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Impacting Precursors to Sexual Behavior Among Young American Indian Adolescents of the Northern Plains: A Cluster Randomized Controlled Trial

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Abstract

We assessed the effectiveness of a culturally grounded, multimedia, sexual risk reduction intervention called Circle of Life (mCOL), designed to increase knowledge and self-efficacy among preteen American Indians and Alaska Natives. Partnering with Native Boys and Girls Clubs in 15 communities across six Northern Plains reservations, we conducted a cluster randomized controlled trial among 10- to 12-year-olds (n = 167; mean age = 11.2). Club units were randomly assigned to mCOL (n = 8) or the attention-control program, After-School Science Plus (AS+; n = 7). Compared with the AS+

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group, mCOL youth scored significantly higher on HIV/sexually transmitted infection (STI) knowledge questions at both follow-ups; self-efficacy to avoid peer pressure and self-efficacy to avoid sex were significantly higher at posttest; self-perceived volition was significantly higher at 9-month follow-up; and no differences were found for behavioral precursors to sex. mCOL had modest effects on precursors to sexual behavior, which may lead to less risky sexual behavior in later years.

Keywords
American Indian/Native American, sexual behavior (incl. pregnancy), self-efficacy, technology, intervention/prevention

Rates of teen pregnancy among American Indians and Alaska Natives (AIANs) are substantially higher than among non-Hispanic Whites (31 per 1,000 vs. 18 per 1,000), and are the third-highest among all races (Hamilton, Martin, & Ventura, 2013). AIANs also experience high levels of sexually transmitted infections (STIs). In 2011, rates of chlamydia and gonorrhea in AIAN girls aged 15 to 19 years were 2.8 and 3.5 times greater, respectively, than those of their non-Hispanic White counterparts (Centers for Disease Control and Prevention, 2013). Risk behaviors are strongly associated with these sexual health statistics for AIAN teens (DeRavello, Everett Jones, Tulloch, Taylor, & Doshi, 2014). According to the 2011 Youth Risk Behavior Survey, a national sample of high school youth, AIAN teens had the highest levels of ever having had sex (69%), having had sex in the past 3 months (46%), and using substances before last sex (32%) compared with all other racial and ethnic groups (Centers for Disease Control and Prevention, 2011).

The epidemiological profile of AIAN teens suggests the importance of delivering prevention programming; their behavioral profile calls for intervention when sexual risk behaviors are still uncommon—prior to their teen years (Igras, Macieira, Murphy, & Lundgren, 2014). Intervening on precursors to sexual behavior—such as knowledge or self-efficacy—may be key to reducing sexual risk in later years (Buhi & Goodson, 2007; Pearson & Wilkinson, 2013). Observational studies have demonstrated a relationship between self-efficacy and risk behavior among AIAN adolescents (Hawkins, Cummins, & Marlatt, 2004; LaFromboise, Hoyt, Oliver, & Whitbeck, 2006; Mitchell, Kaufman, & Beals, 2005); however, randomized controlled trials (RCTs) evaluating interventions that change behavior by targeting these variables are rare. Although research has long supported the value of culturally syntonic interventions (Griner & Smith, 2006; Resnicow, Baranowski,

Ahluwalia, & Braithwaite, 1999), to date, only two RCTs on sexual risk reduction programs for American Indian youth have been published (none for Alaska Native youth) (Kaufman, Whitesell, et al., 2014; Tingey et al., 2015), of which only one included preteen youth. That study, an earlier project of the lead author's, used a cluster RCT to assess effectiveness of a culturally grounded middle school intervention called Circle of Life (COL). Results showed that COL was found effective in delaying the onset of sexual activity among young American Indian adolescents (11-13 years) (Kaufman, Whitesell, et al., 2014). Qualitative results from the COL study indicated high interest in a technology-based version of the intervention—one that could be easily accessed by teachers and students to encourage engagement. This recommendation is consistent with recent research which suggests that technology-based and -administered interventions are able to reduce sexual risk among adolescents and to increase accessibility to and engagement with effective programs (Guse et al., 2012; Noar, Black, & Pierce, 2009). Although few examples exist for AIAN youth (Craig Rushing et al., 2016), adapting a proven AIAN-specific intervention to a hybrid of online content and in-person group activities—and for the youngest adolescents—holds great promise to reach underserved, dispersed, and increasingly Internet-connected AIAN youth (Craig Rushing & Stephens, 2011). Such a blended approach may be particularly salient for young adolescents, offering individualized skill development through online content while also addressing social norms or peer influence through group activities. Although sexual risk behaviors are scarce in this young age group, we hypothesized that a culturally grounded and developmentally indexed intervention would effect changes in knowledge, self-efficacy, and foreplay behaviors, all of which are theoretically and empirically linked to risky sexual behavior in the teen years. For example, knowledge has been shown in numerous studies to be associated with behavior change (Glassman, Franks, Baumler, & Coyle, 2014; Markham et al., 2012), although often insufficient on its own to effect that change (DiClemente, Brown, Beausoleil, & Lodico, 1993). Self-efficacy is also theorized to mediate sexual risk behavior (cf. Bandura, 1990), and as such, is a central component in numerous sexual risk reduction interventions (Glassman et al., 2014; Hardnett et al., 2009). Self-efficacy has been empirically supported as an important element in behavior change across multiple settings and with diverse populations (Noar, 2008). Finally—and especially salient for young adolescents—studies have pointed to the association of early initial physical contact, including kissing and making out, and its relationship to sexual self-concept and onset of sexual activity (O'Sullivan, Meyer-Bahlburg, & McKeague, 2006; Welsh, Haugen, Widman, Darling, & Grello, 2005). Intervening on these precursors, then, may present a critical

opportunity for sexual risk prevention among adolescents. Following standard guidelines (Campbell, Elbourne, & Altman, 2004), we present results of a cluster RCT testing this hypothesis.

Method

The study used a two-armed, cluster RCT design. The project included extensive input from American Indian community partners and a community advisory board. This study was approved by the University Institutional Review Board (IRB), one tribal college IRB, one tribal research review board, and four tribal councils.

Sites

Six Native Boys and Girls Clubs (NBGCs) located in rural North Dakota and South Dakota agreed to participate in the study. Because community confidentiality is often as important as individual confidentiality, our tribal partners ask that we do not disclose the names of communities (Norton & Manson, 1996). Most Clubs had multiple sites in geographically distinct communities across their respective reservations. In total, six NBGCs operated 16 sites, called units, that served as the units of randomization.

The six reservations collectively covered over 12,000 square miles; routes between communities are typically long, with challenging road conditions. Tribes in which the NBGCs were located are diverse but share common attributes: while each has a robust and proud cultural heritage, some of the nation's poorest areas are found within their borders. Most communities have more than twice the national poverty rate and one-half the national median household income (Table 1). Community economic conditions contribute to tenuous financial standings for most NBGCs. Tribal governments often do not financially support NBGCs, membership dues are modest and irregular, the national organization typically provides support only through modest program-specific grants, and no NBGC in the study had corporate sponsorship. The precarious financial position of NBGCs, while common to organizations in poor tribal communities, impacted many aspects of project operations, including recruitment, retention, and intervention implementation schedules. In spite of the operational challenges posed by financial constraints, NBGC unit staffs were enthusiastic about increasing youth programming opportunities offered through this project.

Table 1. Characteristics of American Indian Reservations of Study Sites.

Measure	US	American Indian reservation communities, weighted average[a]	North Dakota	South Dakota
Population	311.5 million	9,036	689,781	825,198
High school or more (%)	86.0	70.8	90.9	90.4
Bachelor's degree+ (%)	28.8	11.9	25.5	26.2
Median HH income (US$)	53,046	29,137	53,741	49,495
HHs below poverty (%)	15.4	37.9	11.9	14.1
Unemployment rate (%)	9.7	25.5	3.3	5.0

Source. 2009-2013 American Community Survey 5-Year Estimates. Margin of errors not reported here.
Note. HH = household.
[a]To maintain community confidentiality, we do not name specific reservation communities, but instead estimate indicators based on weighted averages of those included in the project.

Sample

Youth aged 10 to 12 years who attended the units were eligible to be recruited for the study. No exclusion was made on the basis of race, though most youth were AIAN. Recruitment and consent occurred between September 2012 and July 2014. One unit, projected to open in time for participant recruitment, was never able to open, leaving 15 units as project sites. Parents or guardians of eligible youth were invited to attend an informational meeting, hosted at each unit by project team members and unit staff members. There, parents or guardians learned about the project and had the opportunity to ask questions and to complete the parental permission form or take them home for further review. Enrollment materials (i.e., a study overview and parental consent form) were also distributed by unit staff to those parents unable to attend the meeting. Once parental consent was obtained, youth were offered the opportunity to participate in the study. They provided their assent online, prior to completing the baseline survey. Only youth with parental permission and youth assent were considered enrolled. Most units completed sample recruitment within 6 months; four units experienced staffing changes, temporary closings due to financial difficulties, or unit relocations, thereby delaying the start of the trial by as much as a year.

Enrolled youth were asked to complete three surveys: baseline, posttest, and 9-month follow-up. Surveys were administered online with audio assistance. Baseline surveys were completed between October 2012 and July 2014. Posttest data collection occurred 0 to 3 months after intervention completion, and 9-month follow-up data collection occurred 7 to 11 months after completion. Delays were due to weather-related limitations on travel, temporary closings of clubs, and conflicts with youth schedules. Data collection ended in March 2015. Surveys took about 20 minutes to complete. Each youth received a US$10 gift card for the first two surveys, and a US$15 gift card for the 9-month survey.

Intervention

In partnership with the Office of Minority Health Resource Center and the Indian Health Service, we adapted COL for 10- to 12-year-old AIANs and translated the content to an online multimedia format to produce Multimedia Circle of Life (mCOL; ORBIS Associates, 2002). During the adaptation, the content was expanded to include pregnancy prevention and hepatitis B and C prevention (Kaufman, Litchfield, Schupman, & Mitchell, 2012). We piloted mCOL for content and implementation with a nonparticipating NBGC in the region.

mCOL contains seven chapters. To complete each chapter, youth moved through each online lesson independently on NBGC unit computers and participated in the corresponding in-person group class. Each online chapter contains stories, games, and videos and requires 20 to 25 minutes to complete. The in-person group classes include discussions, instructions, demonstrations, games, and craft activities and require approximately 1 hour. Group classes were taught by local unit staff; health professionals or community members, such as elders, also sometimes assisted with portions of the material. Prior to intervention delivery, project team members traveled to each NBGC to provide unit staff training on mCOL delivery, including an overview of online content, procedures for facilitating in-person group classes, and guidance on fidelity monitoring. Unit staff were also provided access to online video trainings on each chapter, accessible at their convenience, allowing staff to review content and activities over the course of the program.

mCOL content is based on the Medicine Wheel, an indigenous cultural symbol and learning heuristic (LaFrance & Nichols, 2009), and undergirded by Social Cognitive Theory (Bandura, 1986) and Theory of Reasoned Action (Fishbein & Ajzen, 1975). The Medicine Wheel is divided into quarters to represent mental, physical, emotional, and spiritual well-being. Youth learn that everyone has *volition*: the power to make their own decisions (see

Armitage & Conner, 2001, for elaboration of the role of volition in behavioral change). Youth can stay healthy by using their volition to strengthen and balance their own Medicine Wheel. In turn, this strength empowers them and honors their families and communities. mCOL teaches skills such as decision-making, avoiding risky situations, and standing up to peer pressure. Prevention topics include (a) how diseases are spread, (b) the health effects of HIV, (c) STIs and teen pregnancy, and (d) how to avoid sexual risk.

Attention-Control

After-School Science Plus (AS+), an evidence-based program designed for youth aged 8 to 14 years, was offered to youth in the control units (Fhi360, Education Equity Center, 1999). Topics included bubble science, liquids and solids, and gravity. To match the mCOL condition, AS+ was shortened from 11 to seven lessons. Similar to training for mCOL, project team member traveled to each AS+ sites to provide training to unit staff. Staff were provided an overview of each lesson and the corresponding activity, and also provided online video instruction resources for each chapter. Unit program staff delivered AS+ lessons in group sessions. Although AS+ did not include youth online learning opportunities, each lesson consisted of hands-on activities and took about an hour to complete, for a total of about 7 hours of instruction.

Outcome Measures

We assessed mCOL's impact, relative to AS+, on youths' knowledge, self-efficacy, and behavioral precursors to sex at posttest and 9-month follow-up. Community partners reviewed all questions and provided input. We asked the same items at all three survey data collection time points.

- *Knowledge of HIV/STI risk* was assessed using seven true/false questions from the HIV Knowledge Questionnaire (Carey, Morrison-Beedy, & Johnson, 1997) and from the curriculum. These items, which have been used successfully in American Indian youth samples (Kaufman, Whitesell, et al., 2014), include (a) *People who have STIs know that they have one*, (b) *Hepatitis is an inflammation of the liver*, and (c) *You can get HIV by hugging a person with HIV*. The number of items answered correctly at each wave was a student's knowledge score. Unanswered questions were counted as incorrect.
- The concept of *volition* was central to mCOL. We gauged understanding of the term using a multiple-choice question that asked youth to

define it. We also asked youth to rate their own volition by assigning a number from 1 (rarely) to 4 (almost always) to the statement, *I stand up for what I believe*.

- *Self-efficacy to resist peer pressure* was measured by a three-item scale (α = .85). Youth were asked to rate from 1 (*definitely would not do this*) to 4 (*definitely would do this*) what they would do if friends wanted them to smoke a cigarette, offered them a beer or asked them to smoke marijuana with them, or wanted them to skip school. Scales were reverse-coded so that the higher numbers reflected greater self-efficacy.
- *Self-efficacy to avoid sexual risk* was assessed with a three-item scale (α = .91). Items to be rated 1 (I definitely would not do this) to 4 (I definitely would do this) included *If I didn't want to have sex, I would avoid places where that might happen; I would stay away from someone who was pressuring me to have sex*; and *If my partner were trying to get me to have sex, I'd leave*. This scale has been validated and found reliable (Cecil & Pinkerton, 2000) and has been used successfully with American Indian youth (Mitchell, Beals, & Kaufman, 2007).
- *Behavioral precursors to sex*, although not specifically addressed in mCOL, included two separate items, deemed age appropriate by our advisory committee, that could mark a pathway to sex: (1) *In the past 3 months, have you kissed a boy/girl who you like?* and (2) *In the past 3 months, have you made out with a girl/boy who you like?* (1 = yes, 0 = no).

Additional Measures

In addition to the outcome measures, we collected information on demographic variables, including sex (female = 1/male = 0) and age of youth (in years). Race and ethnicity were measured by asking participants to select every category that applied to them from a list of potential identities. All participants who identified as American Indian or Alaska Native, regardless of other selections, were coded 1, otherwise 0. To indicate the level of sexual activity for the sample, we asked youth whether they ever had had sexual intercourse (yes = 1/no = 0).

Randomization

Random assignment was conducted by the principal investigator using the random number generator application in Microsoft Excel. Club units were the unit of randomization. The units were grouped into strata according to

state (seven for South Dakota and eight for North Dakota) and size (two large and 13 small). Random assignment of units was conducted before enrollment of youth began, but the information was not shared with unit program staff charged with assisting in recruitment efforts until after recruitment.

Statistical Methods

Using an intent-to-treat framework, we analyzed data in SPSS 22.0 (SPSS, 2013) to assess baseline comparability between groups, baseline equivalence of the analytic samples, and estimate treatment effects for posttest and 9-month follow-up. To determine comparability between arms, we used chi-square and *t* tests for categorical and continuous variables, respectively.

Baseline equivalence for the posttest and 9-month follow-up samples was assessed using linear probability modeling by regressing baseline scores for each variable of interest (age, race, gender) on the treatment indicator (mCOL = 1/AS+ = 0). Binary blocking variables included unit size (small = 1/large = 0) and state (South Dakota = 1/North Dakota = 0). Using the Complex Samples Plans for General Linear Models procedure in SPSS, standard errors were adjusted for clustering at the unit level with the Huber-White sandwich estimator.

Treatment effects at posttest and 9-month follow-up were assessed with linear probability models as well. In addition to blocking variables, all models were adjusted for age, gender, race, and the baseline value of the outcome. Standard errors were again adjusted for clustering via the Huber-White sandwich estimator. Owing to within-unit attrition at posttest and 9-month follow-up, complete case analysis was used.

Based on prior Club enrollment figures, we anticipated that over 600 youth would enroll in the study across 15 units. We used Optimal Design Software (Raudenbush, S. W., Spybrook, J., Congdon, R., & Liu, X., 2011) to calculate that with an expected 9-month sample size of 510, $\alpha = .05$, and average knowledge and self-efficacy intraclass correlations of .125 and .002, respectively (based on prior American Indian youth samples), we would have 80% power to find minimal-detectible-effect sizes of 0.68 for knowledge and 0.29 for self-efficacy.

Results

Sample

Of the 15 participating units, eight were allocated to deliver mCOL, the other seven delivered AS+. Of 208 eligible youth, 14% ($n = 30$) of parents did not

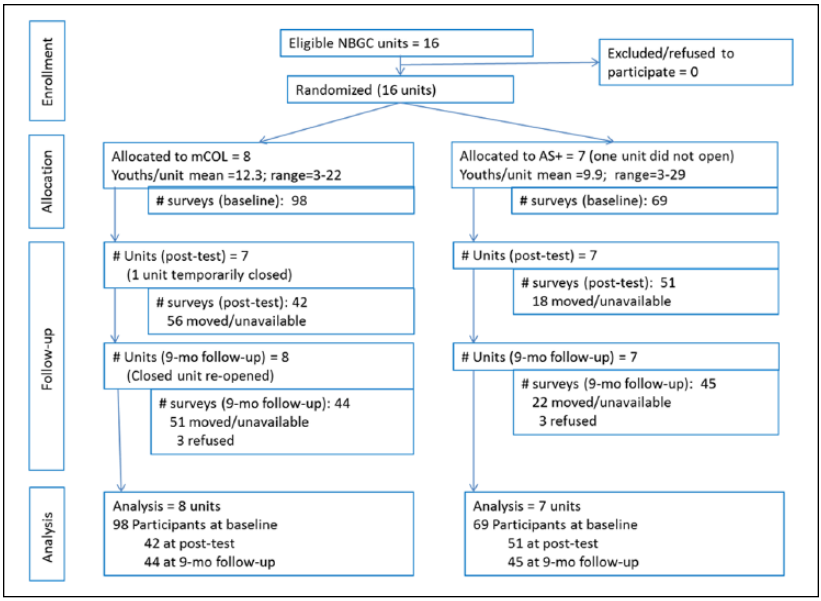

Figure 1. mCOL cluster randomized controlled trial CONSORT diagram.
Note. mCOL = Multimedia Circle of Life; NBGC = Native Boys and Girls Club; AS+ = After-School Science Plus.

complete a consent and 5% (n = 11) of youth did not assent. In total, 167 youth completed the baseline survey. At posttest with 14 units participating, 93 youth completed the survey (56%); at 9-month follow-up, with all 15 units participating, 89 completed the survey (53%; see Figure 1 for the Consolidated Standards of Reporting Trials [CONSORT] diagram).

A description of youth characteristics by data collection period is in Table 2. The sample comprised young adolescents, with an average age of just over 11 years at baseline; about half were female. AIAN race varied between 91% and 77% across the three waves. Sexual activity (defined as "ever had sex") was low (<6%) at each time point. At baseline, the mCOL and AS+ groups did not differ on age, race, gender, or the outcome variables (Table 3). Baseline equivalence was maintained in both the posttest and the 9-month follow-up analytic samples across all measures except self-efficacy to avoid sex (results not shown). This measure was statistically different at baseline in the 9-month follow-up analytic group (p = .018), with the comparison group 0.63 points higher than the intervention group.

Table 2. Characteristics of the Youth Sample.

Measure	Baseline $\bar{X}$ or percent (*SD*)	Posttest $\bar{X}$ (*SD*)	9-month follow-up $\bar{X}$ or percent (*SD*)
Age	11.17 (0.918)	11.76 (1.15)	12.44 (1.08)
Female (%)	52.7	50.5	50.6
AIAN (%)	91.0	77.4	84.3
Ever had sex (%)	1.2	5.6	5.7

Note. All estimates are adjusted for clusters. Standard deviations based on raw mean scores. AIAN = American Indians and Alaska Natives.

Fidelity to Intervention

Seven of the eight units assigned to the mCOL arm delivered all online content (one site, $n = 3$, temporarily closed during the intervention period), and four units delivered all the in-person group classes. On average, youth accessed six of the seven online intervention sessions and attended 3.5 of the seven in-person group classes.

Outcomes

In Table 4, we present the findings of the estimated impact of mCOL on knowledge, volition, self-efficacy, and behavioral precursor measures relative to the AS+ group, at posttest and 9-month follow-up. Knowledge of HIV/STI risk was different across the two groups at posttest ($p < .001$) and 9-month follow-up ($p = .005$). The mCOL group scored, on average, 2.1 points and 0.87 points higher at respective time points than the AS+ group.

At posttest, mCOL youth were significantly more likely to correctly define volition ($p = .026$), but not at the 9-month follow-up. Self-perceived volition did not differ at posttest, but was significantly higher among mCOL youth at the 9-month follow-up ($p = .045$).

Self-efficacy to resist peer pressure and avoid sex were significantly higher among mCOL youth at posttest ($p = .027$ and $p < .001$, respectively), but effects were not detected at the 9-month follow-up.

Three-month prevalence reports of kissing and making out were not found to be different at either assessment point, though kissing was found to be marginally less prevalent among mCOL youth at the 9-month follow-up ($p = .06$).

Table 3. Baseline Equivalency Statistics for Youth Completing Posttest and 9-Month Follow-Up.

	Posttest			9-month follow-up		
Measure	Intervention $\bar{X}$ (*SD*) or %	Comparison $\bar{X}$ (*SD*) or %	*p* value	Intervention $\bar{X}$(*SD*) or %	Comparison $\bar{X}$ (*SD*) or %	*p* value
Age	11.32 (0.86)	11.05 (0.99)	.112	11.22 (0.86)	10.96 (0.85)	.164
Female	58%	45%	.173	60%	41%	.180
AIAN	93%	90%	.578	93%	94%	.896
Knowledge	1.88 (1.44)	1.78 (1.42)	.810	1.80 (1.29)	1.68 (1.41)	.739
Volition (knowledge)	0.03 (0.16)	0.02 (0.14)	.663	0.09 (0.30)	0.01 (0.00)	.133
Self-perceived volition	2.96 (1.10)	2.92 (1.21)	.777	3.17 (1.10)	2.88 (1.17)	.182
Self-efficacy						
Resist peer pressure	3.78 (0.56)	3.60 (0.77)	.222	3.60 (0.71)	3.65 (0.79)	.718
Avoid sex	2.19 (1.24)	2.60 (1.29)	.072	2.04 (1.25)	2.67 (1.27)	.018*
Behavioral precursors						
Kissing	0.14 (0.36)	0.09 (0.28)	.141	0.14 (0.36)	0.10 (0.29)	.435
Making out	0.06 (0.22)	0.05 (0.24)	.874	0.03 (0.16)	0.06 (0.26)	.404
Sample size	42	51		44	45	

Note. Mean scores and percentages are adjusted for unit clustering, unit size (small or large), and unit state (North Dakota or South Dakota). Standard deviations are calculated from the raw mean scores. AIAN = American Indians and Alaska Natives.
*$p < .05$.

Discussion

RCTs evaluating the effectiveness of sexual risk reduction interventions among American Indian adolescents are scarce. This is due in part to the challenges of conducting rigorous evaluations in remote and resource-thin communities (Kaufman, Black, et al., 2014). The present study is the first to examine the effectiveness of an intervention among the young adolescents of this population—when sexual risk prevention is perhaps most critical. Since rates of having had sex are low at young ages, changes in behavior are challenging to detect without an extended follow-up period and untenably large sample size. Therefore, this study focused on precursors to sexual activity of preteens, including knowledge, self-efficacy, and behaviors that may lead to sex, as a theoretically based approach to reduce sexual risk in later teen years.

Knowledge and self-efficacy to resist peer pressure and avoid sex were higher in the mCOL group compared with the AS+, with the effects on knowledge also higher at 9-month follow-up. Given the strong correlation between these precursors and subsequent risky sexual behaviors (Buhi & Goodson, 2007), mCOL provides an important opportunity to intervene effectively at

Table 4. mCOL Program Effects at Posttest and 9-Month Follow-Up.

	Posttest (n = 93)			9-month follow-up (n = 89)		
Outcomes	b (SE)	p value	95% CI	b (SE)	p value	95% CI
Knowledge	−2.11 (0.04)	.000***	[−2.97, −1.25]	−0.87 (0.26)	.005**	[−1.43, −0.31]
Volition (definition)	−0.34 (0.14)	.026*	[−0.64, −0.05]	−0.07 (0.05)	.122	[−0.17, −0.02]
Self-perceived volition	0.18 (0.19)	.383	[−0.24, −0.59]	−0.45 (0.21)	.045*	[−0.89, −0.01]
Self-efficacy						
Resist peer pressure	−0.41 (0.17)	.027*	[−0.77, −0.05]	−014 (0.18)	.449	[−0.53, −0.25]
Avoiding sex	−1.02 (0.17)	.000***	[−1.39, −0.64]	0.17 (0.26)	.540	[−0.40, 0.73]
Behavioral precursors						
Kissing	−0.07 (0.12)	.583	[−0.31, −0.18]	0.11 (0.06)	.063	[−0.01, 0.24]
Making out	0.03 (0.08)	.726	[−0.14, −0.19]	0.05 (0.06)	.371	[−0.07, 0.18]

Note. Estimates of outcome effects are adjusted for baseline value of outcome, age, gender, race, unit clustering, unit size (small or large), and unit state (North Dakota or South Dakota). mCOL = Multimedia Circle of Life; CI = confidence interval.
*p < .05. **p < .01. ***p < .001.

early ages. Of note, the core messages of mCOL, measured by definitional knowledge and self-perception of volition, were significant at different time points. Understandably, youth may not retain the definition for an extended period of time. Differences in self-perception of volition—standing up for personal beliefs—and (marginally) kissing appeared at the latter time point. This suggests that youth may require more time to internalize and act on mCOL content than can be measured in posttest assessments for some precursors, delays that have been noted elsewhere in prevention research, including in AI samples (Moran & Bussey, 2007). The effects on both self-efficacy measures, in contrast, did not appear in the 9-month follow-up. Preteens may need additional boosters to reinforce confidence in skills. However, even short-lived gains in self-efficacy during preteen years may result in averted risk-taking during this formative developmental period.

This study provides several important advances in approaches to sexual risk reduction among young adolescents. Ours is among the first to deliver an intervention electronically to AIAN youth (Craig Rushing et al., 2016; Markham et al., 2015). Technology-based interventions are evolving quickly and show promise in reaching youth who may otherwise not receive effective interventions in a timely and engaging way (Guse et al., 2012). This study highlights the potential for this approach: while some of the units were unable to conduct group classes, all units but one were able to administer the complete online

content. Nonetheless, blending online and group activities may be particularly important for young adolescents. Online activities offer engaging and self-paced skills training, and group activities provide an adult-facilitated address of social norms, peer pressure, or specific questions. The results also show the importance of focusing on precursors to sexual behavior in young adolescents. Prevention science must take theoretical bases of interventions seriously for preteens. Absent large samples and generous funding, assessing change in sexual behavior for this young group is not feasible. However, assessing changes in known precursors to risk behavior may provide an ample and sustainable path to healthy outcomes in later years.

This study reveals the challenges of implementing rigorous evaluation studies in low-resourced communities. A number of requirements, such as stable infrastructure and consistent program staff, were not reliably sustained across study sites. However, in spite of methodological challenges, evaluating program effectiveness where youth live is critical to establishing viability and appropriateness. With careful study documentation, transparency in methodology, and flexibility to accommodate study conditions to the extent possible, valid findings are possible. However, RCTs may not be the best way to ascertain program effectiveness in all communities. Other designs, including single case methodologies (Kazdin, 2011), interrupted time-series (West et al., 2008), or preference trials (Torgerson & Sibbald, 1998) may offer rigorous evaluation options. The challenges inherent in RCTs are a call for innovation and creativity for new, rigorous methodologies amenable to low-resourced settings or stressed populations.

The accomplishments of the study should be understood in light of its limitations. Because of challenges in community conditions and research requirements, delays and departures from intervention implementation as intended occurred. Uneven implementation likely compromised intervention efficacy, and will likely continue to hamper similarly constructed RCTs. Self-efficacy outcomes were measured with few items, and may have not comprehensively captured psychosocial changes related to the intervention. Moreover, the items for the measure may attend to intentionality rather than self-efficacy, a closely related concept (Crick & Dodge, 1996). In addition, the sample was small and experienced high levels of attrition (largely attributable to temporary unit closures, staff turnover, and a highly mobile youth population). As such, the small sample sizes conservatively biased our estimates; relationships may have existed, but could not be detected in this study. Finally, the study focused on Northern Plains American Indian reservations and so the results cannot be generalized to other AIAN communities. However, given the paucity of sexual risk reduction intervention research in this population, this work presents a solid foundation for future investigation.

Indeed, specific lines of inquiry based on this study might include the integration of parents or other adult mentors into facilitation of sexual health content, the specific components of the online or in-person content tapping sexual risk reduction, and investigating recruitment and retention practices that may foster inclusion among young AIAN adolescents.

Study findings support the value of intervening at early ages; they also highlight the challenges involved in implementing rigorous research trials in settings where youth who most need them live. Importantly, the study portends the potential of technology-based and hybrid interventions for this hard-to-reach and highly diverse population.

Declaration of Conflicting Interests

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