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An online diabetes nutrition education programme for American Indian and Alaska Native adults with type 2 diabetes: perspectives from key stakeholders

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Abstract

Objective: To explore stakeholder perspectives regarding online diabetes nutrition education for American Indians and Alaska Natives (AI/AN) with type 2 diabetes (T2D).

Design: Qualitative data were collected through focus groups and interviews. Focus group participants completed a brief demographic and internet use survey.

Setting: Focus groups and community participant interviews were conducted in diverse AI/AN communities. Interviews with nationally recognised content experts were held via teleconference.

Participants: Eight focus groups were conducted with AI/AN adults with T2D (*n* 29) and their family members (*n* 22). Community participant interviews were conducted with eleven clinicians and healthcare administrators working in Native communities. Interviews with nine content experts included clinicians and researchers serving AI/AN.

Results: Qualitative content analysis used constant comparative method for coding and generating themes across transcripts. Descriptive statistics were computed from surveys. AI/AN adults access the internet primarily through smartphones, use the internet for many purposes and identify opportunities for online diabetes nutrition education.

Conclusions: Online diabetes nutrition education may be feasible in Indian Country. These findings will inform the development of an eLearning diabetes nutrition education programme for AI/AN adults with T2D.

Keywords
American Indian and Alaska Native
Diabetes nutrition education
Online
eLearning

Healthy eating is the cornerstone of diabetes self-management, and nutrition education is shown to promote healthful dietary behaviours and reduce diet-related complications among people with diabetes[1,2]. American Indian and Alaska Native (AI/AN) adults have more than double the risk of type 2 diabetes (T2D) and diabetes-related complications compared with non-Hispanic whites[3]. Additionally, AI/AN adults experience a greater burden of living in poverty than the general US population (poverty rate 22 *v.* 13 %, respectively)[4]. Despite the high prevalence of T2D in AI/AN communities, AI/AN often lack access to registered dietitians (RD) and nutrition education classes[5], particularly resources targeted at AI/AN audiences[1]. Given the diversity among the 573 federally recognised tribes in the USA[6], developing and accessing culturally relevant diabetes nutrition education materials that resonate with the particular dietary preferences, cultural practices and food acquisition habits of each AI/AN community is challenging. Research suggests that diabetes, nutrition and health education programmes that build on AI/AN culture have more

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positive results regarding health behaviour change and self-efficacy than programmes that do not emphasise or build on AI/AN cultural strengths[7–10]. The majority of AI/AN (70 %) live in urban areas[6], but those living in rural areas have fewer diabetes education resources than those living in urban areas[1]. Literature also suggests that AI/AN may experience challenges engaging in conventional classroom-based diabetes nutrition classes due to variable schedules and transportation barriers[11].

Online learning may be an innovative, cost-effective and potentially acceptable method of providing diabetes nutrition education for AI/AN adults with T2D, given increasing rates of AI/AN access to the internet[12]. Access to the internet and internet-enabled devices is growing among many low-income communities in the USA[13]. More than half of urban and rural living AI/AN have broadband access[14]. Online nutrition education represents an opportunity to expand the availability and decrease the barriers to attending conventional face-to-face classes such as issues with transportation, childcare or variable work schedules[15]. Nutrition education literature does include studies demonstrating the feasibility of online diabetes nutrition education programmes for low-income populations[16–21], but comparable research is rare among AI/AN populations. However, research involving AI/AN communities indicates that online diabetes and nutrition education should be a future direction to serve AI/AN communities to expand reach, should better serve the increasingly tech-savvy and connected communities, and should include online peer support opportunities[22–25]. Literature suggests that AI/AN adults use the internet for communication, day-to-day tasks and for health information[26]. The use of online health education programmes tailored to AI/AN is a relatively new area of research. Several researchers have begun to explore this topic with promising results[17,19,27]. Online diabetes self-management education has been explored with AI/AN as a part of a larger study, but this programme was not culturally tailored for AI/AN and not specific to diabetes nutrition education[28]. Health education delivered at least in part via text message may have a potential for improving the health of AI/AN[29,30].

The focus of this study was to understand the perceptions of AI/AN adults with T2D, their adult family members, and stakeholders who work with AI/AN communities regarding the potential value and acceptability of online resources for diabetes nutrition education. In this study, we analysed existing data originally collected to inform the cultural adaptation of an existing classroom-based diabetes nutrition education programme for AI/AN with T2D.

Methods

Conceptual framework

The research team employed a constructivist epistemological approach for this qualitative data collection and analysis. Constructivism is the recognition that reality is a product of human experience, and can help researchers more dynamically understand the perspectives of community members with whom they are working[31]. This approach is particularly helpful when researchers and educators explore how innovative solutions to complex problems may be perceived and adapted by the members of the priority audience. Additionally, this work is guided by the Theoretical Framework of Acceptability, which supports the importance of exploring the attitudes and perceptions of key stakeholders, including members of the priority audience, to pre-emptively assess how healthcare interventions may (or may not) work within any given community[32]. Theoretical support for the topic of online learning includes constructs from Adult Learning Theory[33] and eLearning theory[34].

Study design

This study describes the analysis of existing qualitative data that were collected in August–October 2018 through focus groups and interviews with AI/AN adults with T2D and additional stakeholders. As part of the cultural adaptation project, extensive qualitative data were collected to gain broad perspectives on healthy eating for diabetes, diabetes nutrition education, barriers and facilitators to healthy eating, current use of technology and feasibility of online education, and recommendations for programme adaptation. Data were collected through focus groups with AI/AN adults with T2D, focus groups with adult family members of AI/AN with T2D, interviews with community-based participants and interviews with national content experts. The data were originally collected to inform the cultural adaptation of an existing classroom-based diabetes nutrition education programme for use with AI/AN with T2D. That programme is the American Diabetes Association's 'What Can I Eat? Healthy Choices for People with Type 2 Diabetes' curriculum, which includes five 90-minute, classroom-based diabetes nutrition education classes for adults with T2D. The programme was developed for a general audience and was not specific to any particular racial/ethnic group. The classes, which address diabetes nutrition principles such as portion control, food label reading, healthful cooking, physical activity and mindful eating practices are designed to be led by an RD[35]. During the preliminary planning stages of the project, to culturally adapt the curriculum the research team determined that it would be prudent to explore the feasibility of online diabetes nutrition education for AI/AN adults with T2D as a potential means to address the scarcity of RD in many AI/AN communities, especially those located in rural and remote areas[1].

Participating sites

Data were collected in four AI/AN communities across the country. Two of the selected sites were rural and two were

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Table 1 Participants in focus groups and individual interviews

Site	Focus group participants: American Indian and Alaska Native adults with type 2 diabetes mellitus	Focus group participants: adult family members	Interviews with community-based key participants	Interviews with national content experts
Saint Regis, NY (rural)	7	5	3	–
Tulsa, OK (urban)	6	6	2	–
Chicago, IL (urban)	5	5	2	–
Lakeport, CA (rural)	11	6	3	–
Nationwide	–	–	–	9
Total	29	22	10	9

urban. Table 1 summarises the number of participants included in each research activity by location.

Focus groups and recruitment

AI/AN adults with T2D (*n* 29) and family members of AI/AN adults with T2D (*n* 22) participated in eight focus groups across four collaborating sites. At each site, focus groups for people with T2D were conducted separately from those for family members. The size of focus groups ranged from five to eleven participants. Inclusion criteria for AI/AN with T2D were: ≥18 years old, English speaker, self-identified as AI/AN and have T2D. Participants in family focus groups were required to be ≥18 years of age and a significant support person for a person with T2D. Of these twenty-two family members, sixteen identified as AI/AN. Most were parents, significant others, adult children or close friends of an AI/AN with T2D. At each site, a community-based collaborator was recruited for both focus groups and key participant interviews. Recruitment took place for approximately 1 month at each site, prior to the scheduled focus groups and interviews. Collaborators recruited the focus groups through word-of-mouth, posting flyers and posting information on social media sites. Focus groups were held at locations familiar to the participants, including health centres, community clinics and community centres. Focus group participants received a $25·00 gift card.

Community participant interviews and recruitment

Community participant interviews were conducted with respected community members with knowledge of resources, needs, challenges and strengths of the community specific to diabetes and nutrition education. Community-based participants (*n* 10; eight of whom were AI/AN) completed individual interviews at each of the four sites. Community-based key participants included tribal elders and elected tribal leaders as well as local RD, certified diabetes educators (CDE), mid-level healthcare providers, health education administrators and health centre support staff. These one-on-one interviews took place in interviewee homes, clinic offices, clinic conference rooms and one local café per the participant's preference. Collaborators recruited community participants by purposive selection, seeking individuals known to them for their expertise in the community, nutrition/diabetes education and/or traditional culture[36]. Participants received a $40·00 gift card.

National content expert interviews and recruitment

National content expert interviews focused on obtaining the perspectives of national experts in the field of diabetes nutrition education for AI/AN. Nine interviews were conducted with national content experts (three of whom were AI/AN). Interviewees were from academic or clinical AI/AN sites other than the four participating sites and included RD, CDE and researchers. Their expertise spanned nutrition and diabetes education for AI/AN adults, development and evaluation of health education programmes for AI/AN adults, and obesity and food security among AI/AN adults and their families. Interviews were conducted using Zoom videoconferencing technology, which allowed for video and audio recording. The project's principal investigator (KM) initiated recruitment of key content experts through her professional network using a personalised e-mail invitation. Study staff then used a modified snowball sampling technique, relying on Dr Moore's network, to recommend additional interviewees[37].

Data collection

Focus groups and interviews were digitally audio-recorded. Interviews were facilitated using a semi-structured moderator guide by the same trained qualitative researcher (SS). Moderator guides were developed by the research team and informed with a constructivist approach and constructs from the Theoretical Framework of Acceptability[32]. Example moderator guide questions include: 'Tell me what it's like to learn about diabetes and nutrition in your community'. Moderator guide questions were adjusted to accommodate differing perspectives; for example, 'your community' was used for focus groups and community participant interviews, but 'AI/AN communities' was used for national content experts. The moderator guide for 'family member' focus groups included minor adjustments, such as 'How do you and your family member with diabetes like to learn best about diabetes and healthy eating?' The full moderator guide can be

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found in the online supplementary material to this article. Community-based collaborators provided feedback on the moderator guide prior to data collection. All focus group participants were asked to complete a survey measuring demographic characteristics, diabetes history, access to food, nutrition habits and technology use at the start of each focus group discussion.

Data analysis

The project team analysed qualitative transcripts available from the needs assessment as detailed above using a content analysis approach[38,39]. All transcripts were professionally transcribed and checked for accuracy by the lead qualitative researcher (SS). Two researchers (SS and SL) reviewed the transcripts and worked closely to establish a code book that included both deductive codes, determined *a priori* based on the moderator guides[32,40], and inductive codes that emerged directly from the data. These researchers first coded two transcripts together, and then independently double-coded 25 % of the transcripts. They met weekly until they achieved >80 % concordance[40]. Concordance was determined using the same code attached to the same general portion of text. The constant comparative coding approach included coding data, categorising the codes and reorganisation of the categories into thematic representation through a series of assertions and interpretations[41]. Using this method, researchers compared data across transcriptions to find similarities and differences. For example, when a participant referenced using his/her smartphone, that portion of text was coded with SMARTPHONE. Additionally, a participant may have mentioned accessing the internet on a TABLET, which was coded as such. Essentially both these devices indicated mobile internet access and, therefore, were collapsed into category PERSONAL MOBILE ACCESS. If a participant referenced accessing the internet through a computer at a public library, that portion of text was coded as PUBLIC LIBRARY, and was not collapsed into the aforementioned PERSONAL MOBILE ACCESS category. After a series of collapsing and reorganising categories, the overarching theme to this topic was ACCESS. The research team used Atlas.ti, version 8.4.4, to organise, sort, code and store data, which helped to facilitate a transparent analytical process[42].

The research team calculated descriptive statistics (means and frequency distributions) from surveys to describe the sample of focus group participants. All survey data were analysed using Stata, version 15·0. For this analysis, the project team analysed the data for questions on technology use.

Results

Survey results

Table 2 presents the descriptive characteristics of focus group participants (AI/AN with T2D and their family members). Across the eight focus groups, fifty-one community

Table 2 Characteristics of focus group participants (*n* 48)*

	Family members (*n* 21)		Participants with type 2 diabetes mellitus (*n* 27)	
	%	*n*	%	*n*
Age				
Mean	59		59	
SD	12		19	
Gender (female)	62	13	63	17
Race†				
American Indian/Alaska Native	86	18	93	25
White	24	5	26	7
African American	10	2	0	0
Native Hawaiian/Pacific Islander	0	0	4	1
Other	10	2	4	1
Ethnicity: Hispanic or Latino/a	0	0	7	2
Highest grade completed‡				
<High school graduate	5	1	8	2
High school graduate/GED	33	7	44	11
Some college/vocational	38	8	24	6
College degree or more	24	5	24	6
Internet use‡				
Have access to and use the internet	90	18	81	21
Access the internet via a smartphone	61	11	67	14
Probably or definitely would take a free 15-min online nutrition programme	85	17	88	23

*Only forty-eight of fifty-one participants completed the demographic survey.
†Participants could select more than one race.
‡Missing data on key variables (*n* 2 for education; *n* 2 for interest in online nutrition programme; *n* 2 for internet access).

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members participated, forty-eight of whom completed surveys (94 %). Focus groups lasted 69 min on average (range 62–75 min). Family members and participants with T2D were 59 years of age, on average. Nearly two-thirds of both family members and participants with T2D were women. Although the majority of participants self-identified as AI/AN, 24 % of family members and 26 % of participants with T2D identified as white and 10 % of family members identified as African American. These individuals were included in the analysis because many AI/AN families are mixed-race with non-AI/AN.

The sample was well educated, compared with the AI/AN population nationally. Ninety per cent of participants reported having a high school diploma/GED or a higher level of educational attainment. This compares with 83 % of AI/AN nationally[43]. The sample had a slightly higher percentage of having a bachelor's degree or higher, compared with AI/AN people nationally (24 *v.*19 %)[43]. Nearly all participants reported having access to the internet, with >60 % indicating they use the internet 'every day' or 'several times a day'. Of those who access the internet, 64 % said they primarily connect from their smartphones. Most participants indicated they would probably or definitely participate in a free 15-minute internet-based diabetes nutrition education programme.

Qualitative findings

Across all qualitative data, three key themes were identified: Participants described (i) accessing the internet primarily through smartphones; (ii) using the internet for many purposes, including searching for health-related information; and (iii) possible opportunities for online diabetes nutrition education such as provision of peer-to-peer social support, RD-moderated diet tracking and cooking education.

Accessing the internet primarily through smartphones

Across all data collection approaches, participants shared that they had access to the internet and that other members of their community did as well. They discussed primarily smartphone devices and a combination of data plans and Wi-Fi as methods for accessing the internet. As one RD shared:

> I would say that [the] overwhelming majority of our patients have smartphones. Or they might not have a computer at home but they have their smartphone and they're looking up information.

Similarly, a healthcare administrator shared:

> A lot of times, their access to internet is their phone. Almost everybody … I shouldn't say almost everybody, but a great deal.

Participants suggested that internet access was so ubiquitous; it has become an 'addiction' for younger people. One participant indicated, 'we don't have Wi-Fi at home, only because I don't want people on their phones all the time'. A few participants also shared that some older adults (typically aged >70) choose not to have regular internet access and prefer in-person communication. One participant shared:

> All that connection all the time – I find it irritating. I don't like going on the Internet. I don't go on the Internet. I've got a [smart]phone, but it's in the car now. I don't even carry it with me. I just got it for emergency if I broke down by the side of the road and I need to get help. I got a phone I can go to. But I don't play around on there all the time.

Some participants lamented that 'constant connection' enabled by smartphones and computers has stymied traditional physical activity and outdoor time.

> **Participant A:** We sit behind computers – that doesn't help. Used to … we worked outside and we'd work in the fields all day.
>
> **Participant B:** Yeah, I think we're a lot less active.

Some participants suggested that in remote rural areas Wi-Fi connection can 'come and go', but that most people can drive a short distance to find an internet connection, if they need it. Participants indicated that access to the internet is so common in many AI/AN communities that it could be considered a barrier to traditional healthful lifestyle practices and engagement in community connection.

Using the internet for many purposes, including searching for health-related information

Participants discussed their current use of technology, both specific to diabetes and/or nutrition education and general use. Of note, this theme emerged from both participant-driven comments about their use of the internet, and responses to the moderator's question, 'Tell me about your use of the Internet'. Communication appears to be the primary reason that AI/AN adults engage in using the internet. They connect with friends and family through a variety of social media, e-mail, messaging, text and basic calling platforms. One community-based health administrator and clinician, reflecting on her 91-year-old mother's use of an iPad, shared:

> But, also, in terms of older people staying connected and to fight isolation, and maybe even as a learning tool … I think it's important. My mom is 91. We got her an iPad. She uses it to stay connected to people … It keeps her up to date … I think that … the best thing about it is the ability to learn.

Educators reported using text messaging to communicate with and send reminders to their patients. Programme coordinators reported that social media and text messages are

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an effective way to get participants to attend classes. Specific web-based platforms appeared to be particularly effective. One programme coordinator remarked:

> It's actually a lot of old people on Facebook now. We do a lot of posting it [information about diabetes classes] there. Then, of course, on the other Instagram and Twitter, but you don't really get much from those. It's mostly Facebook.

When asked to explain how they learn about diabetes or nutrition in their community, participants shared that they 'Google' questions about their diabetes medications and side effects, use 'apps' to track their food intake or physical activity, and look up recipes online. One focus group participant shared:

> I use Google for – new ideas, new recipes, for cooking for the family. I went on Google also because I found I was iron deficient. I didn't like taking the iron pills. So I [am] … not eating a steak a week you know, but finding other things like beans and legumes and you know kale and things like that you can … and chickpeas. I was surprised to find online that chickpeas have a lot of iron in them.

Educators said their patients come to appointments with questions about what they have read online 'all the time'. Sometimes providers are in a position of having to dispel myths and 'inaccurate' information that patients find on the internet.

Both AI/AN adults with T2D and RD shared how they already use technology informally to communicate and continue diabetes nutrition education beyond the face-to-face setting. One participant shared:

> I'm also linked to [dietitian] with My Fitness Pal. So she is able to look at what I'm eating, what I'm logging, and then she sends suggestions based on that or if I have a question on what I'm eating I can easily message her from there and she gets back very quickly.

An educator shared about her use of technology to support patients living in remote areas:

> Well, I text because, I mean … I'm not supposed to technically, but sometimes people are like texting and they prefer that to talking on the phone. Everyone has my phone number, so I can't avoid it.

Finally, educators shared that many of their patients are already accustomed to 'remote' diabetes nutrition education as their institutions have been practicing telehealth for many years. One educator suggested:

> **Interviewee:** Yeah, we actually have telehealth over here as well because our reservation extends to some other counties, so we have clinics in those counties, and we have some of our dietitians that go to those counties … Prior to this, she was actually driving to that clinic. So now she's not actually going to those clinics at all.
>
> **Moderator:** Ah, okay. Okay. And how has telehealth been received by your patients?
>
> **Interviewee:** Well, so for that particular clinic, it's been very well received because that clinic doesn't have the infrastructure that we do in the hospital where we have everyone over here to see the patients. So they were somewhat almost neglected out there so that's been a good thing for them.

Possible opportunities for online diabetes nutrition education such as provision of peer-to-peer social support, registered dietitian-moderated diet tracking and cooking education

Participants shared their recommendations and thoughts as to how technology could be intentionally utilised to support diabetes nutrition education for AI/AN adults with T2D. RD were enthusiastic about the prospect of online resources as many AI/AN adults do not have access to RD-facilitated nutrition education. One participating AI/AN RD who had been serving AI/AN communities for over 20 years said:

> We so have to engage technology. It's way overdue. We so need to do that. Please, technology can make it interactive … there's not enough me. I mean seriously, we can't clone enough dietitians. We just can't and there's not enough of us and they don't have access to good information. So, yeah, I think technology … if it can help them be interactive, okay this is what carbs look like, now we're going to show you some visuals and you're going to practice identifying carbs, and then they could do that for … That would be so great. So yeah, please, please, come up with something we could get out there. That'd be awesome.

A researcher with over 30 years of experience with AI/AN health education programming and evaluation shared:

> Maybe 10 years ago I would have never even considered incorporating social media into an intervention in Native communities. What I found is that smartphone penetration is extremely robust even in rural, remote Native communities, at least with adults. Pretty much everybody has one and no longer is limited by who can access a computer at their community center or whatever, everybody has one of these crazy things and so everyone is able to … People utilize Facebook heavily in Native communities … What I'm suggesting is I think that you consider making Facebook groups for all the participants. If you have a group of people who are receiving these lessons, part of the very first lesson, or maybe even before the very first lesson or meeting is you establish a Facebook group for that group. It's not only for announcements going out to them, it's a two-way connectivity so that they're reporting their experiences. 'Hey, I tried that recipe', or, 'I was looking for this you know, promoting plain low-fat or non-fat yogurt,

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but I can't find that in the store. Does anybody know where I can get that', that sort of thing. That's going to strengthen that kind of social networking that … would potentially strengthen the intervention and make it more likely to be successful.

Many AI/AN adults with T2D and their family members suggested they are visual learners and prefer to both see and hear information in order to best understand and retain it. Participants also shared how they could benefit from nutrition education in places like the supermarket, where they have the opportunity to make critical food-purchasing decisions. Finally, these participants indicated they often see 'misleading and wrong' nutrition information online and would like a trusted online resource with reputable information. Two participants exchanged here:

Participant E: If you have a real informative site online where you could go to the grocery store and look up information even when you're there to try to, because there's so much stuff and some of it's not real accurate. Some of it is kind of misleading or false. If there was a good destination with information like that where when you're shopping and stuff you go, 'Okay, how about this recipe', or 'Oh, is this good to eat?' Or whatever. That would definitely be helpful, for sure.

Participant F: Oh, that's true. That's a good idea.

Participant E: Yeah, like where you could pull something up on your phone and do that immediately.

Participants also indicated they would be interested in online diabetes nutrition education that was specifically tailored to Native food traditions. Participants shared that many of these traditional foods are specific to a particular region or tribe, and that online resources may help target the programme to specific tribes, rather than trying to address all AI/AN people. One participant shared:

Well, of course, it's a great challenge to develop a single curriculum to address American Indians because as any person of that background will tell you there are 500 plus federally recognized tribes, many with their own languages, differences, and culture. It's quite a challenge I would say to develop a single curriculum that would be targeted enough to American Indian audiences.

This inductive theme includes participant-driven recommendations and opportunities for online diabetes nutrition education for AI/AN adults with T2D.

Discussion

The findings that emerged from this secondary analysis suggest participant support for the feasibility of an online diabetes nutrition education programme for AI/AN with T2D. Literature among AI/AN[22–24,44] and other Native communities[25,45] suggests that online learning is a logical future direction for both diabetes and nutrition education among this audience. The literature suggests that a growing number of adults of all economic conditions have regular access to the internet[13]. Consistent with this finding, all focus group discussions mentioned widespread access to the internet in Indian Country, with smartphones being the most common device by which AI/AN people get online. In fact, online access has become so commonplace in these communities that several participants lamented the 'over-connectivity' of their communities and had concerns relating to the negative implications of too much access, including reduced in-person communication and overreliance on the 'device' and decreased physical activity.

In all focus groups and individual interviews, participants shared the many ways AI/AN currently use the internet and how they observe other AI/AN in their communities utilising the internet and smartphones. Educators and clinicians (RD/CDE) who serve AI/AN audiences discussed the use of the internet among patients for health- and nutrition-related purposes. The literature suggests that dietitians are interested in engaging with technology to support their patients, but do have concerns about digital literacy and misinformation online[46–49]. Participants in this study, in all focus groups and interviews, indicated frequent use of 'Google', text messaging, many social media platforms, diet or physical activity tracking applications and websites with cooking videos and recipes. Of note, eLearning instructional design theory highlights the importance of building online education on platforms already familiar to and those regularly used by the priority audience[50]. This approach is hypothesised to mitigate concerns of digital literacy learning curves and allows participants to focus more on learning the intended content of the programme (in this case, diabetes nutrition education). These results suggest that it would be prudent to utilise these familiar platforms when developing an online diabetes nutrition programme, and it becomes important to consider strategic evaluation methods to understand the uptake and effectiveness of such a programme[51]. The use of social media is relatively well documented as a tool to enhance health education programme recruitment[52], and our findings suggest that almost all educators interviewed who work with AI/AN adults with T2D are utilising these social media tools.

Finally, participants in almost all focus groups and interviews described their perceptions of possible opportunities for online diabetes nutrition education. Ideas such as peer-to-peer social support, RD-moderated diet tracking and cooking education were discussed. Literature suggests that online diet tracking and technology-based opportunities for extended support beyond in-person education visits could enhance diabetes and nutrition education programmes[17,18,27,47,49,53]. As supported by a constructivist epistemology[31], this theme is an inductive finding as these

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ideas were participant-led and in response to their own imagination of how to improve access to diabetes nutrition education for AI/AN adults. The Theoretical Framework of Acceptability supports the importance of exploring the attitudes and perceptions of members of the priority audience to pre-emptively assess how healthcare interventions may work within any given community[32].

Research with non-AI/AN adults shows promising potential in terms of improvements in glycaemic control[54–56] and weight management[57,58] through online education resources utilising social media[59] and diet or physical activity trackers[60]. Technology also fits well with important findings from research on adult education. Adult Learning Theory suggests that adults tend to be visual learners and prefer self-paced and interactive learning opportunities[33]. Internet-based educational resources can take advantage of adults' preferences for visual learning, interactivity and can be developed to support an asynchronous, start-and-stop interface[33]. Online learning has many interactive opportunities, including game-based, knowledge checks, video and communication options. Additionally, online access through mobile devices allows for 'anytime, anyplace' learning opportunities that are participant-driven and contextual. Examples provided by our participants' narratives include learning at the point-of-purchase in a supermarket. Also, eLearning theory supports the development of online education programmes with an intention that participants will engage in point-of-decision-making education to facilitate immediate application of new information learnt[61].

Of note, focus group participants in this study did have higher-than-the-national-average levels of educational attainment for AI/AN[4], and this likely impacted their reported frequency and access to the internet. However, the use and acceptance of technology was not the specific aim of the parent project from which these data were derived. All participants were recruited to engage in focus groups and interviews to discuss diabetes nutrition education in their communities and Indian Country in general – not specific to technology. Therefore, a strength of these findings is that participants did not have the opportunity to agree (or not) to participate based on their use of or access to technology. Because of this, the sample was not likely skewed by those who are not familiar with or do not use technology opting out.

Limitations

These qualitative findings may not generalise to AI/AN across the USA, and further exploration on the feasibility of an online diabetes nutrition education programme should be done to determine the potential impact for a wider AI/AN audience. Of note, the collaborating community-based sites (both rural and urban) are considered to have more resources in general than some more rural and remote AI/AN communities. Also, focus group participants were recruited from diabetes centres at each of the sites, suggesting that these participants may have disproportionate access to diabetes education resources given their involvement in local diabetes centres.

In terms of the feasibility of online diabetes nutrition education and its effectiveness on improving the lives of AI/AN with T2D, we must remember that AI/AN experience some of the greatest health inequities in the USA[62]. Individual education strategies cannot fully address the layers of complexity that contribute to rates of diabetes and associated complications in AI/AN communities or the challenges with diabetes self-management in this population[63,64]. For example, specific to healthful eating and diabetes self-management, a disproportionate number of AI/AN live in food deserts and suffer from food insecurity[65–70]. The impact of poverty and lack of access to healthy food on AI/AN communities is particularly devastating when considered in conjunction with the loss of land, forced relocation and environmental pollution, all of which have compromised traditional healthful food practices[71,72]. Education is one piece of the solution, but it needs to be supported by policy, systems and environmental approaches[73,74].

Public health implications

Overall, participants were enthusiastic about online diabetes nutrition education opportunities for AI/AN adults with T2D. According to the Theoretical Framework of Acceptability[32], in order to determine the feasibility and acceptability of an online diabetes nutrition education programme for AI/AN adults, an imperative first step includes gaining an understanding of the perspectives of key stakeholders prior to programme development[16]. Alongside evidence from literature showing increased access to the internet, challenges with attending conventional classroom-based health education and lack of culturally targeted diabetes nutrition education resources for AI/AN adults with T2D, findings of this project lay the foundation for an online diabetes nutrition education programme as a logical next step. Future work should target the development and comprehensive evaluation of an online diabetes nutrition education programme for AI/AN with T2D.

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Supplementary material

For supplementary material accompanying this paper visit https://doi.org/10.1017/S1368980020001743

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