervention: (1) a teacher-focused responsive feeding training, using 'best practices' around encouraging the children to try fruits and vegetables; and (2) orientation to the FRESH preschool curriculum.

Responsive Feeding Training

In the first training, all teachers were trained by a national expert (52) on the importance of role modeling healthy eating in the classroom. Responsive feeding training focuses the teachers on actions during mealtime to promote healthy dietary intake with encouragement and role modeling and elimination of pressure, bribing, and coercion. Topics included sitting with the children during mealtimes, eating the same foods as the children, not bringing fast food into the classroom, being positive with reactions around vegetables, being discrete with reactions to any

vegetables they do not enjoy, and taking a "courtesy bite" as a role model for the children. More details of the responsive feeding training are described elsewhere (53).

Preschool Curriculum Training

During the second training, delivered only to intervention teachers, a Registered Dietitian and co-author guided the teachers through the FRESH preschool curriculum, giving step-by-step guidance on the different themes, target vegetables, and objectives of each lesson plan (52), reinforcing lessons learned from the first teacher training on responsive feeding.

Data Collection

All measures, except demographics, were collected at two time points: baseline and post-intervention, from parents/guardians, children, ECE teachers, and site managers. Baseline measures were collected from August 2017 to January 2018, before the intervention launched. Post-intervention measures were collected from May to July 2018, ∼six months after the FRESH intervention was initiated. Before the baseline assessment, research staff confirmed the date, time, and location of the visit by text, email, or phone call and reminder text messages were sent the day before the scheduled study visit.

Participant incentives included Walmart gift cards for baseline and post-intervention measures. Participants received $20 for completing biometric data (height, weight, and blood pressure), $20 for a dietary questionnaire, and $20 for a parent survey (demographics, home environment, health history), for a total incentive of $60 at baseline and $60 post-intervention ($120 total). ECE program teachers and site managers also received $40 gift cards for school environment surveys completed at baseline and post-intervention.

Measures

Demographics

Parent/guardian and children's age, sex, and racial/ethnic background was assessed. The number of adults and children that live in the same household, parent/guardian educational attainment, employment, marital status, annual household income, and whether the parent/guardian utilized public assistance programs such as Temporary Assistance for Needy Families, Supplemental Nutrition Assistance Program (SNAP), and Supplemental Security Income were also documented.

Dietary Intake

Dietary intake of parents/guardians was assessed using the National Cancer Institute's Multiple Pass Automated Self-Administered 24-hour Recall (ASA24-2016) (54). One 24-hour recall was obtained each at baseline and post-intervention by trained study staff either in-person or via phone. These data were used to estimate mean intake of nutrients and food groups between intervention and wait-list control groups. Usual fruit and vegetable eating patterns were assessed using the 7-item Fruit and Vegetables Behavior Checklist (55, 56), which has been validated for use in low-income and lower-literacy populations.

Child consumption of target vegetables in the FRESH preschool curriculum was measured using weighed plate waste. Each child was provided a pre-weighed vegetable snack plate before a snack or lunch period in the classroom. While the children were eating the vegetables, researchers recorded their willingness to try each of the six target vegetables using the five-point scale developed by Farfan-Ramirez et al. (57): 0 = Did not remove vegetable from container, 1 = Removed food, but did not bring to nose/mouth, 2 = Removed food and brought to nose/mouth, 3 = Put food in mouth, but did not swallow food, 4 = Put food in mouth and swallowed. Researchers then collected the plates from the children and re-weighed them to assess objective levels of vegetable consumption, subtracting the post-weight of the plate from the pre-weight of the plate. More information regarding the methods of child food intake are described elsewhere (58).

Biometrics

Height was measured on parents/guardians and children using the Hopkins Road Rod Portable Stadiometer (#680214). Weight was measured without shoes and light clothing using the Health o meter® 349KLX. Adult height and weight were used to calculate Body Mass Index (BMI; kg/m^2). Children heights and weights were converted to BMI percentiles using Center for Disease Control and Prevention parameters (59). Blood pressure was measured on parents/guardians. The blood pressure protocol required adults to first empty their bladder and sit quietly for 5 min before measurements. Blood pressure measurements were taken three times, and then averaged using the last two measurements. These values were used to calculate the mean arterial pressure: average diastolic blood pressure + 0.333*(average systolic blood pressure – average diastolic blood pressure) (60).

Household Food Security and Perceived Food Environment

The United States Department of Agriculture (USDA) 18-item Household Food Security Survey Module was used to assess household food security (61). This instrument contained 18 items to capture the qualitative and quantitative dimensions of the household food supply, including psychological and behavioral responses of household members. To compute levels of food security, the number of affirmative responses to these items were totaled, counting "often" and "sometimes" as affirmative. Consistent with USDA guidelines, 0–1 affirmative response indicates high food security; 2–3 indicates marginal food security; 3–7 indicates low food security; and 8–18 indicates very low food security. Perceived food environment items asked where the family procures their food and how often they visit different types of food stores.

Self-Reported Health

Self-rated general health was assessed in parents/guardians with responses indicating "excellent," "very good," "good," "fair," or "poor." Parents/guardians were also asked about their participating child's overall health status using the same responses. Medical history, such as hypertension and diabetes diagnosis, was assessed in parents/guardians. Diagnosis of hypertension was assessed by the question, "Other than

pregnancy, has a doctor ever told you that you have high blood pressure?" Diagnosis of diabetes was assessed by the question, "Other than pregnancy, has a doctor ever told you that you had diabetes or sugar diabetes?" Parents/guardians were also asking about tobacco use, by the question "Do you now smoke cigarettes every day, some days, or not at all?"

Physical Activity

Physical activity for parents/guardians was assessed using the validated International Physical Activity Questionnaire Short Form (IPAQ-SF) (62). Parents/guardians were asked how many days in the last week they participated in walking, moderate-intensity activities, vigorous-intensity activities, and were asked about the amount of time spent doing each (63). Children's physical activity was also assessed by asking parents/guardians questions from the validated Preschool-Age Physical Activity Questionnaire (Pre-PAQ) (64), which asked about the number of days in the last week their child walked to get around their community, time spent performing organized physical activity (e.g., gym/tumbling, dance, swimming, soccer), time spent playing outdoors, and time spent performing sedentary activities (e.g., watching television/movies, playing computer/phone games, looking at books).

Family Eating Patterns, Cooking Confidence, and Serving Children Fruits/Vegetables

For family eating patterns, 12 questions from the Neighborhood Impact on Kids Study (65) were used with response options on a five-point Likert scale: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always. For questions on cooking, three previously used questions (66) were used with response options on a five-point Likert scale: 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree. For the two sections on the parent's confidence in serving fruits and vegetables to their children, there were four questions for fruits and four questions for vegetables, and responses ranged from: 1 = Not sure, 2 = A little sure, 3 = Sure, 4 = Very sure, 5 = Extremely sure.

Process Evaluations

Weekly process evaluations were completed by teachers during the intervention to assess fidelity of the FRESH preschool curriculum implementation in the classroom and to assess children's exposure to intervention activities. After teaching each weekly session, classroom teachers completed an online survey with ∼8–10 questions about the completion of activities, length of time for activities, and whether learning objectives were met.

An observation-based process evaluation method was also used to assess implementation of the first teacher training (responsive feeding). Direct observations were conducted in all intervention and control schools before and one month after the FRESH intervention by trained research staff using standardized protocols and instruments. More details and results of the evaluation are published elsewhere (53).

School Nutrition and Physical Activity Environment

Site managers and teachers completed surveys on ECE program and classroom environments at baseline and post-intervention. To assess nutrition and physical activity environments at the ECE programs, the validated Environment and Policy Assessment and Observation-Self Report (EPAO-SR) survey was used (67). Site managers completed the EPAO-SR Director survey and were asked nutrition-related questions regarding foods and beverages served at the school, feeding environment and practice, school menus and variety, and nutrition education, training, and policy. Site managers were also asked questions regarding physical activity time provided at the school, indoor play environment, outdoor play environment, screen time availability, and physical activity education, training, and policy. Teachers completed the EPAO-SR Staff General survey and were asked nutrition-related questions specific to the classroom. Topics included classroom space, equipment, and environment, practices around food and eating, and nutrition training.

Statistical Analyses

Sample size was calculated based on the primary outcome of vegetable and fruit intake. A target sample size of 168 per group was estimated to detect a mean difference of 0.3 servings of fruits and vegetables per day among adults ($SD = 1.2$) as the primary study outcome. This value is slightly higher than in previous studies, but would produce a more meaningful difference than the 0.2 reported previously (68). To detect a difference in target vegetable consumption by plate weight assessment in children, 19–73 children per group were estimated to be needed to detect a difference of 15–30 grams ($SD = 34$) (69, 70). For each of these calculations, 80% power and an alpha of 0.05 was used. Secondary outcomes for the FRESH study included reductions in BMI among adults and children (among those with overweight and obesity at baseline), reduction in blood pressure among adults (among those with elevated blood pressure at baseline), and an increase in food security among households.

DISCUSSION

The FRESH study will be one of the first comprehensive studies to investigate the impact of a multi-level, multi-component intervention to build community food sovereignty capacity and reduce risk for obesity among AI children attending ECE programs. There are several benefits that may come of this study, such as increased knowledge about food environments, increased access and intake of fruits and vegetables, as well as possible reductions in adult BMI and blood pressure. The principles of CBPR were used to work closely with the tribal Executive Committee to co-develop, implement, and evaluate the multi-level intervention. Together, the research team and tribal leaders will disseminate study findings, tools, and the preschool curriculum used at the ECE programs to other tribal communities. In doing so, the results can be disseminated more widely in a way that will ultimately benefit more AI families with young children. Final study results will be published separately in peer-reviewed journals. This study will advance the state of CBPR and intervention science in AI communities.

A recent systematic review of the application of Indigenous food sovereignty principles to intervention research found that studies that scored higher in food sovereignty principles were

more likely to show impact on dietary quality (71). According to the scoring mechanism provided by this review, our intervention scored high in all four principles of Indigenous food sovereignty (Community Ownership, Inclusion of Cultural Food Knowledge, Inclusion of Traditional Foods, and Environmental Sustainability of Intervention). The results of this intervention may provide further evidence of the potential of using an Indigenous food sovereignty approach to support health interventions and improve dietary quality.

Strengths and Limitations

Several study limitations must be recognized. First, the study population was a convenience sample of residents of the Osage Nation community who may have already been motivated to make healthy lifestyle changes. This would result in a bias toward the null and there may be smaller differences between groups because control group participants may also be making behavior changes that are not part of the study intervention. Secondly, many of the outcome variables are self-reported and may be subject to recall and social desirability bias. The intent was to capture patterns of health habits rather than measuring definite amounts of food intake or physical activity.

Despite these limitations, this study has several notable strengths and novel contributions. This intervention used a CBPR approach which has the potential to build community capacity to conduct research and address future community health challenges. An additional benefit of using CBPR is that there is greater likelihood that the intervention will be sustained outside the of original grant cycle. Additionally, this intervention was designed and implemented in partnership with a community food sovereignty initiative, which may have greater likelihood for addressing the root causes of food insecurity and other complex food system related issues within this community.

CONCLUSION

The FRESH study is a multi-level, multi-component intervention, using a wait-listed controlled trial design and driven by CBPR goals and methods. Study processes can be used to broaden the knowledge regarding implementation of diet-related chronic disease interventions in collaboration with AI communities. If results support the efficacy of the FRESH intervention, this would support implementing multi-level interventions that capitalize on food sovereignty initiatives that many other tribal nations have initiated to promote health and wellness. Overall, findings will provide insights on the potential of a CBPR community-university collaboration to address diet-related health inequities and promote food security among AI families.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

VB conceptualized the study, led its implementation, and developed the manuscript. TT, AH, and MWi oversaw all aspects of data collection and analysis and assisted with manuscript development. MWe and SS oversaw all aspects of dietary data collection and analysis and assisted with manuscript development. TM and CN assisted with manuscript development and editing. CL assisted with study implementation and manuscript development. TJ oversaw study components and assisted with manuscript development. All authors contributed to the article and approved the submitted version.

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Engaging Native American High School Students in Public Health Career Preparation Through the Indigenous Summer Enhancement Program

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Native American[1] populations are systematically marginalized in the healthcare and public health workforce. One effective approach to reduce health disparities and improve health care delivery among Indigenous populations is to train more Native American health professionals who integrate academic and cultural knowledge to understand and influence health behaviors and perspectives. Diné College partnered with Northern Arizona University to develop the Navajo Native American Research Center for Health (NARCH) Partnership, funded by the National Institutes of Health. The high school component of the Navajo NARCH Partnership created the Indigenous Summer Enhancement Program (ISEP), a 1-week summer training program providing exposure to health careers and mentorship in pursuing public health careers for Native American high school students. ISEP utilizes the Diné Educational Philosophy (DEP), a Navajo conceptual framework to serve as the foundation of the program. In 2020–2021, due to COVID-19 restrictions, the DEP model had to be incorporated in the Navajo NARCH high school virtual program activities. ISEP used 2018 and 2019 past program evaluation data to inform the virtual programming. Students' perception of the program was collected using an online Qualtrics evaluation questionnaire. Students stated appreciation for program staff, fellow students, peer mentors and culturally relevant learning experiences in both virtual and in-person environments. Recommendations included: expanding the length of ISEP and continuing the hands-on activities and Public Health Leadership series.

Keywords: Native American, Indigenous health, Indigenous framework, Navajo, high school, STEM, peer mentor, American Indian

[1]Throughout the article, the terms American Indian, Native American and Indigenous will be used interchangeably. Native American is preferred, yet many Institutional and Federal resources used American Indian.

INTRODUCTION

Native American (NA) populations are systematically marginalized in the healthcare and public health workforce. Native American students have the lowest percentage of college enrollment; 19.6% earn at least a bachelor's degree when compared to 35.8% of non-Hispanic whites (1). In 2019, NA high school students were less likely to pursue higher education due to the highest dropout rate at 9.6% compared to Whites at 4.1%, Blacks at 5.6%, and Hispanics with 7.7% (2). According to the American Council of Education, 70.6% of NA students enrolled in bachelor's degree seeking programs attend a public 4-year institution, where 6.8% pursued a major in a public health or health sciences field. Not only are NA students disproportionately underrepresented in higher education, but they are also disproportionately underrepresented in the public health and health sciences fields (3).

Barriers that NA students face to complete a post-secondary education includes health disparities, discrimination in health care delivery, cultural differences, low socioeconomic status, historical trauma, and underrepresentation in the health care professional workforce (4–6). In the 2010 Census, 22% of American Indian and Alaska Natives (AI/AN) that live on reservations or other trust lands were living in poverty in comparison to non-Hispanic whites at 9.6% (1). One effective approach to reduce health disparities and improve health care delivery among Indigenous populations is to train Native American health professionals who understand cultural influences on health behaviors and perspectives (5, 7–9).

On the Navajo Nation and in other tribal communities, sustainable Science, Technology, Engineering, and Math (STEM) pathway programs are needed at the high school and college levels; incentives to increase student engagement could include paid internships, dual credit programs, and service learning experiences. These pathway programs help guide and encourage students to pursue an education and career in a STEM-related area. For Diné (Navajo) people, providing culturally relevant pathway programs for high school students can stimulate their entry into health and public health professions that support the development and use of culturally and contextually concordant public health strategies, which in turn may increase the likelihood of their use in local communities (10). Through training and cultivating an understanding of their own cultural and strength-based assets, the future Diné public health workforce can be equipped to create effective methods to address health disparities in their communities (5, 7–9).

Community Partnership

Recognizing the need for public health pathway programs, Diné College, a Navajo Nation tribal college, partnered with Northern Arizona University (NAU) to develop the Navajo Native American Research Center for Health (NARCH) Partnership funded by the National Institutes of Health's National Institute of General Medical Sciences (5S06GM123550). The Navajo NARCH Partnership aims to develop Diné scientists and health professionals to enhance research skills and knowledge among high school, undergraduate, graduate students, and Diné health department employees. The Navajo NARCH Partnership's existing programs include a NAU Masters in Public Health with an Indigenous Health track, a Diné College 4 year undergraduate degree program in public health, a 10-week Summer Research Enhancement Program (SREP) for Indigenous undergraduate students (11) and high school outreach programs. During the academic year, current high school programs include dual credit classes through Diné College, monthly public health seminars, internships with local public health programs, and a service-learning program in collaboration with the Navajo Epidemiology Center and Diné College public health programs. The high school component of the Navajo NARCH Partnership, in collaboration with Central Consolidated School District's Shiprock High School located on the eastern side of the Navajo Nation, created the Indigenous Summer Enhancement Program (ISEP), a 1 week summer training program that provides exposure to and mentorship in pursuing public health careers for Native American high school students.

PEDAGOGICAL FRAMEWORK

Inspired by the successful application of the Diné traditional living system, known as the Diné Education Philosophy (DEP), for the foundation of undergraduate courses and the public health SREP for Native American undergraduate students (12), ISEP also is guided by the culturally grounded DEP model. The DEP model, created by Diné cultural specialists at Diné College, is based on the four phases of the Diné way of life (13). The first phase is *Nitsáhákees* (Thinking), the second phase is *Nahat'á* (Planning), the third phase is *Iiná* (Living) and the fourth phase is *Sihasin* (Assuring). Each phase represents cultural elements and values associated with the natural processes of life, such as daily living activities. This article describes the innovative strategies used to adapt the DEP model for high school students as well as the application of peer mentoring in the ISEP program. This article presents qualitative and quantitative outcomes from program evaluations conducted after the implementation of ISEP and highlights the cultural relevance and acceptability of the public health summer program. In addition, this article will explore both the original innovation and the incorporated changes after the program moved to a virtual format.

LEARNING ENVIRONMENT

Program Description: Indigenous Summer Enhancement Program

ISEP is a 1-week program that promotes the field of public health, health research, and health professions among high school students, grades 9th through 12th. This program is distinctive in its incorporation of Diné cultural values and models. The overall learning objectives for ISEP include (1) increase knowledge of public health careers and research opportunities on the Navajo Nation; (2) identify with successful Native American public health professionals and college students, (3) apply cultural models to career pathway planning, and (4) learn and apply digital storytelling skills to develop a culminating project. The

ISEP curriculum begins by introducing the DEP model to high school students through Navajo traditional stories (14). Students learn these teachings by illustrating essential elements of the DEP model, and gaining knowledge of the associated colors, animals, mountains and sacred stones of each direction. Then the DEP model is adapted for use with high school students by applying it to the college application process and career planning. ISEP introduces an indigenous public health lens that explores the Diné concept of *Hózhó,* "—beauty, balance, peace, wellness, and harmony" (15). Students apply the concept of *Hózhó* as a health promotion intervention activity when they reflect on *Hózhó* (protective) and risk factors in their own lives. The ISEP team introduces the *Hózhó* Resilience model, consisting of three main elements, (1) harmony in relationships, (2) respect, and (3) spirituality as an existing asset that can be used to design public health prevention strategies (16). The program opens with a Navajo prayer and introductions by clan, which is typical of Diné people to acknowledge existing relationships through kinship or common clans. This sets the stage for interactions among students and staff. The program closes with a talking circle, an in-depth reflection of the ISEP program's influence on students' future career directions and a Blessing Way and Protection Way Prayer to promote positive gains and guards against threats to health and wellbeing. These elements ground the ISEP program in Diné culture.

Peer Mentor Process

Mentorship strategies implemented into pathway programs have been shown to increase peer mentor's confidence, leadership abilities, and awareness about the importance of cultural diversity and community engagement (17, 18). An innovative peer mentor strategy, where youth serve as role models for other high school students, was implemented after students from the first ISEP cohort in 2018 requested to return and be part of ISEP again. As a result of the initial success, past ISEP participants or alums currently are recruited to serve as peer mentors for the subsequent year.

Prior to the first day of ISEP, peer mentors attend a training that includes a leadership self-assessment, communication tips and ways to operationalize their leadership skills. The leadership self-assessment, based on six key dimensions for mentors (19), invites peer mentors to reflect on their current areas of strength and growth. Both the self-assessment and skills for effective mentors were adapted from the LEAD Peer Mentor Program (19). First peer mentors reflect on the following questions: What helps you to be a good communicator? What do you need from others to communicate well? What does good communication look like? What does good communication sound like? When interacting with other students, how can you be supportive in your words and in your actions? Think of a time you felt supported, what does it look like/sound like to be supported? Then basic communication tips, such as being present, active listening, asking facilitative questions, using I statements, use of tone and paraphrasing to clarify and summarize are enforced through a series of situational role plays between peer mentors. Peer mentors prepare to co-teach lessons and assist with ISEP activities such as morning check-in, daily reflections, icebreakers and mentoring peers in digital storytelling.

Digital Storytelling Workshop

Digital stories are typically 3–5 min in length and are created in a collaborative workshop model. The digital storytelling (DST) process lends itself to strengthening social support systems by listening to others, being heard, and co-constructing collective meaning (20, 21). The DST workshop within ISEP serves as both a learning tool and a final assessment to synthesize the collective learning about public health career pathways and the planning required to pursue each of the core public health disciplines. Students work in DST teams of three to four students and use guiding questions to research the academic requirements for various public health careers, colleges and universities that offer these academic programs, estimated salary ranges, and potential jobs on the Navajo Nation. Students are encouraged to interview a Native public health professional to gain more understanding of how a specific public health discipline, such as epidemiology or child and family health plays an important role in their community and what a typical work day includes. This method is used to engage students to explore the different disciplines of public health and to reflect on their personal resilience or how their communities demonstrate resilience.

Implementation of Programmatic Changes

Due to unprecedented challenges presented by COVID-19, ISEP transitioned to an online format for the summers of 2020 and 2021. Kahn et al. (11) describes the adaptation of the SREP and ISEP programs. In 2020, a virtual model mirroring an online college course was implemented. The ISEP team used past evaluation data from 2018 to 2019 to guide the virtual programming. The content moved from 8 h days to two shorter blocks of time. New content was covered in the morning block and in the afternoon, students participated in a digital storytelling workshop, extending structured time dedicated to digital stories.

Based on the request for additional public health speakers and culturally related topics in the 2019 ISEP evaluation, in the 2020 virtual edition Indigenous health professionals were invited to participate in a Leaders in Public Health series. Each professional shared their personal career paths and presented on public health topics such as COVID-19, genetics, maternal and child health, and One Health. In 2021, the Leaders in Public Health series, purposively invited public health leaders actively working with projects on the Navajo Nation. These series focused on the leader's background, support systems and challenges on their academic pathway, current projects in public health on the Navajo Nation, project strategies to arrest COVID-19 infection, and specific leadership qualities used in their work. The ISEP team facilitated first hand access to local role models during the series by building in time at the end of the presentation for students to talk informally with these current Diné public health leaders.

Based on the suggestions from the ISEP 2018 and 2019 cohorts for more hands-on problem solving activities about public health and culturally related topics, the ISEP team implemented culturally grounded daily mindfulness and the

TABLE 1 | DEP research process and mini DEP experiential research activities.

DEP term	Meaning	Research process	Activities
Nitsáhákees	Thinking	Identify a research question	Develop a research question
Nahat'á	Planning	Select study approach Design study	Identify and create a data collection tool
Iiná	Living	Collect and analyze data	Collect and analyze data in research teams
Sihasin	Assurance	Draw conclusions Disseminate findings	Share findings internally with staff and peers using google slides template

Mini DEP Experiential Research Project, which spiraled and reinforced the DEP framework throughout the ISEP curriculum. Through mini-lessons on the DEP model, research process, and data collection and analysis basics, students experienced a mini research project from start to finish. The ISEP staff divided students into four research teams, each team consisted of three to four students, a peer mentor and an ISEP staff member. First students learned about the DEP model by identifying the four phases and their associated values & symbolism. Second, students learned about the research process to understand ethical research, institutional review boards, and how to formulate a research question. Next students engaged in the research process by applying the DEP model to their research protocol: (1) **Nitsáhákees:** Thinking: Develop a research question, (2) **Nahat'á:** Planning: Methods, (3) **Iiná:** Living: Data collection and analysis, and (4) **Sihasin:** Assurance: Draw conclusions and plan for dissemination (**Table 1**). As part of a mini lesson on data, students classified the difference between quantitative and qualitative data and learned how data can validate research questions. Students applied this to their team's project by identifying the data collection method and creating their team's data collection tool. Depending on the research question, students selected their data collection tool (e.g., questionnaires, photographs, or interviews). Then to embody **Iiná**, the ISEP students assumed the role of the researchers and the peer mentors assumed the role of the research participants, while students collected data from all of the peer mentors. Finally, students regrouped as research teams to analyze the data and prepare for a brief internal sharing of each mini research team's conclusions using a staff-created template in Google Slides.

RESULTS

Data Collection and Data Analysis

A pre-/post-test design was conducted to evaluate the program and inform the next iteration of ISEP. Data was collected by an online Qualtrics program evaluation questionnaire (**Table 2**) survey. Students completed an evaluation questionnaire at baseline and at the conclusion of the program. They responded to the cultural relevance and understandability of the ISEP content, interest in college preparation, baseline and post public health knowledge, academic challenges and barriers, their further career aspirations, education, and suggested program improvements. A NARCH team member who did not mentor or instruct any student assignments administered the evaluation. Descriptive statistics were used to report the aggregate data using Excel. The open-ended responses were analyzed using a thematic analysis method.

TABLE 2 | Program evaluation questions from post-survey with high school students.

Closed-ended questions based on Likert scale (strongly agree, agree, disagree, strongly disagree):

- This program provided me basic hands-on experience in health-related research
- During the program, I was able to learn about ways I can advocate for the health of my community
- During the program, I was able to learn about and consider various careers in the health field
- This week-long experience of the Indigenous Summer Enhancement Program (ISEP) met my expectations

Open-ended questions:

- What did you like best about the program?
- What did you like least about the program?
- What suggestions would you make to improve this program in the future?

TABLE 3 | ISEP cohort demographics.

	Post-evaluation participants (*n*)	Female % (*n*)	Age (years old)	Self-identified as Native % (*n*)	Self-identified as Dine % (*n*)
2018 ISEP (In person)	11	73 (8)	15–17	100 (11)	91 (10)
2019 ISEP (In person)	16	75 (12)	14–17	94 (15)	100 (16)
2020 ISEP (Virtual)	10	80 (8)	15–18	100 (10)	100 (10)
2021 ISEP (Virtual)	17	82 (12)	14–18	100 (17)	94 (15)

ISEP Evaluation Data

The 2018–2021 ISEP cohort demographics (**Table 3**) remained similar even after the transition to a virtual format. The 2018 ISEP cohort consisted of eleven students, 73% identified as female. All eleven students self-identified as Native; ten as Diné and one as White Mountain Apache. The 2019 ISEP cohort included sixteen students, 75% identified as female. A majority (94%) of students self-identified as Native; fifteen as Diné and one as non-Native. The virtual 2020 ISEP cohort had ten students, 80% identified as female and all ten students self-identified as Native and Diné. The virtual 2021 ISEP cohort consisted of seventeen students, 82% identified as female. All seventeen students self-identified as Native; fifteen as Diné. Students' ages ranged from 14 to 18 years old in all four of the cohorts.

In the four cohorts of ISEP, most students reported that the program influenced their knowledge and awareness of careers in the health field. A majority of students agreed or strongly agreed that the program provided hands-on experience; 82% (9

students) in the 2018 cohort, 100% (16 students) in the 2019 cohort, 80% (8 students) in the 2020 cohort, and 100% (17) in the 2021 virtual cohort (**Table 4**). Most students felt that the program met their expectations; 73% (8 students) in the 2018 cohort and 100% (16 students) in the 2019 cohort, 100% (10 students) in the 2020 cohort, and 100% (17 students) in the 2021 cohort.

Program Acceptability

Students provided feedback about what they liked best about ISEP. All four cohorts of ISEP students consistently expressed that they liked the program staff, fellow students, peer mentors, guest presenters, and opportunities to get to know each other.

"The thing I liked most about the program was learning about all of the people who contribute to the health and wellbeing of my community. I also enjoyed getting up in the morning to work out and meeting amazing people…" (2018 student)

"Learning about how leaders have impacted our community and the instructors have made me feel like I can do the same also in the future. The program educated and informed me about public health, college, and life choices. The information taught has given me experience and knowledge I need for my future, plus the instructors were very helpful, nice, caring, and motivating." (2018 student)

"I liked how we had interacced [*sic*] in with the SREP (Summer Research Enhancement Program) students, it was an experience to hear their college experiences, to help us out." (2019 student)

"I liked the staff, the instructor, the peer mentors, the other students best about the program. They all were very helpful and supportive of me throughout the week. All of the staff that presented throughout the days were all so kind and they wanted to see me and the others succeed and be the best that we can be. That made me feel good about the program." (2019 student)

"I loved the staff and how open everyone was. I liked this because the program can be perfectly planned, but it is the people who make it enjoyable. Furthermore, I liked how everyone learned how to work together and the icebreakers." (2020 student)

"I liked that everyone involved played an amazing role in this program. I got to know a lot of people and make good connections. I believe these connections will last a lifetime and help me better my life and education in the future." (2020 student)

"I liked brainstorming with my groups, and discussing our topic. Another thing I like was hearing the different health professional speak, they had so much information to give." (2021 student)

"I like how we can communicate with each other since it helps with my communication skills." (2021 student)

Students from the in-person cohorts of 2018 and 2019, expressed that they liked the program structure with hands-on and outdoor activities that take place on a college campus.

"I liked that it was treated somewhat like a college class because it sorta gave a look into a college student's life. I also liked that we didn't just stay indoors all day like a high school class. I also like that we talked about college and what to expect when we get there, it was inspiring to hear stories." (2018 student)

Student Digital Storytelling Videos

In the 2018 cohort, four digital stories were developed by students that focused on health disparities and social determinants of health (SDOH) relevant to the Navajo Nation: homelessness, mental health, environmental health, and alcoholism. In the 2019 cohort, four digital stories were developed by students that focused on public health career paths in the following areas: family and child health, behavioral health, epidemiology, and environmental health. Both cohorts of students developed high quality digital stories using voice overs, pictures and videos. However, in 2019, the students featured two Indigenous public health professionals in their videos. The interviewees discussed their educational background and job duties as an epidemiologist and environmental scientist. In 2020 and 2021 students continued to virtually interview public health professionals to learn more about public health career paths for their digital stories on epidemiology, biostatistics, and global health. Students used break out rooms in zoom to collaborate virtually on these team based digital stories.

Cultural Relevance

All four ISEP cohorts strongly agreed or agreed (100%) that they learned how to advocate for the health of their communities. Students gained more cultural insights, one student from 2018 recounts, "I got to understand how important my culture is and how there is so much i [*sic*] can teach with just *Hózhó* and *ke*." Students also identified as resilient, "[I can] overcome any obstacle no matter the difficulty because I am indigenous and resilient, I can do it." Students stated appreciation for the Public Health Leadership series that provided access to relatable Native American public health role models and the professional connections created during ISEP.

"I liked how we had visitors who presented information and how they also gave us helpful information about college, being resilient." (2020 student)

"I like the guest speakers because they wanted to help people in public health and that is exactly what they are doing to achieve that goal and I liked the ice breakers because I got to know everyone and I liked how they all participated." (2021 student)

"I liked the guest speakers. They were very informative, encouraging, and a great reminder that we as high school ISEP students also can achieve great things." (2021 student).

Program Improvement

Overall many students stated that they did not have any recommendations for improvement because they liked the current program. One common recommendation among all four cohorts was to increase the length of ISEP for longer than 1 week. The 2018 and 2019 ISEP cohorts recommended to incorporate more activities, cultural components, and guest speakers (**Table 4**). Many of these suggestions were implemented in ISEP 2020 and 2021. Recommendations from the 2020 and 2021 cohorts included more movement activities to get students out of their seats, especially in a virtual environment, increase time for digital stories, include more peer mentors, invite college students to work with high school students, and a return to in-person learning. Another student from ISEP 2020 shared appreciation for the Public Health Leadership series, "I suggest

TABLE 4 | ISEP acceptability and recommendations.

Acceptability of the program	2018 (11 students)	2019 (16 students)	2020 (10 students)	2021 (17 students)
Thoughts of ISEP	• 91% agree/strongly agree that the program provided hands-on experience in health-related research • 81.8% agree/strongly agree that they were able to learn about and consider careers in the health field • 72% agree/strongly agree ISEP met their expectations	• 100% agree/strongly agree that the program provided hands-on experience in health-related research • 100% agree/strongly agree that they were able to learn about and consider careers in the health field • 100% agree/strongly agree ISEP met their expectations	• 80% agree/strongly agree that the program provided hands-on experience in health-related research • 100% agree/strongly agree that they were able to learn about and consider careers in the health field • 100% agree/strongly agree ISEP met their expectations	• 100% agree/strongly agree that the program provided hands-on experience in health-related research • 100% agree/strongly agree that they were able to learn about and consider careers in the health field • 100% agree/strongly agree ISEP met their expectations
Recommendations for improvement	• Add more topics that relate to culture • More time to create digital story • More structure/clear schedule • Teambuilding/games (outside) • Pick own roommates • Clear program expectations/what to bring • More hands-on/problem-solving activities about public health issues	• Increase exercise time, class breaks and free time • More hands-on experiences • Invite more public health guest presenters • More time with SREP students • More time on DST (pre-planning before ISEP to gather photos) • Time management • Add a laptop to supplies needed	• Better hours • More hands-on activities to get people moving out of their seats • More time • Keep involving public health personnel in the program • Seeing each other in person	• Lessons on video editing • More time to work in groups • Have college students work with ISEP • Return to in person learning • Invite college students from diverse backgrounds to the college panel • Include more peer mentors
Length of ISEP	• Make program longer	• Make program longer (>1 week)	• Make program longer	• Make program longer (>1 week)

to keep involving great public health personnel in the program. I loved meeting new role models and hearing their stories. I would love to meet more in the future."

DISCUSSION

Overall ISEP students expressed appreciation of program staff, fellow students, peer mentors, guest presenters, and the hands-on learning experiences in both in-person and virtual college environments. Our findings are in alignment with other health professional career programs that provide an experiential approach in creating pathways into health professions programs (5, 9, 10, 22). The Navajo NARCH Partnership met its goal of increasing exposure to public health professions and encouraging students to continue on their health professions pathway while still in high school.

Lessons Learned

Even though the majority of participants agreed/strongly agreed that the program provided hands-on experiences in health-related research, both cohorts requested more hands-on problem solving activities about public health issues. The first cohort recommended the addition of more culturally related topics. Both cohorts requested the incorporation of more teambuilding, longer amount of time dedicated to the digital storytelling process and an overall increase in program duration to span over 1 week in length. While the second cohort suggested integrating more guest speakers and more interaction/contact time with students from the SREP undergraduate program. Kahn et al. stated that resilient teams make for positive student experiences and the ISEP evaluation findings affirm that cohesive teams have a positive impact (11). Students consistently stated how the staff, peer mentors, and guest speakers had a direct positive influence on their learning experiences.

Another valuable lesson resonates with the concept of cultural relevance. The findings report a clear need for thoughtful integration of culturally concordant role models in high school public health pathway programs. The more we can involve community members and connect high school students with Native American public health professionals, specifically role models from their own communities, the more positive impact programs can have on high school students' career pathways.

Program Strengths/Limitations

ISEP reaches students at an early stage in their career planning. Ultimately the collaborations between high schools and the Navajo NARCH Partnership may serve to build capacity in Diné communities by developing future health professionals to implement culturally congruent public health practices and interventions. While ISEP was highly acceptable to the participants, efforts are needed to increase the length of the summer program to address the recommendations

for improvement. The current evaluation data only measures individual cohorts, while this is a weakness of this study, the team plans to follow up with all ISEP cohorts (2018–2021) to determine the longitudinal impact of ISEP. Preliminary steps have been taken to learn about past ISEP participants' career goals, college enrollment, college major, studies or works in a health field, and the peer mentor impact on student success.

Another limitation of these cohorts is the small sample size. Since this program is for high school students, future recruitment needs to focus on reaching not only potential students, but also their parents, guardians, teachers, academic counselors, and school administrators. Expanding recruitment efforts to those who teach and guide students will increase awareness of the program, promote participation and ultimately increase interest in STEM-related health profession careers among high school students.

CONCLUSION

ISEP demonstrated programmatic success, by achieving the overall learning objectives. All students increased their knowledge of public health careers and research opportunities on the Navajo Nation. ISEP participants' narratives support the benefits of identifying with successful Native American public health professionals, undergraduate and graduate students. Diné philosophies and beliefs were applied to career pathway planning with high school students and 100% of participants stated that the program met their expectations. An unintended benefit of peer mentoring that came about in the first year of ISEP was when participants of the first cohort requested to attend ISEP again. Due to the demand the ISEP team fostered a peer mentor strategy that provides leadership and communication training as well as leadership opportunities during ISEP. As indicated by the results, the following cohorts of ISEP students appreciated this added level of mentorship by feeling supported by the peer mentors.

While these findings are positive, the value of ISEP will be found as the team explores the impacts of ISEP. The next planned assessment will explore if past ISEP participants select public health or health sciences as a college major and then the team will study the long-term impact of students choosing public health or health sciences careers. The team's next assessment will require a follow-up strategy to be developed and implemented for long term tracking to determine the true impact of ISEP.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the data belongs to the Navajo Nation, according to the Navajo Research Act and longstanding IRB policy, so any data sharing would have to be specifically approved by them, not by the authors. The datasets are small and include details that could potentially reveal the identity of individual subjects. Requests to access the datasets should be directed to Nicolette I. Teufel-Shone at Nicky.Teufel@nau.edu.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Navajo Nation Human Research Review Board. Participants who were 18 years old or older provided their own consent. Anyone under 18 years old provided written informed consent and consent was also provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

All authors contributed to writing, editing, and approving the article for publication.

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Increasing Native Research Leadership Through an Early Career Development Program

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Inequities impact American Indian, Alaska Native, and Native Hawaiian populations across various health conditions; in particular, many Native communities bear a disproportionate burden of substance use disorder. Such inequities persist despite concerted efforts of communities and significant research directed toward prevention and intervention. One factor hampering these efforts is the underrepresentation of researchers who are themselves Native and uniquely equipped to respond to the needs of their communities. This paper describes the innovative Native Children's Research Exchange (NCRE) Scholars program, now entering its ninth year of successful career development support for emerging Native scholars. We summarize the history of NCRE Scholars, outline the mentoring and training approaches taken to meet the unique needs of early-career Native scholars, and present key progress of program alumni. The current cohort of Scholars provide first-person perspectives on how four key program elements have supported their career development to date. NCRE Scholars has been an effective approach for supporting the next generation of Native research leaders and for helping to build an essential mass of Native researchers prepared to respond to Native community health priority needs.

Keywords: American Indian, Alaska Native, health equity, scholarship, early career academic, Native Hawaiian

INTRODUCTION

Two facts about American Indian, Alaska Native, and Native Hawaiian (i.e., Native) populations and substance use stand in striking opposition. First, statistics document problematic patterns of substance use and rates of disorder that have remained stubbornly high despite concerted efforts by both Native communities and academic researchers to develop effective prevention and intervention strategies. Disproportionate rates of substance use disorder in Native communities are well documented (1–4). Research suggests that Native youth are at heightened risk for early substance use and the development of substance disorder relative to their non-Native peers (5–10), and that the opioid crisis has exacerbated this inequity (11–15). These realities are discouraging, particularly given extensive efforts to address them by Native communities, researchers, and funders alike.

In contrast to these data documenting the tremendous need for solutions to substance use and disorder in Native communities are those that demonstrate notable underrepresentation of Native researchers who serve as Principal Investigators (PIs) of National Institutes of Health (NIH) grants addressing these priorities. Recent efforts by the NIH, including the establishment of the Intervention Research to Improve Native American Health (IRINAH) Initiative in 2012 and the Tribal Health Research Office in 2015, have been instrumental in addressing this underrepresentation. Nonetheless, as a group, Natives have been the most significantly underrepresented group among NIH PIs (16, 17) and the NIH continues to highlight the underrepresentation of Native scientists funded through extramural research (18).

This gap in Native leadership of research related to substance use and disorder is likely hampering innovative breakthroughs to disrupt inequities (19). Although culturally sensitive non-Native researchers can effectively lead research with Native communities, provided they are responsive to community needs and priorities, we believe that Native researchers will ultimately be more effective. Numerous non-Native PIs who work closely with Native communities, effectively employing community-based participatory research approaches to enhance the rigor and relevance of research to address health inequities (including a co-author of this paper, Whitesell, who has collaborated with Native communities for 20 years). Nonetheless, Native researchers–including co-authors Sarche, Marshall, Russette, Ullrich, White, and Ivanich–offer critical perspectives from their lived experiences of *being* Native (17). Such investigators have the potential to deeply integrate rigorous scientific approaches and cultural knowledge throughout study design, measurement, analysis, interpretation, and dissemination in ways that non-Native PIs cannot, and are thus uniquely positioned to play leadership roles in research that will generate scientific breakthroughs needed to achieve health equity for Native communities.

Strategic Mentoring of Native Researchers

Closing the gap in NIH PI representation will rely on intentional efforts that go beyond traditional training and mentoring programs for students and early career researchers. An approach focused explicitly on the needs of diverse Native scholars is indicated. Two elements are critical in this regard. First, we must identify and engage with Native graduate students, post-doctoral trainees, and junior faculty dispersed across the country, often working in or near their home communities and frequently in relative isolation from other Native researchers. Participants in the last three cohorts of NCRE Scholars, for example, are from Alaska, Arizona, Hawaii, Oklahoma, Oregon, Michigan, Montana, Washington, and Wisconsin. Bringing these investigators together is both challenging and essential, and is a feature of the program many mentees have highlighted as fundamental to their successful career development. Connecting Scholars to other Native investigators–both as mentors and peers–is vital.

The second critical element is providing mentorship, support, and training tailored to the unique needs, cultures, contexts, and goals of Native researchers.[1] The number of Native researchers is both small and diverse. Those poised to benefit from early-career mentoring at any particular time is fewer still and includes a range of graduate students, post-docs, or junior faculty from diverse Native backgrounds and communities. The NCRE Scholars whose perspectives are shared in this paper are from five different Native communities: *Chippewa-Cree*, *Native Hawaiian*, the *Nome Eskimo Community*, *Tsimshian*, and the *Absentee Shawnee Tribe of Oklahoma*. Each early career researcher brings a unique perspective to this work. Early career researchers also have different visions for how they will engage with research and the community. For example, some see themselves housed within academia while partnering with communities, while others see themselves housed within their communities while partnering with academia. These different paths require different guidance and strategic planning and thus flexibility in programs designed to support the career development of Native researchers.

The Native Children's Research Exchange Scholars Program

In 2012, the Native Children's Research Exchange (NCRE) Scholars program was created to help address the underrepresentation of Native researchers leading NIH-funded research. NCRE Scholars builds on the foundation of the NCRE network, which has provided fertile ground for growing this mentoring program. The NCRE network was founded in 2008 by co-authors Dr. Michelle Sarche (Lac Courte Oreilles Band of Ojibwe) and Dr. Nancy Whitesell. Both recognized the need to create space for researchers working with Native children and adolescents to gather to exchange information, build collaborative relationships, and mentor junior researchers. Two NCRE conferences (2008-2009) were supported by the Society for Research in Child Development Small Groups Initiative (Sarche, Spicer, and Whitesell, PIs), followed by five conferences (2010-2014) supported by the National Institute on Drug Abuse (NIDA; R13DA029391; Whitesell and Sarche, PIs), and four (2015-2019) by the Tribal Early Childhood Research Center (Administration for Children and Families, 90PH0027, Sarche, PI). In 2020, Drs. Whitesell and Sarche were awarded an R13 conference grant from NIDA (R13DA051122; Whitesell and Sarche, PIs) to host three additional NCRE conferences (2021-2023). Since the network started in 2008, NCRE has grown from 30 to more than 350 members from universities and other organizations (e.g., tribes, federal agencies, early childhood programs) around the United States and Canada. Membership includes representation from more than 40 tribes and is cross-disciplinary, including the social sciences (psychology, sociology, anthropology), medicine (psychiatry, pediatrics, dentistry, nutrition, nursing, pharmacy), public health (community health, epidemiology, global health), social work, education, and Native American Studies.

[1] It should be noted that genuinely achieving equity in PI representation will also require engaging potential researchers earlier in the educational pipeline to expose them to research career opportunities, and we are engaged in some efforts to that end. However, those are beyond the scope of this paper.

Mentorship of early-career scholars has been a priority for the NCRE network and conferences from the very beginning (e.g., providing travel support to students and recent post-graduates, connecting junior scholars with senior researchers, and highlighting the work of junior scholars with special sessions at meetings). In 2012, these efforts advanced significantly with the launch of NCRE Scholars (funded by NIDA through a series of contracts and a research education grant[2]). While NCRE itself focuses broadly on Native children's development, the NCRE Scholars program focuses more narrowly on preparing early-career scholars to lead research regarding the onset, progression, and impacts of substance use and disorder among Native children and adolescents.

Creating a mentoring program on the foundation of NCRE has had several advantages. The network has reach to support the recruitment of early career researchers, depth to provide Scholars with senior mentors, and regular opportunities for rich interaction and collaboration at national conferences. Another feature of NCRE fundamental to the mentoring program is its academic, community, and disciplinary diversity. As noted above, membership and participation in conferences include researchers embedded across academic and community settings, representing both diverse Native communities and scientific disciplines. This provides a rich context in which emerging Scholars can find mentors and engage in collaborative research as they pursue their own career pathways.

This paper reports on the NCRE Scholars Program as a model for tailoring career development support for Native researchers (and researchers from other underrepresented groups), describing the key elements of the career development approach and outcomes for the program's first nine years.

METHODS

The foundational approach we have used since the inception of the NCRE Scholars program has been to bring early-career investigators together in *small cohorts* to participate in both *Common* and *Tailored Activities* designed to leverage their previous experience and training, broaden and deepen their professional *Networks*–both with peers and senior mentors–to and help them successfully navigate transitions to subsequent phases of their careers. Here we describe each of these foundational elements.

Small Cohorts

NCRE Scholars strategically recruits small cohorts, providing intensive mentoring to a few individuals rather than achieving greater reach with less depth. This approach has allowed us to focus narrowly on a few emerging investigators in each cohort, those whose interests align broadly with child and adolescent development within Native communities and, in particular, on the intersection of child development with substance use and disorder. Focusing on small cohorts has allowed us to tailor our mentoring plans to the particular needs of each Scholar in the program. Scholars enter the program at different points in their education and career development, come from different cultural and academic backgrounds, and have different research agendas and career goals. A singular approach to preparing them for the next step would be inefficient and ineffective. A tailored approach with large cohorts, however, would be unmanageable. Matriculating small cohorts each year has allowed us to provide the personalized attention required to truly adapt the program to be relevant to each scholar's needs and support their individual goals.

Common and Tailored Activities

Within each Cohort, Scholars participate in *Common* activities, providing opportunities for shared experiences, along with *Tailored* activities that support their individual trajectories.

Common Activities

Common Activities support goals essential to all early career researchers. These include building a portfolio of publications to document expertise and productivity, writing grant applications, and developing relationships with other researchers working in the field. Common Activities have evolved over the years in response to feedback from Scholars and observations of what has been effective in supporting their progress. Here we describe critical Common Activities currently in use.

Intensive Writing Retreats

Intensive Writing Retreats began on an experimental basis with Cohort 4 in 2015 and were officially integrated into the program with funding for Cohort 6 in 2017. They provide opportunities for Scholars to step away from their everyday environments for protected time to focus on achieving writing goals, either toward publication of research findings or development of grant applications. During these two- to three-day retreats, Program Mentors (Drs. Sarche and Whitesell) offer feedback on drafts and analytic guidance as relevant. In addition, Scholars have opportunities for peer feedback on works-in-progress. These retreats have also include targeted technical support; for example, Dr. Whitesell created a two-day workshop on latent growth curve modeling using M*plus* for Cohort 4.

Virtual Writing Workshops

Scholars from across cohorts who convened at the NCRE Conference in 2017 discussed how valuable both mentor and peer-to-peer feedback had been in their writing efforts. This conversation launched Virtual Writing Workshops, monthly Zoom meetings of NCRE Scholars, past and present, that provide Scholars opportunities to strengthen their writing before submitting for journal or grant review. Each month, a Scholar shares a paper or grant application; others volunteer to serve as primary reviewers, along with either Dr. Whitesell or Dr. Sarche. All Scholars are invited to review and provide constructive critical feedback during the meeting and via written edits and comments. This forum has supported successful publication of manuscripts and submission of grant applications that have been awarded. These monthly meetings also provide regular opportunities for Scholars to check in across cohorts and across the country,

[2]HHSN271201200692P, HHSN271201500717P, HSN271201700715P, Whitesell and Sarche, PIs; R25DA050645; Whitesell & Sarche, PIs.

fostering collaborative relationships among this generation of Native researchers.

NCRE Conferences

As noted earlier, the foundation of NCRE Scholars is the NCRE network of researchers. "NCRE" is included in "NCRE Scholars" because of the intimate link to the large group of experienced researchers who are poised to foster the career development of the Scholars. The NCRE conference is a central gathering space for network members, bringing together leading researchers studying an array of health factors among Native children and youth. Leading experts on substance use and disorder among Native youth regularly attend this conference, as do leading scholars working in prevention in Native communities. The conference structure involves research presentations with extended conversations afterward, rather than 5-min question and answer sessions more typical at conferences, and NCRE participants engage actively in these conversations. Scholars have the chance to see their academic heroes present (people whose articles they have read and cited) and to have one-on-one conversations with them afterward. Scholars are also required to present their research at NCRE, before senior researchers committed to supporting them by offering constructive criticism, suggestions, and support. Outside of the research sessions, NCRE conferences include many networking opportunities. Scholars have lunch and dinner with senior researchers and with their peers. They have opportunities to develop personal relationships that break down barriers and encourage them to reach out and build collaborations. They talk about ideas that inspire them in informal settings. It all works to foster connections that have blossomed into joint publications, diversity supplements, post-doctoral positions, and faculty appointments. In short, NCRE Conferences are the breeding ground for essential network connections.

Society for Prevention Research Conference

An additional networking and research exchange opportunity built into experiences for Scholars since the inception of the program is attendance at the annual Society for Prevention Research (SPR) conference. SPR has become a gathering place for a broad group of researchers working to address public health issues among Native populations in the United States. NIDA supports travel scholarships to SPR for graduate students and post-doctoral early career investigators; there is an active Diversity Network, and the Intervention Research to Improve Native American Health (IRINAH) Consortium frequently hosts its annual grantee meeting in conjunction with this conference. These factors contribute to the concentration of investigators attending and presenting at SPR, providing opportunities for NCRE Scholars to connect, learn, and develop collaborative relationships.

Didactic Trainings

In 2020, additional funding with the R25 education grant provided resources to develop additional training for NCRE Scholars and three courses were created. The first expands on the standard CITI training in the *Responsible Conduct of Research* to explore issues of particular concern and relevance to research with Native communities. Due to the COVD-19 pandemic, this course was adapted for virtual delivery, through a series of four discussion sessions with Native researcher guest discussants. Also included was the rETHICS Human Subjects Research curriculum (Research Ethics Training for Health in Indigenous Communities) (20) and *American Indian and Alaska Native Research in the Health Sciences: Critical Considerations for the Review of Research Application* (21).

The second course focuses on Grant Writing. This course was initially designed to be an intensive in-person course but was also pivoted to accommodate virtual learning due to the pandemic. The course includes an introduction to NIH institutes and centers, grant mechanisms and funding opportunities, application and review processes, structured guidance for creating a successful application (e.g., investigator readiness, realistic timelines for grant preparation, building research teams, crafting specific aims, connecting with program officials, budgeting, writing for review, obtaining feedback), and an optional session on NIH Loan Repayment Program applications. This course draws on intensive grant-writing curricula developed by advisor Dr. Spero Manson as part of the Native Investigator Development Program and the GUMSHOE program (Grantwriting Uncovered: Mentoring, Support, Help, Opportunity, and Experience), one of the NIH Common Fund's National Research Mentoring programs to increase the representation of racial and ethnic minorities among funded NIH scientists. The curricula and guest lectures have proven success in NIH funding for Native community research and understand the balance needed to push Indigenous methodologies, while appealing to NIH reviewers.

A third course focused on community-based participatory research (CBPR) was added in the spring of 2020. CBPR Chats were developed after the COVID-19 pandemic forced the cancelation of the SPR Conference, precluding a significant learning and networking opportunity generally provided to Scholars. Conversations with Scholars about their needs revealed that they were eager to hear stories of how senior researchers had established relationships with communities. CBPR Chats were organized to meet this need, providing opportunities for Scholars to meet with leading researchers to ask them about their experiences in an informal setting. The added advantage was giving Scholars a chance to get to know senior researchers, and vice versa. These chats have turned into a highlight of virtual learning during the pandemic and exemplify the value of a small cohort approach that can be flexible and responsive to the needs of the Scholars.

Tailored Activities

In addition to the Common Activities, each Scholar creates an individual Tailored Career Development Plan (TCDP), articulating their short-term career goals–in alignment with their long-term goals–and proposing how they will use NCRE Scholars time and resources to achieve those goals. TCDP activities can include connecting with senior mentors, writing papers for publication, participating in training or workshops (e.g., statistical training, training, in particular, interviewing methods),

participating in conferences, or writing grant proposals. Each Scholar is allocated funds to support the activities outlined in their TCDP, creates a budget and develops a NIH-style budget justification of each expense in relation to stated goals.

Program Mentors (Drs. Whitesell and Sarche) work with Scholars in developing TCDPs, which are then reviewed and approved by the Scholars Advisory Board; a group made up of three senior researchers (Dr. Melissa Walls, Bois Forte and Couchiching First Nation Anishinaabe; Dr. Amy West, Southern Cheyenne; and Dr. Allison Barlow) and three former NCRE Scholars (Dr. Jessica Elm, Oneida Nation, Stockbridge-Munsee Band of the Mohicans; Dr. Angela Walden, Cherokee Nation; and Dr. Jerreed Ivanich, Tsimshian, Metlakatla Indian Community). Once approved, Scholars begin working on their plans. Progress toward completion of TCDPs is evaluated through monthly meetings with Program Mentors and Scholars track their expenditure vis-à-vis their approved budgets.

RESULTS

The NCRE Scholars program has now supported 27 rising Native investigators in ten cohorts as they have embarked on careers related to the emergence and prevention of substance use and disorder among Native children and adolescent**s**. Twenty of these Scholars are American Indian; four are Alaska Native; two are Native Hawaiian, and one is a non-Native person of color. Fourteen were doctoral students, six postdoctoral fellows, and seven early career faculty. Some postgraduate Scholars were working in academic settings, while others were clinician researchers working in their home communities (e.g., tribal behavioral health or Indian Health Service clinics). By offering flexible mentoring, the NCRE Scholars program has supported diverse individual career pathways that we believe will be critical for a research workforce prepared to work collaboratively with tribal communities to create equity around substance use and disorder for Native communities.

Quantitative metrics document the progress of NCRE Scholars. Of 19 Scholars across eight Cohorts who have completed the program to date, 15 have obtained academic promotions since beginning the program (see **Table 1**). Nine have been promoted to Assistant Professor (or the equivalent, e.g., Assistant Scientist) and one was further promoted to Associate Professor with Tenure. Five obtained post-doctoral fellowships after being graduate student NCRE Scholars. Three have moved into community-based positions, working as epidemiologists, clinicians, or program directors in tribal communities; one took a position with the Centers for Disease Control and Prevention. Of the eight active Scholars (Cohorts 9 and 10), four are currently still in doctoral training, one has obtained a postdoctoral fellowship, and the remaining three are Assistant Professors (one promoted as a Scholar).

These metrics demonstrate that NCRE Scholars have been productive in the traditional academic sense and successful in career advancement. However, there are additional nuanced ways that the NCRE Scholars program supports these emerging researchers. As a group, Native scientists are in a unique position. As noted, they are the most underrepresented of all ethnic groups as NIH PIs; thus, they have few senior role models to follow. In addition, many are deeply embedded within cultural communities in which strong values for collective responsibility are at odds with the individualistic, achievement-based culture of academia. What it takes to get ahead in the competitive world of NIH and the need to focus on individual career development can create tension for young researchers who often have significant responsibilities as leaders in their home communities (17, 22). Mentoring Scholars thus includes supporting them as they navigate these challenges, helping them find a balance between building their own skills and being responsive to community and extended family needs. Our approach requires a focus on the long-term goals of addressing the public health needs of Native communities through science and understanding the role of prioritizing Scholars' skill building and career development in achieving that goal.

Another challenge many Native researchers encounter is that they often find themselves isolated in their work. If they are working in academic settings, they may be the only Native graduate student, post-doctoral fellow, or faculty member in the institution. Alternatively, the only person doing research with Native communities or both. These scholars may find themselves in the position of "speaking for all Natives" all too often. Scholars doing research on the ground in tribal communities, in contrast, often find themselves isolated from other researchers. There are challenges in finding a balance between pressing needs for service in the community and doing research in academic settings. These scholars may find themselves in the position of "speaking for all researchers." One of the things NCRE Scholars have told us that is of most value about the NCRE Scholars program is that it brings them out of isolation and connects them with other Native researchers. We believe that the bridges built among these Scholars do as much for their career development as the discrete training opportunities the program supports. The relational bridges *sustain* them moving forward. The impact of these "soft supports" is hard to quantify, but feedback from Scholars helps tell the story. Three excerpts from evaluations solicited from early cohorts, reprinted in **Table 2**, are particularly illustrative, and in what follows, Scholars who have recently completed the program (Cohort 8) reflect on four key elements of the program and the value of these activities for their career development.

Establishing a Record of Research Productivity (Dr. Evan White, Absentee Shawnee Tribe of Oklahoma)

A key factor in developing a successful academic career is strong writing capabilities and a demonstrable record of contributions to the field. This underscores the importance for Scholars to disseminate findings from our work through peer-reviewed publications, books (e.g., chapter, encyclopedia entries), and articles written for broader community consumption. NCRE Scholars has facilitated my own development in writing both manuscripts for peer-review publication and NIH grant proposals. With respect to manuscript development, the first

TABLE 1 | Metrics of the progress of NCRE Scholars in Cohorts 1-10.

Position at start of the program	Current position	Presentations	Publications	Grants
Cohort 1 | 2012				
Clinical psychologist	Tribal vice president	31	11	3
Assistant professor	Associate professor with tenure	54	17	2
Cohort 2 | 2013				
Post-doctoral Fellow	Community health services Regional administrator	2	7	0
Senior researcher	Assistant professor of clinical and translational research; co-director of research and evaluation	111	65	11
Cohort 3 | 2014				
Student	Health service psychologist	29	3	1
Student	Assistant scientist	8	10	4
Student	Assist. professor, director of inclusion initiatives	59	15	1
Cohort 4 | 2015				
Post-doctoral Fellow	Tribal epidemiologist	27	12	2
Behavioral health clinic director	Assistant professor	19	8	0
Cohort 5 | 2016				
Student	Tribal community facilitator	1	1	2
Student	Health scientist	30	14	1
Cohort 6 | 2017				
Student	Assistant professor	34	25	4
Post-doctoral fellow	Assistant professor	45	16	5
Cohort 7 | 2018				
Post-doctoral fellow	Assistant professor	85	24	1
Student	Assistant scientist	13	14	3
Cohort 8 | 2019				
Adjunct faculty	Post-doctoral fellow	9	6	1
Student	Post-doctoral fellow	21	5	1
Student	Assistant professor	31	13	1
Postdoctoral research associate	Associate investigator	106	33	2
Cohort 9 | 2020				
Assistant professor	Assistant professor	33	9	5
Student	Intern	23	13	0
Student	Post-doctoral fellow	17	6	1
Assistant professor	Assistant professor	20	2	1
Cohort 10 | 2021				
Student	Student	9	5	0
Student	Student	15	3	1
Assistant professor	Assistant professor	22	10	0
Student	Student			

Intensive Writing Retreat facilitated the development of an introduction section for an empirical manuscript. Specifically, within the two-day retreat, the introduction was fully drafted for the paper in preparation.

Furthermore, the monthly Virtual Writing Workshops serve as an essential review stage before journal submission. These avenues provide the opportunity for other Native scholars to offer feedback on writing, as I am the only Native Scholar at my home institution. In response to COVID-19 travel restrictions, NCRE Scholars leadership facilitated virtual writing retreats with the current cohort of Scholars *via* Zoom to ensure we could still achieve our writing goals.

Concerning grant writing, the monthly Virtual Writing Workshops enabled the solicitation of constructive critiques from a range of Native scholars on a recent proposal before its submission. As with the manuscript, this workshop is the primary avenue for me to engage with other Native scholars regarding the proposal and provides a critical perspective on the project that would otherwise be missing. For both grant and manuscript writing, future planned activities for the remainder

TABLE 2 | Selected evaluation responses from NCRE scholars in Cohorts 1-3.

Cohort 1 scholar
The experience of being an NCRE Scholar has been the most influential in my career as a researcher and continues to provide opportunities for me to grow as a professional. Thus, I will always wholeheartedly support NCRE in any and all capacities.
Cohort 2 scholar
Many of the techniques that I use daily in mentoring my team were learned through the two years that I spent as an NCRE scholar, and in the ongoing outreach of you both as I have developed as an independent researcher. Since my acceptance to NCRE, I have published 33 manuscripts and have received a Native American Research Centers for Health center NIH grant and an R0l award. I credit the NCRE training and nurturing in my success as an indigenous investigator. I value the ongoing support I continue to receive as a member of the NCRE network these years later.
Cohort 3 scholar
Becoming an NCRE Scholar was a career-changing experience for me. Before being selected for the program, I had worked with only one other American Indian researcher. I felt isolated personally and professionally; I had always been one of few or the only American Indian in every professional space I had been part of. The program provided me with resources to carry out a secondary data analysis, which enhanced my quantitative data analysis and manuscript writing skills, and paired me with two nationally recognized American Indian researchers. Dr. X[a] And I continue to collaborate; we have co-authored two manuscripts, and a book chapter focused on the health and experiences of American Indians. The connections I made and tremendous support I received as an NCRE Scholar directly facilitated my ability to successfully obtain pilot grant funding to carry out a research project in my own American Indian community here in Chicago. In sum, I believe this program was absolutely essential for my career development.

[a]*Name removed to protect the confidentiality of this Scholar.*

of the program will provide immense benefit. The upcoming grant writing workshop will provide focused time and hands-on training to facilitate an NIH R21 proposal development. Also, ongoing NCRE Scholar mentoring relationships are incredibly beneficial in building collaborations for manuscripts as well as grants. As a result, I have been able to incorporate experts in American Indian research as co-authors on manuscripts as well as consultants and mentors on grant submissions. These opportunities would not have been available without NCRE Scholars' support. Finally, in addition to direct writing projects, I have received experience reviewing academic writing in a mentored setting by serving as a reviewer in the monthly Virtual Writing Workshops. This fosters skill development essential for peer review service, which is nearly ubiquitous among academic careers.

Building Professional Connections (Dr. Sarah Momilani Marshall, Native Hawaiian)

The importance of building strong professional connections cannot be overstated. Through numerous formal and informal avenues, NCRE Scholars has provided me with crucial opportunities to develop and utilize relationships with senior mentors, early career researchers, and peers. Before my involvement with the NCRE network, I had minimal exposure to other Native researchers focused on substance abuse prevention and Native health issues. As a recent Ph.D. graduate who had chosen to remain in my rural community rather than re-locate to the city, I continuously encountered professional isolation and limited opportunities for career development. The professional connections facilitated by Drs. Whitesell and Sarche have become a vital resource for establishing relationships with other Native scientists throughout the country while remaining in my rural community. These opportunities to learn from other Native scientists have helped shape my expectations as a Native researcher, better prepared me to work with Native communities, and strengthened my identity as a Native scientist.

Another indispensable strength of NCRE Scholars is its ability to develop and maintain productive relationships among its current and former scholars and a broad national network of researchers in the field. As a Scholar in the program, I have richly benefitted from mentorship with other NCRE network researchers who have shared insights and perspectives with me from their own experience as early career Native scientists. Both peer mentors and established scientists in the field have generously shared personal challenges and triumphs and extended offers of consultation and collaboration. These unique opportunities to engage in informal conversations with peers and senior researchers have been structured around my individual professional needs and have provided me with invaluable support and guidance. Before becoming an NCRE Scholar, I could not have envisioned the depth of experience, knowledge, and wealth of resources I would receive through the program. The professional network that I have inherited as an NCRE Scholar has established a robust and critical foundation upon which I am better equipped to continue building future success.

Strategic Planning and Support for Career Development (Helen Russette, Chippewa-Cree)

As part of the in-person orientation meeting, NCRE program mentors provided our Cohort with designated time and guidance to develop our individual Tailored Career Development Plans (TCDPs). I had selected four specific career development objectives and received a careful review from my NCRE program mentor to ensure my TCDP objectives were specific, measurable, achievable, relevant, and time-sensitive (SMART). I felt the following objectives were feasible within the NCRE Scholars period of support: submit at least one research-related manuscript as the first author to a peer-reviewed journal and submit one grant application; connect with a substantive mentor in my field of research, and develop a professional network with other Native researchers. With the ongoing support and

opportunities provided by NCRE, I have made progress on several of my objectives and have completed two of them to date.

Such NCRE Scholar-supported research-related activities have helped me move forward in my research. I used a portion of our TCDP budget, which is designated solely for research-related costs, to work with another Native doctoral student to conduct an inter-rater reliability assessment for my qualitative study. My draft manuscript received a critical review from my fellow Scholars, NCRE program mentor, and members of the Scholars Advisory Board during a Virtual Writing Workshop, which allowed me to submit a more polished manuscript to a peer-review journal currently in review. I plan to submit at least one more draft manuscript to the workshop during my time as an NCRE Scholar. I, as well as another current Scholar, applied for and received diversity fellowship grants. Both of our proposals were strengthened by having letters of support from the NCRE Scholars Program Mentors. One reviewer noted specifically that a strength of my application was being an NCRE Scholar.

In light of the COVID-19 pandemic, travel has been interrupted. With support from NCRE Scholars Program Mentors, I have met and collaborated with my substantive mentor via Zoom. This career-altering connection would not be possible without NCRE Scholars. Within the first few meetings with my substantive mentor, I have gained a wealth of knowledge in my research field, which focuses on early community intervention among families with children with prenatal substance exposure. My mentor and I are currently discussing a possible post-doctoral position within their research institute upon my graduation, and I am currently collaborating on a project within their center.

Didactic Trainings (Jessica Saniguq Ullrich, Nome Eskimo Community)

In addition to building professional connections, strategic planning, and writing productivity, my fellow NCRE Scholars and I received didactic training on community-based participatory research (CBPR) and responsible conduct of research with Native communities. Virtual workshops were held with guest speakers who have expertise in engaging Native communities in successful research. Our first guest spoke about the principles of CBPR and the importance of providing helpful research to the community. Our second guest shared what motivated them to research with Native communities and gave practical advice on the importance of "failing forward," taking the perspectives of others, tolerating ambiguity, continuing to be reflexive, and ensuring that writing happens every day. Our third guest discussed how CBPR had made paradigmatic shifts within research more relational and community-driven because there is now a growing recognition that the community contains the knowledge and solutions. These discussions provided an opportunity to solicit practical advice for navigating the research landscape as a junior scholar, network with distinguished CBPR researchers, and learn from their collective research journeys that helped develop more effective health interventions for Native communities.

During the scheduled two-day Virtual Writing Workshop, Scholars listened to two former Scholars discuss their early career research strategies for ethically working with Native communities and how building mentoring relationships can guide community-based research. Their guidance was helpful because they could readily relate to what NCRE Scholars currently maneuver within research and academia. NCRE Scholars also had discussions with NCRE Program Mentors about the assigned readings and the conversations that took place with guest discussants, such as one Native researcher who provided her perspective on the grant review process. The next phase of the NCRE program will involve training and education about grant writing, which will be extremely valuable to junior scholars mapping out how to access funding that will benefit and serve Native communities. The training and relationships that have been established provide NCRE Scholars with connections, knowledge, and opportunities to launch successful research careers with Native communities.

DISCUSSION

Scientific leadership from within Native communities can play a vital role in research to inform solutions to persistent health inequities. Growing that leadership requires intentional and strategic efforts to support the development of Native students and early-career scientists. Engaging with emerging researchers in the NCRE Scholars program over the past decade, we have found four key elements critical to enhancing career progress. A focus on *establishing a record of research productivity* has helped Scholars gain practice and proficiency and document expertise necessary to obtaining jobs and grant funding. Introducing them to senior researchers, key mentors, and a network of early-career Native researcher peers enables them to *build professional connections* that generate collaboration, provides support, and reduces the sense of isolation many encounters in academic settings. Offering *strategic planning and support for career development* allows us to work with Scholars to create tailored plans for career development that honor individual goals, respect the different visions Native researchers have for working with communities to create research and adapt to varying career levels. More recently, with additional resources, we have been able to enhance Scholars' experiences through *didactic pieces of training* that allow strengthening skills and practice, particularly in grant writing, that we hope will increase their success in obtaining research funding.

The success of these strategies is reflected in the progress of Scholars across the ten cohorts to date, but perhaps most strikingly in the fact that Scholars across most cohorts remain actively connected to and committed to one another. Their strength is in the bonds they form. Many participate at least periodically in monthly Virtual Writing Workshops, and most attend NCRE conferences and convene for NCRE networking events at the annual Society for Prevention Research conference. As a testament to the strength of these connections, three past Scholars from two different cohorts submitted a collaborative NIH grant application in 2020 that was funded in 2021.

As Scholar's comments above reflect, they form a network of collegial support that is an invaluable resource for many as they navigate the waters of academia–together–as Native researchers, otherwise easily drifting alone in many institutions and professional organizations. The relationships they form are meaningful, lasting, supportive, and generative. They consult with one another, share ideas, problem-solve, and together they persist and thrive.

The need for more Native researchers is clear. Native researchers can collaboratively find the solutions to the unresolved inequities within Native communities through building effective prevention and intervention strategies that will relieve the undue burden of substance use disorders. The importance of supporting the career development of emerging Native researchers is also evident because they are often thrust, too soon, into the fray. Communities and academia alike are eager for bright new Native researchers and often urge them to take up the charge too soon. They are pulled forward and sideways into commitments and responsibilities, denied the protected time and support needed to demonstrate productivity and develop research independence (23). Meanwhile, their non-Native peers have time to publish, write grants, and establish productive research careers (24).

The NCRE Scholars program is an example of how training tailored to meet the needs of Native researchers–in this case, those specifically focused on research addressing the impacts of substance use and disorder on Native children and adolescents–can have a significant and lasting impact. Programs like this are needed across scientific disciplines to support the career development of Native scientists broadly and to increase representation in the leadership of research that is with and about Native communities so that the research can be more effective in addressing the community needs and priorities. We believe that the NCRE Scholars program can be a model for successful mentorship for other underrepresented scholars in the academy.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

ETHICS STATEMENT

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

JI, MS, and NW contributed to conception, design of the study, and wrote the first draft of the manuscript. EW, SM, HR, and JU wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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Centering the Strengths of American Indian Culture, Families and Communities to Overcome Type 2 Diabetes

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Type 2 diabetes (T2D) is a critical Indigenous health inequity rooted in experiences of colonization and marginalization including disproportionate exposure to stressors, disruption of traditional family and food systems, and attacks on cultural practices that have led to more sedentary lifestyles. Thus, an important step in redressing inequities is building awareness of and interventions attuned to unique Indigenous contexts influencing T2D and Indigenous culture as a pathway to community wellbeing. Using a dynamic, stage-based model of intervention development and evaluation, we detail the creation and evolution of a family-based, culturally centered T2D preventive intervention: Together on Diabetes (later Together Overcoming Diabetes) (TOD). The TOD program was built by and for Indigenous communities via community-based participatory research and has been implemented across diverse cultural contexts. The TOD curriculum approaches health through a holistic lens of spiritual, mental, physical and emotional wellness. Preliminary evidence suggests TOD is effective in reducing diabetes risk factors including lowering BMI and depressive symptoms, and the program is viewed favorably by participants and community members. We discuss lessons learned regarding collaborative intervention development and adaptation across Indigenous cultures, as well as future directions for TOD.

Keywords: CBPR, American Indian/Alaska Native, Native American, intervention–behavioral, diabetes, prevention

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INTRODUCTION

Type 2 diabetes (T2D) represents a critical health inequity in many American Indian (AI) communities where rates are more than double the overall US population (1), including in the Midwest and Southwest regions where our research primarily takes place (2–5). Diabetes is also a major player in cardiovascular disease, the leading cause of AI death (1), and contributes to complications that substantially reduce quality of life (6). Prevalence of T2D for AI youth is 7 times greater than White youth (1.2 vs. 0.17/1,000) (5) and 2.6 times more than US all races (1.2 vs. 0.46/1,000). Amidst such startling statistics are realities of human suffering reflected in excerpts from focus groups our team led with Ojibwe adults: *"I live with pain every day, if I don't take those pills every day my arm goes numb, gets useless."* and *"I found out about 35 years ago that I had diabetes. I've lost a lot of my eyesight, I developed cataracts from the diabetes. I'm in the last stages of kidney disease."* These stories motivate our goals of health promotion for and with current and future generations of AI people.

Doubly motivating are the roots of injustice underlying the T2D epidemic. Stress has been considered an etiological agent of T2D for centuries (7) and compromises disease management, healthy behaviors and metabolic control (8, 9). Many AIs experience heightened exposure to stressors including poverty, intergenerational trauma, and discrimination (10). A deep-rooted backdrop of these stressors and health inequities is historical trauma, the cumulative wounding from collective AI exposure to policies and practices perpetuated with ethnocidal intent (11–14). Notably, rates of AI T2D were low prior to the 1940s (15). Disruption of Indigenous family and sustenance systems via attacks on cultural practices, traditional languages, and relocation policies led to sedentary lifestyles and reliance on government commodity food programs (14) contributing to disparate T2D rates today. In sum, uniquely profound issues of social justice underpin this modern epidemic for AIs.

There is thus a critical need to address the fundamental causes (16, 17) of and risk/protective factors linked to T2D and its complications within AI communities. Behavioral interventions have been shown efficacious for improving outcomes related to chronic disease and result in treatment-related cost savings (18–20). For instance, the Special Diabetes Program for Indians Diabetes Prevention Program (DPP) aimed at reducing fat intake and promoting healthier diets and physical activity through individual counseling has seen remarkable success in terms of reductions in kidney failure, diabetic eye diseases, and stabilization of obesity rates among AIs (21, 22).

Our community/university team has worked to create, enhance, and evaluate a multi-generational preventive intervention for AI families within diverse tribal communities called Together on Diabetes and later Together Overcoming Diabetes (TOD). Our approach emphasizes lessons learned in prior T2D prevention and treatment programs and expands the approach to include family-centered, home-based holistic health promotion, community-specific targets for health promotion and risk, and addressing common barriers to care. A major tenet of the development, piloting, and ongoing trials for TOD is that Indigenous community perspectives and co-creation of preventive interventions are necessary for program effectiveness, acceptability, and sustainability. Indeed, authentic community engagement through orientations such as community-based participatory research (CBPR) are essential for ethically addressing health priorities within any community; such approaches also align with the sovereign right of Tribal Nations to govern and oversee any research that takes place within its territories (23).

Another tenet of our approach is that Indigenous Peoples have long centered cultural ways and the reclamation of traditional values and teachings as critical components of health promotion (24, 25). Yet, positivist science frameworks have lagged behind Indigenous wisdom with minimal (albeit growing) inclusion of Indigenous-specific programs in what is considered "evidence-based" (26). Incorporating Indigenous culture in preventive interventions also represents a redressing of historical trauma and a pathway to healing for T2D specifically wherein the disease has been understood in diverse Native contexts as a disruption of balance, loss of cultural ways, attacks and loss of traditional language, and/or contamination of lifeways due to colonization (27–29). Incorporating contemporary Native cultural context, such as the existence of food deserts, was also another valuable aspect of our approach to T2D prevention. For example, the Navajo Nation only has 13 grocery stores in a land area equivalent to New England (30). We aimed to address these issues by centering community and cultural contexts in the *process* and *content* of TOD curriculum creation and evaluation.

A FRAMEWORK FOR ITERATIVE, COMMUNITY-DRIVEN PUBLIC HEALTH INTERVENTION DEVELOPMENT AND EVALUATION

As noted, our team's approach to public health intervention development and evaluation is rooted in community-researcher relationships and collaboration. **Figure 1** displays a stage-based model of tribally-based intervention development and evaluation.

The framework includes considerations such as community identification of priorities, iterative, cyclical processes, and a range of intervention development and/or adaptation possibilities drawing from previous researchers working with Indigenous communities (31, 32). We consider and describe seven stages to our approach; importantly, stages may not neatly flow in numerical order, and some stages may not be clearly relevant to all iterations of intervention progression or community priorities. Keeping this in mind, and in alignment with CBPR, a common early stage (**Stage 1**) involves an invitation from a community to address an issue of concern. **Stage 2** prioritizes the identification of community and/or culturally relevant risk/protective factors related to the health outcome and/or formative work to identify issues relevant to the feasibility and/or acceptability of a proposed intervention. This is often accomplished through "basic" (vs. applied) or formative research techniques. Stage 3 considers a range of possibilities for intervention development or adaptation such as those outlined by Okamoto et al. (33); this could include building an intervention from the ground-up, implementing an existing program, and/or adapting a program to match local culture and context. Stages 4 & 5 represent a move to intervention implementation and evaluation; at Stage 4, initial evaluation work may be process oriented, collect pilot evaluation data, and/or focus more deeply on feasibility or acceptability. **Stage 5** represents "next phase" efficacy evaluation, which has a primary focus on understanding the impact of the program on intended outcomes. This may include mixed-methods, qualitative methods to identify nuanced mechanisms of program effectiveness, and/or quantitative methods including variations on western scientific experimental designs to isolate and evaluate the impacts of the intervention on outcomes. At **Stage 6**, partners focus on sharing results within the community where work has taken place, and later sharing and scaling lessons learned so other communities may benefit or use the program. **Stage 7** is an explicit nod to the fact that this process is dynamic; any "final" intervention may need to be agile to modification, re-evaluation,

FIGURE 1 | A stage-based model of tribally-based intervention development and evaluation.

and so forth, and thus require a revisit to any or all previously completed stages. In the sections that follow, we detail our team's diverse pathways through these stages as part of two distinct iterations of the TOD program in the Southwestern and Great Lakes regions of the United States.

PROGRAM ITERATION #1: TOD_SOUTHWEST (SW)

TOD_SW Stage 1: Invitation and Description of the Team

In 1980, a Johns Hopkins pediatrician, Dr. Mathuram Santosham, began work with the White Mountain Apache Tribe (WMAT) to address an outbreak of diarrheal disease in babies. Following this, he moved his family to the Fort Apache reservation where he lived and worked for over 5 years. Here, he worked with WMAT and later, the Navajo Nation to identify and address disparities in infectious disease among Native children. In 1991, he founded the Johns Hopkins University (JHU) Center for American Indian Health (CAIH) with a mission to *work in partnership with tribal communities to design public health programs that raise the health status, self-sufficiency, and health leadership of Native people to the highest possible level.* CAIH strives to use community-engaged approaches, especially CBPR, in all aspects of its work. Over the past 30+ years, JHUCAIH grown to also address behavioral and mental health inequities (e.g., suicide, early childhood health and well-being, obesity, etc.), including T2D.

In the late 2000s, Navajo and Apache communities identified T2D as an urgent issue and began to work with CAIH to identify strategies to address this concern. In Fall of 2011, CAIH researchers applied for and received funding to develop, implement and evaluate a program to address T2D with 1 Apache and 3 Navajo communities. The funding was flexible, providing the team the opportunity to adapt existing or develop new intervention content and structure, determine the target population for the intervention, and identify the most appropriate study design.

The TOD_SW team initially included an On-site Manager at the Albuquerque Hub of CAIH; local study teams comprised of 3–4 local Native staff at each of the 4 communities; Community Advisory Boards (CAB) from the 4 participating communities; a Cross Site Steering Committee (CSSC); and a Curriculum Specialist, Evaluator, Program Manager, and PI based in CAIH administrative offices in Baltimore, MD. We also consulted with a Harvard-based pediatrician with nutrition expertise, a diabetes expert from Indian Health Services (IHS) and various other experts across the partnering communities and the US. CABs at each site were created to guide program development and implementation. Each CAB consisted of 8–12 members and included health educators, teachers, law enforcement representatives, medical providers, behavioral health specialists, traditional practitioners/elders, parents, youth and community members from the study sites. The CSSC was comprised of pediatricians, nurse practitioners, diabetes consultants and educators, mental health providers, IHS clinic leaders, community-based program leads, diabetes focused program leads, cultural consultants, a traditional practitioner, elders, wellness center coordinators, and CAIH study staff from the four study sites. Many CSSC members also joined their local CABs. All study staff who worked on the TOD_SW study were hired as full-time employees of JHU. All community staff were Native; most were from the community in which they worked.

TOD_SW Stage 2: Basic and Formative Research

Initial TOD_SW formative work took place over a period of 9 months, during which we aimed to build a culturally appropriate program that fit the unique needs of the four communities and adequately addressed existing gaps in T2D prevention and management. The CSSC met four times in the first 6 months of the project (2012) and annually thereafter; meetings were held in person, began with a prayer followed by lunch and a sharing of knowledge. Meetings ended with a closing prayer. At the first meeting included presentation from site representatives that include information about: (1) T2D prevalence and incidence data from their site/service unit, (2) T2D programming in their community, (3) perceived gaps and opportunities in T2D prevention, management and treatment, and (4) perceived diabetes risk and protective factors; the urgent need for programming for youth with diabetes or pre-diabetes emerged as a need across sites. Additional gaps included those at the service level (e.g., lack of standardized protocols for screening youth for T2D, need for culturally-centered care) and at the program/community level (lack of evidence-based materials for youth with T2D, need for family-centered programming, limited holistic training/holistic health focus for educators, inconsistent nutrition information about traditional foods, language/cultural disconnect barriers, predominant focus on negative vs. positive behaviors, lack of transportation services). Identified opportunities included enthusiasm of local partners, robust network of diabetes programming for adults, and traditional Native medicine programs at many of the participating sites.

CABs met quarterly throughout the duration of the study. CAB meetings incorporated the Indigenous holistic framework (34) as follows: *Respect*: CAB meetings ensured TOD was designed and implemented with respect for Navajo/Apache culture and communities. *Responsibility*: a wide range of community members were engaged consistently in order to develop and sustain meaningful relationships and foster a shared responsibility/commitment toward community wellness. Further, the impact of the TOD program was discussed at final CAB meetings. *Relevance*: CABs provided information about changing needs of the community and identified potential activities that could be implemented at community level. *Reciprocity*: CAB meetings engaged Native and non-Native community members and had a primary goal of shared learning. Resources exchanged at these meetings were also mutually beneficial. Community partners helped each other because we all had a shared goal of community wellness.

Early in the study the CSSC proposed roundtables with youth and parents in the four communities to better understand how to address T2D through team-identified gaps and opportunities. Roundtable guides were developed with CABs and Baltimore team members. The guides focused on healthy and unhealthy behaviors and knowledge and attitudes about physical, mental, spiritual and emotional health. Participating youth were also asked about their role models and who/what influences their behaviors. A total of 12 roundtables were completed with youth ages 10–19 years and nine with adult parents. Roundtables were facilitated by trained Navajo or Apache study staff who took notes which were reviewed and compiled to inform TOD. Roundtables were not recorded. Key takeaways were: (1) youth did not think holistically about the food they ate, (2) parents wanted to be involved in programming, as they had limited knowledge of healthy eating/exercise and wanted to support their children's lifestyle changes, (3) there were few activities available for families, and (4) youth needed additional support related to life skills (e.g., learning about problem solving and communication). A theme across roundtables was that parents play a key role in youth diets, physical activity, and mental health. Thus, TOD would be delivered to youth alongside their parents or trusted adults, named "Support Persons (SPs)," with a family/multi-generational, holistic health emphasis. A family focus also aligns with Navajo and Apache cultural norms, which are common across many Indigenous groups (35–37).

When TOD was being developed, few evidence-based diabetes prevention or management programs existed for Native populations (38). There were even fewer programs for youth with or at risk for T2D and none that met the criteria of being family-centered, home-based, and/or tailored by and for Native populations. The study team identified and reviewed four programs that met at least one of these specifications: (1) The *Diabetes Prevention Program (DPP)* which has a rich evidence base for reducing incidence of diabetes among at-risk adults (39). At the time, the DPP had been adapted into the adult-focused Native Lifestyle Balance Program–designed for Native adults. (2) The TODAY (Treatment Options for Diabetic Youth and Young Adults) study curriculum, designed for youth with T2D, was undergoing a rigorous efficacy trial at the time the TOD

program was being developed (40). (3) *Cherokee Choices*, a school and community-based diabetes prevention program designed for Native youth and their parents (41), was undergoing a pilot feasibility trial. (4) CAIH programs that were home-based, for families, designed for Native populations and efficacious, such as the Family Spirit program (42). Ultimately, we determined that none of these programs fully met the gaps and built on the opportunities identified across our target communities. As such, we decided to use the DPP program as a model of TOD structure and utilize other programs to inspire curriculum content.

TOD_SW Stage 3: Program Adaptation and Refinement

Information from the CSSCs, CABs, and roundtables was coupled with knowledge from local study staff and scientific experts in order for a Curriculum Specialist and Study Manager (Curriculum Team) to draft a basic outline of 12 intervention lessons. The outline was reviewed and revised with CSSC members, the CAB, local staff, and content experts (e.g., cultural consultant and physician with extensive knowledge of pediatric diabetes). Feedback was minimal and included specific suggestions for incorporating local knowledge. The Curriculum Team then created first lesson drafts by reviewing activities/content in programs described in Stage 2 for possible integration or adaption into TOD, and adding original content for topics that addressed community needs and assets. Content was also informed by findings in the scientific literature. The Curriculum Team reviewed draft lessons with the local study team. In some instances, the local team was asked to come up with additional ideas for lesson activities, which were incorporated into next drafts. These lessons were then reviewed by CAB and CSSC members; using their feedback, the Curriculum Team revised drafts and finalized/refined content in collaboration with local study team and/or CAB members and/or content experts (e.g., cultural consultant and diabetes/nutrition experts). It was determined that cultural elements that were not appropriate to be incorporated into the curriculum would be delivered orally by family health coaches during lessons. Penultimate drafts were reviewed and feedback collected from in-person CAB meetings, the CSSC, and local study staff prior to finalization.

The resulting TOD_SW program curriculum is summarized in **Table 1**. The program engages youth ages 10–19 with or at-risk for T2D and an adult "support person." Lessons are taught by a Family Health Coach (FHC), a Native paraprofessional trained in delivery of TOD.

The program addressed multiple levels of influence (e.g., individual, family, community) using: (1) youth curriculum (details below); (2) support person curriculum (four lessons delivered during the first 6 months of the intervention and focusing on active listening, support skills, nutrition and physical activity), (3) engagement with local healthcare providers (e.g., transporting to clinical appointments, FHCs attending appointments with youth when possible, sharing reports with local providers as chart notes, presenting during pediatric provider meetings, etc.), (4) community connections and events (e.g., hosting monthly events like fun runs/walks, cooking lessons, dance classes), and (5) optional social support visits from FHCs. The youth curriculum included an intervention phase and a maintenance phase. The intervention phase included 12 lessons, each lasting about 45–60 min, delivered biweekly during the first 6-months of enrollment. All lessons were delivered in the home to the youth, and support persons were encouraged to attend. The 12 intervention lessons focused on balance and moderation and provided enrolled youth with knowledge and skills regarding nutrition, physical activity, diabetes, and life skills such as positive thinking, problem solving, support networks and communication. All lessons included the incorporation of Motivational Interviewing to help youth make and reach realistic healthy living goals based on information youth had learned, and a check in time to follow up on previous goals (43). Lesson activities included games, discussions, hands-on learning, and animated videos developed by local AI youth to reinforce lesson objectives through a serial drama. The first 10 intervention lessons were the same for all youth; for visits 11 and 12, the FHC worked with the youth to choose 2 of 4 lesson options based on their interests and progress through the program. These 12 intervention lessons were followed by a 6 month maintenance phase during which the FHC met with the participant monthly for about 20–30 min. These lessons included the youth, their support person, and the FHC and were designed to help youth sustain behaviors and transition support provided by the FHC through the TOD program to their support person.

Many of the community-driven targets within TOD curriculum are paralleled by existing or emerging scientific evidence. For example, TOD emphasizes balance and holistic wellness. This includes balancing energy in (food) with energy out (physical activity), overall wellness across physical, spiritual, emotional and mental health. Holistic health considerations are also critical to T2D outcomes. For example, those living with T2D are more likely than people without diabetes to experience depression, which in turn is associated with a variety of consequences such as increased rates of hospitalization and health care spending, activity impairment, comorbidities, and heightened mortality (44–47). Similarly, reports of apathy among Indigenous adult patients with T2D has been linked to lower quality of life and worse blood glucose management, while connection to cultural/spiritual ways is inversely associated with apathy (48).

As noted previously, the home-based, family-focused nature of TOD recognizes the centrality of family in many AI communities. Home-based delivery also addresses community-cited transportation issues that diminish access to care. For example, prior research shows that AIs report transportation barriers to healthcare twice as often as Whites (39% vs. 18%) and transportation was a contributor to intervention dropout in the AI DPP (49, 50). Our FHCs were pivotal in meeting participants "where they were at" by providing lessons where participants were most comfortable: in or outside their homes, at the TOD office, or at another communal location of their choosing.

Past research suggests that cultural and communication differences between AI patients and non-AI providers may compromise T2D care, and AI adults have reported feeling

TABLE 1 | TOD Southwest curriculum outline.

Lesson	Topic area	Content	Examples of inclusion of indigenous knowledge and values
1	Ready, Set, Go! Setting My Goals	FHC meets with Youth Participant, SP and other family members to review TOD Program structure and expectations. They also learn goal setting and set a long-term and short-term goal related to healthy living.	• Interconnectedness
2	Making My Healthy Plan	FHC works with youth to help them better understand the diabetes process in the body and address any of the youth's barriers in managing or preventing diabetes. Optional: FHC, Youth, SP and Provider meet to discuss youth's diabetes plan.	• Inclusion of cultural perspective of diabetes • Honesty • Bravery
3	Eating to Win! A Balancing Act	This lesson introduces youth to energy balance. Youth learn about sources of energy for our bodies, understand how much energy our bodies need and, by the end of the session, are able to identify the amount of energy in many foods.	• Balance • Holistic teachings • Traditional foods
4	The SPIRIT Approach to Tackling Problems	Youth learn problem solving utilizing the SPIRIT approach (S-Stop and relax; P-understand the Problem; I-Identifying possible solutions; R-Review each solution; I-I choose this solution; T-Try it out and Treat yourself.). By the end of the session youth can identify and tackle problems, including barriers to achieving goals.	• Resilience • Interconnectedness
5	Think Positive!	Youth learn ways to think positive, turn a negative situation into a positive experience and understand the contribution a positive outlook has in living a healthy life. They also work with their FHC to create a positive sense of self.	• Positivity • Respect for self • Strength • Community values incorporated into personal power statements
6	Building a Winning Team	Youth work with FHCs to identify people in their support network who can help them overcome barriers to achieve goals, address problems, motivate them for success, and build self-esteem	• Interconnectedness • Community support • Importance of family
7	Sweet Revenge! Don't Be Fooled!	Youth work with their FHC to learn about carbohydrates, mainly sugar in their food and the difference between a lot of traditional foods and contemporary foods in their sugar content. They learn about hidden sugars and complete activities in which they can visualize sugar in foods.	• Traditional foods, importance of water • Food's connection to all living things • Food's connection to one's cultural, mental and emotional health
8	Let's Move: Exercise and Me	Youth learn the meaning of physical activity and different types of physical activity they can integrate into their daily routine. They learn what happens in our bodies during exercise and discuss the difference between sedentary activity and exercise. They learn about spiritual and cultural importance of running.	• Traditional forms of physical activity • Showing respect for our bodies • Balance • Connection of specific types of PA to cultural and spiritual wellness • Mindfulness
9	Finding My Groove	Youth work with the FHC to discover physical activities they like to do and understand how they can integrate these into their weekly schedule with support of family members	• Traditional forms of physical activity • Support from family • Gratitude
10	Eating to Win	Youth learn the importance of "My Plate," portion size, food groups and meals. They learn about the function of different vitamins and minerals and will revisit the concept of energy in = energy out. They discuss where food comes from and how all things are connected to the earth.	• Natural foods, traditional foods
11–12	Yes I Can! Series	Take Control (Social Development and Diabetes)—Youth learn strategies to promote healthier choices when attending parties and going out to restaurants to eat. They discuss mindfulness when eating	• Mindful Eating • Appreciating the nutritional, cultural, and medicinal value of foods
		Say No (Dealing with Peer Pressure)—Youth learn about assertive, aggressive, and passive communication. They develop skills that help them say no to peer pressure and build the strength to stand up for what they believe when faced with a difficult situation.	• Bravery • Respect for others and self
		Plan for Success (Meal Planning)—Youth work with FHCs to come up with a strategy to meal plan. They also learn about the importance of being intentional when eating.	• Traditional foods and preparation • Eating seasonally

(Continued)

TABLE 1 | Continued

Lesson	Topic area	Content	Examples of inclusion of indigenous knowledge and values
		Manage my Diabetes (Diabetes Management)—Youth with diabetes may complete this lesson. They learn about managing their diabetes and work with their family health coach to identify and overcome barriers to diabetes their management.	• Self-Care • Interconnectedness • Bravery • Honesty
Four optional visits during first 6 months			
	Social support visits	FHCs conduct a Social Support Visit with a participant if they arrive to a scheduled visit and it is apparent that the participant is not ready to discuss curriculum content due to difficult circumstances in their life. FHCs will be trained to provide support and refer the participant to appropriate resources in the community. Four Social Support visits are included in the curriculum structure. If additional support is needed, the case is discussed with the study team.	
Monthly check-ins during second 6 months			
16–22	Monthly check-in	FHCs schedule monthly check-ins with the participant and support person. These meetings are used to teach curriculum topics that were not covered during the 6 month core sessions, provide additional support to the participant and their families, and work to transition the support provided by the FHC during TOD to the support person.	

inadequately supported in T2D management (51–55). Loss of support has been viewed as a determinant of disease for some Indigenous people where disconnection leaves one "open to illness…from the outside world" (29). Community-based team members shared that their own experiences with prior T2D care was overly focused on individuals and medical aspects of disease and acknowledged benefits of a supportive AI FHC to deliver education in homes in culturally appropriate ways.

TOD_SW Stage 4: Initial Program Evaluation Work

Implementation and evaluation of TOD included hiring and training FHCs to deliver the curriculum and conduct evaluation work. Training focused on curriculum delivery, study protocols, and special topics (often hosted by Native organizations), including motivational interviewing, facilitation skills, cultural teachings, diabetes knowledge, and Native nutrition. Follow-up trainings were conducted based on needs of FHCs identified through feedback on anonymous surveys and through regular check-in calls with all study team members.

The CSSC and Baltimore-based team members collaborated to identify TOD_SW evaluation methods. Because there were no other services or programs for youth with T2D and because TOD was a new program, we felt it was unethical and premature to conduct a randomized controlled trial to assess program efficacy. Thus, we designed a pilot pre/post evaluation study to assess program impact and acceptability.

Evaluation outcomes were selected by reviewing scientific literature and measures previously used in CAIH behavioral intervention studies, from which we created a matrix of potential measures (diet, A1c, zBMI, physical activity) to guide discussion at CAB and CSSC meetings. Community-based team members suggested inclusion of resiliency and medical home measures. We piloted measures with ∼20 youth and their caregivers. Based on feedback, we made edits to the language of existing measures to improve face validity and comprehension (56, 57).

A total of $N = 256$ youth ages 10–19 years and $N = 226$ adult support persons enrolled in the study. Baseline data was collected from all youth enrollees. A total of 217 (84.8%) youth completed the 12-month evaluation. Youth completed an average of 9.35 lessons, with 73.4% of youth completing $\geq$8 lessons. A total of 21 FHCs across the four tribal community sites delivered 3,118 lessons and 1,149 evaluations during the project period. Sites also hosted regular community-based wellness activities (e.g., cooking demonstrations, walks/runs, biking). Over 30 outreach activities and 10 diabetes support services were conducted at community sites during the project period.

Throughout implementation, the Baltimore and Albuquerque teams met weekly with each site team to discuss case load, identify barriers to implementation and generally talk through what was and was not working in relation to the TOD program. The Baltimore and Albuquerque teams also led a cross-site teleconference meeting with all four sites once a month. This meeting was a time for sites to share successes and challenges. During these calls, we identified and made minor edits to the curriculum (e.g., creating a step-by-step visual of how diabetes happens in the body) and to the evaluation outcomes (e.g., collecting physiological measures from the Support Person) (58).

Findings provided promising evidence for the effectiveness and acceptability of TOD. Youth reported a significant increase in diabetes-related knowledge and pediatric quality of life from baseline to 12 months post intervention (59). The proportion of youth with depressive symptoms, those with hypertension and those reporting no days of physical activity in the past 3 days significantly decreased from baseline to

12 months post intervention. Youth experienced a significant decrease in zBMI, and youth with T2D at baseline experienced a significant decrease in A1c from baseline to 12 months post intervention. We also observed that a subset of adult support persons ($n = 35$) experienced a significant decline in BMI (58).

Reported program acceptability and overall satisfaction among support persons was high (58). Youth satisfaction was also high with 95.6% reporting they *learned a lot*, 95% reporting the program *helped them a great deal* and 96.13% reporting they would recommend this program to others. Acceptability was also high among youth with 87.2% reporting the number of visits with the FHCs was "just right," 87.2% reporting the length of the program was "just right," and 83.4% reporting visits with the health coach were "important" to their life.

The value and importance of FHCs who are members of the communities they serve cannot be overstated. Like many community health workers, FHCs shared similar lived experiences with participants and had invaluable cultural knowledge, both of which likely factored into overall satisfaction and retention. As one example, FHCs were able to incorporate traditional teachings that were not included in the curriculum. One FHC stated: "*Several families were already familiar with this teaching so it wasn't necessarily us sharing with them. Rather, it came up organically during certain lessons and FHCs related this discussion to TOD teachings*." FHCs thus could tailor the program in culturally safe ways that acknowledge the diversity of Indigenous spiritual and cultural beliefs, which can vary dramatically even within specific communities. We also learned that in some instances, youth engaged in the program and worked toward behavior change because they considered the FHCs "cool;" FHC relatability to youth thus may influence program acceptability.

TOD_SW Stage 5. Next Phase Efficacy Evaluation

The TOD_SW team has applied for funding to implement the program with expanded focus on mental health outcomes and a more rigorous evaluation design. In addition, a description of a "next iteration" efficacy trial currently underway in the Great Lakes region is described in detail below.

TOD_SW Stage 6. Dissemination of Findings, Sharing, and Scaling

Findings from TOD_SW study were disseminated to participating communities through various methods. First, local study teams presented findings at a CAB meeting in their community. Second, letters were sent to participants presenting findings. Third, a report of findings along with all journal articles about the TOD program were reviewed and approved by local governing bodies. Fourth, the study team presented final TOD findings at the bi-annual Navajo Research Conference. Fifth, local Site Coordinators included TOD findings in their regular updates to local governing bodies. CAIH posted study findings on their website and disseminated findings to partners through their monthly newsletter. They also presented outcomes at scientific conferences including the biannual International Meeting on Indigenous Child Health and the annual meeting of the Society for Prevention Research.

TOD_SW Stage 7: Ongoing Refinement, Next Generation Programming

We noted at the outset that the stage-based framework of intervention development and evaluation underpinning this work is dynamic and may not always follow a linear pattern. Beyond the processes described throughout the TOD_SW pre/post study, iterative changes and focal shifts continue. For instance, one of the TOD_SW community's Indian Health Service Units asked the CAIH team to translate the program to be implemented throughout school health clinics. The adapted TOD program, "Yéégo" (meaning "with great effort, do it" or "with spirit"), is currently being implemented. The TOD program has also been implemented in Native communities in California. This stage also interacts with Stage 5 (next generation efficacy trials) as we implement the TOD program in the Great Lakes region.

PROGRAM ITERATION #2: TOD GREAT LAKES (TOD_GL)

The foundational work of the TOD_SW team resulted in a promising multigenerational home-based diabetes preventive intervention developed by and for Indigenous Peoples. Below, we describe a next-generation iteration of TOD development and evaluation using **Figure 1** as a guiding framework.

TOD_GL Stage 1: Invitation and Description of the Team

In June 2019, a team of Ojibwe community and JHU-based researchers working in the midwestern US received funding to adapt, implement, and evaluate the TOD program through a wait-list RCT (TOD_GL). The team had already completed two observational studies focused on Ojibwe experiences with a) mental health and diabetes (Mino Giizhigad study), and b) stress and diabetes (Gathering for Health study); additional background information for these studies has been published previously (60, 61). In alignment with CBPR approaches a longstanding goal of the team was to translate their research findings into action in the form of public health programming (62). After reviewing existing literature on diabetes preventive interventions, the team invited TOD_SW researchers to a local meeting to present information about the program and share preliminary outcome data. Additional information on the formative work surrounding TOD_GL is noted in Stages 2 and 3 below.

The TOD_GL team includes JHU researchers at the CAIH Great Lakes Hub offices in Minnesota and Community Research Councils (CRCs) from five participating Ojibwe reservation communities. Each CRC is comprised of four to eight individuals who act as equal partners with academic researchers in every stage of program adaption, implementation, and evaluation (59). The term *Community Research Council* was adopted to replace *Advisory Boards* to acknowledge the substantial

and active contributions of the CRCs in the project that goes far beyond advising. CRCs include representatives from participating communities who have diabetes or have family members with diabetes, work at local clinics, and/or are Elders, nurses, diabetes educators, fitness coaches, and representatives of tribal governments.

TOD_GL Stage 2: Basic Research and Formative Work

The GL team's prior research on mental health, stress, and T2D generated foundational basic/observational knowledge that informed TOD adaptation processes. In particular, our team generated scientific evidence that aligned with stress process models of disease (63, 64) to suggest: a) stressors, including exposure to discrimination, trauma, family stress, and health-related strains, are associated with worse health and diabetes-related outcomes among Ojibwe adults living with T2DM; and b) coping factors like family and community support and Ojibwe cultural factors (e.g., identity, communal orientation, etc.) offset or buffered the negative impacts of stress on health and/or served as protective factors for diabetes patients (48, 65, 66). Given this, one component of TOD_GL program adaptation focused on inclusion of stress/coping curricular content.

Additional formative work for the GL team included CRC-led community feasts and forums, listening sessions, brief surveys, and group discussions at all 5 tribal sites prior to applying for funding for the TOD_GL trial. These activities generated preliminary community-based data to suggest that residents across the five tribes were interested in the content of the program, found it matched gaps in terms of their needs/their community needs, and that they gave high rankings of perceived effectiveness and willingness to participate in the program.

TOD_GL Stage 3: Program Adaptation and Refinement

The TOD_GL curriculum is rooted in the lessons, structure, and foundational successes of TOD_SW. The process of adapting curriculum was iterative and centered Ojibwe community and cultural perspectives in alignment with Okomoto et al.'s (33) description of deep-structure cultural adaption. We used findings from our observational studies to create two new lessons to address historical trauma, healing, stress, coping, and the relationship of these factors to diabetes. Additional changes were made to the curriculum to enhance the presence of Ojibwe-specific cultural knowledge and strengthen existing content related to values such as connection to the earth, the importance of family and community, and drawing on the strengths of past generations to forge a better future. We also shifted the primary "target" of intervention to adults living with T2D who would enroll in the program alongside a youth who lived in their home; that is, adults with diabetes would enroll in the program for intervention purposes, and youth would enroll with a primary focus on preventing diabetes. Based on community input, a foundational premise of TOD_GL was that adult-child interaction is a leverage point for family-based motivation (67). This shift required basic changes to curriculum examples, language, and removal of "support person" content that had been used in TOD_SW. In addition, CRC members recommended renaming to call the program *Together Overcoming Diabetes* in English. The resulting TOD_GL intervention includes 14 core lessons, six maintenance lessons, and four optional social support visits. Following TOD_SW, the intervention is delivered to adult-youth dyads in their homes by local FHCs. **Table 2** summarizes the TOD_GL curriculum.

The process of adapting and refining TOD_GL curriculum involved deep reviews and demonstrations of draft lessons by/with community/university teams, advisement by elders, and reviews and consultations with outside experts and medical clinic staff in each community. This process varied based on the objectives of specific lessons. For example, lessons 1 and 2 focus on understanding the biomedical mechanisms of diabetes and its management and thus were shared with local clinic staff early in our adaptation process. Staff reviewers included diabetes educators, nurses, administrators, physicians, and fitness coaches who gave us feedback on the medical accuracy and alignment of lessons with local clinical protocols. As another example, five nutrition lessons were reviewed by CRCs during a full day in-person meeting. Team members reviewed each lesson in small groups and provided feedback on necessary cultural adaptions and general improvements. Refinements included further integration of traditional Ojibwe foods and processing techniques, inclusion of the role and importance of traditional foods in Ojibwe spiritual and social traditions, and strengthening the focus on the interconnectedness of people with nature (i.e., recognition of the plants and animals that feed and nourish us).

A respected Ojibwe Elder Lee Obizaan Staples provided Ojibwemowin (Ojibwe language) words and phrases relevant to each lesson and cultural teachings on topics such as traditional cultural practices, dealing with stress, and taking care of oneself. The critical need for Ojibwemowin throughout the curriculum has been reinforced by FHCs, who set aside weekly meeting time for language lessons and practice time. The TOD_GL team also included and cited a variety of regionally relevant content from published and online materials from Indigenous-serving organizations, activists, chefs, and authors. All curricular revisions were facilitated by a project coordinator and drafted in collaboration with the JHU Curriculum Team, most of whom had worked on TOD_SW. University and community members reviewed and provided input on all lessons after adaptations and revisions were completed prior to pilot sessions.

TOD_GL Stage 4: Initial Program Evaluation Work

Our focus at Stage 4 was to ensure basic acceptability and comprehension of the revised TOD curriculum. All lessons were piloted with Indigenous families from each of the participating communities ($N = 15$ participants). Pilot families included one adult and at least one youth aged 10–16 years. All pilots were conducted in late 2020 and facilitated virtually to align with COVID-19 safety protocols put in place by JHU and tribal agencies. Pilots lasted between 30 and 90 min and involved a JHU team member completing a verbal consent process before guiding

TABLE 2 | TOD Great Lakes curriculum outline.

Lesson	Title	Content	Examples of inclusion of indigenous knowledge and values
1	Diabetes 101 and Goal Setting	FHC and adult-youth dyad meet to learn about risk factors for T2D, how diabetes occurs in the body, and how to use goal setting as a tool for preventing or management diabetes.	• Bravery as an Ojibwe cultural teaching to promote T2D management
2	More Information on Diabetes	FHC and adult-youth dyad meet to review how diabetes occurs in the body and learn about the long-term effects of diabetes complications, how diabetes can be controlled, A1c, how to check blood sugar, and role of diabetes medications.	• Revisiting bravery and honest communication with self, others around T2D care
3	Historical Trauma and Healing	Focus is on the impact of historical trauma on Indigenous communities and health. Explores connection between historical trauma and diabetes. Describes the role of traditional healing activities in helping people heal and guides families through traditional healing practice (if family is interested).	• Use of traditional practices for healing • Elder's teachings on traditional healing practices
4	Stress and Diabetes	Understanding relationships between stress and diabetes. Topics covered include the difference between stress and stressors, strategies for relieving stress, the benefits of meditation, a guided visualization activity, and an opportunity for the participants to reflect on their support network.	• Cultural connection as a protective factor • Elder's teaching on dealing with stress • Drawing on community support
5	Nutrition 101	This lesson is the first of five lessons that focuses on nutrition. In this lesson, adult-youth dyads are guided by an FHC through content about different food groups, the body's energy balance, how to build a balanced plate of food, and how to read nutrition facts labels.	• Elder's teaching on traditional foods • Examples of traditional foods for each food group • Importance of traditional food for spiritual, nutritional, and cultural health • Connectedness to all living things
6	Exercise Effects and Safety	This lesson is the first of two lessons that focuses on physical activity. In this lesson, FHCs and adult-youth dyads learn about sedentary v. active behaviors, what happens to our bodies when we exercise, and how to stay safe while exercising.	• Traditional forms of physical activity • Showing respect for our bodies
7	The SPIRIT Approach to Problem Solving	FHC and adult-youth dyad meet to learn about strategies for overcoming challenges. This lesson uses the SPIRIT problem solving framework and offers the participants a chance to practice using this approach for a problem they are facing in their own lives, or in the lives of fictional characters.	• Reinforcing culturally-grounded relaxation techniques
8	Mindful Eating in cultural context	In this lesson, participants are guided by their FHC through content and activities related to savoring foods, the difference between mindful and mindless eating, understanding portion sizes, recognizing when you are full, and food journaling.	• Mindful eating with traditional foods • Appreciating the nutritional, cultural, and medicinal value of foods • Encouragement to food journal using Ojibwemowin
9	Building Positivity	FHC and adult-youth dyad meet to learn about how appreciating the good things in our lives, and how to strengthen positive thinking in their lives.	• Respect for self • "Appreciating our strengths" in context of fulfilling our family and community responsibilities • Shift from "self-esteem" to consider cultural emphasis on humility • Elder's teaching on taking care of self
10	Not All Foods are Created Equal	FHCs and adult-youth dyads learn about the six major nutrients, vitamins and minerals, empty calories, whole grains, sugar sweetened beverages, and the importance of water.	• Eating minimally processed foods (like traditional foods) • Importance of water
11	Let's Get Moving	In this second lesson about physical activity, participants and FHCs learn content related to overcoming common obstacle to exercise including how to exercise without a gym, drawing on the support of others to help in your exercise journey, finding time to fit in exercise, and exercising as a family.	• Respect for our bodies • Traditional forms of exercise • Drawing on the support of family and community
12	Communication	The FHC and adult-youth dyad meet to learn about non-verbal communication, body language, different communication styles, and active listening.	• Elder's teaching on talking circles

(Continued)

TABLE 2 | Continued

Lesson	Title	Content	Examples of inclusion of indigenous knowledge and values
			• Protecting one's community by being a warrior against violence and bullying
13	Putting Nutrition Knowledge Into Practice	Participants and FHC explore content around cooking, meal planning, strategies for eating healthy on a budget, and eating seasonally.	• Traditional food preparation methods • Eating seasonally
14	Focus on Family in Community	The adult-youth dyad and FHC learn about the importance of eating with others, eating well as a family, and strategies for eating well when at restaurants or at community or family events.	• Drawing on and supporting, family and community • Love
All lessons include Ojibwemowin vocabulary lessons			
Four additional optional visits during first 6 months			
	Social support visits	FHCs conduct a Social Support Visit with a participant if they arrive to a scheduled visit and it is apparent that the participant is not ready to discuss curriculum content due to difficult circumstances in their life. FHCs trained to provide support and refer the participant to appropriate resources in the community. Four Social Support visits are included in the curriculum structure. If additional support is needed, the case is discussed with the project team.	
Maintenance visits			
16–22	Monthly check-in	FHCs schedule monthly check-ins with the participant and support person. These meetings are used to review curriculum topics that were covered during the first 6 months of the program, provide additional support to the participant and their families, and work to build skill among the adult-youth dyad to support each other on their healthy living journeys	

participants through 1–2 individual lessons. After completion of the lesson, JHU staff asked families a series of questions soliciting feedback on sections that were confusing, hard to follow, whether or not cultural teachings or language flowed or was appropriate to the lesson, if anything important was missing. Families received a $50 gift card for participating in pilot sessions.

TOD_GL Stage 5: Outcome Evaluation

As of this writing, the TOD_GL team has officially launched a wait-list randomized control trial (RCT) with a randomized block design by reservation community to evaluate program effectiveness. We chose a wait-list design (as opposed to a classic RCT where the control group foregoes treatment) in alignment with cultural and community goals of sharing, inclusion, and equitable distribution of benefits. Primary and secondary outcomes for the trial are HbA1c and lipids (adult participants); and BMI/zBMI, depressive symptoms, physical activity, nutrition, and coping resources and responses (e.g., family support, engagement with cultural activities, stress management) (adult and youth participants). We anticipate families will continue enrolling in the trial through summer, 2022, and we will gather evaluation data at baseline, 3, 6, 12, 18, and 24-month intervals. In addition, we plan to complete a participatory evaluation activity called ripple effects mapping with families and community members across sites twice throughout the duration of the study.

TOD_GL Stage 6: Dissemination of Findings: Sharing and Scaling

A mission of the CAIH and a goal of our teams is to partner with Indigenous communities to improve health and well-being. As such, we are strategic about prioritizing dissemination of eventual findings and lessons learned along the way using techniques that move beyond conventional academic publications. In addition to empirical manuscripts, our team produces and presents Technical Reports to partnering Tribal Governing Boards/Councils and reservation-based health and human service workers and grant writers. We create public webpages, use social media, and have a project YouTube channel to share information about the project and eventual results. If TOD is found effective through this research, our CBPR design will expedite program uptake and integration with existing services within communities and our attention to dissemination possibilities will promote sharing with other Tribal and Urban Indian groups and organizations.

TOD_GL Stage 7: Ongoing Refinement, Next Generation Programming

The TOD_GL team is following the lead of the SW experience: curriculum refinement continues as FHCs provide feedback on lessons "live," as they are learned and rolled out within their own communities. For example, Lesson 13 is being adapted to provide more content for those who get their groceries via food assistance programs. FHCs recognized that the current version of the lesson was geared toward those who were able to shop for

their groceries and therefore have control over what foods are available in their homes. In addition, the curricular adaptations made for TOD_GL have been shared back to SW teams, who in turn are working to implement these changes within their own communities.

DISCUSSION

The TOD program has been developed, evaluated, and iteratively refined across multiple Tribal communities over the span of a decade. While we have taken distinctive paths through the stages of intervention development and evaluation displayed in **Figure 1**, the two iterations of TOD described in this manuscript share important commonalities that we view as key markers of successful collaboration. These include investing time and resources in community-university partnership building and the creation of systems and structures to support shared work (e.g., CRCs, CABs, CSSCs, etc.), community-driven identification of priorities for programs and outcomes, attention to and incorporation of general and local Indigenous knowledge, and employment of FHCs who are members of the communities with which they work (60). All of this work requires attention to what has been called a "flexibility imperative" (23), both in terms of agility to address unique needs across communities, and being prepared to facilitate necessary shifts in curriculum content, methodological processes, and target outcomes as a study unfolds.

The need for such flexibility is of course made more challenging in the context of sponsor/funder, institutional, and local pressures to address urgent issues within what can sometimes be stringent milestone metrics and budget constraints. As others have argued, there is need for expansion of markers of "success" in health equity research to include partnership synergy, infrastructure development, resource sharing, and sustainability efforts via flexible timelines and funding structures (23, 68). Further, challenges related to the COVID-19 pandemic continue to impact the TOD_GL trial in several ways: a delayed launch, missed and delayed study milestones, and difficulties securing adequate staffing all exist vis-à-vis significant losses and stressors related to the pandemic for all study staff and TOD families and the ongoing, heavy toll of the pandemic on Tribal and public health infrastructure (69).

There are also distinctions between the two iterations of TOD worthy of attention. While Stage 7 is important for flexibility and applicability of the program over time and across groups, this can also make comparability across distinct iterations of a curriculum difficult. For instance, we do not know if the addition of content around historical trauma, stress, and coping in TOD_GL will activate unique mechanisms for health promotion or change compared to the SW iteration. In addition, the complexities navigating five distinct clinical systems, dozens of diabetes healthcare providers, and practical constraints of COVID-19 mean that TOD_GL FHCs are not as connected to local healthcare providers or systems as was done in the SW. Despite these differences, both iterations of the program share a similar structure and target common "active ingredients" for health improvement (e.g., family-based changes, connection to culture and support systems, goal-setting, knowledge sharing, addressing barriers to care, etc.). Furthermore, our stage-based process of program development and implementation is potentially useful across community contexts, including in non-Indigenous communities.

A number of questions and areas for future exploration remain. We found that 62% of TOD_SW lessons were attended by at least one family member in the household who was not officially enrolled in the study. This finding suggests to us that inclusion beyond target dyads may allow for more deliberate family systems changes. Additional studies are needed to better understand the role of the family and extended family engagement on the efficacy of TOD. Sustainability of the program within Tribal or urban Indian or non-Native community settings beyond grant funding periods is not fully determined (billing for FHCs, program costs, etc.). Perhaps most importantly, major efficacy questions remain to be answered with regards to the impact of TOD on diabetes outcomes for Native families. Some of these questions can be empirically answered in planned and ongoing trials.

We also recognize the need for humility in our work. TOD as a single program does little to address structural or environmental determinants of health, many of which are rooted in historically anchored traumas and policies that translate into tangible issues in modern times (16). As one FHC commented, "youth were not exposed to many healthy foods, specifically vegetables, because they weren't available in local stores." While behavioral interventions hold promise for improving health at individual and family levels, systematic efforts to address ongoing marginalization and promote equitable access and policies surrounding healthy food systems and culturally safe services and healthcare are required for lasting impacts on health equity.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

MW created an initial model and outline for this manuscript and led a collaborative writing process. RC drafted significant sections of the manuscript and helped with final edits. All remaining authors contributed equally to the work by assisting with literature reviews, writing sections of the manuscript, and providing comments on final drafts.

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Identification of Cancer Related Risk and Protective Factors for American Indian Youth: A Mixed Studies Review

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Introduction: Many causes of cancer related morbidity and mortality can be traced back to childhood behaviors. The culmination of cancer related risk and protective factors impacting the health and wellbeing of American Indian youth is unknown. The aim of this Mixed Studies Review was to identify cancer related risk and protective factors among American Indian youth. Results will be shared with Tribal communities to inform surveillance efforts.

Methods: A Mixed Studies Review process was deemed most appropriate for the search process and data collection. Seven databases were included in the search along with 3 databases that were hand searched. Google Scholar and Google power searching were also conducted. Covidence was utilized for abstract and full-text review. Out of 1,512 articles, 75 articles were included for review and data from each article was sorted out into the levels of the social ecological model.

Results: After extracting significant cancer related risk and protective factors from the 75 relevant articles, cancer related themes were identified at the individual, relationship (family and non-family), community, institutional, and cultural levels of the social ecological model. It was observed that the risk and protective factor profile for substance use spanned all levels of the social ecological model, whereas physical health-diet indicators and sexual health indicators did not. Most articles ($n = 58$, 77%) focused on substance use-related risk and protective factors.

Discussion: The method that was used for this study can be utilized by other professionals researching risk and protective factors impacting the health and wellbeing of American Indian youth for a multitude of health outcomes. Tribal communities will be able to use the results from our literature review to inform the creation of a community specific data collection tool focused on cancer related risk and protective factors. Upon completion of the overarching research, results will be shared with the community and can be used to inform ongoing surveillance efforts, influence priorities for intervention and education work, and inform the management of resources. The continuation of

community informed and driven research with Tribal communities is essential to the health and wellbeing of Tribal Nations as community grounded research is limited.

Keywords: risk factor, protective factor, Native American, American Indian, adolescent, youth

INTRODUCTION

Many causes of cancer related morbidity and mortality can be traced back to childhood behaviors (1). The framework for the current study stems from the Youth Risk Behavior Surveillance System (YRBSS), which monitors health-related behaviors among youth and young adults. These health-related behaviors are categorized into six themes which include unintentional injuries and violence, sexual health behaviors, alcohol and other drug use, tobacco use, dietary behaviors, and physical activity behaviors (1). The categories that are cancer related are sexual health behaviors, substance use, and dietary and physical activity behaviors. The YRBSS is designed to determine the prevalence of health behaviors and assess changes over time. Although the YRBSS disseminates useful results for youth across the nation, it is not representative for Tribal nations. Currently there are only two representative Tribal government surveys included, Cherokee Nation and Winnebago Tribe (2). There are 574 federally recognized tribes in the United States (3), so surveys that are representative are needed for most of the Tribal Nations. As a result, the risk and protective profiles for these cancer related categories is unknown for American Indian youth. Therefore, a review of the literature was necessary to identify the risk and protective factors associated with these cancer related categories (substance use, diet and physical health, sexual health, etc.) in Tribal communities.

The purpose of this literature review was to identify common risk and protective factors for cancer related indicators (substance use, sexual health, diet, and physical health, etc.) that are likely to result in cancer related morbidity and mortality over the lifespan for American Indian youth (see **Figure 1**). This literature review is part of a larger research project that is focusing on developing and administering a community informed data collection tool with one Tribal community. The goal of the overarching research proposal is to determine the prevalence of community level cancer-related risk and protective factors among Tribal youth by creating and administering a community informed data collection tool.

American Indian populations suffer disproportionately from cancer compared to other races and ethnicities in the nation. According to the United States Cancer Statistics (USCS) in 2018, 10,019 new cases of cancer were reported for American Indian and Alaska Native people, and 3,502 American Indian and Alaska Native people died of cancer (4). In 2018, for every 100,000 American Indian and Alaska Native people, 259 new cancer cases were reported and 98 died of cancer (4). According to Espey et al., cancer was the leading cause of death for Native women and the second leading cause of death for Native men between the years of 1999–2009 (5). Cancer incidence rates vary by region for American Indians, whereas rates among non-hispanic Whites do not. Wiggens et al. explains that cancer rates for American Indians are the highest in Northern and Southern Plains in the United States (6). For all regions combined, the cancer related death rates for American Indians were nearly 50% greater than rates for Whites (6).

A multitude of factors impact the health and wellbeing of American Indian youth and many of these factors are known to lead to cancer over the lifespan. According to the Department of Health and Human Services, "Cigarette smoking increases the risk of... cancers of the lung, larynx, oral cavity, pharynx, pancreas, and cervix..." (7, 8). Smokeless tobacco increases the risk of developing cancer of the oral cavity and cigars increase the risk of developing lung, oral, and pharyngeal cancer (9–12). Lung cancer is one of the leading causes of cancer diagnosis and death for American Indians in the Northern Plains (13). American Indians in the Northern Plains also have a Larynx Cancer Death rate that is 2.5 times higher compared to Whites (13). Nutrition and physical activity-related health conditions specific to cancer include breast and colorectal cancer (14). Along with lung cancer, breast and colorectal cancer are also leading causes of diagnosis and death American Indians in the Northern Plains (13). "There is probable evidence to suggest that dietary patterns with higher intakes of fruits and vegetables are associated with a decreased risk for some types of cancer..." (15–17). Consistent regular physical activity decreases the risk of... some types of cancer (i.e., breast and colorectal), and premature death (18).

To our knowledge, a comprehensive community specific data collection tool that assesses the risk and protective factors for cancer related indicators (substance use, sexual health, diet, and physical health, etc.) that is informed by both the literature and the community has not been developed. The results of this review will be used to educate the community regarding the national presentation of previous research utilizing the social ecological model. The social ecological model conceptualizes health broadly, focusing on the impact of multiple factors, as well as the interaction between these factors at multiple levels (19). Identifying modifiable factors and understanding the social ecological presentation of these factors more broadly and at the Tribal level can inform community efforts aimed at improving the health and wellbeing of American Indian youth. These activities will inform the process of developing a Tribally informed data collection tool. Once the tool is developed and administered to Tribal youth, the results from the overarching study will be shared with Tribal communities to inform ongoing surveillance efforts, aid in prioritization and decision making, and guide the development of health-related interventions.

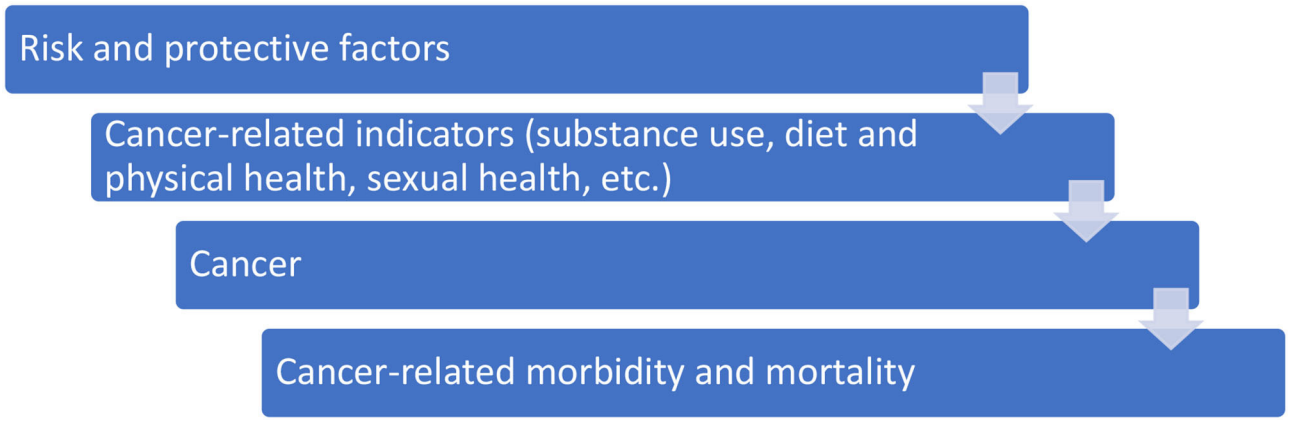

FIGURE 1 | Concept model for cancer related risk and protective factors.

METHODS

Prior to creating a community informed survey, a review of existing literature was necessary. This literature review examined quantitative and qualitative peer reviewed studies to identify risk and protective factors for cancer related indicators (substance use, sexual health, diet, and physical health, etc.) among American Indian youth aged 10–21. Findings are organized by levels of the social ecological model and categorized into three themes, substance use, sexual health indicators, and diet-physical health indicators (see **Table 1**).

Mixed Studies Review Criteria

A Mixed Studies Review (MSR) search process is best for topics that have a body of literature that includes quantitative, qualitative, and mixed methods studies. The authors utilized the Toolkit for Mixed Studies Review (20). MSR is a literature review approach in which studies are systematically identified, selected, appraised, and synthesized. The first step in a MSR is to formulate a question, either qualitative, quantitative, or both (20). For this search, we wanted to understand what significant and salient risk and protective factors were impacting cancer related indicators present among American Indian youth. Quantitative and qualitative studies were screened for inclusion. The inclusion and exclusion criteria can be found below (see section Inclusion and Exclusion Criteria). Next, we identified the sources of information where data could be found. This included multiple databases, Google Scholar and Google power searches. With these different sources, an exhaustive search of relevant documents was undertaken. Relevant studies were pulled from the different sources by the University of North Dakota, School of Medicine and Health Science's Research and Education Librarian (author Olson), who was responsible for search strategies and formulating the search phrase. After completing the search, relevant studies were selected by two reviewers and the Principal Investigator (author Nadeau) to reduce bias. The Principal Investigator, a social/behavioral epidemiologist, assessed the quality of selected studies and extracted the data. Lastly, the results were combined and interpreted.

Search Phrase

The research team wanted to ensure that all aspects of literature were included in this search. To do this, the following databases were included in the search: PubMed, CINAHL, PsychInfo, ERIC, University of New Mexico Native Health Database, Google Scholar, and iPortal. Journal hand searches have also been conducted for the Journal of Indigenous Research, the American Indian and Alaska Native Mental Health Research Journal, and Journal AlterNative. Google Scholar and Google power searching were also conducted. The search conducted for Google Scholar and Google power searches consisted of viewing articles until there were two consecutive Google pages with no relevant articles. The search phrase that was utilized for all databases was ("risk factor" OR "supportive factor" OR "supportive mechanism" OR "protective factor" OR "protective mechanism") AND ("Native American" OR "American Indian" OR "Alaska Native") AND (adolescent OR teen OR youth OR "young adult"). This phrase was inclusive of all relevant subjects that the team wanted to focus on. The focus of this review was on identifying cancer related risk and protective factors, so the word cancer was not included in the search phrases to avoid missing relevant articles. The Google Scholar and Google power search phrases were similar, but included "site:.gov", "site:.edu", and "site:.org" in the beginning of the phrase to only show these types of web pages.

Inclusion and Exclusion Criteria

Inclusion and exclusion criteria were created. To be included for review, studies had to be published later than January 1st, 1970, and had to be conducted in the contiguous United States. In addition, studies needed to include significant and/or salient risk and/or protective factors for cancer related indicators "A protective factor can be defined as a characteristic at the biological, psychological, family, or community (including peers and culture) level that is associated with a lower likelihood of problem outcomes or that reduces the negative impact of a risk factor on problem outcomes" (21). Risk factors, are, "characteristics at the biological psychological, family, community, or cultural level that precedes and is associated with

TABLE 1 | Risk and protective factor themes.

SEM level	Cancer themes	Risk/protective factors
Individual	Substance use (45) • Alcohol = 8 • Tobacco = 8 • Hard drugs = 3 • All = 26	**Risk factors**: stressful life events, prior substance use/early substance initiation **Protective factors**: connected to school, participation in extracurriculars
	Physical health-diet indicators (12)	**Risk factors**: screen time/TV viewing, consumption of junk food **Protective factors**: participation in sports team, participation in physical activity
	Sexual health indicators (9)	**Risk factors**: substance use and having been sexually abused **Protective factors**: involvement in extracurriculars and self-efficacy
Relationship (Non-family)	Substance use (26) • Alcohol = 5 • Tobacco = 4 • Hard drugs = 3 • All = 14	**Risk factors**: friends' substance use and substance use offers from friends and family friends **Protective factors**: supportive/positive friendships and having a role model
	Physical health-diet indicators (0)	**Risk factors**: none identified **Protective factors**: none identified
	Sexual health indicators (3)	**Risk factors**: none identified **Protective factors**: support from friends and having a role model
Relationship (family)	Substance use (27) • Alcohol = 7 • Tobacco = 3 • Hard drugs = 2 • All = 15	**Risk factors**: family substance use and lower family SES **Protective factors**: family connectedness and family norms that discourage substance use
	Physical health-diet indicators (9)	**Risk factors**: parental weight-related behaviors (sedentary, TV viewing, diet) and lower family SES **Protective factors**: Having physically active parents
	Sexual health indicators (7)	**Risk factors**: none identified **Protective factors**: feeling connected to family and family communication
Community	Substance use (9) • Alcohol = 2 • Tobacco = 2 • Hard drugs = 0 • All = 5	**Risk factors**: lack of opportunities and access to substances **Protective factors**: opportunities for prosocial involvement and positive social norms
	Physical health-diet indicators (1)	**Risk factors**: environmental risks **Protective factors**: none identified
	Sexual health indicators (0)	**Risk factors**: none identified **Protective factors**: none identified
Institutional	Substance use (5) • Alcohol = 2 • Tobacco = 0 • Hard drugs = 1 • All = 2	**Risk factors**: none identified **Protective factors**: clear rules at school
	Physical health-diet indicators (0)	**Risk factors**: none identified **Protective factors**: none identified
	Sexual health indicators (3)	**Risk factors**: none identified **Protective factors**: opportunities for extracurriculars and relationships formed at school
Cultural	Substance use (7) • Alcohol = 1 • Tobacco = 2 • Hard drugs = 0 • All = 4	**Risk factors**: ethnic dislocation and historical trauma **Protective factors**: cultural connectedness having strong cultural/ religious values
	Physical health-diet indicators (0)	**Risk factors**: none identified **Protective factors**: none identified
	Sexual health indicators (2)	**Risk factors**: none identified **Protective factors**: engagement with cultural activities and spiritual traditions

a higher likelihood of problem outcomes" (21). Lastly, most of the population included in each study had to be within the age range of 10–21 years. For example, if the age range was 16–25, and most of the study population fell within the age range of 10–21 years, the study would be included. Similar work being conducted in the field defined adolescence as 10–21 to be as inclusive as possible, as no standard age definition currently exists for the adolescent life stage (22–24).

Covidence

Covidence, a web-based software program, was utilized for abstract and full-text review. Articles that were found in the search were uploaded into the Covidence platform where researchers could read the abstracts and full texts on the web page. Both master level students read through abstracts and gave the studies a "yes", "no", or "maybe" vote. "Yes" and "maybe" votes were moved onto full text review. Conflicts were resolved by the Principal Investigator. The full text review differed slightly, as reviewers had to provide a reason for exclusion (see **Figure 2**). One thousand five hundred twelve articles were imported for screening and 94 duplicate articles were removed. One thousand four hundred eighteen studies were screened by title and abstract and 1,105 studies were deemed irrelevant. Three hundred thirteen full-text articles were assessed for eligibility, 238 studies were excluded. One hundred forty-one of these were not cancer related, 17 were not American Indian populations, 29 included the wrong Tribal population, 14 included adults, 7 were prevalence studies, 17 contained wrong outcomes (no salient outcomes), 5 were duplicate studies, 5 were not accessible, and 3 were physical books. With this, 75 studies were included for data extraction, 61 from databases and 14 from Google.

Data Extraction Process

The data was pulled from the 75 relevant articles by the research team (see **Appendix** in **Supplementary Material**). Significant and salient results were gathered and put into a spreadsheet which was sorted out by levels of the social ecological model [individual, relationship (family and non-family), community, institutional, and cultural]. Then, results were thematically combined and tallied to find which risk and protective factors were most prevalent. These results are shown in **Table 1** and described in the results section.

RESULTS

After extracting significant and salient cancer related risk and protective factors from relevant articles, cancer related themes were identified at the individual, relationship (family and non-family), community, institutional, and cultural levels of the social ecological model (see **Table 1**).

Individual Level

At the individual level, the most prevalent risk factors for substance use include stressful life events and prior substance use or early substance initiation. The protective factor for substance use that was most prevalent was being connected to school and participation in extracurriculars. When looking at physical health-diet indicators at the individual level, the prominent risk factor was TV viewing/screen time and consumption of junk food. The significant protective factors were participation in a sports team or participating in physical activity in general. The risk and protective factors that were significant at the individual level for sexual health indicators were substance use and having been sexually abused, and the significant protective factors are involvement in extracurricular activities and self-efficacy.

Relationship Level (Non-family)

The most prominent risk and protective factors found at the non-family relationship level for substance use are friends' substance use and receiving substance use offers from friends and family friends and the protective factors are supportive and positive friendships and having a role model. No risk or protective factors for physical health-diet indicators were found at this level. No risk factors were identified for sexual health indicators at the relationship level. The significant protective factors for sexual health indicators at the relationship level are support from friends and having a role model.

Relationship Level (Family)

At the family relationship level, the most significant risk factors for substance use are family substance use and a lower household socioeconomic status (SES). The significant protective factors are family connectedness and family norms that discourage substance use. The most prominent risk factor found at the family relationship level for physical health-diet indicators were parental weight-related behaviors (such as TV viewing, sedentary behaviors, and diet), and lower family SES. The significant protective factor identified was having physically active parents. No risk factors were found for sexual health indicators at the family relationship level. The prominent protective factors found at the family relationship level for sexual health indicators were feeling connected to family and family communication.

Community Level

The community level risk factors for substance use that were identified were lack of opportunities and access to alcohol and cigarettes. The significant protective factors for the community level were opportunities for prosocial involvement and positive social norms. Risk factors that were identified for physical health-diet indicators at the community level were environmental risks. No protective factors for physical health-diet indicators at the community level were found. No risk or protective factors were found at the community level for sexual health indicators.

Institutional Level

No significant risk factors were found at the institutional level for substance use, physical health-diet indicators, or sexual health indicators. The significant protective factors identified for substance use were having clear rules at school. No protective factors were found for physical health-diet indicators at the institutional level. The protective factors for sexual health indicators at the institutional level were opportunities for extracurriculars and relationships formed at school.

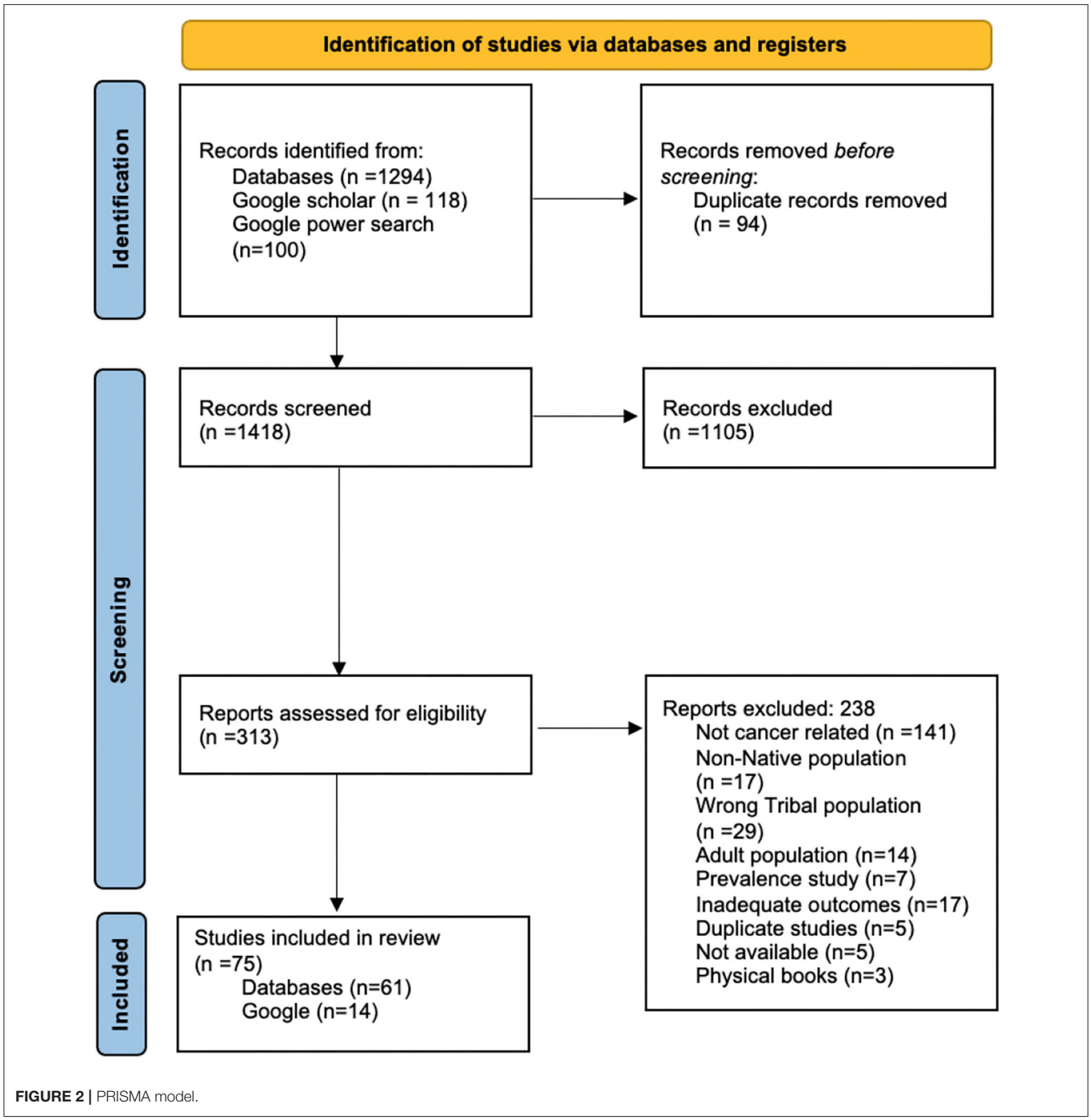

FIGURE 2 | PRISMA model.

Cultural Level

Significant risk factors that were found at the cultural level for substance use were ethnic dislocation and historical trauma. The prominent protective factors for substance use at the cultural level were cultural connectedness having strong cultural and/or religious values. No risk or protective factors were identified at the cultural level for physical health-diet indicators. No risk factors were identified for sexual health indicators at the cultural level. The significant protective factors for sexual health indicators at the cultural level were engagement with cultural activities and spiritual traditions.

The research team explored the presentation of significant and salient findings at the individual, relationship (non-family), relationship (family), community, institutional, and cultural levels. No cancer related themes were identified at the policy level. Substance use presented as a key cancer related indicator, with the presence of associated risk and protective factors, at all

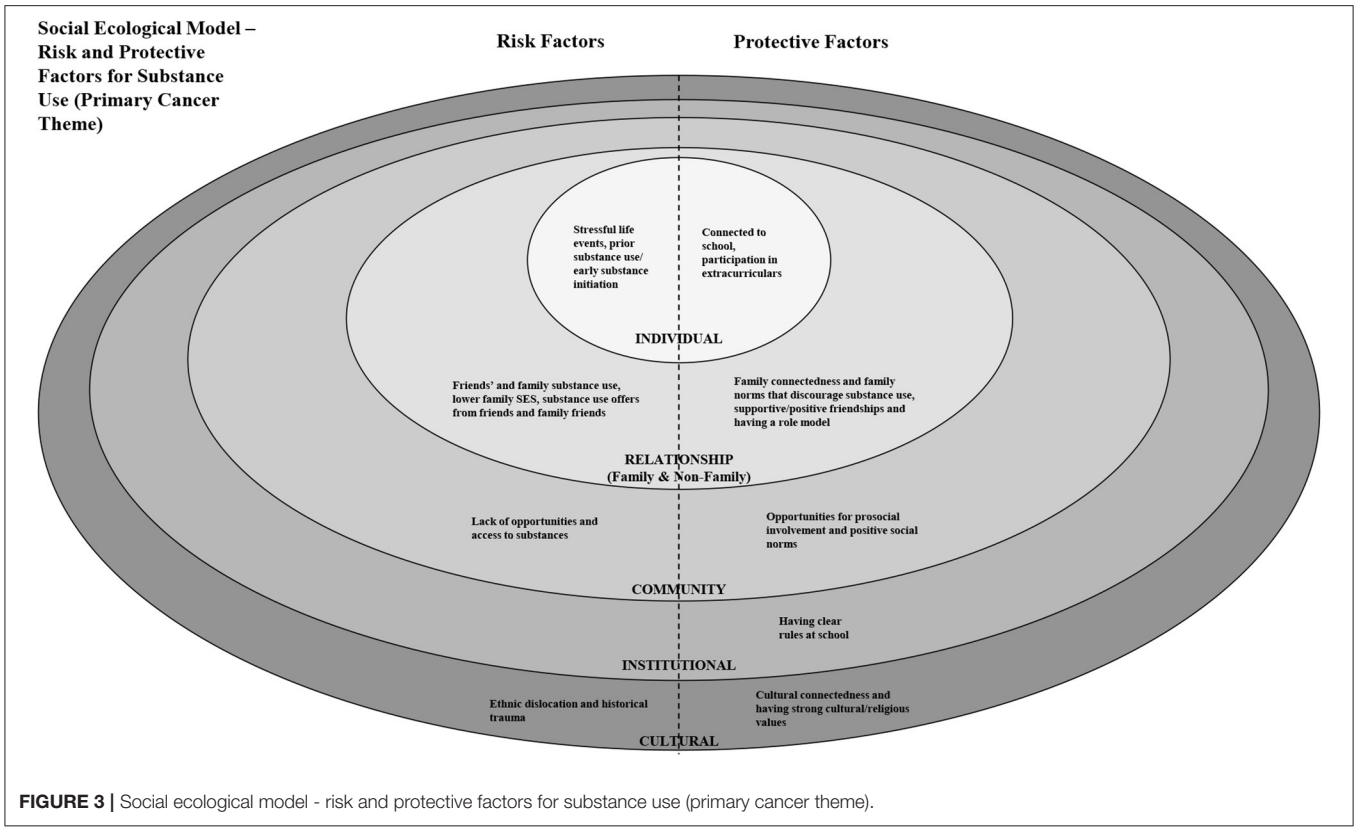

FIGURE 3 | Social ecological model - risk and protective factors for substance use (primary cancer theme).

levels of the social ecological model (see **Figure 3**). Substance use indicators were also identified as risk factors for substance use at the individual, relationship (non-family) and relationship (family) level. For example, at the individual level, risk factors for alcohol use include using tobacco and marijuana (25). At the relationship level, peer and family substance use are risk factors for substance use. Substance use was also a risk factor for sexual health indicators at the individual level and physical health-diet indicators at the relationship (non-family) level.

STRENGTHS AND LIMITATIONS

This study had limitations which included not having full access to all available databases. Despite having a broad search phrase and the utilization of multiple databases and Google Scholar, there may have been relevant articles that were missed in our search. Of further consideration, the majority of articles ($n = 58$, 77%) focused on substance use-related risk and protective factors, indicating limited research focused on physical health-diet and sexual health indicators. Furthermore, as mentioned by Mackin et al. in 2012, additional risk and protective factors for cancer may exist for American Indian youth, that are not yet examined or published (26). And finally, there are 574 federally recognized tribes in the United States (3). Each tribe has its own culture, language, practices, and resources. Given these differences and the presentation of cancer varying from tribe to tribe, the risk and protective factors presented here may not be generalizable to all tribes and the translation of pertinent findings may vary at the community level.

The strengths of this study included having multiple reviewers, the use of Covidence, use of a multitude of databases and utilization of Google Scholar and Google power searches. The use of Google broadens the search so that the inclusion of marginalized voices, or perspectives not included in traditional academic searches is more likely. Without the utilization of Google power searches and Google Scholar, researchers are potentially missing out on salient articles that can be included to enhance research studies. Exploring multiple sources expanded the breadth of our search and diversified our search strategy. The use of multiple reviewers during our data extraction process and screening process is essential to minimizing biases and human error. Without the use of Google Scholar, 14 articles would not have been found even with the use of the broad search phrase that was applied in this study.

DISCUSSION

This is the first review of its kind. However, a similar review, conducted in 2018 by Hensen et al., explored protective factors across multiple health outcomes for AIAN adolescents. Henson et al. discusses the effects of protective factors on positive social and health outcomes among AI/AN youth and touches on topics including substance use, mental health, and delinquent behavior (27). The authors found that protective factors span multiple levels of the social ecological model and explain how findings could guide strength-based health promotion and prevention programming for AI/AN youths (27). Henson et al. found that protective impacts of culture also span all levels of the social

ecological model and recommend the need for better data collection tools that measure cultural factors and incorporate the Tribal communities' views regarding research priorities as well as factors that impact the health and wellbeing of Tribal youth (27).

Although fewer ($n = 17$, 23%) articles focused on physical health-diet and sexual health indicators, meaningful findings arose from the search. Engagement with cultural activities and spiritual traditions presented as protective factors for sexual health indicators. Another protective factor for sexual health indicators is feeling connected to family and family communication. For physical health diet indicators, having physically active parents presented as a protective factor. Tribal people are very family oriented and value family connectedness as part of their culture. As previously mentioned, cultural indicators span the social ecological model. Promoting culture and initiatives grounded in cultural values would be a meaningful way for Tribal communities to advocate, support and engage in protective factor rich environments and positively impact the health of youth at multiple levels of community.

A summary table containing all substance use related articles (n = 22) and related protective factors is shown in **Supplementary Table 1** and a social ecological model illustrating significant risk and protective factors for substance use is shown in **Figure 3**. This information can be used to inform Tribally driven/informed data collection efforts. Initiatives focused on reducing substance use/abuse would benefit from focusing on risk and protective factors that span the social ecological model.

Future Directions

For this research, a Mixed Studies Review was deemed most adequate. This process can be utilized by other professionals researching various study types (i.e., quantitative, qualitive, and mixed) for risk and protective factors impacting the health and wellbeing of American Indian youth for a multitude of health outcomes. A multitude of factors contribute to the high rates of cancer in Indian Country in addition to these well-known cancer indicators including the impacts resulting from intergenerational trauma, barriers to prevention and care due to high rates of poverty, lack of access to healthy foods and underfunding (28). Our review identified a multitude of cancer related risk and protective factors, with the majority being identified at the individual, family relationship level and non-family relationship level.

The results from this study outline the risk and protective factors that can be found in American Indian communities in the contiguous United States. Tribal communities will be able to use the results from our literature review to inform the creation of a community specific data collection tool focused on cancer related risk and protective factors. Upon completion of the overarching research, results will be shared with the community which will inform ongoing surveillance efforts, influence priorities for intervention and education work, and inform the management of resources. The continuation of community informed and driven research with Tribal communities is essential to the health and wellbeing of Tribal Nations as community grounded research is limited.

Approximately 30% of what impacts our health can be attributed to health behavior. However, the physical environment along with social and economic factors impacts ∼50% of our health. More research is needed to assess community, policy and cultural impacts on youth health and wellness. To properly assess AI youth health and wellbeing, we must look at conditions that create or limit opportunity. Doing so will provide us with the important perspective for understanding both the nature and the sources of disparate health outcomes and will guide us to viable and effective solutions (28).

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

MN, DO, and KS: study conception and design of the work. MN, DO, KW, and VF: data collection. MN, KW, and VF: data analysis and interpretation of results. MN and KW: draft manuscript preparation. All authors reviewed the results and approved the final version of the manuscript to be published.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.828776/full#supplementary-material

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Rationale, Design, and Methods for *Nen Unkumbi/Edahiyedo* ("We Are Here Now"): A Multi-Level Randomized Controlled Trial to Improve Sexual and Reproductive Health Outcomes in a Northern Plains American Indian Reservation Community

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American Indian (AI) youth in the United States experience disproportionate sexual and reproductive health (SRH) disparities relative to their non-Indigenous, white counterparts, including increased rates of sexually transmitted infections (STIs), earlier sexual debut, increased rates of teen birth, and reduced access to SRH services. Past research shows that to improve SRH outcomes for AI youth in reservation communities, interventions must address complex factors and multiple levels of community that influence sexual risk behaviors. Here, we describe development of a multi-level, multi-component randomized controlled trial (RCT) to intervene upon SRH outcomes in a Northern Plains American Indian reservation community. Our intervention is rooted in a community based participatory research framework and is evaluated with a stepped wedge design that integrates 5 reservation high schools into a 5-year, cluster-randomized RCT. Ecological Systems Theory was used to design the intervention that includes (1) an individual level component of culturally specific SRH curriculum in school, (2) a parental component of education to improve parent-child communication about SRH and healthy relationships, (3) a community component of cultural mentorship, and (4) a systems-level component to improve delivery of SRH services from reservation healthcare agencies. In this article we present the rationale and details of our research design, instrumentation, data

collection protocol, analytical methods, and community participation in the intervention. Our intervention builds upon existing community strengths and integrates traditional Indigenous knowledge and values with current public health knowledge to reduce SRH disparities.

Keywords: community based participatory research, American Indian, sexually transmitted infections, teen pregnancy, sexual health education, culture, ecological systems theory, stepped wedge design

INTRODUCTION

Comprehensive national surveillance data on sexual and reproductive health (SRH) among American Indians (AI) is difficult to assess due to the underrepresentation of AIs in national surveys (1, 2). Extant studies demonstrate that AIs are disproportionately affected by adverse conditions attributable to SRH, compared to other populations (3, 4). AI youth report earlier onset of sexual intercourse than other adolescent populations in the U.S. (5, 6). The teen birth rate among AIs is 2 to 3 times higher than that among Caucasians (5, 7, 8). In addition, the rates of pre-term birth and low birth weight are much higher in AIs compared to Caucasians (9–12). STIs are up to 4.8 times higher for AI males and females compared to Caucasians, with young AI females having gonorrhea rates 6.6 times higher than white females (13). AI females have higher rates of miscarriages and ectopic pregnancies than Caucasian females and are at risk for infertility (14). For AI males, STIs can lead to urethritis, epididymitis, and prostate cancer, which is higher in AI men than all other racial and ethnic males in the U.S. (14). In addition, the costly and burdensome health consequences of AI youths' high STI rates include HIV and HCV infections. The estimated incidence rate of HIV in AI males and females is 1.97 times higher than in Caucasian males and females, and in recent years the incidence of HIV in AI males and females continues to rise (15). Furthermore, of all population subgroups in the U.S., the incidence of HCV is highest in AI groups (16).

In Montana, AI youth living on reservations experience disproportionate rates of sexually transmitted infections (STIs), early childbearing, and earlier sexual debut than their non-Indigenous peers at the state and national levels (17, 18). In 2019 in Montana, 54.6 percent of AI youth aged 15 to 18 reported ever having sexual intercourse in their life, compared to 42 percent of their white, non-Hispanic peers (17, 18). AI youth in Montana also experience higher rates of chlamydia (6,497 cases per 100,000 youth) as compared to white, non-Hispanic youth in the state (1,760 cases per 100,000 youth) (19). As of 2018, AI people accounted for 40 percent of reported gonorrhea cases and 23 percent of reported chlamydia cases in Montana, yet AI people make up only 6.6 percent of Montana's population (20, 21).

The literature related to SRH among AI youth identifies poverty, isolation, alcohol and other drug use, physical and sexual victimization, and lack of comprehensive and coordinated SRH education and clinical services as factors that influence unintended pregnancies and STIs (22–27). Evidence also suggests that ambivalence toward sex, social pressures, depression, anxiety, and experiences of historical trauma and loss influence sexual risk behavior among AIs (28–33). Mistrust of research and researchers continues in AI communities due to a legacy of neglect and betrayal by the U.S. government and by researchers from outside their communities (34–37). This mistrust impedes the cooperation between tribal communities and academics to design, implement, and evaluate effective interventions to address SRH disparities among AI youth (38, 39). Specifically in Montana, numerous socio-economic and environmental barriers contribute to SRH disparities for AI youth living on reservations across the state's sparsely populated Northern Plains, including lack of comprehensive SRH education in the schools, intergenerational historical trauma that impedes families and elders discussing topics related to SRH with young people, reduced access to comprehensive, evidence-based sexual and reproductive health (SRH) services, limited access to contraceptive options, and historic discrimination in healthcare settings (30, 40–43).

The complex factors that influence sexual risk behaviors among AI youth warrant novel AI community–specific interventions. Previous research with AI youth on SRH has lacked an ecological design and implementation, and it has neither addressed nor leveraged the interconnectedness of the individual, family, community, and larger systems in preventing STIs, HIV, HCV, and teen pregnancy (6, 44–46). For example, more research is needed into how the history of sexual trauma experienced by AI communities in the United States because of colonialization may be passed down through generations in families to impact family communication patterns about SRH, AI youth' sexual decisions, and their comfortable level accessing SRH services. Given the existing data that underscore the substantial SRH disparities among AI youth, there is an acute need for the rigorous testing of interventions using randomized controlled trial (RCT) designs in Indigenous communities (47–49).

Current intervention science research with Indigenous communities proposes further investigation in: (1) how to integrate diverse cultural belief systems, ecological perspective, and political contexts into RCTs; (2) how isolated communities with small populations that pose limits to statistical power, external validity, and generalizability assess scientific significance; (3) how effective implementation of RCTs can assess fidelity, acceptability, and sustainability; (4) how local ethical issues are conceptualized and addressed during RCT implementation with tribal members; and (5) how to effectively utilize Indigenous Research Methods (IRMs) and mixed methods in RCTs to decolonize research (50–53).

Furthermore, CBPR, which has become an established methodological framework for partnering with AI communities to conduct research, has been sparsely applied to understanding and addressing Indigenous SRH (54, 55). CBPR has the potential to facilitate the implementation and evaluation of an ecological intervention in AI communities, particularly given its amenability to multi-sectoral and multi-level stakeholder involvement in the research process (56–58). CBPR as a participatory framework for partnering with Indigenous communities has been identified as a methodological bridge to address the gaps in intervention science because it: (1) builds and maintains trust and reciprocity in community-academic partnerships; (2) empowers communities to address health disparities of importance to them in a culturally relevant manner; (3) unites the skills and knowledge of researchers with traditional and local knowledge and resources of the community to enhance research relevance to improve health; (4) increases community participation in research by involving community members; and (5) enriches data interpretation through the integration of community and academic expertise (59).

The aim of this paper is to describe the development of a CBPR multi-level, multi-component SRH intervention for AI youth. Our study, *NenUnkUmbi/EdaHiYedo* ("We Are Here Now," or *NE*), is grounded in a 15-year collaborative research relationship between the Assiniboine and Sioux Tribes of the Fort Peck Reservation in Northeastern Montana and Montana State University (MSU) researchers to prevent STIs, HIV, HCV, and teen pregnancy among AI youth. *NE* is based on the Fort Peck Tribal Council's desire to implement a holistic, tribally driven SRH intervention for AI youth.

METHODS AND ANALYSIS

Study Site

NE's study site is the Fort Peck Indian Reservation (herein referred to as Fort Peck) in Northeastern Montana (**Figure 1**). Fort Peck is located in a Northern Plains frontier environment and spans 2.1 million acres. The reservation borders the 47½ parallel to the north (just south of the border with Canada), with Big Muddy Creek to the east, the Missouri River to the south, and Big Porcupine Creek to the west. Approximately 8,000 enrolled tribal members, predominately from the Assiniboine and Sioux Nations, live on the reservation. The Assiniboine and Sioux are descendants of the Nakoda, Nakota, Nakona, Lakota, and Dakota Nations. The Assiniboine comprise Wadopana (Canoe Paddlers Who Live on the Prairie) and Hudashana (Red Bottom) bands, and the Sioux comprise Sisseton/Wahpetons, the Yanktonais, and the Teton Hunkpapa bands (60).

NE is implemented in the communities of Frazer, Wolf Point, Poplar, Brockton, and Culbertson. These 5 communities have public high schools that serve Fort Peck tribal members. Frazer, Wolf Point, Poplar, and Brockton are on the reservation, and Culbertson is a border town on the east end of the reservation that AI youth from the reservation community of Fort Kipp attend.

Fort Peck tribal members between the ages of 14 and 18 experience poor SRH outcomes. Sixty-two percent of Fort Peck youth report being sexually active (61–63). For 2015-2017 Fort Peck Reservation had the second highest incidence rate of STIs in Montana (2159.2 cases per 100,000 people), a rate nearly 4 times higher than the rest of the state (64). The incidence of teen pregnancy among 14- to 18-year-old Fort Peck tribal members is 101.9 per 1,000 and is higher than the national average (61–63). Other problematic health trends among AI youth at Fort Peck include elevated rates of substance abuse, violence, depression, suicidal thinking, and self-reported suicide attempts that regularly exceed recent national base rates for other adolescent populations (65).

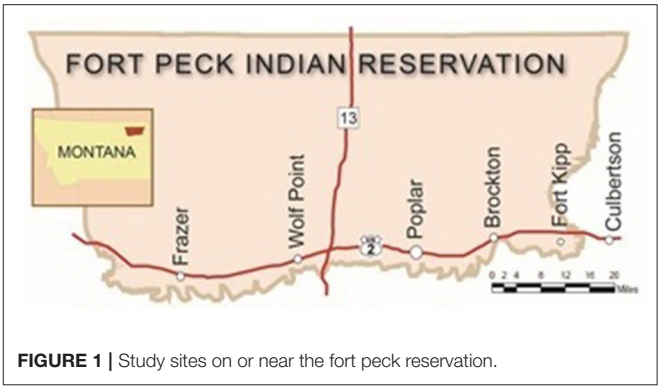

FIGURE 1 | Study sites on or near the fort peck reservation.

Study Background and CBPR Foundation

NE utilizes a CBPR framework. *NE's* Principal Investigator (PI), Dr. Elizabeth Rink, began working with Fort Peck in 2006 when she was invited to Fort Peck by the then Fort Peck Tribal Health Director and council members from the Fort Peck Tribal Council to develop CBPR studies to address STIs among AI males. These early CBPR studies on AI males' SRH over a 5-year period led to the Fort Peck Tribal Council asking Rink to shift her focus from young adult AI males to developing an intervention for male and female AI adolescents to reduce SRH disparities among this population. The Council's primary request to Rink was that the intervention be holistic and involve youth, their families, and community members. This directive led to a four-year CBPR exploratory study and pilot intervention funded through the Center for American Indian and Rural Health Equity (CAIRHE) at MSU, collectively called the Fort Peck Sexual Health Study.

The Fort Peck Sexual Health Study used a CBPR framework and included a research team of tribal members working with Fort Peck Community College, outside researchers, and a community advisory board (CAB). The CAB was made up of five tribal representatives. CAB members included 3 females (2 Assiniboine and 1 Sioux) ages 30 to 50, and 2 males (1 Assiniboine and 1 Sioux) ages 45 to 55. The role of the CAB was to provide oversight and guidance for the exploratory study, the development of a pilot intervention, and ultimately the development and implementation of *NE*.

The Fort Peck Sexual Health Study was used to develop the research design for *NE*. The exploratory study used an explanatory sequential mixed methods design consisting of focus groups and interviews followed by a survey. Results from the

exploratory study found: (1) family structures and values have shifted with sexual norms over time, changing how families communicate and address SRH; (2) youth culture surrounding sex is dissociated from the traditional cultural beliefs about sex, intimate relationships, and parenting held by elders; (3) social media impedes parents, elders, and youth from having thoughtful discussions about SRH; (4) SRH information received by AI youth was not associated with a decrease in sexual risk behaviors; (5) youth had positive attitudes toward pregnancy and positive familial support if they became pregnant; and (6) alcohol and substance use history, exposure to adverse life experiences, and increased levels of depression and anxiety were associated with increased likelihood of sexual risk behaviors (66). These results were then used to develop and implement a pilot intervention. Findings from the pilot intervention demonstrated increased condom use self-efficacy, increased condom use, and positive agreement with attitudes toward pregnancy among AI youth ages 14 to 18 years old. Our pilot intervention results also suggested: (1) parents needed their own education about SRH topics and strategies for speaking with their children about SRH; (2) increased interaction and communication with elders were desired by the youth; and (3) youth were not seeking SRH services for STI testing and birth control (66–68).

Overview of *NenUnkUmbi/EdaHiYedo*

Over a 6-month period, meetings among the CAB and the research team were held to review and discuss our qualitative and quantitative data on Fort Peck youth from our exploratory study and pilot intervention as well as existing literature on SRH interventions for youth. This series of meetings, in addition to the original direct request from the Fort Peck Tribal Council to Rink to develop and implement a holistic SRH intervention for youth on the reservation, resulted in *NE's* research design (**Figure 2**) (69).

To create a holistic intervention, *NE* was designed as a multi-level intervention. *NE's* different levels included: (1) A school-based SRH curriculum called *Native Stand,* designed to address individual-level factors that lead to sexual risk behaviors; (2) a family-level curriculum called *Native Voices,* tailored to increase communication between adult family members and youth about SRH topics; (3) a cultural mentoring component at the community level that pairs AI youth with adults and elders to discuss traditional AI beliefs and practices about SRH; and (4) a mobilizing strategy to activate a multi-sectoral network of youth-servicing organizations at the systems level in Fort Peck to coordinate SRH services for AI youth. *NE* uses a cluster-randomized stepped-wedge design (SWD), in which the 5 schools that AI youth from Fort Peck attend were the clusters randomized into the intervention 1 at a time, with all schools eventually being randomized to the intervention (70–74). The 5 schools are located in separate communities (Frazer, Wolf Point, Poplar, Brockton, Culbertson), mitigating the potential for cross-contamination between study sites. *NE* includes collaborations with Fort Peck Community College, the Fort Peck Language and Culture Department and the Fort Peck Tribal Epidemiology Team (Epi Team), which is a local committee that monitors infectious diseases on the reservation and the health status of tribal members; and the high schools of Frazer, Wolf Point, Poplar, Brockton, and Culbertson; and the Fort Peck Tribal Council.

NE is designed using Ecological System's Theory (EST). EST had intuitive appeal for Fort Peck tribal members who have expressed an Indigenous worldview that emphasizes the interconnectedness of social, historical, cultural, spiritual, and kinship dynamics concerning SRH. Central to EST is an emphasis on the interaction of individual, family, social, cultural, and environmental factors to influence adolescents' behavior as they progress into young adulthood (75, 76). We specifically applied EST to assess our outcome variables, which included: (1) increased condom use, delayed onset of sexual intercourse, reduction in sex partners, increased contraceptive use, and reduction in substance use during sex (individual level); (2) increased youth–parent/legal guardian communication on SRH topics (family level); (3) increased cultural values and traditional beliefs about SRH topics (community level); and 4) increased coordination among education, health care, and social services on Fort Peck to provide SRH services for AI youth (systems level) (**Figure 3**).

Intervention Levels

NE is implemented simultaneously over the 9-month school year (**Table 1**)**.** Components include:

1) Individual Level

Native Stand is a school-based, 27-module STI-, HIV-, and teen pregnancy–prevention curriculum, originally developed for rural white youth and adapted in 2008 as a stand-alone SRH curriculum for AI youth. For *NE*, an adaptation of *Native Stand* was developed by the research team, CAB, and Fort Peck Language and Culture that reduced *Native Stand's* 27 modules to 18 modules and included specific community-relevant traditional and contemporary cultural lesson plans (47, 77). *Native Stand* is integrated into each of the 5 schools' participating in *NE* established curriculum and delivered by trained facilitators in a classroom setting as part of the students' regular class schedule.

2) Family Level

Native Voices is a video-based HIV/STI-prevention intervention designed for AI youth to address condom use, negotiation skills, group discussion, and role playing. *Native Voices* was adapted from 1 module into 4 modules to involve parents/legal guardians, as recommended by the CDC (48). Our adaptation of *Native Voices* involved students with one of their parents/legal guardians to promote parent/legal guardian/youth discussions about preventing STIs, HIV, HCV, and teen pregnancy. *Native Voices* is delivered by a trained facilitator.

3) Community Level

The third level of *NE* is a cultural mentoring component that pairs AI youth with older adults and elders to discuss traditional AI beliefs and practices about reproductive health. The mentoring program is based on Assiniboine and Sioux traditional knowledge and the National Mentoring Partnership standards for mentoring (78–80). We integrated the cultural

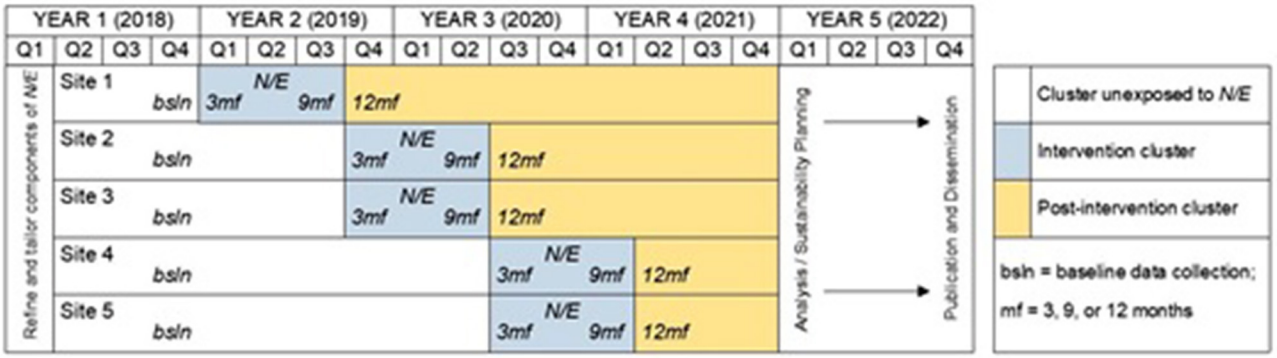

FIGURE 2 | Trial design and timeline for implementing *NE* relative to grant and sites/schools.

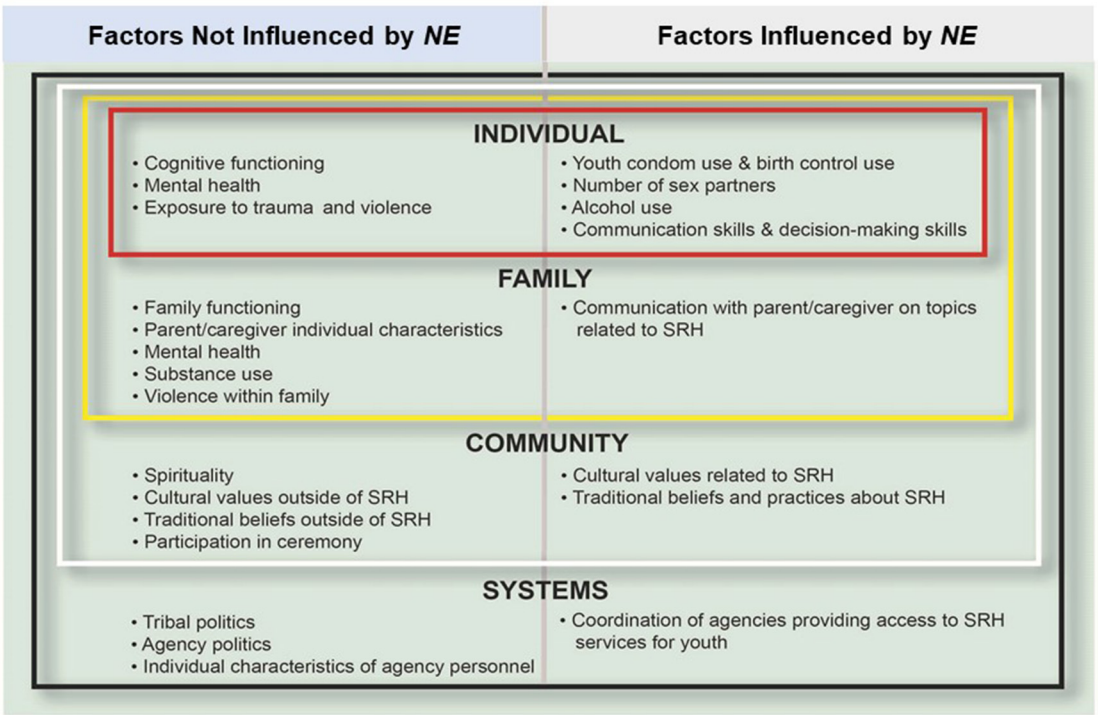

FIGURE 3 | *NE*'s conceptual framework.

mentoring program into *NE's* overall framework with an emphasis on addressing traditional topics related to SRH, such as overall information on cultural beliefs, values, and ceremonies, and more specific information on cultural beliefs and values regarding sex, having children, parenting, and relationships. Our cultural mentoring program includes older male and female tribal members paired with the youth by gender and tribal affiliation. AI youth meet one-on-one with their mentors each month and also monthly in mentor-mentee small groups. Depending on the purpose of the cultural mentoring sessions, the sessions are held at either the study's high schools, the Fort Peck Language and Culture Department's main office in Poplar, community centers on the reservation, or the Buffalo Ranch at Fort Peck.

4) Systems Level

The fourth level of *NE* mobilizes the Epi Team to enhance the coordination and implementation of SRH services at Fort Peck. The members of the Epi Team utilize the recommendations in the CDC's *Contraceptive and Reproductive Health Services for Teens: Evidence-based Clinical Best Practices Guide* to enhance the coordination and implementation of SRH services for AI

TABLE 1 | Overview of *NE*'s 9-month multi-level, multi-component intervention plan.

Individual	Family	Community	Systems
Native Stand (NS): 18-session school-based curriculum delivered twice a month over 9 months in *NE*'s 5 participating schools. NS will be integrated into the schools' existing class schedules.	**Native Voices (NV):** 4 sessions delivered once every other month to students and parents/legal guardians after school hours at *NE*'s 5 participating schools.	**Cultural Mentoring Program (CMP):** 9 mentoring sessions delivered twice a month over 9 months that include one group activity with CMP mentors and mentees and one 1:1 meeting. CMP activities will take place at varying locations on the Reservation depending on the activity.	**SRH Services:** Monthly meetings over 12 months with Epi Team at the Fort Peck Tribes Headquarters offices in Poplar, Montana
NS 1: Introduction to an overview of *NE* and Native Stand	NV 1: Introduction to *NE* and Native Voices	CMP 1: Assiniboine/Sioux kinship networks and concepts of family and genealogy	Epi Team meetings will take place monthly over 9 months to enhance coordination and implementation of SRH services for AI youth.
NS 2: Culture and tradition-part 1			
NS 3: Culture and tradition-part 2		CMP 2: Traditional male/female roles and cultural beliefs about healthy relationships	
NS 4: Healthy relationships-part 1			
NS 5: Healthy relationships-part 2	NV 2: Talking with youth about topics related to sex	CMP 3: Cultural beliefs about sex and how to make decisions about sex that integrate cultural values	
NS 6: Reproductive health-part 1			
NS 7: Reproductive health-part 2		CMP 4: Cultural beliefs about parenting and the role of family	
NS 8: Pregnancy and parenting			
NS 9: Preventing pregnancy	NV 3: Prevention of STIs, HIV/AIDS, and HCV	CMP 5: The role of ceremony in traditional Assiniboine/Sioux culture	
NS 10: Condoms and birth control			
NS 11: Sexually transmitted diseases		CMP 6: The role of sweat lodges in AI spirituality	
NS 12: HIV/AIDS and HCV			
NS 13: Drugs, alcohol, and sex	NV 4: Strategies for fostering healthy relationships in your child's intimate relationships	CMP 7: Honoring ceremonies in the lives of young men and women	
NS 14: Mental health and sex			
NS 15: Negotiation and refusal skills		CMP 8: Understanding the sacredness of the land	
NS 16: Decision-making			
NS 17: Effective communication		CMP 9: Buffalo harvest	
NS 18: Putting it all together			

youth at Fort Peck (53, 59, 81). This enhancement process takes place during the Epi Team's monthly meetings by developing a coordination and monitoring plan that is tracked over time to address the barriers, facilitators, and solutions to increase access to SRH services for AI youth at Fort Peck.

Trial Design

A Stepped Wedge Design (SWD) trial is used to evaluate the effectiveness of NE. The SWD is a cluster-randomized trial, which involves random and sequential crossover of clusters from control to intervention until all clusters are exposed to the intervention (70–74). In *NE* the schools in Frazer, Wolf Point, Poplar, Brockton, Culbertson are the clusters randomized into the intervention. Our discussion to use SWD is consistent with tribal members' desires that all 14- to 18-year-old AI youth receive the intervention. In our SWD the first observation period corresponds to a baseline measurement observation, in which none of the clusters have been randomized to the intervention. Clusters are then randomized to the intervention at subsequent steps until all clusters have completed treatment.

Following randomization of the clusters to the intervention, *NE* is implemented and evaluated across three steps: Step 1 (1 school), Step 2 (2 schools), and Step 3 (2 schools). *NE* takes 9 months to implement in each cluster. To evaluate the intervention, the first observation period provides baseline measurements for all respondents drawn from every cluster. The cluster is then surveyed at 3, 9, and 12 months for the students in the cluster once they have begun participation in the intervention, and at baseline, 9 and 12 months for the parents/legal guardians in the cluster once they have begun participation in the intervention. Following completion of the intervention across all clusters, we will conduct the quantitative

analysis. The SWD allows us to control for the effect of time and ensure that the full AI population of schools at Fort Peck receives *NE* (70–73). The systems-level component of *NE* is implemented reservation-wide rather than school-wide as the SWD is rolled out (82–85).

Instrumentation

NE's data collection includes a student survey, a parent survey, and Epi Team tracking logs. *NE's* data collection instrumentation was designed in partnership with the study's CAB and collaborating tribal agencies using a combination of local and Indigenous knowledge about SRH topics and established measures.

To assess student participation in *NE,* we developed a student survey that draws from existing measures that have been implemented and validated in research studies with AI youth (22, 23, 47–50, 77, 86–92). Our primary outcome measure addresses condom use relative to the frequency of sexual intercourse. Secondary outcome measures address age of onset of sexual intercourse; the number of sex partners; frequency of sexual intercourse; pregnancy history; frequency and type of birth control used during sexual intercourse relative to the frequency of sexual intercourse; and frequency and types of substances used relative to the frequency of sexual intercourse. Tertiary outcome measures include parent/legal guardian communication about SRH topics, cultural identity, access to SRH services, and STI/HCV/pregnancy testing history. Other variables included in our student survey are attitudes, intentions, and skills related to SRH and mental health. Standard demographic measures in the student survey are age, gender, sexual orientation, school, and highest grade completed.

The parent/legal guardian survey is based on parents'/legal guardians' participation in *Native Voices*. It includes a list of SRH topics about which the parent/legal guardian have spoken to the child, as well as the frequency at which topics were discussed. The parent/legal guardian measures have been validated in previous studies evaluating parent/child SRH communication (91–93). Standard demographic measures included in the parent/legal guardian survey are age, gender, marital status, highest grade completed, and occupation.

The Epi Team's tracking logs monitor the progress toward completion of the 8 service domains (contraceptive access; provision of hormonal contraception/IUD; emergency contraception; cervical cancer screening; STI/HIV/HCV testing and treatment; cost, confidentiality, consent; health center infrastructure; and health center environment) for clinical practices outlined in the CDC's *Contraceptive and Reproductive Health Services for Teens: Evidence-based Clinical Best Practices Guide* (53, 59, 81). The Epi Team tracking log identifies the barriers, facilitators, solutions, and responsible personnel to increasing SRH service coordinate for tribal youth. The Epi Team tracking logs are measured qualitatively.

Data Collection and Management

Data collection for the student and parent/legal guardian surveys are conducted on password protected iPads. The student and parent survey responses are then uploaded and housed on REDCap for data management (94, 95). Data collection for the students takes place during regular school hours. Data collection of the parents takes place individually either in their home or in an agreed upon location by the parent and the Fort Peck based research team. The data collection of the Epi Team tracking logs is conducted manually by the Epi Team member responsible for providing SRH services to AI youth on behalf of their agency. The tracking logs are collected quarterly by the MSU based research team during a regularly scheduled Epi Team meeting and uploaded to a secure server at MSU for organization.

Recruitment

Students and their parent/legal guardian are recruited from each of the study's 5 schools. Based on discussions with school personnel and our previously successful recruitment strategies in our exploratory study and pilot intervention, recruitment occurs via flyers posted in the schools, letters to the parents, parent-teacher meetings, and word of mouth. Additionally, we hold a parent/legal guardian session at each of the study's 5 schools that provides an overview of *NE*, the content and format of the intervention components, and risks and benefits of participation. After written consent and assent is obtained from the parent/legal guardian and youth, respectively, they are enrolled in the study. Students and their parents/legal guardians, and students from each cluster, are recruited for participation at baseline. Students and parents/legal guardians are assigned unique study identification numbers. For the systems-level component of *NE*, only those staff members who sit on the Epi Team as representatives of their respective agencies participate in the study. Written informed consent is obtained from the head of each agency represented on the Epi Team and the staff member participating in the Epi Team.

Incentives

Incentives for the students and parents/legal guardians are based on discussions with the CAB, research team members, and our prior experience implementing research studies at Fort Peck (96). Students receive $10 at the baseline, 3, and 9-month data collections and $20 at the 12-month data collection. Parents/legal guardians receive $10 at the baseline and 9-month data collections and at each of the 4 sessions of *Native Voices,* plus $20 at the 12-month data collection. A meal is also provided at the *Native Voices* sessions. Epi Team members do not receive incentives for participation in *NE,* as it is part of their tribal employment responsibilities. However, a meal is provided at the Epi Team meetings where the tracking logs are reviewed and discussed.

Analysis Plan

NE's analysis plan uses a mixed methods approach. Student survey data will be evaluated using generalized linear mixed-effects models (GLMMs) for longitudinal data to model our outcome variables (97). The GLMM allows for individual-level binary and continuous responses to be modeled to control for baseline characteristics, autocorrelation within individuals, and clustering by school. We chose the GLMM approach for several reasons (98). First, analyses provide proper weighting when cluster sizes vary, which will be likely given the distribution of schools at Fort Peck (87–89, 97, 99). GLMMs are also

the most frequently employed analytic method to adjust for the longitudinal nature of SWDs, and were chosen over the Generalized Estimating Equations (GEEs) because GEEs show inflated Type 1 error rates when the number of clusters is small, as is the case with the number of schools at Fort Peck (97). The GLMMs also allow us to model the unique effects of time that are evident in the SWD trial (this will be helpful, as sexual risk has been shown to vary over time in control group conditions at Fort Peck) (87–89, 97, 99).

Our quantitative data analyses also evaluate the influence of demographic factors, condom use intention, self-efficacy, refusal skills, knowledge, and motivation. Missing data is examined using multiple imputation, where missing values are replaced by a set of plausible values to generate a single estimate of the parameters of interest (100). Sensitivity analyses will be used to assess the robustness of primary results attributable to changes in assumptions regarding missing data by examining imputed and non-imputed data, adjusted for clustering (101, 102). STATA and R statistical software packages will be used to conduct the statistical analyses (103).

We estimate that a total of 456 students will be enrolled in *NE*. For our primary outcome variable, we expect to increase condom use as measured by the proportion of condom use relative to frequency of sexual intercourse from baseline to 12 months. Given our SWD, with an α of 0.05, power of 0.8, Nu = 292, DE_{sw} = 1.3273, and the expectation of 15% attrition during the study, a sample size of 456 will allow the detection of a 0.14 increase in the proportion of condom use relative to the frequency of sexual intercourse from baseline to the 12-month observation period (71–74).

For our systems level and the evaluation of the SRH services coordination on the reservation, we use qualitative data analysis. Epi Team tracking logs developed for *NE* based on the CDC's 8 service domains for improving SRH services for youth are transcribed and analyzed by coding for emergent themes that portray ongoing barriers and/or strengths in coordinating SRH services for Fort Peck youth. We sort the qualitative codes, relative to the CDC's 8 service domains. Then, within each service domain, we ascertain the axial and theoretical underpinnings relative to each. Atlas.ti software are used to develop open codes which are shared with the Epi Team and the CAB for discussion, refinement, and approval (104).

Fidelity, Acceptability, and Sustainability

In addition to the actual intervention to measure SRH outcomes in AI youth, *NE* includes two qualitative methods of intervention fidelity and acceptability assessment to monitor and enhance the reliability and validity of the intervention. First, fidelity recommendations from the National Institutes of Health Behavior Change Consortium are implemented across 5 areas of study design and specifically include qualitative documentation of research team training, delivery of the intervention, receipt of the intervention, and enactment of intervention skills using Fidelity, Acceptability, and Sustainability (FAS) forms developed by the CAB and the research team members (82). Second, focus groups are an additional qualitative assessment to determine fidelity and acceptability, given the utility of focus groups in inductively determining key issues and ideas, their ability to elucidate process-oriented outcomes, and their use in previous SRH intervention evaluation studies (105, 106). We implement 4 to 8 focus groups at 12 months upon completion of the intervention in each cluster with students, parents/legal guardians, teachers and professionals from schools, agencies, and health care organizations.

The FAS forms and focus groups are analyzed using a grounded theory approach (107). All themes that emerge from the FAS forms and focus groups are reviewed, discussed, and agreed upon by the CAB. We will triangulate the qualitative data from our fidelity and acceptability strategies with the results from the data analyses of the primary, secondary, and tertiary outcomes to understand the value and effectiveness of *NE's* intervention levels (108–111). This analytical process will be conducted in iterative conversations between the study's CAB and research team members to reach consensus about *NE's* overall efficacy. Our overall goal is to use our findings to establish a culturally relevant sustainability plan for the integration of *NE* into extant Fort Peck infrastructures, and eventually replication *NE* in other tribal communities to prevent STIs, HIV, HCV, and teen pregnancy among AI youth (112–114).

ETHICS AND DISSEMINATION

Ethical Approval

NE's ethical approval has had several steps. All of *NE's* research protocol s were reviewed and discussed amongst the research team members and the CAB for agreement and approval. *NE's* research protocols were then reviewed by the Fort Peck Institutional Review Board (IRB) for approval. Finally, the research protocols were sent to the MSU IRB as MSU policies require approval from a tribal IRB or tribal governance board, such as a tribal council, prior to the MSU IRB providing ethical approval for the study.

Dissemination

The 15-year partnership between the Fort Peck Tribes and MSU researchers has resulted in numerous peer-reviewed publications, national presentations, and documentary films. Results of *NE* will continue our partnership's established record of disseminating research findings to scientific, professional, and community audiences. Work associated with *NE* will be presented at Fort Peck community meetings, to the Fort Peck Tribal Executive Board, on local radio, in the tribal newspaper, and presented to staff and faculty from the local high schools.

DISCUSSION

Limitations

NE has anticipated limitations. First, our study relies on a number of widely-used self-reported measures of sexual risk behaviors, which may risk social desirability bias. We have successfully used these measures in our past exploratory studies

at Fort Peck with AI youth and we are confident that they give accurate results of our outcome variables. Furthermore, our use of iPad increases perceived privacy. Previous studies of questionnaire administration modalities have documented that social desirability bias is a factor that may be mitigated by the use of password protected data collection devices when screening youth for health risk behaviors (115–117). Second, recruitment and retention of students may pose challenges, which we address by working closely with our CAB, all of whom have deep roots with the families and communities at Fort Peck. In addition, *NE's* Fort Peck based research team members are trusted tribal members with extensive experience working in the schools on the reservation and can work with school staff, youth, and families to recruit and retain participants. *NE's* Principal Investigator's 15 years of research experience with the Fort Peck Tribes is also an asset for addressing recruitment and retention. Despite recruitment and retention being a stated limitation, given the combined strengths of *NE's* Fort Peck- and MSU-based research team members and the CAB, we are confident in our ability to recruit and retain an adequate sample size to detect a treatment effect set at a power of 80%, thereby establishing the potential generalizability of *NE*. Third, potential contamination is possible to sites that have not yet entered or completed the intervention. However, we anticipate that cross-contamination will not occur because the 5 schools participating in *NE* are situated 15 to more than 30 miles from each other in distinctive, self-contained rural reservation communities. Fourth, under the SWD, there is the possibility that an unobserved 3-way interaction will exist for time by cluster by intervention. Based on our work with the Fort Peck community and the multiple factors we have documented as implicated in sexual risk-taking among youth on the reservation in our exploratory studies, we do not expect appreciable exogenous or endogenous temporal impacts on sexual risk outside of the intervention. The small likelihood of this possibility is outweighed by the Fort Peck Tribes' requirement that all youth from each of the communities be able to receive the full intervention. Hence our decision to use the SWD.

Discussion

NE was designed as part of a long standing tribal-academic partnership between the Fort Peck Tribes and MSU at the bequest of the Fort Peck Tribal Council. *NE's* innovative design is the result of an integration of current academic knowledge with tribally specific data, cultural wisdom, and existing reservation resources.

NE's individual level utilizes an adaptation of Native Stand, an evidence based sexual health curriculum for AI youth. *Native Stand* has been adapted for use in other tribal communities as a stand-alone SRH curriculum for AI youth (47, 77). In *NE*, Native Stand is integrated into the study's multi-level design as part of a larger community-wide initiative to reduce SRH disparities among AI youth. Specifically, we reduced *Native Stand's* standard 28 modules to 18 with a focus on healthy relationships, decision making, mental health and substance use, and communication skills. *NE's* family level has adapted the *Native Voices* curriculum for parents/legal guardians which was originally designed by the Centers for Disease Control and Prevention (CDC) as a one-time STI/HIV prevention educational session for AI youth. In *NE* we have adapted *Native Voices* for parents/legal guardians based on recommendations by the CDC for parental adaptions to *Native Voices* that have not been previously undertaken with AI families in an RCT (48). *NE's* community level involves cultural mentors teaching youth participating in the intervention. Existing cultural mentoring programs for AI youth have primarily been designed to address substance use, juvenile delinquency, and suicide prevention (49, 50). *NE* fills a gap in the body of research on the use of older adults and elders to strengthen AI youths' understanding of their traditional beliefs and practices about topics related to SRH. *NE's* system level utilizes the CDC's *Contraceptive and Reproductive Health.* Services for Teens *Evidence-based Clinical Best Practices Guide* to evaluate the coordination of SRH services for AI youth in a tribal community (53, 59, 81). The CDC guide was developed based on research with non-Native SRH–serving agencies and provides recommendations for tribal communities that, to our knowledge, have not been used in an Indigenous community. The adaptions made to *Native Stand, Native Voices*, and the *CDC's Contraceptive and Reproductive Health Services for Teens: Evidence-based Clinical Best Practices Guide* in combination with the creation of a SRH cultural mentoring program were the result of collaborative efforts between the study's CAB and members of the Fort Peck and MSU research team members.

NE's methodological approach combines a cluster-randomized SWD within a CBPR framework. We use quantitative and qualitative methods to assess our outcome variables. Further, *NE* has a fidelity, acceptability, and sustainability component using a combination of evaluation forms to document how the intervention was implemented and focus groups to ascertain how participants experienced the intervention. *NE's* multi-level design is consistent with the emerging field of Indigenous intervention science. In a review of 21 RCTs, Dickerson et al. found that integration of cultural contexts and traditional knowledge with western scientific methodologies warranted qualitative and quantitative techniques as well as CBPR strategies to generate culturally adapted RCT designs with Indigenous communities in the United States (118). Additionally, Jerrigan et al. highlight the importance of developing evidence based multi-level intervention designs in partnership with tribal communities that address the historical and contemporary contextual issues in tribal communities shaping health disparities (119). Others suggest that multi-level interventions are needed to build local capacity that can effect systems and the interactions within systems in tribal communities to make structural and policies changes that can ultimately impact individual level health outcomes (120). By incorporating individual-, family-, community-, and system-level context-specific factors in AI youth's human ecology, *NE* is positioned to intervene in behaviors, situations, and structures that lead to SRH disparities in tribal communities. Our qualitative and quantitative techniques and the multiple ways in which we triangulate our findings also can contribute to new conceptual and analytical paradigms for analyzing the

effectiveness of RCTs within the unique cultural context of tribal communities (121).

CONCLUSION

NE seeks to understand the complex factors influencing SRH among AI youth to ultimately reduce SRH disparities in tribal communities. *NE* integrates current public health knowledge about how to prevent STIs, HIV, HCV, and teen pregnancy with traditional Assiniboine and Sioux cultural values and existing tribal resources and infrastructure. *NE* is consistent with Fort Peck tribal values, belief systems, and ways of life on the reservation; thus, it is more likely to result in decreased SRH disparities. The CBPR process by which *NE* was developed can be generalizable to other AI communities with similar values, belief systems, and ways of life. *NE* can also serve as an evidence-based, culturally adapted, and multi-level, multi-component SRH intervention for AI youth and families aiming to prevent and reduce STIs, HIV, HCV, and teen pregnancy in AI communities.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary materials, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Montana State University Institutional Review Board and Fort Peck Tribes Institutional Review Board. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

The authors of this manuscript were the original research team members that designed the randomized control trial presented in this manuscript. ER completed the writing of the manuscript. OJ, PF, AR, RG, MA, MP, and JB reviewed the manuscript and provided editorial and content specific feedback. MP conducted the formatting for the manuscript. All authors have reviewed the submitted manuscript and approve the manuscript for submission.

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Predictors of STD Screening From the Indigenist Stress-Coping Model Among Native Adults With Binge Substance Use

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Objective: The American Indian/Alaska Native (AI/AN) population in the U.S. is thriving in spite of settler colonialist efforts of erasure. AI/AN people, however, continue to experience persistent health disparities including a disproportionate burden of substance use and sexually transmitted diseases/infections (STDs/STIs), as well as a disproportionate lack of public health STD screening services and STD prevention interventions grounded in AI/AN social contexts, experiences, and epistemologies. The present study explored how stressors and protective factors based on the Indigenist Stress Coping framework predict STD screening outcomes among Native adults.

Methods: We analyzed baseline self-report data from 254 Native adults ages 18–55 years with recent binge substance use who were enrolled in an evaluation of "EMPWR," a two-session STD risk reduction program in a rural, reservation-based community in the U.S. Southwest. Logistic regression models with robust variance were used to estimate odds ratios of lifetime STD testing for the theoretical stressors and cultural buffers.

Results: A little over half the sample were males (52.5%, $n = 136$), with a mean age of 33.6 years (SD = 8.8). The majority (76.7%, $n = 195$) reported having ever been screened for STD in their life. Discrimination score were significantly associated with lifetime STD testing: The higher discrimination was associated with lower odds of STD testing in the fully adjusted model (aOR = 0.40, 95%CI: 0.18, 0.92). The effects of AI/AN-specific cultural buffer such as participation in traditional practices on STD testing outcomes was in the expected positive direction, even though the association was not statistically significant. Household size was significantly associated with STD screening: The higher the number of people lived together in the house, the higher the odds of STD testing in the fully adjusted model (aOR = 1.19, 95%CI: 1.04, 1.38).

Conclusion: Our findings suggest that STD prevention programs should take into consideration AI/AN-specific historical traumatic stressors such as lifetime discrimination encounters and how these interact to drive or discourage sexual health services at

local clinics. In addition, larger household size may be a protective factor functioning as a form of social support, and the extended family's role should be taken into consideration. Future research should consider improvement in measurements of AI/AN enculturation constructs.

Keywords: sexually transmitted diseases (STD), cultural buffering, enculturation, historical loss, stress coping and/or resiliency, perceived discrimination, American Indian/Alaska Native, sexual and reproductive health service

INTRODUCTION

The American Indian and Alaska Native (AI/AN) population in the United States is growing and thriving in spite of settler colonialist efforts of erasure. Recent census data show that from 2010 to 2020, the AI/AN-alone population grew by 27.1%, and AI/ANs in combination with other race/ethnic subgroups (or AI/AN mixed ethnicity) grew by 160% (1). AI/ANs, however, continue to experience persistent health inequities including a disproportionate burden of sexually transmitted diseases (STDs), also referred to as sexually transmitted infections (STIs). For the purposes of this manuscript, we use STD interchangeably with STI. While recent national surveillance data between 2016 and 2019 show annual increases in all three common reportable STDs across races/ethnicities, i.e., chlamydia (+19% since 2015), gonorrhea (+56%), primary and secondary syphilis (+74%), as well as congenital syphilis (+279%), STD rates are disproportionately higher among AI/ANs compared to Whites and all other racial/ethnic groups except for Blacks (2, 3). In 2019, compared with Whites, the chlamydia rate among AI/ANs was 3.6 times greater (760 vs. 209.7 per 100,000, respectively), gonorrhea was 4.8 times greater (355.8 vs. 73.9 per 100,000), and primary and secondary syphilis was 3.2 times greater (21.3 vs. 6.6 per 100,000) (2).

Given the high rates of STDs in the AI/AN population, and the serious health consequences of STDs if left untreated, AI/ANs are deemed a priority population (2) for STD intervention including testing and screening for STD, and promotion of sexual health equity (3, 4). STD transmission probability is influenced by various individual behaviors such as condom use, number of new partners per unit of time, sexual partnering, community STD prevalence, and syndemics such as substance use and hepatitis C virus (HCV) infections (3). In addition, the complex structural and social contexts of historical and ongoing oppression and resulting exposure to stressors and trauma within which these factors interact also drive inequities in STD rates among AI/ANs (5).

AI/ANs also experience disproportionately high rates of alcohol and drug use and comorbid substance use disorders which are associated with increased STD risk. In 2020, 9.1% of Native adults reported past month heavy drinking and 14% reported past year Alcohol Use Disorder, the highest rates of any race/ethnic group, while in 2019, 22.8% of Native adults reported past month binge alcohol drinking (6). Further, 25.5% of Native adults reported having a substance use disorder in the past year, more than 10 percentage point above the rate for Whites. More specifically, alcohol and other substance use are associated with increased STD risk through unsafe sexual practices including unprotected sex (7), as well as increased number and concurrency of sex partners (8). Research conducted with AI/ANs who engaged in sex while drunk or high showed they were 14 times more likely to engage in sexual risk behaviors than those who had not (9). Screening for STD among AI/ANs who binge substance use is particularly important.

While data on screening rates of Native adults is sparse, there is ample information about structural determinants that preclude STD testing in Native communities including a shortage of sexual healthcare providers and access barriers to healthcare including confidentiality concerns, and geographic isolation (10–15). In relation to access to STD testing among participants in this study, in the community in which this study was conducted which spans over 1.5 million acres, there is only one health care facility in which STD testing is available and STD testing by mail was not offered. Community members often travel 60 miles or more to access services at the one clinic.

An important contextual barrier specific to AI/AN healthcare access is that rural and/or reservation-based areas have historically had limited and/or underfunded medical and social services that limit the delivery and quality of STD care. Furthermore, among AI/ANs residing in these communities, stigma, provider bias, and mistrust of the health care system contribute to decreased health care utilization resulting in delays in diagnosis and treatment, which pose significant challenges to STD prevention efforts (3). In small tribal communities on reservations where personal relationships exist between health care seeking community members and health care providers, fear of potential breach of confidentiality in STD testing and treatment are additional barriers (16, 17).

The Centers for Disease Control and Prevention's newly released STD treatment guidelines indicate that primary prevention of STDs should include assessment of both behavioral risk (i.e., assessing the sexual behaviors that can place persons at risk for infection) and biologic risk (i.e., testing for risk markers for STD and HIV acquisition or transmission) (18). In addition, the National Academies of Sciences, Engineering, and Medicine (NASEM) articulates that efforts are needed to determine how to best integrate health services for populations that are at risk of substance use and syndemic infections, such as HIV and STDs in order to provide integrated care delivery models for STDs and related syndemics (3). This paper focuses on STD screening among Native adults with binge substance use who reside on a rural reservation.

Conceptual Framework

Several tribes and Tribal Epidemiology Centers in partnership with universities have developed culturally relevant and

age-appropriate tribal best practices of sexual health curricula for AI/AN youth, including several by the tribal-academic team who co-authored this manuscript (16, 19, 20). Classical theories of behavioral change—in particular, risk perception and behavior intention—have been found helpful in explaining individual-level mechanisms of sexual risk or protective behaviors among AI/ANs. For example, lower perception of risk to STD susceptibility, generally due to misconceptions about STD prevention and treatment, have been found to be associated with risky sexual behaviors among AIs (21, 22). Alternatively, in Native communities it is important to consider the importance of communal risk; literature specific to Native communities underscores Native cultural practices and values about the importance of family and community for promoting health and wellness (23, 24). Thus, we suggest taking a more holistic view of behavior change when working with Native communities which includes utilizing Native-centered theories and including measures such as household size as a proxy measure for social support and family engagement (25). Furthermore, treatment approaches that are congruent with AI/AN cultural values, traditions, and customs enhance treatment engagement (26–28).

A number of culturally relevant organizing conceptual frameworks have emerged in the last two decades that synthesize our understanding of and ways to address health inequities among AI/ANs (29). These include the Native-Reliance theoretical framework to explain substance use in AI/AN youth, the Indigenist Stress-Coping (ISC, a stress process approach) model to explain health outcomes including STD/HIV infections among other health conditions (5, 30, 31) and the Framework of Historical Oppression, Resilience, and Transcendence (FHORT) which has been used to explain violence (32, 33) and depression experienced by Indigenous peoples (33). The contributions of these models and others suggest that Native cultural values, identities, and traditional and spiritual practices are critical for AI/AN peoples to cope with stressors and thrive for wellbeing. For example, enculturation—inclusive of positive identification with AI/AN ethnicity, internalization of cultural values, connectedness to and participation in community and traditional cultural practices, and participation in spiritual traditions—has been found to protect AI/ANs against risks for STDs (34–37). Cultural identity manifested as social support and protective family and peer influences have also been cited as protective buffers for substance use and risky behaviors among AI youth (38). Thus, it is imperative to consider cultural tailoring processes in substance use interventions including incorporating traditional AI/AN rituals, practices, ceremonies, and cultural activities (e.g., talking circles) (39).

This paper aims to apply the Indigenist Stress-Coping (ISC) theoretical framework to examine Indigenous-specific risk and protective predictors of STD screening among rural, reservation-dwelling AI adults who binge drink or use drugs (30, 31, 40). The ISC is a stress process model of understanding health disparities, that emphasizes how socio-cultural and historical processes influence stress exposure and the impact of stress on AI/AN individual behavioral health. Stressors may stem from a complex interplay of contemporary structural and interpersonal discrimination and violence exposure, socio-economic and environmental structural inequities, and, historical and lifetime cultural trauma rooted in histories and legacies of settler colonialism, forced relocation and removal from land (41, 42). These stressors have been associated with high risk-taking behaviors. Stressful life events in AI youth have been shown to be positively associated with substance use and risky behavior (38). Similarly, traumatic life events and stress have been associated with sexual risk behaviors in AI youth and adults. This was especially the case among young women in a study conducted with a Northern Plains tribe (43) and in a study with a Southwestern tribe (7, 25).

We will examine the factors that predict STD screening outcomes in a high-risk population of rural, reservation-dwelling AI adults who binge drink or use other substances. AI people who reside on tribal lands tend to have strong connections to their ancestral geographies, original instructions, traditional cultural practices, and ways of life including reciprocal relationality grounded in family and community support (44). The ISC model proposes that AI/ANs' sexual health outcomes should be understood in the context of their unique socio-demographic vulnerabilities due to historical and current trauma that give rise to multiple co-occurring stressors (see **Figure 1**). The ISC framework articulates that Indigenous cultural, community, spiritual, and personal resources/strengths may buffer the effects of stressors and risk on poor sexual health outcomes (31).

Historical social events such as historical trauma (HT) (e.g., collective loss or pain) that interact with proximal contemporary chronic stressors such as microaggressions, discrimination, exposures to lifetime trauma, and interpersonal violence are unique to AI/AN-specific contexts and may impact healing, health, wellbeing, and stress processes (44, 46). At the individual level, HT impact includes impairments in family system disruption including communications (47), mental health symptoms, substance abuse (46), and sexual risk behaviors (43, 44). At the community level, collective responses to HT include the disruption of Native culture such as Native identity, languages, traditional practices, and spirituality (44, 48).

The Historical Loss Scale (HLS) is a standardized measure that assesses the frequency with which AI/ANs think about the losses to their culture, land, and people as a result of settler colonization (41, 46). The HLS is conceptualized as a contributor to negative contemporary experiences of historical trauma or historical grief, and thus a stressor (41). These persistent thoughts of historical loss appear to have emotional and behavioral consequences. They are associated with alcohol abuse, anger, and symptoms of internalization and violence (46). Researchers posit that the more an AI/AN individual thinks of the collective losses and associated griefs rooted in historical injustices endured by their communities, the higher the level and intensity of contemporary stress they will experience (41, 44, 45, 49).

Another stressor in the ISC framework is perceived or experienced discrimination, by which AI/ANs experience negative or unfair treatment because of their ethnicity. Interpersonal discrimination can affect health and health-seeking behaviors (50, 51). Research has shown that perceived and experienced interpersonal discrimination against AI/ANs and other social determinants described above produce heightened

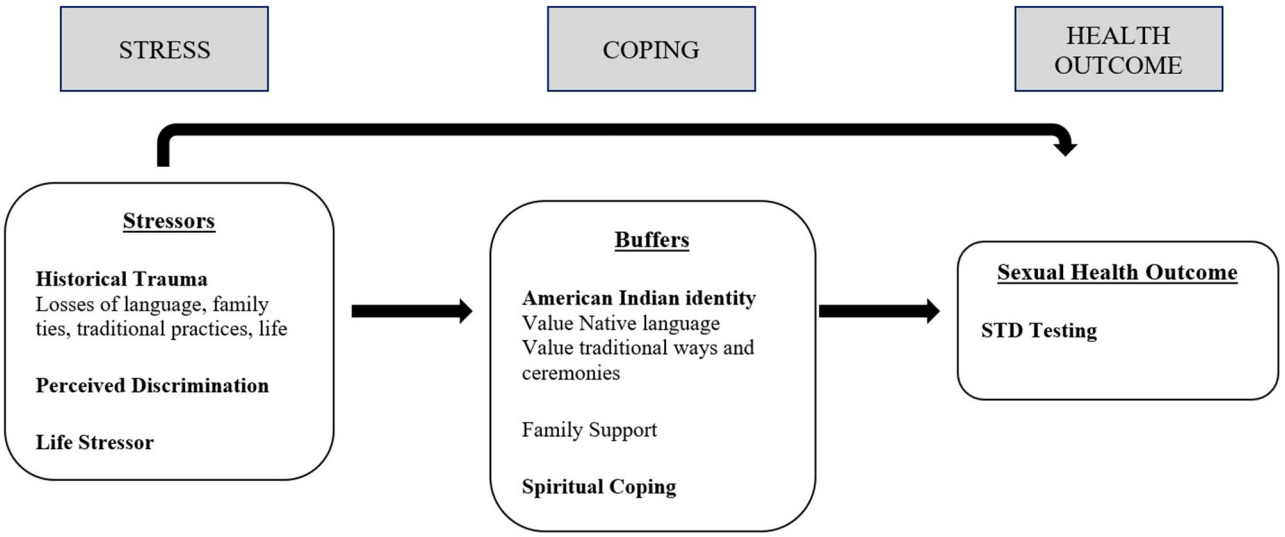

FIGURE 1 | Modeling indigenist stress-coping model predicting STD testing. Adapted from Walters and Simoni (31) and Walters et al. (5, 44, 45).

stress responses, affect risky health behaviors (40, 50, 51), and impede equitable access to sexual healthcare services including regular STD screening, care, and treatment.

Cultural factors have been found to buffer AI/ANs against the negative health effect of stressors. AI/AN enculturation is the process by which individuals learn about and identify with their ethnic minority culture (increasing knowledge about, engaging with, and identifying with traditional cultural practices). Across studies, enculturation has been found to be protective in nature, promoting academic success and decreasing violent behavior and alcohol abuse among AI youth (41, 52). Specific aspects of enculturation including connection to traditional cultural values and ethnic identity and a sense of family belongingness have been found to be protective against heavy alcohol use (52).

Enculturation may hold a particular strength for AI/ANs who were born and raised in the decades since the 1960's and 1970's tribal self-determination movement era "when tribes were able to "determine" their identity, or in other words, to create their own identity through defining and affirming their cultural values" (53), p. 782. Although the Civil Rights movement of the 1960's brought high hopes for social and racial justice within the U.S., institutional and interpersonal racism and discrimination continue to plague the country impacting health disparities (54).

The purpose of this analysis was to explore the predicted Indigenous stressors and cultural buffers of STD screening among AIs with recent binge alcohol use using the ISC model. Thus, we test the following two hypotheses:

Hypothesis 1: Stressor exposures such as economic stress, thoughts of historical loss, and perceived or experienced discrimination decrease protective sexual health behaviors such as STD screening.

Hypothesis 2: Cultural buffers, namely AI enculturation factors such as Native language, traditional practices and ceremonies, and spirituality buffer against the negative effects of stressors on STD screening.

MATERIALS AND METHODS

Data Source and Participants

Study Design and Setting

Data for this paper were gathered in 2015 at the baseline assessment as part of a randomized controlled trial (RCT) evaluating the EMPWR (Educate, Motivate, Protect, Wellness and Respect) intervention for impacts on several sexual health risks, including completion of STD screening (25, 28, 55, 56). EMPWR was culturally adapted from an evidence-based intervention "Project RESPECT" (28). The RCT was developed in the context of a well-established sustainable collaboration between the participating reservation-based tribal community in the Southwestern United States and the study's academic partners. The participating community is located in one of the hot-spot counties in the Southwestern U.S. with higher multi-STD concentration rates than in other counties (2–4, 12, 57). When spatial disparity in STDs juxtaposes on racial disparity, hot-spot analyses indicate that a 10-percentage point increase in the proportion of AIs as a share of the county's population was associated with a 53% increase in the odds of being a hot-spot county for chlamydia and a 55% increase for gonorrhea (57).

The EMPWR program is a brief, client-focused counseling intervention that aims to motivate STD screening and reduce sexual risk-taking behaviors. The study was conducted from July 2015 to June 2019, and the study aims were evaluated at three time points (baseline, 3-, and 6- months post-intervention). Details about the RCT design, protocol and intervention outcomes are reported elsewhere (25, 27, 28, 55). This paper utilizes the cross-sectional baseline data collected prior to participants receiving EMPWR intervention sessions.

The governing Tribal Council and Health Advisory Board of the participating tribe, along with the participating academic and Indian Health Service Area research review boards, approved the study. This article was reviewed and approved by the Tribal Council and Health Advisory Board of the participating tribal community.

Participants

Participant inclusion criteria included adults ages 18–55 years who self-identified as AI, were residing in the participating tribal community, were sexually active in the last 3 months (self-report on eligibility screener), reporting at least one episode of binge alcohol or other substance use within the last 3 months, and provided informed consent. Participants were referred for study recruitment from the tribe's public health surveillance system which tracks all incidents of binge substance use, defined as use which results in serious consequences associated with a high blood alcohol level or drug toxicity level (27, 28). Surveillance staff are authorized by tribal law to conduct in-person follow-up visits with every reported individual to confirm the event and triage the individual to outpatient treatment (27, 28). During that visit, surveillance staff screened potential participants for study eligibility criteria. All participants were consented by trained local study staff and then completed a baseline assessment. In total, 301 participants were consented and completed the baseline assessment.

Cultural and Contextual Adaptation

Tribal community stakeholders engaged in decision making in all phases of study design. One of the strengths of the research partnership is that local para-health professionals served on the research team as local research staff. All evaluation instruments including the baseline assessment questions were adapted and piloted with members of the participating tribal community. For instance, the "loss of land" item was dropped from the standard HLS instrument for this community. In order to meet the transportation needs of the participants and assure confidentiality in a small, rural, close-knit tribal community, baseline self-report surveys were completed *via* Audio Computer Assisted Self-Interview technology on laptops at participants' own homes, in the research team's local study office, or in a mutually convenient location in the community, including inside project vehicles (27).

Measures

All measures in these analyses were assessed via self-report survey responses and include sociodemographic characteristics, stressors, and cultural and spiritual buffers, as well as protective and risky sexual health behaviors. Participants received $15 USD for completing self-report baseline assessments via Audio Computer Assisted Self-Interview technology on laptops, or via hard copy.

Outcome Measure

The primary outcome variable used in the analysis in this paper is, "Ever screened for an STD," which was measured by one question which asked if participants had ever been tested for an STD. Response options included: Yes, No, I don't know, or Refuse to answer. For the purposes of this analysis, we dichotomized the outcome variables (0 = no and 1 = yes). The "I don't know" or "Refuse to answer" responses were coded into missing. Participants with missing values for STD screening were removed from the analytic dataset.

Control Variables

Sociodemographic characteristics such as age (18–55 years), sex (male = 0, female = 1), has children (none = 0, has any number of children = 1), marital status (single = 0, married or cohabiting = 1), education (less than high school = 0, high school, GED or above = 1) and number of people who live together (count) as an indicator of household size (a proxy for social support) were each assessed via self-report survey responses.

Stressors

Table 1 presents stressors and cultural buffers, and corresponding Cronbach's alpha for scales. Three measures of psychosocial stressor exposure were included in these analyses: Economic stress, Historical Loss Scale (HLS), and the Perceived Discrimination Scale.

Economic stress was measured by whether the participant was unemployed at the time of the baseline assessment (0 = employed, 1 = unemployed).

The HLS is a 10-item standardized measure. The participants were asked to report the frequency with which they think about the three types of losses due to the historical process of colonization: the losses to their culture, land, and their people, as well as thoughts of mistreatment for being AI (46). Two items specific to loss of land and loss of families from the reservation due to government relocation to reservations and urban areas were deemed inapplicable to the participating tribal community's context, and were excluded. Average of non-missing responses to 10 items on a Likert scale was used to assess thoughts of historical loss (possible range: 0 = never, 1 = yearly or at special times, 2 = monthly, 3 = weekly, 4 = daily, and 5 = several times a day) so that higher values indicate more frequent thoughts about historical loss. The ten-item HLS had high internal consistency (Cronbach's alpha coefficient = 0.924).

For STD screening outcome analysis, the HLS was categorized as <3, 3 or greater and missing, which includes participants with missing data to all 10 items. Three subscales were also derived from the HLS per previous research (41, 46, 58): loss of culture (alpha = 0.802); loss of loss of early life due to alcoholism or other accidents (alpha = 0.859); and thoughts of cultural mistreatment in terms of loss of respect, self-respect, trust, and family ties due to colonization (alpha = 0.878). Since the ten-item HLS performed better than each of the sub-scale predictive associations, and fit the model best with the STD screening outcome variable, the overall HLS was selected for final analysis.

Perceived discrimination was assessed with a standard ten-item scale measuring a range of potential types and sources of discrimination (32). The participants were asked to report the number of times they had experienced discrimination defined as negative or unfair treatment because of their ethnicity. Responses to these items were coded so that higher values indicated higher

TABLE 1 | Measures of stressors and cultural buffers operationalized for indigenist stress coping (ISC) model among American Indians with binge substance use in a rural community, $N = 254$.

Variable	Number of items	Response options	Mean (SD)	Alpha
Life stressors				
Economic stressor				
Do you currently have a job?	1	Yes (0); no (1)	0.09 (0.29)	N/A
Traumatic stressors				
Historical loss scale	10	How frequently do the following losses come to mind? Never (0); yearly or special times (1); monthly (2); weekly (3); daily (4); several times a day (5).	1.41 (1.36)	0.924
Fewer people speaking our language				
Less knowledge and participation in our traditional and spiritual ways				
Less knowledge and participation in cultural activities				
Less understanding in preparing Traditional healthy foods and activities				
The effects of alcoholism on our people				
Loss of our people through early death (alcohol related, suicide, accidental, etc.)				
Loss of respect by our children and grandchiildren for elders				
Loss of family ties due to Boarding/residential schools				
The loss of self-respect from poor treatment by government officials				
The loss of trust in white people from broken treaties				
Perceived discrimination scale				
Global discrimination sub-scale	5	How often have you experienced the following? Never (0); sometimes (1); always (2).	0.49 (0.53)	0.915
Someone said something bad or insulting to you because you are Native American				
Someone ignored you or excluded you from some activities because you are Native American				
Someone said a racial slur or racial insult to you or about you				
You felt threatened by someone because you were worried that they may harm you because you are Native American				
Someone treated you unfairly because you are Native American				
Cultural buffers				
American Indian identity (enculturation)				
Use of native language	1		0.52 (0.50)	N/A
What language do you prefer to speak? (Only choose one answer)		Your tribe's language (1); English (0); both English and your tribe's language (3); other (4); I don't know (97); refuse to answer (98).		
Practice of traditional ceremonies and ways	1	Not at all (0); not very important (1); somewhat important (2); very important (3); I don't know (97); refuse to answer (98).	1.57 (1.14)	N/A
How important is it to you to participate in your tribe's Traditional practices?				
Spiritual coping scale				
To what extent is your spirituality involved in understanding or dealing with stressful situations in any way?	1	Not involved at all (0); not very involved (1); somewhat involved; (2) very involved (3); I don't know (97); refuse to answer (98).	1.46 (1.06)	N/A

level of perceived discrimination (possible range: 0 = never, 1 = sometimes, and 2 = always). The perceived discrimination scale had high internal consistency (Cronbach's alpha coefficient = 0.949). Average scores across relevant items were used to assess three subscales or dimensions of discrimination. Perceived global discrimination (five items regarding being ignored, excluded, or verbally insulted by others to hearing racial slurs and threats of physical harm), authority discrimination (three items regarding perceived discrimination by authority figures such as police) and school or work discrimination (two items regarding teachers of employers expecting them not do well because they are AI). Exploratory analysis revealed that the five-item global

discrimination subscale (Cronbach's alpha coefficient = 0.915) was found to have the strongest predictive association and fit the model best with the outcome variable (the lowest AIC or Akaike Information Criterion), and was selected for the analysis.

Cultural Buffers

The self-report survey assessed a variety of cultural affinity and enculturation measures through 17 different questions such as the use of and preference for Native language, traditional cultural values and beliefs, and identification with and involvement in traditional ceremonies and cultural practices. Beliefs and values based on religion and religious practices also constituted this set of theorized buffers. The 17 questions, however, varied in enculturation dimensions, response types, and missing values inhibiting the development of one single enculturation scale or meaningful sub-scales. Therefore, we operationalized enculturation by selecting the two most robust items with the least missing values for analysis, and an entirely separate Spiritual Coping Scale (see **Table 1**).

As illustrated in **Table 1**, one measure of AI enculturation pertaining to the transmission of cultural knowledge was a question about participants' preference to speak their Native language in their daily lives. The response categories were *(prefers to speak: 0 = Native language, 1 = English, 2 = Both Native language and English, 97 = don't know, 98 = refuse to answer).*

The second measure of AI enculturation includes the importance respondents placed on participating in traditional practices and ceremonies (How important is it to you to participate in your tribe's traditional practices?). Responses were treated as categories rather than scales for analyses *(0 = not at all important, 1 = not very important, 2 = somewhat important, 3 = very important, 97 = don't know, 98 = refuse to answer*).

Finally, spirituality as a stress coping mechanism was assessed with a one-item Spiritual Coping Scale question, "To what extent is your spirituality involved in understanding or dealing with stressful situations in any way?" Responses were *(0 = not involved at all, 1= not very involved, 2 = somewhat involved, 3 = very involved, 97 = don't know, 98 = refuse to answer).*

Analysis

"Don't know" or "refuse to answer" choices or missing values were coded as separate response categories in the analyses to avoid sample size reduction in the models. Only one numeric variable in the models still has missing data: number of persons living in the household ($n = 14$). Other categorical variables with missing data include education ($n = 2$), having children ($n = 1$) and employment status ($n = 2$). Since the number of missing observations is too small, we couldn't add "missing" as an additional category for these variables. This resulted in inclusion of $n = 236$ participants in our models ($n = 93\%$ of eligible participants). We also compared characteristics between participants who are included in the analyses and those who do not have a response to ever screened for STD, i.e., with missing data on the STD testing status to assess for any systematic differences. Compared to excluded participants, those included in the analyses were more likely to be married or cohabitating (37 vs. 19%), more likely to prefer to speak English (48 vs. 19%), had higher global discrimination score (median = 0.4 vs. 0), and had somewhat or high extent of spiritual involvement when dealing with stressful situations (41 vs. 9%).

Bivariate associations between sociodemographic variables, theoretical stressors, cultural buffers, and the outcome variable were explored using *t*-tests or Wilcoxon tests for continuous variables, and Pearson's chi-squared tests for categorical variables, except for the situations where the counts in the contingency table were low. In these cases, we used the Fisher's exact test.

Logistic regression models with robust variance were used to estimate odds ratios of the study outcome for the covariates. Visual displays were used to explore potential non-linear relationships between continuous variables, such as age, and the outcome on logit scale. When evidence of non-linear relationship was observed, these were modeled using linear splines with appropriate knots that correspond to change in linear slope.

Models were fit sequentially starting with control variables, and adding measures of economic stress, historical loss, discrimination, and cultural buffers. Akaike Information Criterion (AIC) was used to compare models (including models with different subscales for the HLS). The models with smallest AIC are presented in the results section. Five separate models are shown: economic stress with control variables (model 1), model 1 variables + historical loss scale (model 2), model 2 variables + global discrimination scale (model 3), model 3 variables + preferred spoke language (model 4) and model 4 + importance of participating in traditional practices and spiritual coping scale (model 5).

STATA 16.1 was used to fit the models (58).

RESULTS

Among the 301 participants who completed the EMPWR baseline assessment, 254 (84.3%) responded to the "Ever screened for STD" question and were included in the bivariate analysis. Due to missing data in the covariates, the multivariate analysis included 236 participants ($n = 93\%$ of eligible participants).The majority of the individuals reported having ever been screened for STD in their life (76.7%) while 23.3% reported never been screened for STDs (**Table 2**). Participants on average were 33.6 years old (SD 8.8), and a little over half (53.5%) were males. The majority were single (60.6%) while 39.4% were married or cohabitating, and three-quarters had children (75%). A little over half (52.8%) had completed high school or GED. There were no significant sociodemographic differences between those who had never screened for STD and those who had except for the average number of people living together ($p = 0.028$). On average, individuals who had screened for STD lived with more people (median = 4, IQR = 2–7) than those who had never screened (median = 3, IQR = 2–5).

Bivariate Associations: Life and Traumatic Stressors

The majority of the participants (89.8%) were not employed at the time of the survey, indicating a high level of economic

TABLE 2 | Demographic characteristics and select stressors and cultural buffers among American Indians with binge substance use by lifetime STD screening in a rural community, $N = 254$.

	Total non-missing	Ever tested for STD			
Variable	**(*N* = 254)**	**Yes (*n* = 195, 76.7%)**	**No (*n* = 59, 23.2%)**	***p-value***	**Test**
Sociodemographic Characteristics					
Age	33.6 (8.8)	33.82 (8.67)	32.78 (9.09)	0.43	Two sample *t* test
Sex					
Male	136 (53.5%)	101 (51.8%)	35 (59.3%)	0.31	Pearson's chi-squared
Female	118 (46.5%)	94 (48.2%)	24 (40.7%)		
Marital status					
Single/divorced/separated	143 (56.3%)	113 (57.9%)	30 (50.8%)	0.39	Pearson's chi-squared
Married/cohabiting	93 (36.6%)	69 (35.4%)	24 (40.7%)		
Missing	18 (7.1%)	13 (6.7%)	5 (8.5%)		
Have any children					
No	63 (24.8%)	43 (22.1%)	20 (33.9%)	0.068	Pearson's chi-squared
Yes	190 (74.8%)	151 (77.4%)	39 (66.1%)		
Missing	1 (0.4%)	1 (0.5%)	0 (0.0%)		
Education status					
Less than high school	52.1% (135)	87 (44.6%)	32 (54.2%)	0.17	Pearson's chi-squared
High school/GED and above	46.8% (119)	107 (54.9%)	26 (44.1%)		
Missing	2 (0.8%)	1 (0.5%)	1 (1.7%)		
Household size					
N of people living in the house	4.5 (8.8)	4.67 (2.80)	3.74 (2.35)	0.028*	Two sample *t* test
N of people living in the house	4 (2–6)	4 (2–7)	3 (2–5)	0.032*	Wilcoxon rank-sum
Life stressors					
Economic stressor: current employment					
Unemployed	228 (89.8%)	176 (90.3%)	52 (88.1%)	0.81	Pearson's chi-squared
Employed	24 (9.4%)	18 (9.2%)	6 (10.2%)		
Missing	2 (0.8%)	1 (0.5%)	1 (1.7%)		
Traumatic stressors					
Historical loss scale					
Score <3	(202) (82.8%)	156 (80.0%)	46 (78.0%)	0.43	Pearson's chi-squared
Score ≥3	(42) (17.2%)	33 (16.9%)	9 (15.3%)		
Missing	10 (0.4%)	6 (3.1%)	4 (6.8%)		
Global discrimination scale	0.50 (0.50)	0.47 (0.50)	0.60 (0.61)	0.10	Two sample *t* test
Score <1	185 (72.8%)	147 (75.4%)	38 (64.4%)	0.14	Pearson's chi-squared
Score ≥1	62 (24.4%)	42 (21.5%)	20 (33.9%)		
Missing	7 (2.8%)	6 (3.1%)	1 (1.7%)		
Cultural buffers					
Preferred language spoken					
Native language	50 (19.7%)	36 (18.5%)	14 (23.7%)	0.92	Fisher's exact
English	121 (47.6%)	94 (48.2%)	27 (45.8%)		
Both English and Native language	72 (28.3%)	56 (28.7%)	16 (27.1%)		
Other	1 (0.4%)	1 (0.5%)	0 (0.0%)		
Don't know	2 (0.8%)	2 (1.0%)	0 (0.0%)		
Refuse to answer	8 (3.1%)	6 (3.1%)	2 (3.4%)		
Importance of participating in tribe's traditional practices and ceremonies					
Not at all important	58 (22.8%)	41 (21.0%)	17 (28.8%)	0.90	Fisher's exact
Not very important	42 (16.5%)	33 (16.9%)	9 (15.3%)		
Somewhat important	67 (26.4%)	53 (27.2%)	14 (23.7%)		
Very important	61 (24.0%)	47 (24.1%)	14 (23.7%)		
Don't know	2 (0.8%)	2 (1.0%)	0 (0.0%)		
Refuse to answer	24 (9.4%)	19 (9.7%)	5 (8.5%)		

(Continued)

TABLE 2 | Continued

Variable	Total non-missing (*N* = 254)	Ever tested for STD: Yes (*n* = 195, 76.7%)	Ever tested for STD: No (*n* = 59, 23.2%)	*p-value*	Test
Spiritual coping scale: extent to which spirituality is involved in dealing with stressful situations					
Not involved at all	53 (20.9%)	41 (21.0%)	12 (20.3%)	0.091	Fisher's exact
Not very involved	27 (10.6%)	20 (10.3%)	7 (11.9%)		
Somewhat involved	72 (28.3%)	62 (31.8%)	10 (16.9%)		
Very involved	33 (13.0%)	27 (13.8%)	6 (10.2%)		
Don't know	28 (11.0%)	18 (9.2%)	10 (16.9%)		
Refuse to answer	41 (16.1%)	27 (13.8%)	14 (23.7%)		

* $p < 0.05$.

Data are presented as mean (SD) or median (IQR) for continuous measures, and n (%) for categorical measures.

stress. There was however no significant difference in this stressor between those who have ever screened for STD and those who had not (90.3 vs. 88.1%, $p = 0.81$).

Overall, the majority of the participants (82.8%) reported that they either never thought about historical losses due to colonization, and if they did, the majority only thought about it once a year or on special occasions. Only 17.2% of the participants reported thinking about the losses weekly, daily, or several times a day. The general low frequency of historical loss thoughts was reported by both those who had ever screened for STDs in their life and those who had not (16.9 vs. 15.3%, $p = 0.43$).

In general, participants reported having never or rarely experiencing discrimination due to having Native American identity, whether it was global, authority or school/work discrimination. Lack of or low level of global discrimination was similar between those who had ever screened for STD and those who had not (mean = 0.47 vs. 0.60, $p = 0.10$).

Bivariate Associations: Cultural and Spiritual Buffers

Associations of AI enculturation and spiritual coping measures with lifetime STD testing are indicated in **Table 2**. Half of the participants (50.2%) preferred to speak either their Native language or a combination of Native language and English in their daily lives, and about half (49.8%) preferred to speak English only. Preference for speaking their Native language did not differ between those who had screened for STD and those who had not (18.5 vs. 23.7%, $p = 0.92$).

In regards to actual participation in tribal ceremonies and traditional practices, 24% of participants believed it was very important to participate in their traditional ceremonies, and another 26% reported it was somewhat important, while 39.4% expressed that it was either not at all important or not very important. Ten percent of participants either said "don't know" or refused to answer to this question. There were no significant differences in these beliefs between those who had and had not been previously screened for STD ($p = 0.90$).

Finally, 41% expressed that their spirituality was somewhat involved or very involved in helping them understand or deal with stressful situations. However, 16% of respondents refused to answer this question. The level of spirituality's involvement in stress coping did not differ significantly between those who had ever tested for STD and those who had not ($p = 0.09$).

Multivariate Relationships With STD Screening

Table 3 shows the associations between demographic, stressor, and cultural buffer variables and odds of lifetime STD screening. The models were fit in a sequential manner, starting with all demographic and socioeconomic variables, then adding stressors (such as Historical Loss Scale and global discrimination scale), finally adding buffer variables (such as preferred spoken language, participating in ceremonies and Spiritual Coping Scale).

Among the demographic variables, we found that the number of people living in the household was statistically associated with the outcome of ever screening for STD. Controlling for other demographic variables in the model, for each additional person in the household, estimated odds of STD testing went up by 22% [adjusted OR (aOR) = 1.22, 95%CI: 1.06, 1.39]. The relationship with age was non-linear, with the strongest positive slope for respondents between 26 and 43 years of age. In this group, for every additional year, the odds of ever completing STD testing went up by an estimated 7% (aOR = 1.07, 95%CI: 0.99, 1.15). For those below 26 years of age, the relationship between age and lifetime STD testing was still positive, but did not reach statistical significance. After 43 years of age, there was no positive association between age and lifetime STD testing. These findings were consistent across all models presented in **Table 3**.

Economic stress did not have a significant association with STD testing in all models. In the full model, the odds of STD testing were 27% lower (aOR = 0.78, 95%CI: 0.26, 2.28) for those experiencing economic stress, but were not statistically significant.

Models 2 through 5 included two AI-specific stressors, namely, the Historical Loss Scale and global discrimination scale, in addition to the demographic variables and economic stress. Greater historical loss score was not statistically significantly associated with higher odds of STD testing in all models. In the final model, those who scored 3 or greater in HLS were 62 percent

TABLE 3 | Logistic regression models for STD testing among American Indians with binge substance use in a rural community.

	Model 1	Model 2	Model 3	Model 4	Model 5
Covariate			Odds ratio [95% confidence interval]		
Sociodemographic characteristics					
Age (piece-wise continuous, per year)					
<26	1.04	1.044	1.03	1.004	1.071
	[0.842, 1.283]	[0.846,1.289]	[0.832, 1.274]	[0.800, 1.260]	[0.840, 1.367]
26–<43	1.07	1.069	1.088*	1.104*	1.096
	[0.997, 1.148]	[0.995, 1.148]	[1.008, 1.173]	[1.018, 1.197]	[1.000, 1.201]
43+	0.915	0.92	0.911	0.918	0.934
	[0.778, 1.076]	[0.782, 1.082]	[0.771, 1.078]	[0.780, 1.082]	[0.777, 1.122]
Sex					
Female vs. male	1.552	1.58	1.515	1.509	1.219
	[0.795, 3.028]	[0.797, 3.131]	[0.756, 3.034]	[0.755, 3.016]	[0.558, 2.666]
Marital status					
Married vs. single	0.628	0.638	0.642	0.655	0.488
	[0.320, 1.234]	[0.323, 1.261]	[0.319, 1.294]	[0.321, 1.337]	[0.215, 1.105]
Missing vs. single	0.604	0.595	0.571	0.528	0.468
	[0.146, 2.491]	[0.139, 2.548]	[0.122, 2.677]	[0.121, 2.306]	[0.0930, 2.354]
Have any children					
Yes vs. no	1.598	1.578	1.526	1.523	1.787
	[0.773, 3.305]	[0.759, 3.278]	[0.715, 3.257]	[0.690, 3.359]	[0.785, 4.070]
Education status					
Holds high school diploma/GED vs. <high school	1.282	1.266	1.298	1.162	1.064
	[0.664, 2.477]	[0.647, 2.477]	[0.657, 2.564]	[0.579, 2.328]	[0.528, 2.143]
Household size					
Number of people living in the house (per person)	1.216**	1.217**	1.204**	1.203**	1.198**
	[1.064, 1.389]	[1.063, 1.392]	[1.053, 1.377]	[1.048, 1.382]	[1.044, 1.375]
Life stressors					
Economic stressor					
Employed vs. unemployed	0.737	0.731	0.841	1.011	0.775
	[0.256, 2.122]	[0.253, 2.107]	[0.302, 2.344]	[0.366, 2.790]	[0.264, 2.278]
Traumatic stressors					
Historical loss scale					
Score ≥3 vs. score <3		1.334	1.65	1.947	1.617
		[0.527, 3.372]	[0.598, 4.554]	[0.695, 5.451]	[0.560, 4.663]
Missing score vs. score <3		0.941	0.603	0.378	0.714
		[0.161, 5.508]	[0.0579, 6.274]	[0.0326, 4.395]	[0.0645, 7.909]
Global discrimination scale					
Score ≥1 vs. score <1			0.48	0.452	0.401*
			[0.222, 1.040]	[0.204, 1.003]	[0.175, 0.921]
Missing score vs. score <1			2.185	2.357	2.068
			[0.176, 27.14]	[0.269, 20.63]	[0.238, 18.00]
Cultural buffers					
Preferred language spoken					
English vs. native language				1.956	2.076
				[0.801, 4.777]	[0.802, 5.372]
Both english and native language vs. only native language				1.692	1.714
				[0.697,4 .111]	[0.654, 4.497]
Missing vs. only native language				6.228	3.866
				[0.315, 123.1]	[0.304, 49.14]

(Continued)

TABLE 3 | Continued

	Model 1	Model 2	Model 3	Model 4	Model 5
Importance of participating in tribe's traditional practices and ceremonies					
Not very vs. not at all					1.726
					[0.497, 5.992]
Somewhat vs. not at all					1.221
					[0.472, 3.159]
Very important vs. not at all					1.441
					[0.504, 4.124]
Refuse to answer/missing vs. not at all					2.683
					[0.435, 16.57]
Spiritual coping scale: extent to which spirituality is involved in dealing with stressful situations					
Not very vs. not at all					0.533
					[0.127, 2.243]
Somewhat vs. not at all					1.409
					[0.448, 4.430]
Very vs. not at all					1.051
					[0.251, 4.413]
Don't know vs. not at all					0.409
					[0.110, 1.516]
Refuse to answer vs. not at all					0.275*
					[0.076, 0.987]
N	236	236	236	236	236
AIC	252.8	256.5	256.5	258.8	266.1

Exponentiated coefficients; 95% confidence intervals in brackets.
* $p < 0.05$, ** $p < 0.01$.
Of 254 participants, 18 are excluded in these models due to missing data on having children (n = 1), education status (n = 2), employment status (n = 2) and number of people in the household (n−14).

more likely than those who scored <3 in HLS to get STD testing (aOR = 1.62, 95%CI: 0.56–4.67).

Global discrimination was negatively associated with STD screening in the fully adjusted model. The adjusted odds ratio of lifetime STD testing for those experiencing higher discrimination was 0.40 (95%CI: 0.18–0.92).

Models 4 and 5 included AI-specific cultural buffer variables, such as preferred language to speak at home, level of importance in participation in traditional ceremonies and the Spiritual Coping variable. None of these variables were statistically significantly associated with STD testing after adjustment for demographics and AI-specific stressors.

DISCUSSION

Summary of Findings

A primary goal of study was to explore how risk and protective factors from the Indigenist Stress Coping framework predict the behavior of STD screening among AIs with recent binge alcohol use–a high risk population for STDs and HIV. This hard to reach group which is often mobile is an important subgroup in curbing the rising rates of STIs and HIV as binge substance use is often associated with sexual risk taking and poor mental health (59–62). As with HIV cascade of care, testing is the first necessary step for early detection, treatment, and prevention of STD infection (63); and considering STD testing as a positive sexual health behavior allows for advancing resiliency and strength-based approaches. Our results confirmed one of two hypotheses. More specifically, results show that stressor exposures such as economic stress, thoughts of historical loss, and perceived or experienced discrimination specifically decrease the protective sexual health behavior of STD screening.

The majority (76.7%) of participants reported having completed STD screening at least once in their life (*ever tested for STD*). The high self-reported STD testing rate at the baseline assessment was surprising, given the aforementioned screening access barriers in this and other rural and reservation-based tribal communities such as lack of culturally tailored evidence-based STD reduction programs and poor access to clinic or non-clinic-based self-administered STD screening (17, 27). High proportions of lifetime STD testing, however, may not necessarily reflect timely or regular screening among high risk AI with binge substance use. Specifically, it also does not mean that participants were meeting the CDC recommendations for sexually active adults of completing STD testing at least once a year (64). It also does not reflect linkage to care, retention, treatment initiation or adherence (56).

Results also show that number of members in the household was positively associated with STD testing, with the aOR of lifetime STD screening being statistically positively associated in all five models. A published article from this same AI study sample shows that living with an older generation positively

predicted intervention retention (55). In this present paper, larger household size may be a protective factor in that traditional AI family systems function as a form of social support. The extended family may also help motivate AIs to take care of their sexual health in the presence of co-occurring substance use and/or facilitate access to care by provision of transportation, appointment reminders, etc. This finding again supports the notion that programming for Native populations may benefit from starting with a collective view or utilizing a framework that includes family and community in addition to the individual.

Supporting our first hypothesis, the findings revealed that perceived discrimination stressors are significant predictors of STD testing. Native adults in this study with fewer discrimination encounters had higher odds of lifetime STD screening. Similarly, those who thought of historical loss less frequently were more likely to have screened for STD at some point in their life. Causal association between historical, intergenerational, and lifetime trauma experiences, discrimination experiences, other stressors, and AI/AN psychological health (e.g., depression, anxiety, post traumatic disorder) have been well-established (44, 46, 65, 66). A recent study in Canada examining the mechanisms of these associations found that discrimination played a mediating role in that the more types of traumatic events Indigenous peoples experienced the greater their perceptions of discrimination stressors, resulting in positive association with depressive symptoms (67). While the present paper cannot establish causal association, it expands the AI/AN specific literature by demonstrating associations between historical loss, discrimination, and STD screening and validates these constructs from the Indigenist Stress Coping framework for predicting a sexual health outcome.

The nature and process of clinic-based STD screening tests necessitate accessing and engaging with health services and health care providers. Many concerns with clinic-based services in Native communities have been cited, including mistrust of health services, discrimination and judgement by healthcare providers, fear of disclosure, and lack of anonymity in small communities where everybody knows each other (63, 66). These concerns may preclude seeking of clinic-based services including STD testing. In a recent study conducted with Native American adults, almost one in six (15%) report they avoided seeking health care for themselves or family members due to anticipated discrimination at the clinic (68). Our findings, while unable to draw causal links, may indicate that those who are more likely to anticipate discrimination in clinic-based settings may be more hesitant to seek out clinic-based STD testing. Thus, we conclude additional efforts to address the aforementioned concerns with clinic-based services (i.e., discrimination and judgement by healthcare providers) for Native populations and/or the provision of non-clinic-based testing services in Native communities (i.e., community-based, self-administered testing) is warranted.

Our second hypothesis which articulated that cultural, community, spiritual, and personal resources/strengths from the Indigenist Stress Coping framework may buffer the effects of stressors on poor sexual health outcomes was not supported by the results from this analysis (31). Even though the directions of the associations between these protective factors were positively associated with lifetime STD screening, they were not statistically significant. It may be that because the idea of, action and experience surrounding STD screening procedures are based on strong western medicine and western science perspectives that cultural connectedness plays a less important role in this behavior. Alternatively, the standard measures employed to assess AI enculturation and spirituality may not be the best fit to predict STD screening, as these measures have found to better predict psychological distress and other mental health symptoms (42, 69). Third, in the context of diminished encounters with historical loss and discrimination associated stressors, cultural factors may not operate as direct buffers to cope with these stressors. Finally, participants in this study who all had recent binge substance use, may have faced other challenges and barriers to engaging in traditional practices and ceremonies; thus, results may underestimate the potential for these protective factors to buffer against risks for poor sexual health outcomes.

Limitations

These findings should be considered with several limitations in mind. The study sample constitutes a group of community members who had co-occurring binge substance use and were experiencing crisis with regards to need for services, support and care. Therefore, the findings are not generalizable to all AI populations.

Secondly, recall of events or experiences when reporting on the survey could have been incomplete, resulting in missing data, especially as participants had recent binge substance use. The ISC framework-articulated AI historical loss and discrimination stressors and AI cultural buffer variables had sizeable missing data. These series of questions were located at the very end of the baseline assessment questionnaire, and right after a 53-item measure assessing depression, anxiety, and other symptoms of mental health conditions. The participants may likely have experienced respondent fatigue when they got to this point on the survey, and may have wanted to complete or end the survey quickly. Further exploration revealed that the theoretical predictors of interest—AI enculturation and Spiritual Coping Scale in particular—had considerable "Don't know" or "Refuse to answer" responses. Had these sets of questions been placed near the beginning of the survey, participants may have had responded with more time, potentially avoiding missing data.

A little over half the participants reported having none to minimal experiences with discrimination. For reservation-dwelling community members, the probability of discrimination encounters is more likely to occur in surrounding towns off the reservation. The assessment was administered on the reservation, and the survey items on discrimination did not specify the location of discrimination experiences, potentially leading to under reporting of such experiences. Historical loss instrument responses likely had similar issues. Finally, analyses were conducted cross-sectionally and cannot lead to any conclusions about causation between ICS variables and the behavior of STD screening.

Strengths, Conclusions and Implications

Health disparities in AI/ANs are driven by a complex interplay of historical and lifetime cultural trauma, socioeconomic and environmental inequities, and contemporary socio-cultural and institutionalized discrimination (70, 71). The burden of STD prevalence, incidence, and outcomes is experienced at a disproportionately high rate by AI/ANs. The historical and contemporary Indigenous social determinants of health are multi-level contextual barriers that affect differential AI/AN access to sexual and reproductive health care services including effective interventions to prevent, diagnose, and treat STDs. The STI-National Strategic Plan 2021–2025 articulates the need for integration of alcohol/substance use and STDs services as a promising strategy to promote STD prevention and management among key subgroups, such as the AI sample in this study with recent binge substance use. Our findings suggest that such programs should take into consideration AI-specific historical traumatic stressors such as historical loss, and lifetime discrimination encounters and how these interact to drive or discourage sexual health services at local clinics. Our findings also highlight that these programs consider the extended family as a protective factor in that traditional AI family systems function as a form of social support. Future research should consider improvement in measurements of AI enculturation constructs and data collection minimizing the potential missing data on these variables (42, 69). Future research should also consider the AI/AN experience in STD testing and ensuing STD cascade of care (72, 73) for improving sexual health equity in this priority population.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because Tribal data sovereignty governs the release of and access to the dataset used for this study. Requests to access the datasets should be directed to LT, ltingey1@jhu.edu

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by John Hopkins University Bloomberg School of Public Health IRB, participating Tribal Council, and Tribal Health Advisory Board. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MM drafted the manuscript. MM, LT, and RC revised and edited the final manuscript. RC drafted sections of the methods and discussion sections. GY completed all formal data analysis and contributed to the results section. SR contributed to the methods section. MW contributed to the editing. AS, FL, AL, and LP contributed to reviewing and contextualizing research questions and findings interpretation. All authors contributed to the concept of the manuscript, reviewed and edited multiple drafts of the manuscript, read and agreed to the published version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.829539/full#supplementary-material

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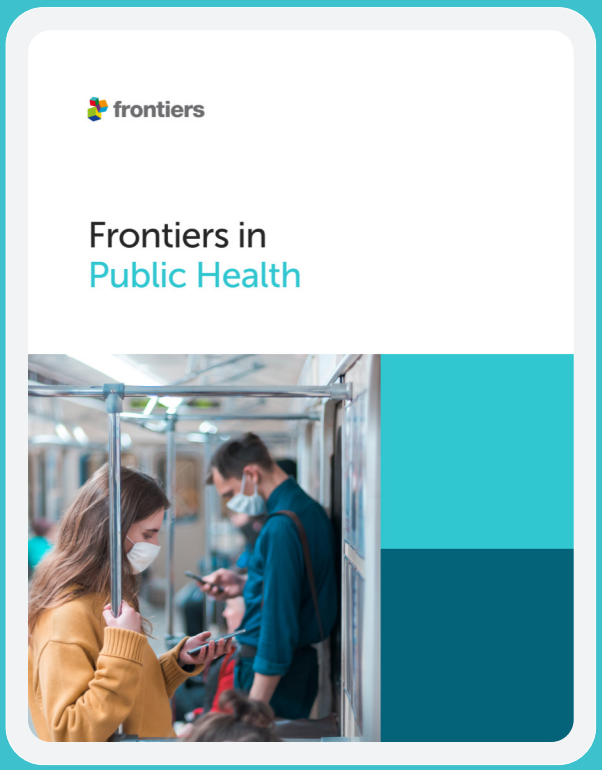

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