Peer Mentoring for Type 2 Diabetes Prevention in First Nations Children

WHAT'S KNOWN ON THIS SUBJECT: Type 2 diabetes mellitus is one of the fastest growing pediatric chronic illnesses worldwide and disproportionately affects indigenous people from all continents.

WHAT THIS STUDY ADDS: These data support the growing body of evidence that peer mentoring is an attractive strategy for teaching health behaviors and improving health outcomes in children.

abstract

OBJECTIVE: The goal of this study was to assess the efficacy of an after-school, peer-led, healthy living program on adiposity, self-efficacy, and knowledge of healthy living behaviors in children living in a remote isolated First Nation.

METHODS: A quasi-experimental trial with a parallel nonequivalent control arm was performed with 151 children in Garden Hill First Nation during the 2010–2011 and 2011–2012 school years. Fourth grade students were offered a 5-month, peer-led intervention facilitated by high school mentors between January and May of each school year; students in the control arm received standard curriculum. The main outcome measures were waist circumference (WC) and BMI *z* score. Secondary outcome measures included healthy living knowledge and self-efficacy.

RESULTS: Fifty-one children (mean ± SD age: 9.7 ± 0.4 years; BMI *z* score: 1.46 ± 0.84) received the intervention, and 100 children were in the control arm. At baseline, WC (79.8 vs 83.9 cm), BMI *z* score (1.46 vs 1.48), and rates of overweight/obesity (75% vs 72%) did not differ between arms. After the intervention, the change in WC (adjusted treatment effect: –2.5 cm [95% confidence interval (CI): –4.1 to –0.90]; $P = .002$) and BMI *z* score (adjusted treatment effect: –0.09 [95% CI: –0.16 to –0.03]; $P = .007$) were significantly lower in the intervention arm compared to the control arm. The intervention arm also experienced improvements in knowledge of healthy dietary choices (2.25% [95% CI: –0.01 to 6.25]; $P = .02$). Self-efficacy was associated with the change in WC after the intervention ($\beta = -7.9$, $P = .03$).

CONCLUSIONS: An after-school, peer-led, healthy living program attenuated weight gain and improved healthy living knowledge in children living in a remote isolated First Nation. *Pediatrics* 2014;133: e1624–e1631

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KEY WORDS

Aboriginal health, obesity, type 2 diabetes

ABBREVIATIONS

AYMP—Aboriginal Youth Mentorship Program
CI—confidence interval
T2DM—type 2 diabetes mellitus

Ms Eskicioglu collected and analyzed the data, and wrote the manuscript; Dr Halas contributed to the study design and acquisition of funding, and revised the manuscript; Dr Sénéchal and Ms Villeneuve analyzed the data and wrote the manuscript; Mr Wood helped design the study and revised the manuscript; Mrs McKay helped design the study and collect data and revised the manuscript; Drs Shen and Dean contributed to the study design and revised the manuscript; Dr McGavock conceptualized and designed the study, participated in data collection, conducted the analysis, and wrote the manuscript; and all authors approved the final version of the manuscript as submitted.

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Type 2 diabetes mellitus (T2DM) is one of the fastest growing pediatric chronic illnesses worldwide and disproportionately affects indigenous people from all continents.[1,2] In Canada, Aboriginal youth comprise ~50% of new cases of T2DM presenting to pediatric endocrinology clinics.[3] The disproportionately increased risk for T2DM in Aboriginal youth may be explained by the interaction between environment and lifestyle behaviors,[4,5] exposure to T2DM in utero,[6] early life events such as the family feeding environment, and genetic factors.[7,8] Several additional factors, common among Aboriginal people, cannot be ignored, including food insecurity, poverty, legacies of colonialism, and acculturation.[9,10] These factors compound physiologic risk factors and likely contribute to the high rates of T2DM seen in Aboriginal youth. The unique clustering of social, historical, and physiologic risk factors that Aboriginal youth encounter necessitate the use of novel, culturally relevant approaches for T2DM prevention.

Despite the increasing rates of T2DM among Aboriginal youth, very few prevention trials exist that are tailored to the unique needs of this vulnerable pediatric population.[11] The two landmark community-based interventions conducted in Canada (The Sandy Lake Diabetes Prevention Program[12] and the Kahnawake Schools Diabetes Prevention Program[13]) led to increased physical activity levels and improved healthy living behaviors; however, they failed to reduce T2DM-related end points, particularly adiposity.[11] Studies by our group and others have recently demonstrated that peer-led interventions are successful at eliciting behavior changes that lead to improved health outcomes in children, in particular weight status.[14–16] Previous community-based interventions tailored to Aboriginal children have not included a peer-mentoring model; therefore, the efficacy of a peer-mentoring approach for attenuating weight gain and risk factors for T2DM in Aboriginal children remains unclear.

In light of the positive effects of peer mentoring on obesity-related outcomes in other settings,[14–16] we partnered with a remote First Nation in northern Manitoba to pilot a community-based participatory action experimental trial to test the hypothesis that an after-school, peer-led mentoring program would attenuate weight gain and improve healthy living knowledge and behaviors in children in primary school. Furthermore, we hypothesized that changes in adiposity would be associated with improvements in healthy living knowledge and behaviors and self-efficacy.

METHODS

Study Design and Population

The research project was conducted through a partnership between study investigators and stakeholders in Garden Hill (Kistiganwacheeng) First Nation that followed the principles of participatory action research[17] and the Canadian Institutes of Health Research guidelines for ownership, control, access, and possession of data.[18] Garden Hill First Nation is a remote Oji-Cree First Nation in northeast Manitoba with ~3500 residents and one of the highest rates of T2DM in youth in Canada. In response to the high rate of pediatric T2DM and its complications, representatives of the health authority approached the research team in 2006 to develop a prevention program for youth. After years of formative work and relationship building, the research team and community stakeholders agreed to pilot a peer-mentoring program that was culturally appropriate for First Nations youth. We piloted a nonrandomized experimental trial with a parallel nonequivalent control group to test the study hypotheses. In the fall of the 2010–2011 and 2011–2012 school years, students in grades 4 and 5 from the Kistiganwacheeng Elementary School were invited to participate in the study, with the knowledge that an after-school program would be offered to grade 4 students and that grade 5 students would serve as the control group. Written informed consent was provided by parents and verbal assent was acquired from children before participation. The research ethics board at the University of Manitoba approved the protocol in accordance with the Declaration of Helsinki.

Intervention

A 90-minute, peer-led after-school program was offered once a week to students in grade 4 between January and May in the 2010–2011 and 2011–2012 school years. The curriculum for this Aboriginal Youth Mentorship Program (AYMP) was developed by teachers and Aboriginal youth in Winnipeg in 2006 to provide a communal, relationship-based wholistic approach to physical activity, nutrition, and education programming.[19–21] The theoretical framework for the curriculum was informed by the Circle of Courage[22,23] and the Four R's model.[23] Specifically, the curriculum was designed to build on the strengths of Aboriginal youth as they assume a leadership role in their community. Four different areas of well-being were also incorporated: healthy food, healthy play, education, and healthy relationships (Fig 1).

The curriculum was delivered by mentors in grades 7 through 12 from the neighboring high school. All high school students were invited to volunteer, with no limit to the number of mentors involved. There were no specific criteria to be a mentor, but all student mentors were enrolled in high school and regularly attended classes. There were 3 to 4 elementary students to each high

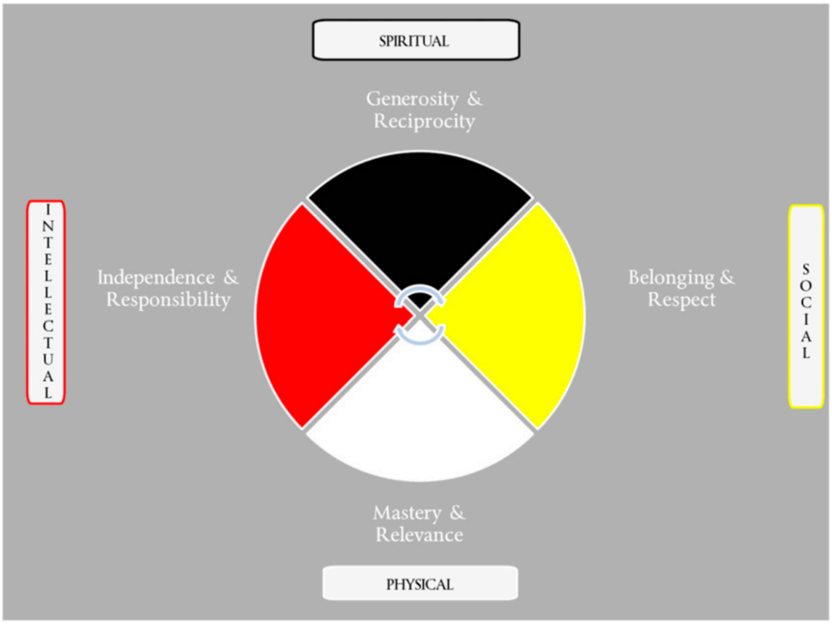

FIGURE 1
AYMP theoretical framework. AYMP is designed to improve wholistic health in youth by providing programmatic components that are targeted at a child's social health (novel relationships and role modeling of healthy behaviors through snacks); physical health (physical activity); mental health (intellectual games and teachings of health); and spiritual health (having fun).

school mentor. During the 2010–2011 school year, one of the research assistants moved to Garden Hill First Nation to train the mentors by using the *Rec & Read Mentorship Program, Staff Manual* (Supplemental Information). The following year, a recent high school graduate, who was a mentor the year before, became the adult mentor. High school mentors met weekly to plan sessions for children that included: (1) peer teaching of low-organized games and activities; (2) sharing of knowledge about healthy foods to prepare for the children; and (3) peer teaching of educational games and activities. High school mentors developed the weekly program components on their own. The only requirement was the provision of a healthy snack, delivery of 45 minutes of supervised moderate to vigorous physical activity, and supervised provision of an educational game or activity. A list of examples of healthy snacks and games was included in the staff manual. The control arm consisted of students in grade 4 who were unable to participate in the intervention and students in grade 5. No students were excluded from participation in the study.

Outcome Measures

The primary outcome measure was waist circumference, which was measured in duplicate to the nearest 0.5 cm by using a flexible tape measure in a standing position at the peak of the iliac crest. Waist circumference is a clinically relevant outcome in children because it is a robust predictor of T2DM and cardiometabolic health.[24] The secondary outcome measure was BMI z score, which was calculated from height and weight measurements and converted to a z score based on normative data from age- and gender-matched children in the United States by using specialized software (Epi Info, Centers for Disease Control and Prevention, Atlanta, GA). Children were categorized as healthy weight, overweight, or obese according to age- and gender-specific BMI thresholds established by the International Obesity Task Force.[25] Body weight was measured to the nearest 0.1 kg in duplicate by using a digital scale (Seca 869; Seca Corporation, Chino, CA). Height was measured to the nearest 0.1 cm in duplicate by using a standard stadiometer (Seca 217; Seca Corporation). All measurements were taken in light indoor clothing.

The exploratory outcomes assessed included self-reported measures of self-efficacy as well as physical activity and healthy eating knowledge using a reliable and validated tool used in previous school-based peer-mentoring interventions.[15] Body satisfaction was also assessed by using a visual Likert scale depicting silhouettes of 7 body types ranging from very lean to overweight, and children were asked to select the body image that they most resembled and another that they most desired resembling.[26] Body satisfaction was treated as a continuous variable and was calculated as the difference between desired body type and perceived body type. A score of zero reflected that the child was satisfied with his or her body type; a positive score would indicate a desire to be larger; and a negative score would indicate a desire to have a smaller body type.

Data Analysis

Data are presented as means and 95% confidence intervals (CIs) or proportions. Differences between study arms at baseline were tested with independent sample t tests. Linear mixed effects models with repeated measures were used to test for group-wise differences in the change in outcome measures over the 5-month intervention, adjusting for baseline differences in age, gender, and adiposity. To test for associations between the change in waist circumference and measures of healthy living, we performed a stepwise multiple linear regression analysis to investigate the independent association of the changes in both waist circumference and BMI *z* score and healthy living behaviors, knowledge, and self-efficacy. We did not use an intention-to-treat analysis because participants were not randomized to control or intervention arms. An interaction term was created to determine if the effects of the intervention differed between boys and girls, considering the differences in gender at baseline. We observed no significant interactions between the intervention and gender; therefore, all analyses were performed with data from boys and girls pooled. A *P* value $<$.05 was considered statistically significant, and all analyses were performed by using SAS version 9.2 (9.2) (SAS Institute, Inc, Cary, NC).

TABLE 1 Baseline Characteristics

Variable	Control (n = 100)	Intervention (n = 51)
Age, y	10.4 ± 0.7	9.7 ± 0.4*
Sex (female/male)	51/49	38/13*
Grade (4/5)	36/64	51/0*
Waist circumference, cm	83.9 ± 15.7	79.8 ± 12.6
BMI *z* score	1.48 ± 0.94	1.46 ± 0.84
Weight status, %		
Normal	28 (n = 28)	25 (n = 13)
Overweight	15 (n = 15)	25 (n = 13)
Obese	56 (n = 56)	50 (n = 25)
Healthy food knowledge, %	76.2 ± 12.3	69.8 ± 13.6*
Physical activity knowledge, %	74.6 ± 24.3	58.7 ± 21.2*
Self-efficacy, %	82.6 ± 16.0	87.3 ± 12.2*
Body image (ideal self – current self)	−0.64 ± 1.02	1.06 ± 1.11

Continuous variables are presented as mean ± SD; categorical variables are presented as a percentage of the total study arm or *n*. **P* $<$ .05 significantly different from the control group.

RESULTS

Between 2010 and 2012, a total of 237 grade 4 and 5 students were invited to participate in the study, and 180 returned consent forms and performed baseline testing. Over the 2 waves of data collection, 29 participants did not return for follow-up testing. Among the 151 youth with complete data (control: n = 100; intervention: n = 51), 58% were girls and 72% were overweight or obese (Table 1). At baseline, no differences were observed for waist circumference, BMI *z* score, or overweight/obese prevalence between children in the intervention and control arms. At baseline, children in the control arm were older and displayed lower self-efficacy scores compared with youth in the intervention arm ($P < .05$).

Measures of adiposity stratified according to study arm are presented in Table 2. The change in waist circumference was significantly lower in children who received the intervention (0.34 cm [95% CI: –0.96 to 1.64]) compared with the control arm (2.87 cm [95% CI: 1.92 to 3.82]; $P < .01$) (Fig 2). The change in BMI *z* score over time was also significantly attenuated in the intervention arm (–0.05 [95% CI: –0.11 to 0.002]) compared with the control arm (0.04 [95% CI: –0.001 to 0.08]; $P < .01$) (Fig 3). When analyses were restricted to overweight and obese children (n = 109), children in the intervention arm experienced a significant attenuation in waist circumference compared with children in the control arm (0.40 cm [95% CI: –1.05 to 1.85] vs 2.58 cm [95% CI: 1.50 to 3.67]; $P < .02$). No differences in BMI *z* score were observed in subgroup analyses restricted to overweight/obese youth.

Measures of knowledge of healthy living behavior, self-efficacy, and body image are presented in Table 3. Children in the control arm displayed better knowledge of healthy foods (P = .006) and physical activity ($P < .001$) compared with students in the intervention arm at baseline. Self-efficacy scores were similar in the control arm at baseline compared with students in the intervention arm (P = .07). Knowledge of healthy foods (P = .021) and body image (P = .04) increased significantly in the intervention arm compared with the control arm. With regard to body image, children in the intervention arm experienced a greater improvement in body satisfaction than children in the control arm (0.34 [95% CI: 0.05 to 0.63]; P = .045).

The results of a multiple linear regression analysis designed to determine the predictors of the change in waist circumference and BMI *z* score are presented in Table 4. After controlling for age, gender, and baseline weight, the change in self-efficacy was the best predictor of the change in waist circumference over the 5-month intervention (β: –8.21; SE: 4.19; P = .03). Neither the change in self-efficacy nor the change in healthy living knowledge was associated with the change in BMI *z* score.

DISCUSSION

The data presented here support previous trials in children and adolescents by demonstrating that exposure to a peer-mentoring program attenuated central adiposity and improved healthy living knowledge.[14–16] The data expand on previous community-based experimental studies in Aboriginal communities[11] by including a control arm recruited from the same community, exposed to the same geographic, sociodemographic, and educational settings, and that was closely matched for outcome measures before the intervention. Our results are also novel because the intervention was delivered in a remote First Nation with very high rates

TABLE 2 Effect of the AYMP on Measures of Adiposity in Children From a Rural First Nation

	Control (n = 100)		Intervention (n = 51)		Group-wise Comparisons		
	Before	After	Before	After	Effect	95% CI	P
All children							
BMI z score	1.26 (1.19 to 1.34)	1.30 (1.23 to 1.38)	1.27 (1.17 to 1.37)	1.22 (1.11 to 1.32)	−0.09	−0.08 to −0.09	.007
Waist circumference, cm	80.0 (78.4 to 81.6)	82.9 (81.2 to 84.5)	77.8 (75.6 to 80.1)	78.2 (75.9 to 80.5)	−2.5	−2.6 to −2.5	<.001
Overweight/obese children only	Control (n = 71)		Intervention (n = 38)		Group-wise Comparisons		
	Before	After	Before	After	Effect	95% CI	P
BMI z score	1.73 (1.65 to 1.83)	1.74 (1.65 to 1.83)	1.66 (1.60 to 1.77)	1.63 (1.52 to 1.74)	−0.04	−0.04 to −0.03	.13
Waist circumference, cm	85.2 (82.1 to 88.2)	87.8 (84.8 to 90.7)	82.0 (78.4 to 85.6)	82.4 (78.8 to 86.0)	−2.2	−2.3 to −2.2	.02

Data are presented as adjusted means (95% CIs). Linear mixed effects models for the change in BMI z score were adjusted for baseline weight category (normal weight, overweight, and obese); the analysis for the change in waist circumference was adjusted for age, gender, and baseline weight category. Effect indicates treatment effect.

of childhood obesity (60%–73%) and T2DM.[27] Finally, our data support previous community-based interventions for First Nations children[12] by demonstrating that self-efficacy can be improved with a school-based healthy living intervention.

Central adiposity is a well-established risk factor for several cardiometabolic conditions in children, including the metabolic syndrome, impaired glucose tolerance, and T2DM.[24,28] In Canada, First Nations and Métis children are more likely to experience central weight gain and display elevated waist circumference, relative to non–First Nations children.[9,29] We recently completed a cluster randomized controlled trial demonstrating that a peer-led, classroom-based healthy living curriculum was effective at attenuating waist circumference in a sample of both First Nations and non–First Nations children in Manitoba.[14] The data from the present study support these findings and extend them by demonstrating that using a peer-led approach which is culturally tailored to First Nations children is feasible and effective when delivered in a remote, isolated setting. Furthermore, although the effect size was modest, compared with intensive clinic-based weight loss programs, it was greater than those seen in previous school-based interventions[30,31] and would translate into a 12% reduced risk of metabolic syndrome.[32]

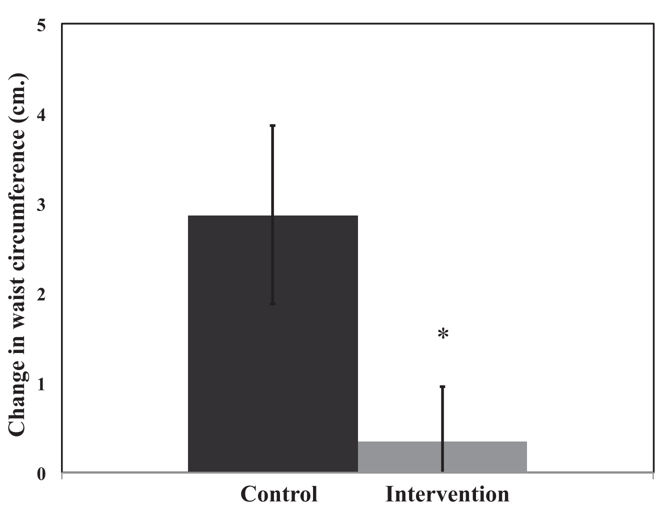

FIGURE 2
Change in waist circumference in children who received the intervention (AYMP) and control subjects. Analyses were adjusted for age, gender, and baseline weight categories (normal weight, overweight, and obese). *$P < .05$.

Taken together with the observed reduction in BMI z score, these data provide preliminary evidence that peer-based mentoring is an effective approach for preventing weight gain (particularly central weight gain) and, by extension, the risk for T2DM in First Nations children.

Similar to other participatory action community-based interventions for First Nations children, exposure to healthy living teaching improved healthy living knowledge and behaviors. For example, the Kahnawake Schools Diabetes Prevention Project elicited significant improvements in physical activity and decreased screen time in children aged 6 to 11 years.[13] The Sandy Lake Diabetes Prevention Program, a comprehensive school-based education program delivered in a remote Oji-Cree community with geographic and genetic similarities to Garden Hill First Nation, enhanced healthy living knowledge and behavior in students aged 7 to 11 years.[12] Our data expand on these studies by demonstrating that a peer-led approach is equally effective for improving healthy living knowledge and enhancing both self-efficacy and body image in First Nations children, 9 to 10 years of age, living on reserve in a remote setting. Because peer-mentoring models are cost-effective and require minimal resources, this option may be an attractive and sustainable model for the delivery of healthy living information for First Nations children

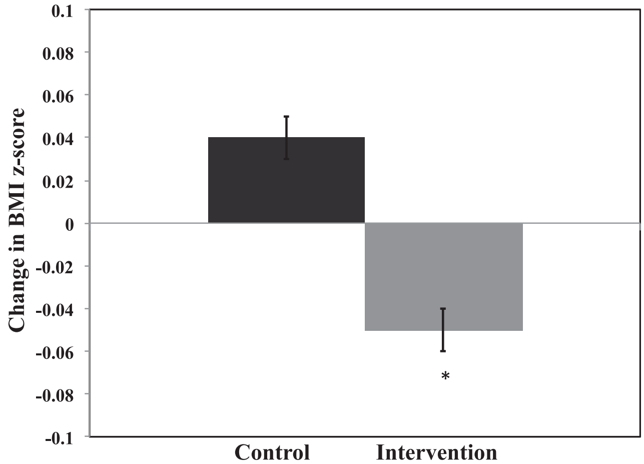

FIGURE 3
Change in BMI *z* score in children who received the intervention (AYMP) and control subjects. Analyses were adjusted for baseline weight categories (normal weight, overweight, and obese). *$P < .05$.

living in remote, isolated communities where travel and resources are prohibitive for conventional T2DM prevention programs.

Self-efficacy is an established determinant of behavior change.[33–35] Self-efficacy is also an important determinant of changes in physical activity levels[34] and weight loss after lifestyle interventions.[35] Children exposed to the school-based component of the Sandy Lake Diabetes Prevention Program, which included peer role modeling opportunities (but not peer mentoring), exhibited significant improvements in dietary self-efficacy in grades 3 to 5.[12] The observation that overall self-efficacy increased after exposure to a peer-mentoring intervention, and was associated with changes in waist circumference, suggests that it may be an important determinant of success associated with healthy living interventions tailored to First Nations children. Additional studies are needed to better understand the aspects of self-efficacy (ie, self-efficacy for making dietary versus physical activity changes) that are enhanced by peer mentoring and how they translate into altered healthy living behaviors.

The present study is strengthened by a longstanding equitable community–university partnership, a relatively large sample size, and the addition of a parallel control arm that was closely matched to the intervention arm before the intervention. Despite these strengths, several limitations need to be addressed. First, because this was a quasi-experimental trial, there is a risk of selection bias related to self-selection to the intervention and age differences between the study arms at baseline. In an effort to minimize selection bias, the control arm was selected to match as closely as possible to the intervention arm for several confounders, including baseline weight, body fat distribution, and sociodemographic variables. Also, we had different gender ratios between the groups (intervention: 3 female subjects, 1 male subject; control group: 1:1). Although we observed no significant interaction across gender, the imbalance is an unavoidable weakness to the design. Second, investigators were only partially blinded to group allocation when assessing outcome measures, thus increasing the risk of investigator bias. Specifically, they were aware that all grade 5 students were in the control arm; however, they were unable to distinguish students in grade 4 who received the intervention from those who did not. Third, we recognize that there is a potential risk of carryover effects of the intervention for youth who crossed over to the control arm after receiving the intervention in year 1 of the study. We performed a subgroup analysis, removing the 13 students who crossed over to the control arm after receiving the intervention, and the effect size and statistical significance remained unchanged. Fourth, the instruments we used to quantify healthy food knowledge and physical activity were rather crude relative to the gold standard 3-day food records, and they may not have been sufficiently sensitive to detect small changes in dietary habits. Fifth, parental involvement was limited. Although parents were invited to observe the program, there was no established curriculum for parents to use to support the healthy living behaviors promoted during the program. Finally, because this study was a pilot project, it was not sufficiently powered to test for

TABLE 3 Effect of AYMP on Knowledge of Healthy Living Behaviors, Self-Efficacy, and Body Image in Children From a Rural First Nation

Variable	Control (*n* = 100)		Intervention (*n* = 51)		Group-wise Comparisons		
	Before	After	Before	After	Effect	95% CI	*P*
Healthy food knowledge, %	76.9 (74.2 to 79.5)	73.3 (70.3 to 76.2)	68.9 (65.1 to 72.7)	71.2 (67.3 to 75.1)	6.1	1.0 to 11.1	.02
Physical activity knowledge, %	75.3 (70.7 to 80.0)	76.9 (71.9 to 82.0)	57.5 (50.9 to 64.2)	62.3 (55.6 to 69.1)	3.6	−3.8 to 11.1	.34
Self-efficacy, %	83.2 (79.8 to 86.4)	88.4 (84.2 to 92.7)	87.1 (82.5 to 91.6)	94.3 (89.2 to 99.4)	2.4	−3.3 to 8.3	.40
Body image (ideal self − current self)	−0.64 (−0.82 to −0.46)	−0.66 (−0.85 to −0.47)	−1.06 (−1.32 to −0.80)	−0.71 (−0.98 to −0.44)	0.37	0.01 to 0.72	0.045

Data are presented as adjusted mean and (95% CI). All the analyses were adjusted for age, gender, and baseline weight. Effect indicates treatment effect.

TABLE 4 Independent Determinants of the Change in Waist Circumference and BMI *z* Score After Exposure to AYMP

Variable	β	SE	*P*
Change in waist circumference			
Age	−0.81	1.01	.42
Gender	1.27	1.16	.27
Weight	−0.85	0.65	.19
Knowledge of physical activity	−0.85	2.52	.73
Knowledge of healthy eating	2.35	4.05	.56
Self-efficacy	−7.90	4.59	.03
Body image	−0.41	0.62	.50
Change in BMI *z* score			
Age	−0.00	0.03	.82
Gender	0.01	0.05	.72
Weight	−0.03	0.02	.22
Knowledge of physical activity	−0.07	0.11	.50
Knowledge of healthy eating	0.15	0.18	.38
Self-efficacy	−0.01	0.20	.94
Body image	0.01	0.02	.66

differences in multiple outcome measures. Despite these limitations and in light of the strategies used to overcome them, we are confident that, short of a randomized controlled trial, this study provides important insight into the effectiveness of a novel peer-mentoring approach for weight management and the promotion of healthy living behaviors in First Nations children at significant risk of obesity and T2DM.

CONCLUSIONS

The results of this pilot project suggest that a peer-led, after-school program grounded in a strengths-based approach is effective for attenuating the age-related increases in waist circumference and weight gain, and improving both knowledge of healthy dietary choices and self-efficacy in First Nations youth living in a remote northern setting. These data support the growing body of evidence that peer mentoring is an attractive strategy for teaching health behaviors and improving health outcomes in children. They also provide a cost-effective model of successful behavior change for a pediatric population at significant risk of T2DM and other obesity-related chronic diseases.

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In agreement with the AYMP Code of Research Ethics, this article was reviewed, discussed, and approved by the following stakeholders and members of the Advisory Committee: Eric Wood (Public Health Director), Larry Wood (Aboriginal Diabetes Initiative worker), Maggie Flett (Health Director), Buddy Beardy (Chief), Annalee Johnson (elementary school principal), Leanne Chornaby (elementary school vice-principal), Madeline Little (high school vice-principal), Wilfred Fiddler (high school principal), Beatrice MacPherson (Health Counselor), Ernie McDougall (Education Director), and Russell Harper (Education Counselor).

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