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Two-year follow-up on an environmental health literacy software intervention for Anishinaabe Native Americans

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Abstract

Fish consumption comprises an important part of what the Anishinaabe (Great Lakes Native Americans) call "*minobimaadiziiwin*" which translates roughly to "living in a good way." Industrial activity leading to the accumulation of persistent contaminants in fish disrupts *minobimaadiziiwin*. Our team of academic and Anishinaabe scientists co-developed a fish consumption advisory for the Anishinaabe using software that can be accessed via mobile phones and the internet. The software, Gigiigoo'inaan ("our fish") is designed to improve environmental health literacy using culturally congruent messaging and aesthetics. In 2021, we conducted a randomized control trial to test changes in environmental health literacy including fish consumption behaviors. The software was determined to improve confidence whilst maintaining contaminant intakes within advisory (i.e., "safe") limits. In 2022 and 2023, we updated the software and conducted user follow-up surveys using email recruitment captured by the software on personal devices. During the 2022 follow-up of software users, 90 respondents indicated significant increases of engagement (80.9%), utility (88.8%), and confidence (91.1%) relative to the original control trial. During the 2023 follow-up, after the additional update, those gains increased even further: engagement (98.4%), utility (97.3%), and confidence (97.3%). Iterations of community-engaged software development was associated with improved environmental health literacy metrics across software updates.

Keywords

Native American; Environmental Health Literacy; Risk Communication; Environmental Exposures

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1. Introduction

The Ojibwe and associated tribes of the upper Great Lakes region (Anishinaabe) of the United States (USA), as well as Canada, maintain traditions of hunting, gathering, and fishing for their diets, commercial fisheries, and culture. These traditions are legally affirmed by treaties with the USA government. Fish consumption comprises an important part of what the Ojibwe call "*minobimaadiziiwin*" which translates roughly to "living in a good way." Similar treaties exist in Canada (e.g., the Robinson Huron Treaty of 1850). Socio-political forces, modernized dietary practices, and industrial activity disrupt *minobimaadiziiwin* as the current study team and others have documented (Dellinger and Poupart, 2021, Dellinger et al., 2020, Dellinger et al., 2023, Dellinger et al., 2018, Dellinger and Ripley, 2016, Isaac et al., 2018). Specifically, persistent bioaccumulative toxic (PBT) contamination, methylmercury (MeHg), and polychlorinated biphenyls (PCBs) of fish tissues present a health risk from consuming fish (Dellinger et al., 2014, Strandberg et al., 2020). The treaty signatory Anishinaabe tribes have established inter-tribal consortia to monitor contaminants and manage these natural resources in partnership with US Federal, State, and academic entities.

The Chippewa Ottawa Resource Authority (CORA) in Sault Ste. Marie, Michigan, represents the fisheries interests of five Ojibwa and Ottawa tribes (Anishinaabe) in Michigan state through the 1836 Treaty of Washington. CORA has been monitoring contaminant concentrations in the fillet portions of two native Great Lakes fish species, lake trout (*Salvelinus namaycush*) and lake whitefish (*Coregonus clupeaformus*), from treaty-ceded waters of lakes Superior, Huron, and Michigan since 1991. CORA has supported fish consumption advisories with these data along with Michigan state and additional fish species sampling supported by two National Institutes of Environmental Health Sciences (NIEHS) grants as described in Dellinger et al. (2023). This article reports one- and two-year follow-up of a National Institutes of Health-funded randomized controlled trial to investigate Anishinaabe fish consumption rates, omega-3 polyunsaturated fatty acids (n-3 PUFA), and PBTs with, and without, access to culturally tailored, personalized fish consumption using mobile software (Dellinger et al., 2022b, Dellinger et al., 2015-2017, Dellinger et al., 2018–2023.). The study team for this project is a partnership between the Medical College of Wisconsin (MCW), CORA, the Great Lakes Inter-Tribal Council (GLITC), and the Inter-Tribal Council of Michigan (ITCMI).

As communicated by Elders and community members in past focus groups and communications (Dellinger and Poupart, 2021, Dellinger et al., 2019), living well is connected to treaty-affirmed hunting, gathering, and ceremonial rights. The important role of culture, especially for Indigenous populations, in guiding healthy eating is well-documented by our group and others (Chong et al., 2024, Kuhnlein and Chan, 2000, Lowitt et al., 2024, Sebai et al., 2025). Furthermore, our team has documented multiple evaluations of risk benefit analyses which identify healthful, safe, and beneficial fish consumption scenarios. This understanding led our team of academic and Anishinaabe scientists to evaluate environmental health literacy improvement using mobile software that provides personalized fish consumption advice (Dellinger et al., 2019, Dellinger et al., 2017). The team developed and tested the impact of the software, comparing pre- and post-intervention ratios of estimated omega-3 fatty acids and mercury/PCB intakes. Findings from the randomized control trial indicated that healthful fish consumption scenarios, those which maximized PUFA-3 intake without exceeding advisory limits, were supported by the software (Dellinger et al., 2022b). An additional exploratory analysis underscored the importance of cultural affinity in decision-making when accessing these environmental data (Dellinger et al., 2022a).

Our team developed Gigiigoo'inaan using a model of community feedback and input from tribal scientists and policy makers described in Dellinger et al. (2017). Under this model, fish consumption recommendations were co-developed with tribal scientists and community members ensuring that both risk assessment and cultural implications were considered. The software's initial focus groups and control trial feedback supported positive useability, acceptability, and likelihood to influence behavior via environmental health literacy improvement (Dellinger et al., 2017, Dellinger et al., 2022b). We hypothesized, based on input from tribal partners and community members, that additional community-engaged software development would further improve these Environmental Health Literacy (EHL) metrics. Therefore, Gigiigoo'inaan received an aesthetic, database, and organizational overhaul (described below). This manuscript reports the effect of additional software iterations on culturally contextualized EHL metrics.

2. Methods

2.1. Iterative software development

Gigiigoo'inaan provides personalized, culturally tailored advice that presents methylmercury (MeHg), polychlorinated biphenyl (PCB), and omega-3 polyunsaturated fatty acids (PUFA-3) data in a user-friendly format, considering the user's age, sex, and weight. The software is the result of over 18 years of community-engaged research. Since its initial deployment in 2017, the software has received three aesthetic and data updates during the project to include community feedback from focus groups (2017–2019), randomized control trials (2021), and user follow-up surveys (2022 and 2023/24). The overall development process for Gigiigoo’inaan followed the Dellinger et al. (2017) iterative design model based on community feedback and input from tribal scientists and policy makers which is illustrated in Fig. 1. As described in Dellinger et al. (2017), a pilot version of Gigiigoo’inaan was programmed by the University of Wisconsin-Milwaukee Mobile Innovation Lab to the specifications of the research partners at MCW, ITCMI, and CORA. All subsequent versions were programmed by Shorewood Tech (LLC). The pilot and all subsequent versions were run on Android™ and IOS™, allowing for on-demand calculation of safe consumption rates for three species of fish (lake trout, lake whitefish, and walleye (*Sander vitreus*)) based on user input data of age, intent to become pregnant, and weight. There is also a web version (mcwfishapp.com ↗) which can be accessed using any web browser. The software features custom-made woodland-styled digital images made in the Woodland Style founded by the Anishinaabe artist Norval Morrisseau (Fig. 2, Fig. 3).

Fig. 1. Iterative software design, with community feedback, concept. Orange arrows represent the first pass, which has already occurred, blue arrows represent future iterations of the process. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

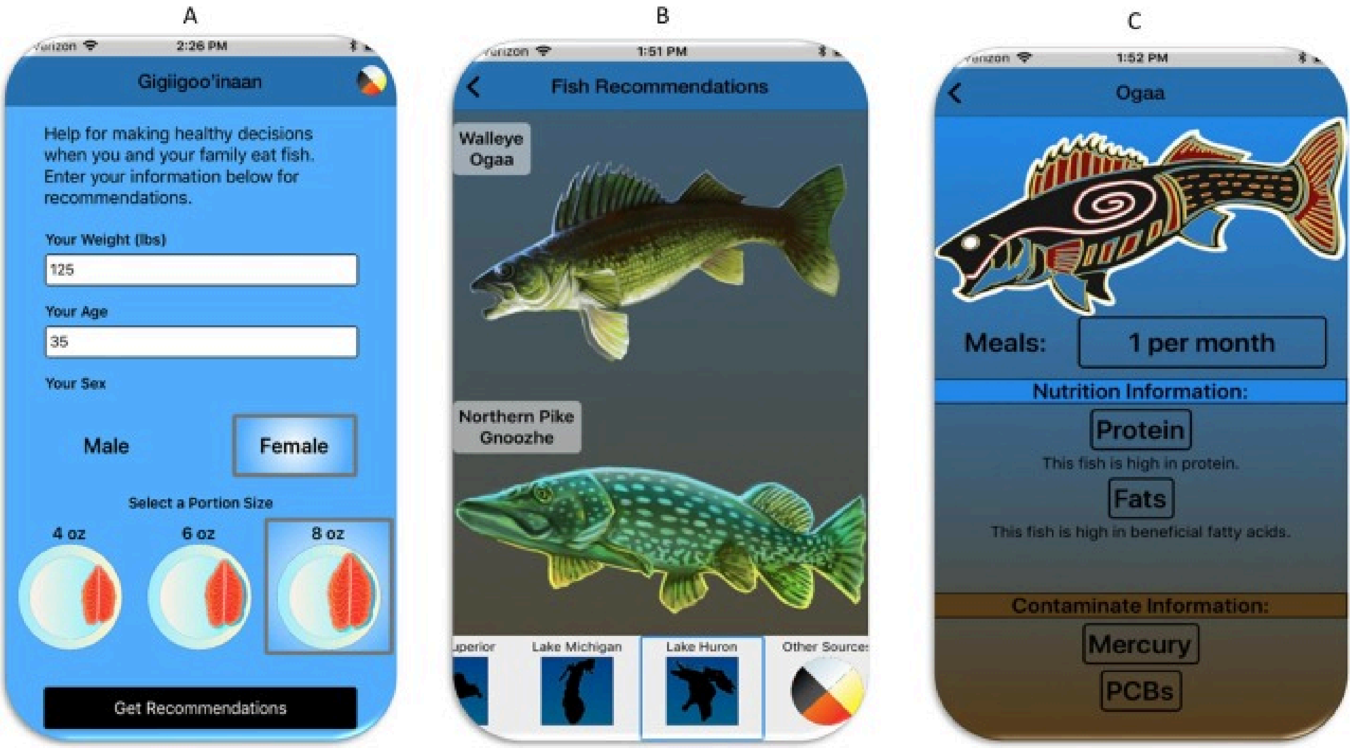
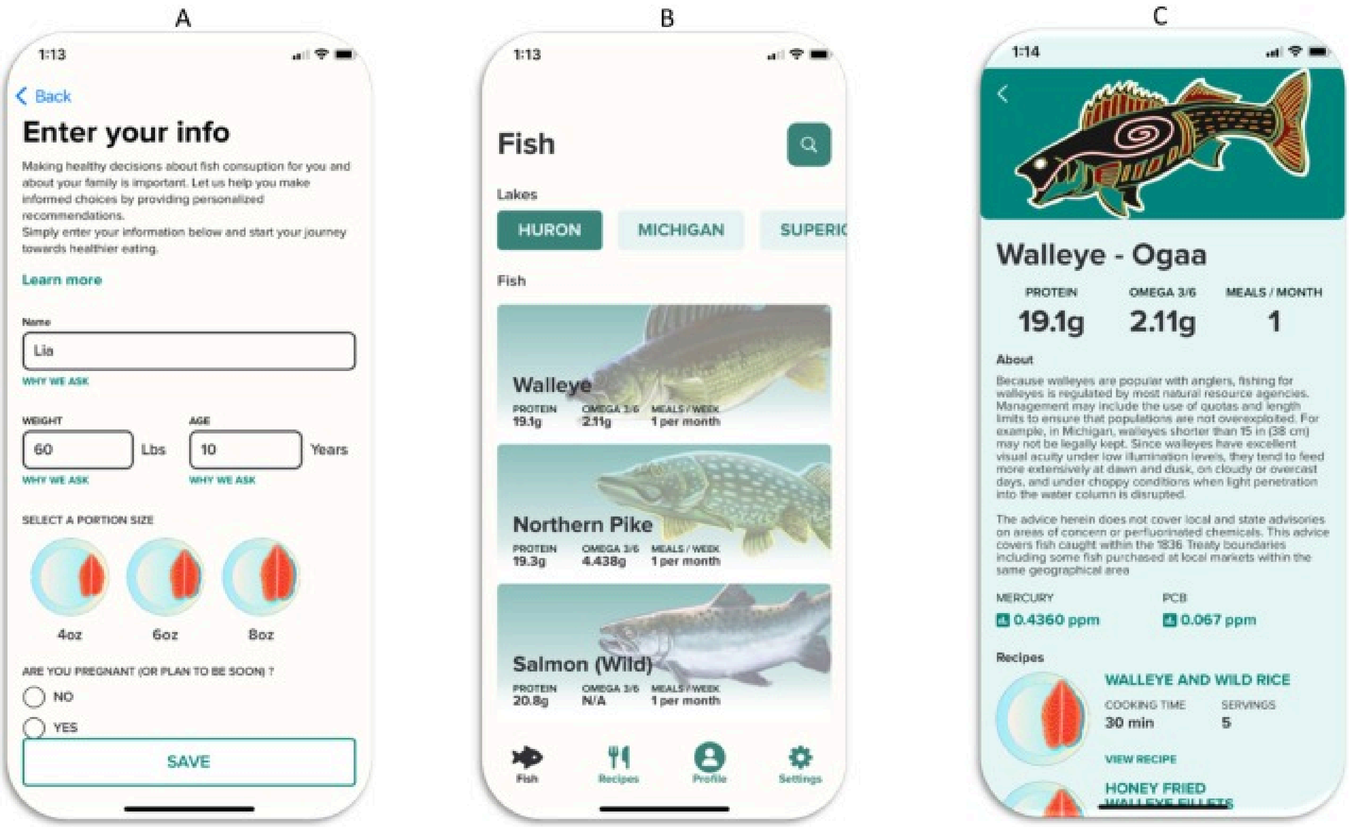


Fig. 2. Gigioo'inaan 2017–2021. A) Personal data entry page, B) Advisory output page, fish list, C) Fish advisory detail page.



Download: Download high-res image (372KB)

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Fig. 3. Gigioo'inaan 2022–2024. A) Personal data entry page, B) Advisory output page, fish list, C) Fish advisory detail page.

2.2. Gigiigoo'inaan basic features

For the purposes of this analysis, Gigiigoo'inaan is compared across three versions: 1) the version tested during the randomized control trial (Fig. 1); 2) an aesthetically overhauled version (Fig. 2); and 3) a finalized version with updated features (aesthetically identical to Fig. 2). Fig. 1 displays the basic features of Gigiigoo'inaan from 2017 to 2021 which received minor data updates during that timeframe and was evaluated in a randomized control trial in Dellinger et al. (2022). All risk (and benefit) estimates are calculated within the software, on demand, based on user inputs. On the first results page (after personalization data is entered), fish are ranked in order of the most to least beneficial fish based on number of recommended meals that minimize contaminant exposures. When selected from this list, the fish display specific consumption advice using safe consumption ranges based on the user input. The information page also includes protein content and PUFA-3 content. These fish can also be browsed by water body (Lakes: Huron, Michigan, and Superior) to represent the options within the fisheries of the Anishinaabe tribes. Distinct from conventional advisories, the software uses input data (bodyweight and selection of illustrated 4-oz, 6-oz, and 8-oz serving sizes) to calculate a ratio of fish grams/meal/bodyweight which can be linked to pre-determined safe consumption ranges per fish using the appropriate guidelines determined by CORA.

In 2022, Shorewood Tech overhauled the user interface and design, adding the following features in response to user feadback: 1) recipe recommendations integrated with fish detail pages; 2) industry standard aesthetics and ergonomics overhaul; 3) additional fish species; and 4) multiple account setup allowing for personalized calculations of multiple family members. The 2023 version was further updated as follows: 1) additional fish species; 2) a major data overhaul based on a 30-year contaminant trend analysis of tribal fish harvests (Dellinger et al., 2023); and 3) additional recipes and the ability to add recipies. These updated versions are illustrated in Fig. 3.

2.3. Recruitment, evaluation, and assessment

2.3.1. 2017–2021 version

Tribal members from the 1836 Treaty tribes were recruited via inter-tribal consortia agreements managed by ITCMI to track prospective fish consumption rates with, and without, access to Gigiigoo'inaan. The experimental design was a pre-/post-dietary assessment with concurrent controls. Upon recruitment, 305 people filled out the enrollment form, but 38 didn't meet inclusion criteria (mostly residence outside treaty areas). Thus, 136 control and 130 intervention (treatment) participants were enrolled. Anishinaabe participants recorded their fish consumption weekly for a month pre-intervention and a month post-intervention with, or without, access to the fish consumption advice: 238 completed their consumption pre-intervention and, among them, 207 post-intervention. Informed consent and enrollment were administered online using REDCap™ (Research Electronic Data Capture), a secure web application for building and managing online surveys and data collection (Harris et al., 2009). Randomized control trial results are discussed in Dellinger (2022), and user feedback and EHL metrics are compared here to the subsequently updated versions (Gigiigoo'inaan 2022 and 2023).

The inclusion criteria were: 1) 18 or more years of age who make their own dietary decisions; 2) reside in the area covered by the treaty-ceded territories; and 3) self-reported tribal membership. Only one person per household, confirmed by their residential address, was enrolled to minimize cross-group control/intervention mixing. Recruitment primarily occurred via ITCM email servers, social media, and in-person meetings between ITCMI partners at member tribes' health departments and offices. Participants were offered gift cards for completing each phase of the trial, with increased amounts for completing the entire trial. All protocols were approved by MCW Institutional Review Board.

All the participants followed an initial weblink that had the enrollment form. Upon agreeing to participate, they completed a short online survey reporting their age, sex, weight, tribal affiliation, contact address and phone number (for incentive distribution), educational attainment, and household income. Participants were emailed instructions on using the REDCap™ survey and instructions on completing online questionnaires along with appropriate web addresses. The fish consumption surveys (Dellinger et al., 2022b), not discussed here, were automatically emailed each week. Participants were incentivized with gift cards to complete useability and environmental health literacy assessments with access to Gigiigoo'inaan.

2.3.2. 2022–2024 version

From 2021 to 2023, the ITCMI enrolled participants via email as above but without weekly fish consumption surveys. As above, participants were incentivized with gift cards to complete useability and environmental health literacy assessments with access to Gigiigoo'inaan. ITCMI staff worked with individual tribal governmental offices, health departments, and social media tools to promote use of the software and encourage enrollment in the follow-up study. Informed consent and enrollment were administered online using REDCap™ (Harris et al., 2009). The inclusion criteria were the same as the randomized control trials. Participants were given access to the software via QR codes and web links. The EHL assessments were sent as separate emails with survey links.

2.4. Statistical analysis

The intervention effect was assessed by comparing scoring criteria across three timepoints (T0=randomized control trial, T1=2022 follow-up, and T2=2023 follow-up). Items, scored via Likert scale, were assigned ordinal values (1, strongly disagree – 5, strongly agree). For significance testing of the targeted relationship of change in EHL constructs, these were dichotomized into "agree" or "disagree." Chi-square was performed comparing proportions of participants scoring as improved versus not at each time point (T0–T1–T2). Fisher's exact tests were used on items with a lower rate of response.

3. Results

Table 1 describes the enrollment across tribal affiliations for the project phases from 2021 through 2022. Tribal participation from Bay Mills, Sault Ste. Marie, and Little Traverse was more consistent than other 1836 Treaty communities across years. As the project increased reach and notoriety, participation from Grand Traverse and Little River increased. As described in Table 2, participants tended to be younger to middle-aged adults with some exposure to higher education. Most had completed some form of college degree. This was consistent across all study phases, and is a well-known, longstanding, recruitment bias in these populations (Dellinger, 2004). This was consistent across study years.

Table 1. Tribal affiliations of participants across study phases 2021–2023.

What is your tribal affiliation?	**Total N = 350 (%)**	**Randomized Trial N = 73(%)**	**2022 Follow-up N = 90(%)**	**2023 Follow-up N = 187(%)**
Bay Mills Indian Community	58 (16.6)	17 (23.3)	22 (24.4)	19 (10.2)
Grand Traverse Band of Ottawa and Chippewa Indians	78 (22.3)	4 (5.5)	5 (5.6)	69 (36.9)
Little River Band of Ottawa Indians	79 (22.6)	0 (0.0)	6 (6.7)	73 (39.0)
Little Traverse Bay Bands of Odawa Indians	21 (6.0)	9 (12.3)	7 (7.8)	5 (2.7)
Sault Ste. Marie Tribe of Chippewa Indians	101 (28.9)	43 (58.9)	37 (41.1)	21 (11.2)
Bad River Band of Lake Superior Chippewa	2 (0.6)	0 (0.0)	2 (2.2)	0 (0.0)
Mille Lacs Band of Ojibwe	3 (0.9)	0 (0.0)	3 (3.3)	0 (0.0)

What is your tribal affiliation?	Total N = 350 (%)	Randomized Trial N = 73(%)	2022 Follow-up N = 90(%)	2023 Follow-up N = 187(%)
Red Cliff Band of Lake Superior Chippewa Indians	1 (0.3)	0 (0.0)	1 (1.1)	0 (0.0)
Lac Courte Oreilles Band of Lake Superior Chippewa Indians of Wisconsin	1 (0.3)	0 (0.0)	1 (1.1)	0 (0.0)
Fond du Lac Band of Lake Superior Chippewa	1 (0.3)	0 (0.0)	1 (1.1)	0 (0.0)
St. Croix Chippewa Indians of Wisconsin	1 (0.3)	0 (0.0)	1 (1.1)	0 (0.0)
Other	4 (1.1)	0 (0.0)	4 (4.4)	0 (0.0)

Table 2. Participant characteristics across study phases 2021–2023.

Survey Question	Total N = 350 (%)	Randomized Trial N = 73 (%)	2022 Follow-up N = 90 (%)	2023 Follow-up N = 187 (%)
What is your sex?				
Male	192 (54.9)	28 (38.4)	46 (51.1)	118 (63.1)
Female	158 (45.1)	45 (61.6)	44 (48.9)	69 (36.9)
Missing	0	0	0	0
What is your age?				
N	349	73	90	186
Mean±SD	35.6±10.7	44.1±14.1	35.1±10.1	32.6±7.0
What is the highest level of school have you completed?				
Some high school	2 (0.6)	0 (0.0)	2 (2.2)	0 (0.0)
High school diploma	21 (6.0)	5 (6.9)	9 (10.0)	7 (3.7)
Technical degree	7 (2.0)	3 (4.2)	1 (1.1)	3 (1.6)

Survey Question	Total N = 350 (%)	Randomized Trial N = 73 (%)	2022 Follow-up N = 90 (%)	2023 Follow-up N = 187 (%)
Some college	90 (25.8)	21 (29.2)	27 (30.0)	42 (22.5)
College graduate or higher education	229 (65.6)	43 (59.7)	51 (56.7)	135 (72.2)
Missing	1	1	0	0

Table 3 presents the user feedback and EHL metrics in response to using Gigiigoo'inaan. Since the initial trial, users have found the software to be generally engaging (89%) and culturally appropriate (90.5%); these metrics significantly increased further across iterations of the software. Metrics that improved the most with updates were improved ability to exercise treaty rights, intention to regularly use the software, and intention to eat more fish when using the software. Utility metrics such as regular usage and consuming more fish with the aid of the software both increased substantially by approximately 40% across software iterations. Users also indicated an increased ability to select the best fish between the last two software iterations (88.8% in 2022 and 97.3% in 2023). Self-efficacy measures of confidence to select fish and exercise treaty rights also saw substantial increased (about 25%) across the three study phases.

Table 3. Environmental Health Literacy (EHL) variables across study phases 2021–2023 (^{c}chi square test, $^{+}$Exacttest, *question added 2022).

Survey Question	Randomized Trial N = 73 (%)	2022 Follow-up N = 90 (%)	2023 Follow-up N = 187 (%)	p-value
The app was engaging	89	80.9	98.4	*0<.001*^{C}
The app is culturally appropriate	90.4	95.5	91.4	*0.405*^{C}
The app would help me exercise my treaty rights.	68.5	78.9	91.8	*0<.001*^{C}
The app helped me to identify the best fish to eat	*	88.8	97.3	*0.005*$^{C+}$
I would use this app regularly	54.8	80	94.1	*0<.001*^{C}

Survey Question	Randomized Trial N = 73 (%)	2022 Follow-up N = 90 (%)	2023 Follow-up N = 187 (%)	p-value
I would eat more fish if I could use this tool	53.5	64	95.2	*0<.001*[C]
I would feel more confident about serving fish to my family	69.9	91.1	97.3	*0<.001*[C]

4. Discussion

Mobile software has become an increasingly popular method to support risk management and health promotion efforts due to their widespread reach and ability to tailor content based on user feedback. Other published mobile software intervention approaches to improve literacy include self-monitoring, goal setting, social support, and personalized feedback (Kankanhalli et al., 2019). This analysis covers similar metrics including the impact of personalized feedback recommendations on fish consumption. This study reflects numerous iterations of Gigiigoo'inaan software redevelopment and collaboration with Anishinaabe tribes. Community participation in software development and design support software engagement, utility, adherence, and efficacy (Iribarren et al., 2021); the data reported here are an example of this and present important opportunities for risk management in diverse settings.

The recruitment sampling and scope of this study was initially designed to test differences in fish consumption and chemical contaminant exposure as discussed in Dellinger et al. (2022). The recruitment for this follow-up was conducted by ITCMI to evaluate user response to the software concurrent with a promotional campaign to encourage its use. The results should be interpreted accordingly. Under these conditions, user confidence, self-efficacy, and intended behavior change increased substantially. It is likely that the user interface and comprehensive data updates contributed to these trends. The ITCMI campaign to disseminate the software may have also increased confidence in the overall endeavor. This included site visits to tribal health departments, special events at health fares, and press releases. These trends are encouraging and support the case for iteratively designed software interventions in collaboration with local cultural leaders, community members, and scientists. These results suggest that the overall approach, including the dissemination campaign, have the cumulative effect of improved environmental health literacy in 1836 signatory tribes.

Future interventions should draw upon these best practices and carefully consider how to improve outreach to older adults, youths, and lower socio-economic status tribal members. The recruitment methods used by tribal organizations such as ITCMI seem to be biased towards participants with some college education or higher. It is likely that lower educated tribal members are less engaged with local health departments and tribal governments. It is also possible that older tribal members are more difficult to engage with mobile software interventions. These groups could benefit from more deliberate recruitment and engagement. Organizations such as CORA and ITCMI are ideally situated to pursue these engagement efforts.

5. Conclusions

Iterative software design, combined with mobile technology and community engagement serve as dynamic methods to communicate complex environmental data to diverse cultural contexts in a meaningful and accessible manner. This process would be valuable in other cultural conditions in which environmental data must be contextualized and effectively communicated. Discussions are underway to implement more software-based interventions as well as youth and Elder engagement with Anishinaabe tribes. Discussions with tribal leaders and community advisors confirm that these are important priorities moving forward.

CRediT authorship contribution statement

Matthew J. Dellinger: Writing – original draft, Funding acquisition, Conceptualization. **Sarah Reed-Thryselius:** Writing – review & editing, Data curation. **Beth Sieloff:** Writing – review & editing, Supervision, Project administration, Methodology, Data curation, Conceptualization. **Sarah Keller:** Writing – review & editing, Data curation. **Alexis Visotcky:** Writing – review & editing, Formal analysis, Data curation. **Thomas Chelius:** Writing – review & editing, Methodology, Data curation. **Otto Wichmann:** Writing – review & editing, Software, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Recommended articles

References

Chong et al., 2024 K. Chong, G.M. Hickey, H.M. Chan, N. Basu
Exploring practices, challenges, and priorities for human health and ecological risk assessments in Indigenous communities in Canada
Integr. Environ. Assess. Manag., 20 (2024), pp. 1677-1692
Crossref ↗ View in Scopus ↗ Google Scholar ↗

Dellinger, 2004 J.A. Dellinger
Exposure assessment and initial intervention regarding fish consumption of tribal members of the Upper Great Lakes Region in the United States
Environ. Res., 95 (2004), pp. 325-340
View PDF View article View in Scopus ↗ Google Scholar ↗

Dellinger et al., 2014 J.A. Dellinger, M.D. Moths, M. Dellinger, M.P. Ripley
Contaminant trends in freshwater fish from the Great Lakes: a 20 year analysis
Hum. Ecol. Risk Assess., 20 (2014), pp. 461-478
Crossref ↗ View in Scopus ↗ Google Scholar ↗

Dellinger and Poupart, 2021 M. Dellinger, A. Poupart

The lessons Native American culture can teach us about resilience during pandemics and healthcare crises
Wis. Med. J., 120 (2021), pp. S80-S84
View in Scopus ↗ Google Scholar ↗

Dellinger et al., 2020 M.J. Dellinger, R. Anguzu, N. Pingatore, M. Ripley
Risk-benefit modeling to guide health research in collaboration with Great Lakes fish consuming Native American communities
J. Great Lakes Res., 46 (2020), pp. 1702-1708
View PDF View article View in Scopus ↗ Google Scholar ↗

Dellinger et al., 2023 M.J. Dellinger, L. Daskalska, M. Ripley
A thirty-year contaminant trend analysis in Great Lakes Native American fish harvests 1991–2021
Environ. Pollut., 333 (2023), Article 122075
View PDF View article View in Scopus ↗ Google Scholar ↗

Dellinger et al., 2019 M.J. Dellinger, M. Lyons, R. Clark, J. Olson, N. Pingatore, M. Ripley
Culturally adapted mobile technology improves environmental health literacy in Laurentian, Great Lakes Native Americans (Anishinaabeg)
J. Great Lakes Res., 45 (2019), pp. 969-975
View PDF View article View in Scopus ↗ Google Scholar ↗

Dellinger et al., 2017 M.J. Dellinger, J. Olson, R. Clark, N. Pingatore, M.P. Ripley
Development and pilot testing of a model to translate risk assessment data for Great Lakes Native American communities using mobile technology
Hum. Ecol. Risk Assess., 24 (2017), pp. 242-255
Google Scholar ↗

Dellinger et al., 2018 M.J. Dellinger, J.T. Olson, B.J. Holub, M.P. Ripley
Mercury, polychlorinated biphenyls, selenium, and fatty acids in tribal fish harvests of the upper Great Lakes
Risk Anal., 38 (2018), pp. 2029-2040
Crossref ↗ View in Scopus ↗ Google Scholar ↗

Dellinger et al., 2022a M.J. Dellinger, N. Pingatore, T. Chelius, A. Visotcky, A. Poupart, R. Sparapani

An exploration of cultural–environmental interactions with Native American health literacy

Environ. Health Perspect., 130 (2022), Article 117703

View in Scopus ↗ Google Scholar ↗

Dellinger et al., 2022b M.J. Dellinger, N. Pingatore, T. Chelius, A. Visotcky, R. Sparapani, M. Ripley

Environmental health literacy for Anishinaabe (Great Lakes Native American) fish consumers: a randomized control trial

Environ. Res., 212 B (2022), Article 113335

View PDF View article View in Scopus ↗ Google Scholar ↗

Dellinger et al., 2015-2017 Dellinger, M.J., Pingatore, N., Ripley, M.P., Cassidy, L., 2015-2017. A fish consumption advisory to promote Anishinabe environmental health literacy. National Institute for Environmental Health Sciences. 1R21ES025788-01, Medical College of Wisconsin, Milwaukee, WI.

Google Scholar ↗

Dellinger et al., 2018–2023. M.J. Dellinger, N. Pingatore, M.P. Ripley, L. Cassidy

Gigiigooinaan (our Fish): a New Advisory to Promote Anishinaabe Health and Wellness

Medical College of Wisconsin, Milwaukee, WI (2018–2023.)

Google Scholar ↗

Dellinger and Ripley, 2016 M.J. Dellinger, M.P. Ripley

Mercury risks versus nutritional benefits of tribal commercial fish harvests in the Upper Laurentian Great Lakes

Hum. Ecol. Risk Assess., 22 (2016), pp. 1036-1049

Crossref ↗ View in Scopus ↗ Google Scholar ↗

Harris et al., 2009 P.A. Harris, R. Taylor, R. Thielke, J. Payne, N. Gonzalez, J.G. Conde

Research electronic data capture (REDCap)–a metadata-driven methodology and workflow process for providing translational research informatics support

J. Biomed. Inform., 42 (2009), pp. 377-381

View PDF View article View in Scopus ↗ Google Scholar ↗

Iribarren et al., 2021 S.J. Iribarren, T.O. Akande, K.J. Kamp, D. Barry, Y.G. Kader, E. Suelzer

Effectiveness of mobile apps to promote health and manage disease: systematic review and meta-analysis of randomized controlled trials
JMIR mHealth and uHealth, 9 (2021), Article e21563
Crossref ↗ View in Scopus ↗ Google Scholar ↗

Isaac et al., 2018 G. Isaac, S. Finn, J.R. Joe, E. Hoover, J.P. Gone, C. Lefthand-Begay, S. Hill
Native American perspectives on health and Traditional Ecological Knowledge
Environ. Health Perspect., 126 (2018), Article 125002
View in Scopus ↗ Google Scholar ↗

Kankanhalli et al., 2019 A. Kankanhalli, J. Shin, H. Oh
Mobile-based interventions for dietary behavior change and health outcomes: scoping review
JMIR mHealth and uHealth, 7 (2019), Article e11312
Crossref ↗ View in Scopus ↗ Google Scholar ↗

Kuhnlein and Chan, 2000 H.V. Kuhnlein, H.M. Chan
Environment and contaminants in traditional food systems of northern indigenous peoples
Annu. Rev. Nutr., 20 (2000), pp. 595-626
Crossref ↗ View in Scopus ↗ Google Scholar ↗

Lowitt et al., 2024 K. Lowitt, A. Francis, L. Gunther, B.N. Madison, L. McGaughey, A. Echendu, M. Kaur, K.A. Roussel, Z.S. Pierre, A. Weppler
Governing for transboundary environmental justice: a scientific and policy analysis of fish consumption advisory programs in the Upper St Lawrence River
Facets, 9 (2024), pp. 1-11
View article Crossref ↗ Google Scholar ↗

Sebai et al., 2025 I. Sebai, A. Ing, M. Nardocci Fusco, K. Fediuk, T. Sadik, H.M. Chan, M. Batal
Eating traditional foods enhances diet quality among First Nations in Canada: an analysis using the Healthy Eating Food Index-2019 (HEFI-2019) and the Canadian Healthy Eating Index 2007 (C-HEI 2007)
Appl. Physiol. Nutr. Metab., 50 (2025), pp. 1-13
View in Scopus ↗ Google Scholar ↗

Strandberg et al., 2020 U. Strandberg, S.P. Bhavsar, M.T. Arts
Interspecific differences in omega-3 PUFA and contaminants explain the most variance in suggested Great Lakes' fish consumption when risks/benefits are considered together
J. Great Lakes Res., 46 (2020), pp. 549-559
View PDF View article View in Scopus ↗ Google Scholar ↗

Cited by (0)

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