Technology-based Health Education Resources for Indigenous Adults: A Scoping Review

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Abstract: Indigenous peoples experience a disparate burden of chronic diseases and lower access to health education resources compared with other populations. Technology can increase access to health education resources, potentially reducing health inequities in these vulnerable populations. Although many Indigenous communities have limited access to the Internet, this barrier is decreasing as tribes and Indigenous-serving organizations work to improve TechQuity. Using Arksey and O’Malley’s framework, we conducted a scoping literature review to identify technology-based health education interventions designed for Indigenous adults. We searched multiple databases, limiting papers to those written in English, describing interventions for participants 18 years of age or older, and published between 1999–2020. The review yielded 229 articles, nine of which met eligibility criteria. Findings suggest a paucity of technology-based health education interventions designed for Indigenous peoples and limited testing of the existing resources. Future health disparity research should focus on development and rigorous testing of such interventions.

Key words: Indigenous; technology-based health education; scoping review.
Indigenous peoples across the world are disparately affected by chronic diseases such as diabetes, obesity, and cardiovascular disease. Furthermore, Indigenous populations experience limited access to health education resources and support. Many of the chronic diseases that Indigenous people experience can be effectively prevented and managed with health education. In the United States and North America, Indigenous peoples, including American Indians, Alaska Natives, and Native Hawaiians, experience inequitable access to quality clinical health education services from health care professionals because of barriers such as transportation, lack of child and elder care, and limited availability of culturally responsive health care opportunities for those who live in urban areas. Health care systems that serve Indigenous peoples in multiple countries are widely acknowledged to be underfunded.

As supported by the Social Ecological Framework, an individual's health is influenced by individual factors, such as health-related knowledge and behavior, as well as factors at the interpersonal, organizational, community, and policy levels. Indigenous peoples are disproportionately affected by health disparities due largely to community-level determinants of health. For example, limited access to healthful food, safe places to engage in physical activity, clean water and air, and high-quality housing challenge Indigenous peoples' ability to prevent and manage chronic disease. Limited access to health care services and health education resources may play a pivotal role in the health of Indigenous people. Further, though the United Nations has declared access to the Internet a human right, Indigenous peoples often experience limited access to reliable Internet service as a community-level barrier associated with health inequities.

Use of telehealth, defined as a synchronous modality using telephone or video conferencing technology to provide health care and health education remotely, has grown over the last several years among Indigenous communities. Given the effects of COVID-19 social-distancing recommendations on group-based health education classes, never before has there been such a compelling need to offer technology-based, distance/remote, online health education resources, especially for at-risk adults. Health care providers are increasingly relying on technology-based health care and education services to comply with social distancing safety guidelines. COVID-19 has affected Indigenous communities in the U.S. at disparate rates and many of the adults who live in these communities have pre-existing health conditions that increase their susceptibility to the devastating consequences of COVID-19 infection. In order to better serve Indigenous communities with evidence-based and research-tested health education interventions, it is crucial to consider improving and expanding on innovative technology-based interventions for Indigenous communities.

Technology has the potential to make health education resources more widely available. Access to the Internet was once considered a barrier to the feasibility of online health education resources for Indigenous peoples in the United States. However, American Indians and Alaska Natives (AI/AN) have increasing access to the Internet through low-cost Internet-accessing devices (e.g., smartphones and tablets), expanding public WiFi availability (e.g., clinics, libraries, retail stores), more affordable data plans, and concerted efforts among Indigenous-serving organizations to improve this access. In some AI/AN communities, efforts are being made to overcome persistent
telecommunication barriers through the extension of broadband networks and coverage to traditionally underserviced areas. Data suggest that approximately half of AI/ANs now have broadband access, and the majority of these individuals connect primarily through smartphones and live in urban areas. Yet, the digital divide continues to affect AI/ANs who live in rural reservation areas that do not provide broadband access, and 68% of those living in rural areas of tribal lands lack broadband access. A 2017 report suggests only 24% of Indigenous peoples in Canada have Internet access, and other studies indicate that Indigenous Australians also lag behind non-Indigenous Australians in access to the Internet. It is difficult to accurately report Internet access among Native Hawaiians as these data are often aggregated with Pacific Islanders and even more broadly with Asian Americans. In Hawaii, 84% of households have broadband Internet access, but this is significantly lower among those households with less household income, and Native Hawaiians are disproportionately represented among low-income households. Trends suggest that access to the Internet and Internet-accessing devices is likely to improve in Indigenous communities just as it has among people who live in developing nations in general.

Use of online health education programs tailored for Indigenous adults is a relatively new area of research. However, needs assessments and qualitative exploration of Indigenous adults’ opinions of the feasibility of technology-based health education programs are promising. Research indicates that accessing health information is a key reason that AI/ANs use the Internet, suggesting that Native people might find technology-based health education resources to be acceptable. In a small mixed-methods needs assessment conducted at four geographically diverse American Indian sites (n=48), researchers found over 60% of American Indian adults use the Internet every day, with 64% of them reporting that they connect primarily through their smartphones.

Further, Indigenous adults across the world have specific ideas concerning how these resources and programs could be culturally tailored to serve their communities and which technological tools would best meet their needs. Building on findings from these needs assessments, some innovative researchers and communities have collaborated to develop, implement, and evaluate technology-based health education interventions for Indigenous communities.

A scoping review methodology is best suited to answer the research question “What is known about the topic of technology-based health education interventions for Indigenous adults?” and doing so was the purpose of this review. Specifically, we sought to identify health education interventions that have been developed for and tested with Indigenous populations. Because the literature in this area is sparse, we included papers focusing on Indigenous peoples around the world, including AI/ANs, Native Hawaiians, First Nations (Canada), and Indigenous Australians and New Zealanders. Given the lack of outcomes literature on technology-based health education interventions for Indigenous adults, in this scoping review, we identify and evaluate the acceptability, feasibility, uptake, and efficacy of these interventions for Indigenous adults.
Methods

Methods used for this scoping review follow the Arksey and O’Malley Methodological Framework. Stage four of this five-stage scoping review process includes charting the data, which describes a technique used to synthesize and interpret findings, much like a narrative analytical process used in qualitative research. For this reason, our study team employed three trained qualitative researchers who led this study.

Data sources and article identification. A comprehensive literature search was performed by a master’s-trained medical librarian in May 2019 and refreshed in October 2020. The medical librarian, a co-author on this paper, met with the first author on six occasions to establish a search strategy, including identification of search terms, and they conversed via email to further refine the search. Relevant publications were identified by searching the following databases: Ovid MEDLINE (including Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE® Daily, and Versions® 1946 to present), Embase (via Elsevier, Embase.com, 1947 to present), CINAHL (Cumulative Index to Nursing and Allied Health Literature via EBSCOhost, 1981 to present), PsycINFO (via Ovid, 1806 to present), and Web of Science Core Collection (via Clarivate Analytics, including Science Citation Index Expanded and Social Sciences Citation Index, 1974 to present). The total search results from all databases were imported into EndNote X8 (Clarivate Analytics, Boston) and the de-duplication function was used to remove duplicate results. As suggested in the Arksey and O’Malley Framework, the search was first conducted with a broad range of synonyms as agreed upon by the research team. The initial search strategy included the following terms, and related search terms: Indigenous, adults, technology, nutrition education, and type 2 diabetes. This initial search included nutrition education and type 2 diabetes as the original intent of the researchers was to determine what technology-based nutrition education resources were available for Indigenous adults with type 2 diabetes. However, this narrower search strategy did not produce enough published papers to warrant a scoping review analysis. Therefore, we expanded our search strategy by removing the term type 2 diabetes and broadening nutrition education to health education.

Screening and eligibility. Papers were screened in several phases. First, we conducted a manual search of all records to remove duplications that had not been removed using the previously mentioned automated de-duplication function. Next, two researchers reviewed all titles and abstracts and removed those records for which the full text was not available and those that did not meet the inclusion criteria. These two researchers met biweekly for four months, reviewing abstracts and discussing eligibility for inclusion in the review. To be eligible for full review records had to be published in the English language, involve human subjects research, be published from January 1999 through October 2020, and include Indigenous adults 18 years old or older. Additionally, eligible papers had to be focused on adult and family-based studies. We excluded studies that focused only on children, as children often have access to the Internet and Internet-accessing devices (e.g., tablets, laptops) at school, and we were specifically interested in outside-of-school programming and access. As further eligibility criteria for this scoping review, family-based studies were required to include health education and behavior focused on the adult family members, as opposed to programs
only focusing on children. Eligible papers for full review also were required to include interventions that used technology-based health education, and so we omitted studies that only used technology as a means of recruitment into the study. For example, interventions that were entirely in-person but used social media for recruitment were not included. Finally, we did not include health education resources that were intended to be “reminder” or “one touch” resources such as text messages to encourage engagement in colorectal cancer screening as we were specifically interested in longer health education intervention studies.

**Data management.** We used a Microsoft Excel 2020 (version 16.4) spreadsheet and Mendeley Reference Manager 2008 (version 1.19.4) to manage the references identified through the literature search. The medical librarian initially provided search output in EndNote X8 (Clarivate Analytics, Boston), but per preference of the first author, these records were imported into Mendeley Reference Manager for all subsequent analysis.

**Data abstraction.** Data were abstracted by two independent researchers using the customized Microsoft Excel file capturing information about the following domains: title, publication year, first author, priority population, type of paper, study design, age of participants, education component (yes/no), technology (type), theoretical framework. Two researchers discussed results on a bi-weekly basis and conferred about discrepancies as they arose. If eligibility of a record was unclear, additional researchers were consulted.

**Data analysis.** Researchers with expertise in qualitative methods used qualitative content analysis strategies, including both deductive (a priori) and inductive coding. One researcher coded all manuscripts and conferred with the collaborating researchers regarding codebook, categories, and overarching themes. The overarching themes across all included records suggest the most prominent similarities across these technology-based health education interventions for Indigenous adults.

**Results**

After de-duplication (both automated via EndNote and manual during initial review), 229 records were obtained using the search strategy described above and were reviewed by two researchers. These two researchers reviewed all titles and abstracts and removed those records which were only an abstract (n=7) and those that did not meet the inclusion criteria (n=180). Records describing interventions in which technology was only used in the recruitment phase of the health education intervention for Indigenous adults were removed (n=3). Records that did not involve interventions were removed (n=30). Therefore, a total of 9 records were included in this full scoping review synthesis (Figure 1).

**Numeric results.** Technology-based health interventions included in this scoping review are detailed in Table 1. Articles in this scoping review focused on technology-based health education interventions developed or tested with Indigenous adults. Of the nine articles included in this review, two included Native Hawaiians, one Alaska Natives, three included Native peoples from a variety of rural American Indian tribes, one included First Nations and Inuit peoples from Canada, one included Indigenous peoples from the Aboriginal Torres Strait in Australia, and one included Māori and Pasifika from New Zealand. The focus of the health education interventions
described in these papers included: physical activity (1); nutrition (3); pre/post-natal physical activity and health (2); both nutrition and physical activity (4); and weight management (6). Note that numbers total more than nine as some studies focused on more than one health education topic (e.g., both physical activity and weight management). Details on the health topics covered, chronic disease focus, and technology employed can be found in Table 2.

Two of the studies enrolled women only, as they were focused on pre/post-natal...
## Table 1.
### DETAILED SUMMARY OF STUDY CHARACTERISTICS

<table>
<thead>
<tr>
<th>Author(s), Year of Publication, Study Location</th>
<th>Intervention Type, Duration of Intervention</th>
<th>Study Population</th>
<th>Study aims</th>
<th>Methodology</th>
<th>Outcome Measures</th>
<th>Key Study Findings and Important Results Specific to Technology</th>
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<tr>
<td>Albright, et al., 2014, Hawai‘i, USA</td>
<td>12-month tailored telephone counseling and tailored website-based physical activity intervention</td>
<td>Multi-ethnic post-partum women aged 18–45 years old (n=311) with infant between 2–12 months</td>
<td>Increase physical activity in multi-ethnic post-partum women living in Hawai‘i</td>
<td>12-month parallel randomized controlled trial comparing the effectiveness of telephone counseling plus tailored (“mom-centric”) website physical activity intervention (TTCW) to standard website-only (SWO) intervention</td>
<td>Active Australian Survey 74 to assess frequency, duration, intensity of physical activity—data collected at baseline, 6, 12, 18 months</td>
<td>TTCW assignment significantly increased self-reported moderate to vigorous physical activity as compared to the standard condition (p = 0.027) TTCW women with ≥ 2 children had significantly greater increases in self-reported moderate to vigorous physical activity compared to those comparable women in the SWO group (p=0.016) Moderate to vigorous physical activity measured by accelerometer increased both conditions, but did not significantly differ by study condition (p=0.61) Telephone and internet interventions are particularly helpful for new mothers who find attending traditional physical activity (fitness centers, personal trainers) challenging but study website should be formatted for smartphone use, as many women access the web through these devices</td>
<td>There is a paucity of research focusing on physical activity interventions for Hawai‘i-based Asian American, Native Hawaiian, and Pacific Islander women, and none exclusively focused on post-partum period. This study fills the gap in research.</td>
<td>A high proportion of the sample included married women with high educational achievement (78% college educated) and findings related to accessibility of technology may not apply to women from socio-economically disadvantaged backgrounds Because the treatment condition included both a telephone enhancement and a website tailored for moms (compared to no telephone and general website for control condition) it is not possible to parse whether difference between conditions can be attributed to telephone support or tailored website.</td>
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<td>Browne et al., 2017; Australia</td>
<td>2-month long social media, radio, and television ad campaign to reduce consumption of sugar sweetened beverages. Messages were tailored for Aboriginal peoples in Australia</td>
<td>Aboriginal and Torres Strait Islander men and women, &gt;18 years old</td>
<td>Decrease sugar sweetened beverage consumption among Aboriginal and Torres Strait Islander people through technology-based, tailored messages</td>
<td>Cross sectional survey to evaluate reach and impact of the two sugar sweetened beverage advertisements among Aboriginal and Torres Strait Islander people</td>
<td>Campaign recall and recognition, perceived message effectiveness, television viewing habits, knowledge of sugar content in sugar sweetened beverages, and actions taken to improve health since viewing advertisements</td>
<td>Self-reported impact of the campaign on sugar sweetened beverage consumption did not differ between those who had seen the tailored advertisement and those not exposed to the campaign. Social marketing campaigns are most likely to change behavior when implemented as part of a comprehensive approach to improving population health.</td>
<td>Aboriginal respondents found the Aboriginal campaign was more believable and relevant for their community—highlights the importance to developing campaigns in collaboration with members of the priority audience. Respondents preferred messages that targeted the family or community rather than the individual.</td>
<td>Used a small convenience sample and individuals who had seen the advertisement who may have been more likely to complete survey.</td>
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<td>Buller et al., 2008; Upper Rio Grande Valley in Colorado and New Mexico, USA</td>
<td>Website tailored for residents of the Upper Rio Grande area of the USA—included content to increase fruit and vegetable consumption such as health benefits, gardening, recipes with fruits and vegetables, links to additional resources such as cooking tips for fruits and vegetables. Website was organized to be freely navigated by the user with no prescriptive navigation.</td>
<td>Adults; &gt;18 years old, (n=755), 9% self-identified as American Indian/Alaska Native</td>
<td>Evaluate the efficacy of a website promoting fruits and vegetables in the rural multicultural Upper Rio Grande Valley to increase individual consumption of fruits and vegetables</td>
<td>Randomized pretest-posttest controlled design. Participants recruited and pretested in person by community outreach trainers and randomly assigned to receive immediate access to the website (intervention group) or delayed access after the posttest (control group). Telephone administered posttest for all participants</td>
<td>Use of the website (user tracking) Food frequency assessment for fruit and vegetable tracking; knowledge of health benefits of fruits and vegetables, support from others to eat fruits and vegetables, involvement and confidence in preparing and purchasing fruits and vegetables, experience/ confidence using computer and the Internet</td>
<td>85% had a personal computer and 66% had used the Internet more than 10 times in the past. More time spent on the website and more time spent using recipes, and sections on seasonal fruits and vegetables and health benefits from the website were each significantly associated with greater pre-to-post change in fruit and vegetable consumption but these associations were significant only via single item assessment (not multi-item assessment of intake)</td>
<td>Website content was geared towards the general audience in the region (not specific to Indigenous peoples) but did include images of diverse (including American Indian) adults. Many participants did not visit the website enough to be broadly effective, may be related to slower Internet speed in rural areas. 88% of participants were female. Website was accessed through a unique participant ID login, which may have served as a barrier to use.</td>
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<td>Gittelsohn et al., 2020, rural USA-based regions</td>
<td>6 phases of an 18-month period; each phase ~2–4 months. Intervention components included: food store, worksite, school, social media/mailing, and policy</td>
<td>6 rural Native American communities in Midwest and Southwest US. Included over 600 Native American adults in collaborating communities, each with at least 1 worksite with 5+ employees, one elementary school, and one food store.</td>
<td>Assess the implementation of OPREVENT2 Intervention Trial. A theory-based, multi-level, multi-component intervention to prevent obesity among Native American communities. Data collected by Native American field staff members who delivered the intervention. Social media process evaluation included online tracking platforms to monitor use of Facebook, Instagram, and Twitter.</td>
<td>Process evaluation using a priori implementation standards based on previous experience with implementation of trials in Native American communities. Data collected by the same by Native American field staff members who delivered the intervention.</td>
<td>Impact results from OPREVENT2 not yet available. Process evaluation: fidelity, dose, reach; challenges and lessons learned; evaluation of intensity and integration of multi-level, multi components.</td>
<td>Social media component was one of 5 components of this multi-level, multi-component intervention. Moderate-high dose delivery but low reach and fidelity. Low engagement by community members.</td>
<td>Concerns among field staff about including images of community members on social media perhaps stymied the personalized tailoring to the community. Challenges with evaluation and promotion without on-site social marketing management team; reinforces the need for local/on-site promotion of the social media component.</td>
<td>Technology served as only part of this intervention.</td>
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<td>McShane et al., 2013, Ottawa Canada</td>
<td>CD-Rom based health education tool focusing on healthy pregnancy and family health, one time CD-Rom viewing with a community facilitator responsible for capturing face to face communications with participant</td>
<td>Inuit adults (n=40) residing in Ottawa: 9 men, 31 women</td>
<td>To evaluate the acceptability of a technology-based health promotion tool (CD-Rom) developed for Inuit adults in Ottawa</td>
<td>Qualitative findings and changes between expectations and reactions of CD-Rom content and delivery method to document acceptability.</td>
<td>CD-Rom technology has potential for health promotion for urban Inuit populations. After viewing CD-Rom participants were more likely to recommend to others, thought the information was similar to talking (with someone in person), and thought health education messages were clearer than before viewing.</td>
<td>Content used oral and visual media in order to tap into known Inuit styles for learning. Content in CD-Rom was delivered by an Elder, who are trusted messengers for public education; use of CD-Rom provides cost-effective way to connect urban Inuit with Elders. Both intervention and assessments offered CD-Rom in both Inuktitut and English languages.</td>
<td>Scope of study focused on acceptability of tool; no information about efficacy for health outcomes. Because a community facilitator was present during CD-Rom viewing, unclear how much participants could navigate CD-Rom content on their own.</td>
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<td>Mhurchu et al., 2019; New Zealand</td>
<td>12-week, two arm cluster randomized controlled trial. Cluster defined as any distinct location or setting in New Zealand where people with shared interest congregated such as church, sports clubs, etc.</td>
<td>&gt;18 years of age, members of Māori (n=337 intervention and 320 control) and Pasifika (n=389 intervention and 405 control) communities in New Zealand, access to an Internet accessing devices.</td>
<td>To evaluate the effectiveness of a mobile health program, entitled OL@-OR@ on adherence to health-related guidelines among participants in the intervention group.</td>
<td>Random assignment (cluster level) to the intervention or control condition. Intervention condition included mHealth program (app and website) and control group received only control app with pre and post data collection feature only. Data collection at baseline, 4 weeks, 12 weeks.</td>
<td>Primary outcome was self-reported adherence to health related guidelines, which were measured with a composite health behavior score (physical activity, smoking, alcohol intake, and fruit and vegetable intake), as adapted from the European Prospective Investigation into Cancer-Norfolk Prospective Population Study.75 The secondary outcomes were self-reported adherence to health-related behavior guidelines at 4 weeks, bodyweight at 12 weeks and holistic health and wellbeing status at 12 weeks.</td>
<td>The OL@-OR@ mobile health program did not improve adherence to health-related behavior guidelines amongst Māori and Pasifika individuals. The program included lifestyle trackers, goal setting, culturally relevant and local information on healthy eating and physical activity, and app notifications with healthy messaging.</td>
<td>Very rigorous process of including community members in development of the app/website. Apps require access to data and adequate storage on a mobile device, which may have limited intervention efficacy. Low engagement of intervention participants with the program, for example, only ¼ of participants set a behavior change goal online or with the app. App-based health education resources should likely be used in conjunction with comprehensive, multi-level health education programs.</td>
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<td>Smith et al., 2001, Alaska, USA</td>
<td>Three-month intervention consisting of fifteen 30-minute television-based nutrition education programs featuring Native Alaskan Elders focusing on topics such as traditional Alaskan food, recipes, breastfeeding, etc. Programs included testimonials from Native Alaskan women, health care providers, and Elders.</td>
<td>Rural Alaska-dwelling adult women (n=400) who received Special Supplemental Nutrition Program for Women (SNAP), Infants, and Children (WIC).</td>
<td>To evaluate the efficacy, feasibility, and likability of a television-based nutrition education program for adult women with children aged 0–5 years in rural Alaska.</td>
<td>10-question pre- and post test (prior to 15 30-minute nutrition education television shows). Nutrition “Question of the Day” after each television show.</td>
<td>Increase in knowledge, significant p&lt;0.05 in 9 of the 10 questions. Community advisory committee felt best measure of success was actually the wide community acceptance and excitement of the program.</td>
<td>Use of visual and oral presentation of nutrition education for this audience enabled culturally acceptable and accessible programming for those living in rural areas. Authors indicate future studies could use the Internet to further expand this audio-visual form of culturally tailored nutrition education. Enrollment in WIC increased 16% during the broadcast cycle</td>
<td>Intervention delivered to entire community may be effective to build community support around a priority population (e.g., mothers, infants and children) Only 23% of participants returned the “Question of the Day.”</td>
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<td>Tomazko, 2019; 5 participating sites across the USA (5 reservation/rural settings and 1 urban setting)</td>
<td>Year-long lifestyle and obesity prevention intervention for both rural and urban-living American Indian families, focused on increasing fruit/vegetable intake, increasing physical activity, improved sleep, decreased added sugar and screen time, and improved stress management (adults only)</td>
<td>450 American Indian family dyads with children between age 2–5 years old. Participants had to have a functioning cell phone to receive text messages</td>
<td>Test the efficacy of Healthy Children, Strong Families 2 intervention. Authors hypothesized the intervention would improve obesity-associated health behaviors and improve or maintain weight status in American Indian children and adults compared to control group.</td>
<td>Modified crossover design where family dyads were randomly assigned to obesity prevention intervention or active control group (child safety-intervention)</td>
<td>Weight, height, waist circumference (children and adults). Health-related behaviors (physical activity, dietary intake), food insecurity, adult stress, adult cultural identity, child sleep and screen time use.</td>
<td>Significant improvements after the intervention in adult and child diet patterns, fruit and vegetable consumption, and home nutrition environment. No significant changes in weight for adult or child. High satisfaction with text messages and Facebook messages according to focus group participants; text messages considered “helpful reminders”; participants also favorable towards motivational messaging delivered by text; Facebook posts with recipes were considered most helpful</td>
<td>More engagement in urban sites; possibly related to social media “bullying” in smaller rural communities as reported by community partners. Technology served as only part of this intervention.</td>
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Table 1. (continued)

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<td>Townsend-Ing, et al., 2018; Hawai‘i, USA</td>
<td>3-month weight loss intervention (face-to-face) entitled Partnership for Improving Lifestyle Intervention (PILI) PILI@ Work Program. Includes eight group-based 90-minute sessions. This phase is followed by 9 month follow up weight loss maintenance phase (either in person or via DVD). In person follow up included 11 group setting, peer-educator led sessions or DVD-based included 11 timed DVD viewings of the same session offered in face-to-face</td>
<td>Employees in Hawai‘i at 15 worksite locations known as Native Hawaiian Serving Organizations comprising 22 employee cohorts; 217 employees completed the 3-month weight loss phase and were eligible for the 9-month weight loss maintenance phase. 83 face-to-face participants and 73 DVD participants were retained in the weight loss maintenance phase</td>
<td>Compare the effectiveness of a 9-month, worksite-based, weight loss maintenance intervention delivered via DVD vs. face-to-face in continued weight reduction and weight loss maintenance beyond the initial weight loss phase</td>
<td>Two arm RCT embedded in community-based participatory approach; Randomized by worksite cohort</td>
<td>Body weight, BMI, blood pressure, 6-minute walk test, exercise frequency, fat intake, family and community support, locus of weight control, exercise and eating self-efficacy, retention in program</td>
<td>No significant differences between DVD and in-person follow up group retention between 3 and 12 month assessments. Encouraging findings in that dissemination, implementation, sustainability of technology-based weight loss intervention is easier and less expensive than live in-person interventions. Could be expanded with web-based delivery or applications (apps).</td>
<td>3 DVDs featured Native Hawaiian researchers serving as peer educators to deliver content</td>
<td>Intervention delivery in DVD phase was assessed only by whether the DVD received by participants, not by whether they actually watched it.</td>
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Table 2.

DESCRIPTION OF HEALTH TOPICS COVERED, CHRONIC DISEASE FOCUS, TECHNOLOGY EMPLOYED, AND EXPECTED OUTCOMES OF STUDIES INCLUDED IN THIS SCOPING REVIEW.

<table>
<thead>
<tr>
<th>Author(s), Year Of Publication, Study Location</th>
<th>Health Topics Covered</th>
<th>Chronic Disease Focus</th>
<th>Technology Employed</th>
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<tr>
<td>Albright, et al., 65 2014, Hawai‘i, USA</td>
<td>Physical activity including: goal setting, recommendations for physical activities, motivational interviewing to mitigate barriers related to physical activity</td>
<td>Prevention of weight gain, hypertension, obesity, and diabetes in post-partum women</td>
<td>Website and telephone counseling</td>
<td>Website and telephone counseling together will be more effective than website alone at increasing physical activity among Native Hawaiian and Pacific Islander post-partum women.</td>
</tr>
<tr>
<td>Browne et. al., 72 2017; Australia</td>
<td>Nutrition—focus on sugar sweetened beverage consumption and promotion of non-sugar sweetened beverage intake</td>
<td>Prevention of chronic disease related to body weight (e.g., diabetes)</td>
<td>Social media, television, radio</td>
<td>Targeted media campaign for Aboriginal and Torres Strait Islander people will be more effective in decreasing sugar sweetened beverage intake than the general audience media campaign.</td>
</tr>
<tr>
<td>Buller et.al, 70 2008; Upper Rio Grande Valley in Colorado and New Mexico, USA</td>
<td>Nutrition—Increase fruit and vegetable consumption including tips on gardening, recipes, and cooking for fruits and vegetables</td>
<td>General—reduced risk of chronic disease as based on national 5 A Day for Better Health program</td>
<td>Website</td>
<td>Adults in the Upper Rio Grande Valley who utilize the fruit and vegetable promotion website will show increased fruit and vegetable consumption pre / post usage.</td>
</tr>
<tr>
<td>Gittelsohn et.al, 68 2020, rural USA-based regions</td>
<td>Nutrition and physical activity including SMART goal setting, decreasing sugar, increasing non-sugary sweetened beverage consumption, decreasing sodium, increasing healthy snacks and family-based meals</td>
<td>Obesity prevention</td>
<td>Social media</td>
<td>Researchers explored social media as a method to augment the multi-level, multi-component obesity prevention intervention as an innovative and forward-thinking addition to their intervention.</td>
</tr>
</tbody>
</table>

(continued on p. 331)
<table>
<thead>
<tr>
<th>Author(S), Year Of Publication, Study Location</th>
<th>Health Topics Covered</th>
<th>Chronic Disease Focus</th>
<th>Technology Employed</th>
<th>Expected Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>McShane et.al., 2013; Ottawa Canada</td>
<td>How to support the health of women prior to pregnancy and during pregnancy</td>
<td>Promoting pre-pregnancy and pregnancy wellness</td>
<td>CD-Rom</td>
<td>Members of the priority audience (urban Inuit) will accept and be receptive of a health promotion CD-Rom that was developed specifically for their community. Participation in the intervention will improve adherence to health-related behavior guidelines among members of the priority audience (Māori and Pasifika adults).</td>
</tr>
<tr>
<td>Mhurchu et.al., 2019; New Zealand</td>
<td>General health topics— Culturally relevant healthy eating, physical activity, goal setting, lifestyle trackers, improving sleep, managing weight, smoking cessation</td>
<td>General health and prevention of non-communicable diseases</td>
<td>Smartphone app and website</td>
<td></td>
</tr>
<tr>
<td>Smith et.al, 2001, Alaska, USA</td>
<td>Nutrition education consistent with Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) messages (e.g., breastfeeding)</td>
<td>General health for pregnant and postpartum women, infants, and children</td>
<td>Television</td>
<td>Television-based nutrition education will expand reach and be acceptable by the priority audience (Alaska Native women).</td>
</tr>
<tr>
<td>Tomayko, et.al., 2019; 5 participating sites across the USA (5 reservation / rural settings and 1 urban setting)</td>
<td>Fruit and vegetable intake, improved sleep, decreased screen time and sugar intake, improved stress management (adults only)</td>
<td>Healthy lifestyle promotion and obesity prevention</td>
<td>Social media and text messages</td>
<td>Participation in the intervention would improve American Indian family-based healthy lifestyle and obesity prevention behaviors.</td>
</tr>
<tr>
<td>Townsend-Ing, et.al., 2018; Hawai‘i, USA</td>
<td>Diabetes Prevention Program Lifestyle Intervention is the basis of this intervention. Topics include physical activity, goal setting, navigating social situations regarding healthy eating, stress management, healthy eating at holidays, etc.</td>
<td>Obesity prevention, weight loss maintenance, hypertension</td>
<td>DVD</td>
<td>Participation in the intervention (either in person or DVD) would be similar in their effects on participants’ continued weight loss or weight loss maintenance.</td>
</tr>
</tbody>
</table>
Although all articles focused on health education for adults, as was required by inclusion criteria for this scoping review, four studies extended health education to families, specifically with children in the home. \cite{65,67} Two of these studies collected outcomes data on children as well as adults, or plan to do so. \cite{68,69} All of these studies met criteria for inclusion because they focused on health education and behavior for adults as well as children. No studies were included if the health education or behavior outcomes were focused on children only.

Types of technology utilized varied across identified studies. Technology used included: telephone, \cite{65} website, \cite{65,70} social media, \cite{68,69,72} radio, \cite{72} television, \cite{67,72} CD-ROM, \cite{71} DVD, \cite{66} text messaging, \cite{69} application (apps), \cite{73} or combinations of these. Three studies used more than one form of technology in their intervention. \cite{65,69,72} In two of the studies, technology was only used in one component of the intervention, while other parts involved in-person education and support. \cite{68,69} Only three of the studies mentioned prevalence of access to the Internet among the priority audience; \cite{65,68,70} however, five of these studies did not use Internet-based technology, and Internet access may not have been relevant for their work. Of the nine interventions described, eight were designed specifically for Native peoples. The one study that was not culturally tailored to Indigenous peoples was intended for rural communities, and American Indians constituted 9% of the study sample. Therefore, this paper was included in the scoping review. \cite{70} Two of the studies specified that their selected technology (social media, television, and/or radio) was intended to serve the whole community, as an effort to address the importance of community-level involvement.

Three interventions revealed positive health and behavior change results including: increased physical activity among postpartum women after engaging in a telephonic and web-based intervention, \cite{65} improved diet patterns in families with more fruit and vegetable intake after a multi-level intervention with American Indian families, \cite{69} and no difference in weight loss between DVD vs. in-person weight loss counseling for Native Hawaiian adults, suggesting DVD-based weight management education and support was just as beneficial as in-person education and support. \cite{66} Three studies did not show any positive results from their technology-based health intervention and cited various reasons. One suggested that social media should be used in collaboration with a more comprehensive intervention to reduce sugar-sweetened beverage intake among Aboriginal and Torres Strait Islander adults; \cite{72} one suggested that a website alone is likely not rigorous enough to improve fruit and vegetable intake among rural-living American Indian adults in southwestern U.S.; \cite{70} and one cited low engagement in the application (app) among participants. \cite{73} One of the intervention studies included did not have outcome results available at the time of this scoping review \cite{68} and one presented only qualitative results from the intervention suggesting that Inuit adults from Canada would be more likely to accept a technology-based (CD-ROM) healthy family and pregnancy intervention if it is specifically tailored to their community. \cite{71} Finally, two intervention studies encountered challenges with evaluation and data collection and suggested their findings were positive regarding the use of technology-based health education, but they needed additional resources to effectively evaluate the programs. \cite{67,70}

**Qualitative results.** Five key themes emerged across the nine studies. These included
1) culturally tailoring technology-based health education interventions for Native communities is important; 2) technology supports learning style preferences and access for many Indigenous adults; 3) programs must be personally tailored and interactive for optimal engagement; 4) evaluation of technology-based health education is challenging; and 5) future needs for research in this area include rigorous evaluation and use of Internet-based opportunities.

**Culturally tailoring technology-based health education interventions for Native communities is important.** All nine studies included in this scoping review emphasized the importance of culturally tailoring the technology for the priority audience.65–73 This included using community-based participatory research strategies, involving members of the priority audience in technology-based program development, featuring actors and images from the community, including elders as public health messengers as much as possible,67,70–73 and being aware of Internet-accessing capability and Internet-accessing devices available to the community in general.65,70

**Technology supports learning style preference and access for many Indigenous adults.** Findings from this scoping review suggested that the inherent audio and visual nature of technology-based learning suits the learning style preference of their priority audience.67,71 Further, especially for busy families, technology was noted to offer asynchronous alternatives to time-and-location-specific classroom-based learning.65,67,69 Finally, among the studies that focused exclusively on rural-living Indigenous adults, it was noted that technology may offer expanded services to those who otherwise experience barriers to attending in-person health education related to transportation and distance to travel.67–70

**Programs must be personally tailored and interactive for optimal engagement.** In one study, personalized telephone calls positively augmented the website-based intervention as the calls provided motivational-interviewing focused personalized support aimed at increasing physical activity.65 Results from studies where the technology was passive and not prescriptive in any way (e.g., optional website, Facebook, other social media) suggested that there was very low engagement in these technology-based resources. This likely contributed to small to no measurable changes in outcomes.68–70 One study did feature an application (app) that included lifestyle tracking as an interactive component, but still yielded no significant changes in healthy-behavior adherence compared with controls.73

**There are challenges to rigorous evaluation of technology-based health education programs.** Challenges in evaluating these programs focused on difficulties with tracking engagement in the technology-based portions of the program.68–70,72 Results of one study suggested evaluation was a challenge due to low response rates to pre-post evaluation questions, but that collaborating community members suggested quantitative pre-post evaluation was not the best measure of the program’s success. These individuals suggested wider community acceptance and excitement is a better measure of program success.67 For one study a CD-ROM-based health education tool was used, which focused on healthy pregnancy and family health. However, investigators noted that since participants were required to come in person to view the CD-ROM at the study site and had help navigating the CD-ROM, they were unsure how confident participants would be in using this technology at home.71
Further research is needed to rigorously evaluate technology-based health education programs for Indigenous adults and expand use of Internet-based opportunities. Three papers described studies that offered non-Internet-based technology interventions. Results suggested that expanding their work to Internet-based portals would be a logical and recommended next step. Researchers suggested that cost- and time-effectiveness of asynchronous health education was encouraging for large-scale dissemination and that technology-based interventions should be explored to expand reach to rural areas. The results of three studies that featured more passive technology-based health education (e.g., self-directed website or application [app] only) suggested that social media and websites would likely be more effective as part of a more comprehensive health education intervention with a community-level focus, but recommended further research to explore this possibility.

Discussion

Given the small number of studies included in this scoping review, it is apparent there is a paucity of published research examining technology-based health education interventions for Indigenous adults. Of the interventions included in this review that had resources available to conduct rigorous outcome evaluation, three cited positive health behavior changes, such as improved nutrition and physical activity among Indigenous adults who participated. As supported by the literature, technology-based weight management, healthy eating, and physical activity promotion interventions can be as effective as in-person interventions, and may have particular appeal to adults with variable work and child care schedules.

Of the nine studies included in this scoping review, six included Internet-based technology and, of those, only three mentioned access to the Internet as a limitation or reason their intervention wasn’t as successful as planned. These three studies focused on rural areas of the United States and noted that slow (or no) Internet access may have been a barrier for their participants. However, at least three of the research groups involved in these papers, along with others, have conducted in-depth needs assessments with members of their partner communities. These qualitative and survey-based needs assessments strongly suggest that Indigenous adults have interest in technology-based health education resources, confidence to use (or learn how to use) these resources, and desire to be involved in development of such resources. In two needs assessment studies, Indigenous adults were resistant to technology-based health education and support—one specific to AI/AN cancer survivors who strongly preferred face-to-face support and one in which AI/AN veterans were resistant to remote-access health education/support but eventually warmed to the idea as their concerns were addressed. As with all health education programs and resources, engaging the intended Indigenous community early in program development will increase the program’s acceptability and usability among the priority audience. The Theoretical Framework of Acceptability supports the importance of exploring the attitudes and perceptions of members of the collaborating community to preemptively assess how health care interventions may work within any given community.
qualitative finding from this scoping review suggests the importance of including key stakeholders in the development of technology-based health education interventions. This finding is strongly supported by community-based participatory research principles as well as literature on co-designing mHealth programs for the most effective user engagement.

These findings document potential for technology-based learning, suggesting that it might match the preferred learning style (visual and audible) of many Indigenous adults. Technology-based learning is supported by Adult Learning and eLearning Theories. Adult Learning Theory suggests that adults tend to be visual learners and prefer self-paced and interactive learning opportunities. Screen-based technology (e.g., computer, smartphones) is inherently visual and has many interactive learning opportunities. As with other studies, these scoping review findings indicate that participants would benefit from “anytime-Anywhere” learning opportunities given barriers to attending traditional health education classes. This was particularly noted for post-partum women and workplace education. For busy parents and working adults, asynchronous learning can support unpredictable schedules and self-directed learning as supported by Adult Learning Theory.

Another key finding from this scoping review included challenges related to rigorous evaluation of technology-based health interventions specific to those offered online and remotely. For example, it was difficult to examine engagement in a nutrition education website, and challenging to determine reach from social media-based interventions. However, two latter interventions included technology only as a supportive feature or smaller component of larger multi-level (e.g., community-level) interventions and very likely the researchers focused their rigorous evaluation efforts on other components of their interventions. This offers an opportunity to consider enhancing community-level evaluation of technology-based health education programs. Among health education research with non-Indigenous communities, rigorous evaluation of technology-based health interventions is possible, given the appropriate resources. Several research groups across the country are collecting formative and process evaluation data on innovative technology-based health education resources for Indigenous communities. These innovative programs include: a website for AI/AN adults with posttraumatic stress disorder, mobile health and cardiovascular disease management, eHealth and breastfeeding promotion, application for healthy living support for pregnant Indigenous Canadian women, smoking cessation, suicide prevention, and a text messaging intervention to promote child health in a rural American Indian reservation, among others. Further, the observed challenges with program evaluation may be addressed by using Indigenous evaluation frameworks, which may measure technology-based health education program success and outcomes in a way that is more culturally relevant to the priority audience.

Limitations. There are several key limitations to this scoping review. First, given that we limited our search to English-language only, we may have missed studies addressing other Indigenous groups (e.g., Indigenous peoples of Central and South America) or other intervention approaches (e.g., text messaging, which is a common mode of communication in African interventions). Second, because of the rapid rate at which
technology evolves, some studies included in this review may be dated. For example, many affordable digital devices (e.g., smartphones and tablets) currently available do not have DVD or CD-ROM ports and therefore this technology may not be adaptable for present-day widespread dissemination in their current form.

**Conclusion.** The United States’ *Healthy People 2030*, released in August 2020, more strongly emphasizes addressing social determinants as key objectives than did *Healthy People 2020*. For decades, *Healthy People* objectives have focused on health promotion and disease prevention measures as tools to benchmark national progress and reduce health disparities. A subset of key objectives in *Healthy People 2030* focus on the COVID-19 pandemic and health-related inequities. One of these key objectives includes increasing broadband Internet access. Reliable, high-speed connections have become essential for people to use the Internet for work, study, health care, and deliverable goods during the pandemic.

The work summarized here suggests that use of technology may aid in reducing health disparities experienced by Indigenous communities. As exemplified by the work summaries in this scoping review, there is much diversity among Indigenous communities and this diversity must be reflected, by design, in online health education resources. The COVID-19 pandemic has forever changed the way everyone will engage in remote-access resources and activities (health, school, work, worship). Research in the area of technology and remote-access health education will expand greatly given the dramatic changes to education, health care, and social support in the COVID-19 era, and awareness of the current and potential growing disparities between those who do and do not have reliable Internet access is of utmost importance to the public and community health professionals. Certainly, the COVID-19 pandemic has revealed the benefits of reliable access to the Internet and the importance of this access to support achieving equity for the most vulnerable communities. As supported by guidance from the United States’ *Healthy People 2030*, improvements in Internet access for Indigenous communities is essential to improve equity and access to culturally relevant, technology-based, online, remote-access health education resources. Next steps in this work include development, implementation, and evaluation of technology-based health education interventions for Indigenous peoples and advocacy to improve access to these resources.

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