

The Kahnawake Schools Diabetes Prevention Project: Intervention, Evaluation, and Baseline Results of a Diabetes Primary Prevention Program with a Native Community in Canada¹

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Objectives. Kahnawake Schools Diabetes Prevention Project is a 3-year community-based, primary prevention program for non-insulin-dependent diabetes mellitus in a Mohawk community near Montreal, Canada. Objectives are to improve healthy eating and encourage more physical activity among elementary school children.

Methods. Intervention incorporates behavior change theory, Native learning styles, the Ottawa Charter for Health Promotion, and a health promotion planning model. Evaluation uses a mixed longitudinal and cross-sectional design to measure obesity, fitness, eating habits, and physical activity of elementary school children in the experimental and comparison communities. Intermediate variables are self-efficacy and perceived parental support. Process evaluation provides feedback to the intervention.

Results. During 3 years, 63 distinct interventions that included a Health Education Program reinforced by school events, a new Community Advisory Board, a recreation path, and community-based activities promoting healthy lifestyles were implemented. Baseline consent rates were 87 and 71% in the experimental and comparison schools. As expected, anthropometric data increase with age. Between 9 and 10 years there are increased weight, height, BMI, and skinfold thicknesses; decreased fitness; and increased television watching.

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Conclusions. Implementing a Native community-based diabetes prevention program is feasible through participatory research that incorporates Native culture and local expertise. © 1997 Academic Press

Key Words: primary prevention; non-insulin-dependent diabetes mellitus; children; Indian, North American; community; school; physical activity; obesity; diet.

INTRODUCTION

This study addresses both the feasibility and the impact of a community-based primary prevention program for non-insulin-dependent diabetes mellitus (NIDDM) in a Native community in Canada. The Kahnawake Schools Diabetes Prevention Project (KSDPP), developed in response to specific community requests, is a 3-year participatory research project. The intervention is an elementary school-based program that is reinforced by supporting programs for teachers, families, and the community. This paper describes the program objectives, model of intervention, early field experiences, evaluation design, and baseline data from the experimental community.

Diabetes has emerged as one of the main public health threats to Native populations in the second half of the 20th century. Rare before the 1940s [1], NIDDM has become increasingly common among many Native groups in North America [2,3], Australia [4], and the South Pacific Islands [5]. In Canada, the prevalence of NIDDM among Native people is two to six times greater than among the general population [2,6-8]. Rates of complications from NIDDM are often higher among Native populations, including increases in the age-adjusted mortality from NIDDM in the United

States [3] and Canada [9], higher rates of end-stage renal disease [2], proliferative retinopathy [2], lower extremity amputations [2], and ischemic heart disease [10].

NIDDM is a disease of multifactorial etiology where genetic and lifestyle factors contribute to the current epidemic [11,12]. Both Native ancestry [13–15] and a parental history of the disease [15–17] increase the risk of NIDDM. Obesity is the most important risk factor for the development of NIDDM, and for Native people, cross-sectional and cohort studies show strong dose-response relationships between increased body mass index (BMI) and the development of NIDDM [16,18–20]. Duration of obesity [21] and abdominal obesity [22,23] are also strong predictors of NIDDM. Native populations exhibit high rates of overweight, obesity, and abdominal obesity [2]. Furthermore, a recent national survey in the United States identified high rates of obesity among Native children [25]. Physical inactivity is a strong predictor of obesity and NIDDM [26–29] and dietary factors such as fat consumption also play a role [30].

The need for primary prevention [31–34] among Native populations is especially urgent given their high prevalence of NIDDM and its complications, the appearance of NIDDM in Native children [18,35,36], and a high prevalence of NIDDM among the offspring of diabetic mothers [37].

The rationale for youth-centered programs is that (1) most lifestyles associated with chronic diseases such as NIDDM are learned early in life and are well ingrained by adulthood; (2) many risk factors, including BMI, track from childhood into adulthood; (3) changes in lifestyles among children can lead to improvements in their risk factor levels or to the prevention of the occurrence of the risk factors themselves (primordial prevention); and (4) school-aged children represent a captive audience that is eager to learn new ideas and that is in the process of integrating societal norms [38–40]. Several youth health promotion programs [38,41–45], including one Native based [46], have shown that effective programs are skill based rather than knowledge based only, are adapted to the child's developmental level, emphasize the total school environment, offer maintenance sessions, and involve the family [47] and the community [48].

BACKGROUND

Target Population

Kahnawake is a Mohawk community of 6,746 people (1994), 12 miles from Montreal, Canada. The Mohawk are Iroquoian and English speaking. The current community was founded in 1680 and the traditional diet was corn, beans, and squash supplemented by foods acquired through fishing, hunting, and gathering. In

the past 30 years Kahnawake has made a strong commitment to reintroduce Mohawk culture and language and to synthesize tradition with modernity [49].

Diabetes in Kahnawake and History of Project

In Kahnawake 12% of adults 45–64 years of age have documented NIDDM, twice the rate of the general population of the same age [50]. This diabetic population suffers the highest rate of macrovascular complications as yet documented in any Native community: 48% have coronary artery disease and the overall risk of a macrovascular complication is six times higher than for those without diabetes in Kahnawake [10]. The average age of onset of NIDDM has decreased from 59 years in 1985 [10] to 49 years in 1995 (personal communication, H. Jacobs-Whyte, Kateri Memorial Hospital Centre, Kahnawake). In 1987 the community-based physicians/researchers returned the results to the community, which led to requests to prevent diabetes [51]. Concerns about the perceived increase of obesity among children, combined with the Mohawk tradition of caring for future generations, led to the development of a prevention program focusing on elementary school children, their families, and the entire community.

Objectives of the Program

The long-term goal of the KSDPP is to decrease the future occurrence of NIDDM. The short-term goals are to reduce the prevalence of obesity, high-calorie and high-fat diets, and physical inactivity among Kahnawake children ages 6 to 12 years. The specific objectives are to increase the proportion of children who consume an age-appropriate balanced diet and who practice regular physical activity. We postulate that improved knowledge, attitudes, perceived self-efficacy, intention, and skills of both children and parents will precede the outcomes of primary interest, and that improvements in the availability of healthy foods and recreational facilities will be necessary to support healthy behavior changes. Other important objectives are to incorporate Mohawk traditions, to mobilize the community, to foster community empowerment and ownership, and to facilitate maintenance of the project beyond the termination of external research funding.

METHODS

Model of the Intervention Program

The model of intervention combines elements from the Social Learning theory [52], the Precede-Proceed model [53], and the Ottawa Charter for Health Promotion [54] and incorporates traditional learning styles of

Native children [55,56]. For KSDPP, three elements of the Social Learning theory are particularly important: self-efficacy, modeling, and self-management. The self-efficacy concept states that behavioral change is effected through mastery and achievement. Because expectations of success help to determine which activities children will pursue or abandon, KSDPP interventions are based on a series of small, incremental, and easily achievable goals. Since modeling of behaviors by relevant and credible others is a powerful source of information for building expectations, KSDPP sponsors family activities in the community to expose children to healthy lifestyles of adults and community elders. Self-management requires the gradual development of internal rather than external gratification for healthy behavior. To this end, KSDPP provides a structured school health education program that creates positive attitudes about healthy lifestyles, increases self-esteem, and also offers external gratification (certificates and prizes) to provide cues to action for newly introduced lifestyle activities.

The Precede-Proceed model identifies predisposing, reinforcing, and enabling factors, as well as environmental and organizational factors, that impact on health behaviors. For KSDPP predisposing factors are childrens' knowledge and skills, reinforcing factors are the support of teachers and family, and enabling factors are the availability of healthy foods and opportunities for physical activity.

The Ottawa Charter for Health Promotion identifies important axes for the intervention: developing personal skills, strengthening community action, creating supportive environments, building healthy public policy, and reorienting health services.

Finally, an overriding principle in implementing the activities is to ensure they incorporate traditional learning styles of Native children, which indicate that visual, spatial, and perceptual modes of learning are preferable for effective assimilation of concepts. This translates into educational activities that favor hands-on experience and "showing how rather than just telling why" [57].

EARLY FIELD EXPERIENCE

KSDPP started in July 1994 and is funded for intervention and evaluation for 3 years. In 1994/1995 90% of elementary school children were enrolled in the community elementary schools. Of the 458 children in grades 1-6, 260 children attended the English school and 198 attended the Mohawk immersion school. In both schools the majority of teachers are Mohawk from Kahnawake. Two full-time Mohawk staff coordinate the field intervention and one non-Native full-time staff coordinates the field evaluation. During the 3 years, a newly created health education program was gradually introduced into grades 1-6 in both elemen-

tary schools and was supported by 63 distinct activities for the children, teachers, families, and community (Tables 1a and 1b).

Developing Personal Skills

The major focus of the intervention is the development and implementation of a health education program for children in grades 1-6. This curriculum, created by a dietitian (C.S.-H.) and community health nurses from the community hospital, contains sections on nutrition, fitness, diabetes, understanding the human body, and healthy lifestyles in 10 45-min lessons per year for each grade. The lessons incorporate traditional learning styles and practical experiences and use interactive and cooperative learning techniques. They include story telling, games, food tasting, experiments, puppet shows, crafts, and audiovisual presentations. The nutrition section discusses healthy eating, balanced meals, healthy snacks, avoidance of high-fat foods, nutrients and their roles, label reading, factors influencing eating habits, body image, and healthy weight. Traditional foods, as well as foods commonly eaten in the community, are incorporated throughout this section. The fitness section emphasizes the benefits and pleasure of daily physical activity and the different types of activity: aerobic, strength building, and flexibility. Finally, a section on diabetes describes NIDDM and its consequences and how it can be prevented. During the first year community health nurses and the dietitian delivered the program in the presence of classroom teachers. Teachers then received training and by Year 3 were delivering the program themselves.

Strengthening Community Action

Community mobilization refers to a process whereby a community becomes actively involved in solving community problems [54]. Increasing community awareness of and improving attitudes toward healthy lifestyles are key objectives for supporting community mobilization. To that end KSDPP makes extensive use of the local media. This includes regular half-page advertisements and press coverage of events and activities in the local newspaper, public service announcements and talk shows on the local radio, and frequent use of posters in public locations. These increase the awareness of events and activities and provide short, behavior-oriented information about healthy lifestyles. KSDPP also supports existing community groups and events that help attain our goals, such as the local youth recreation center, health and harvest fairs, and several sport competitions.

Using the principles of participatory research, a Community Advisory Board was created to ensure broad community involvement, empowerment, and en-

TABLE 1a
Intervention Activities in Kahnawake, KSDPP, 1994–1997

Activity	Factor targeted (PPM/OCHP) ^a	Frequency	Target population	No. of participants
School-based activities				
Health education program (grades 1 to 6)	P/D	10 classes/year	Children	458
Healthy nutrition policy	E/H	Permanent	Children, parents, teachers, and staff	Estimated 1200
Teacher training for health education program	P/D	One day/year	Teachers	35
Teachers and staff update meetings	R/S	4 times/year	Teachers and staff	35 teachers and 25 staff
Monthly calendar activity log	E/C	Monthly	Teachers	35
Teacher healthy activities in classroom	P/D	Variable	Children	Variable
Students healthy breakfast—organized by parents		Annual	Children	251
Healthy Lifestyle fund raiser		Annual	Children	280
Fall Treasure Hunt	E/S-C	Annual	Children and teachers	458
Winter snow Sculpture Contest (includes children from other community schools)	E/S-C	Annual	Children, parents, and teachers	600
lakaonnhiiostha ne Taionre:ren: Racers for Health (includes children from outside the community)	E/S-C	Annual	Children	800
Information booths				
KSDPP	P/D	Once	Parents	100
Healthy foods and snacks at report card days	P/D-C	3 times a year	Parents	100
Community-based activities				
Creation of Community Advisory Board (CAB)	R-E/S-D	Monthly	Community	40
CAB Healthy Lifestyle posters	P/S	Once	Adults	25
Information dissemination				
Kahnawake Conference on Management and Prevention of Diabetes	P-E-R/S-D	Once (2 days)	Adults	126
KSDPP presentations to community organizations	P-R-E/S-D	40	Adults	Variable
Local newspaper advertising	P-R-E/S-C-D	Bimonthly	Community	2,200 printed
Project activity information updates	P-R/S-C	Monthly	Community	
Healthy recipes	P/S	6	Community	
Research results	P/S	5	Community	
Local radio station				Audience is 90% of community
Talk shows	P-R/S-D	15 times	Community	
Commercials and public service announcements	P-R/S-D	12	Community	
Promotional events				
KSDPP logo contest	E/C	Once	Community	4
KSDPP mugs	E/C	Variable	Community	1100 mugs
bags		2	Adults	50 bags
Student comments on Healthy Lifestyle posters	P/D	Once	Children	40 posters 300 copies distributed

^a Precede–Proceed model (PPM): (P) Predisposing factors, (R) reinforcing factors, (E) enabling factors. Ottawa Charter for Health Promotion (OCHP): (S) Strengthening community action, (D) developing personal skills, (C) creating supportive environments, (H) healthy public policy, (O) reorienting health services.

couragement of long-term sustainability. It has 40 members from the health, educational, political, recreational, social, spiritual, economic, and private sectors of Kahnawake. The Board advises on intervention and evaluation objectives, activities, culture, traditions, and current concerns. Members are encouraged to become role models for healthy lifestyles and to promote the goals of the project in the organizations and homes of Kahnawake. A Code of Research Ethics, developed with the Board in the first year of the project, delineates the roles and responsibilities of all those associ-

ated with KSDPP through all stages of the research process.

Creating Supportive Environments

Individual health behaviors are reinforced or hindered by social or physical environmental factors. KSDPP encourages improvements in the physical environment and social norms to support healthy lifestyles. Table 1 shows that in the schools KSDPP has developed events such as a 5-km treasure hunt, a snow

TABLE 1b
Intervention Activities in Kahnawake, KSDPP, 1994–1997

Activity	Factor targeted (PPM/OCHP) ^a	Frequency	Target population	No. of participants
Community-based intervention (healthy eating)				
Promotional healthy meals to organizations	E/C	Annual	Employees	Variable
Promotional healthy meals to CAB		Monthly	CAB	25
Healthy food preparation contests	E/S-C			
Zucchini recipe		Twice	Community	Variable
Best chili in Kahnawake		Twice	Community	
Harvest fair		Twice	Community	
Health fair		Twice	Community	
Healthy food tasting	P-E/S-C-D			
Summer barbeque demonstration		Once	Community	80
Dessert for supper with Santa		Twice	Community	200
Spring into Action '96 lunch		Twice	Community	100
Blood donor clinic '97		Twice	Community	96
Juice donations (banquets)		Once	Community	25
Woman's Center		Once	Community	6
Promotion of traditional food	P-E/S-C-D			
Sale of white corn		Twice	Community	50 lb sold
Sale of wild rice (including recipe book)		Twice	Community	50 lb sold
Sale of squash (with recipe book)		Twice	Community	36
Sale of soup mix		4 times	Community	75 bags
Promotion growing traditional food	P-E/S-C-D			
The seed exchange (corn, beans, and squash)		3 times	Community	100
The Garden Journal		Once	Children and parents	12
Fat and sugar content display	P/D	2	Community	50
Soup contest (vitality program)	P-E/S-C-D	Once	Community	30 people
Community-based intervention (physical activity)				
Creation of a recreation path	E/S-H	Permanent	Community	—
Supporting Youth Center activities				
Mohawk Miles Run	R-E/S-C	Annual	Community	Average: 300
Family participation award				
Class participation award				
Walk and Run Club	P-E/S-C			
Winter Walk and Run Club (200 km)		3 times	Adults	36
Midwinter Walk and Run Club (200 km)		3 times	Adults	36
Spring Walk and Run Club (300 km)		3 times	Adults	31
Summer Walk and Run Club (500 km)		3 times	Adults	50
Community events				
Community Walk for Addiction Awareness	R-E/S-C	Twice	Community	65
Sadie's Walk for Diabetes Prevention		Once	Community	160
Winter sliding party		3 times	Community	70
Community walks		3 times	Community	Average: 75
Spring into Action 1996 Walk		Once	Community	60
Elders walking party		3 times (1/year)	Elders	100
Walking Club		Twice/10 weeks	Hospital staff	24
Juvenile Diabetes Cyclothon Kahnawake team		3 times	Young adults	Variable
Parents/Teens Golf League		Annual	Parents and teens	
Community programs				
Sugar Babies Volleyball Team	E/S-C	Weekly for 6 months (2 years)	Young adults and adults	12
Line dancing course	E/S-C	Twice	Adults	50
Gymnastics	E/S-C	1 year	Children	120
Figure skating	E/S-C	3 years	Children	200
Pow-wow dancing workshops	E/S-C	1 year	Children	40
Seminar at Moose Lodge (Ladies Auxilliary)	P-R/S-D	6 weeks (2 hr/once a week)	Community	20
Incentives for accomplishments (rewards, certificates)	R/C	Variable	Community	Variable
Gift certificate to teachers		Twice a year	Teachers	40

^a Precede–Proceed Model (PPM): (P) Predisposing factors, (R) reinforcing factors, (E) enabling factors. Ottawa Charter for Health Promotion (OCHP): (S) Strengthening community action, (D) developing personal skills, (C) creating supportive environments, (H) healthy public policy, (O) reorienting health services.

sculpture contest, and an elementary school race that has annually attracted over 800 children from five Mohawk communities. In the community, the project was instrumental in the construction of a walking and bicycling path. KSDPP participates in the organization of numerous activities to support healthy lifestyles, including cooking demonstrations, food sampling, healthy food contests during community fairs, and walkathons. It helps other organizations with healthy food sponsorships and trophies for sporting activities. The project has created new ongoing programs such as the walk and run club, line dancing classes, a volleyball league, an outdoors and healthy eating club, and for children, pow-wow dancing and a gymnastics club. Many of the activities target parents and elders to increase their sense of competency as role models.

Healthy Public Policy

KSDPP has successfully lobbied the Kahnawake Education System for a more active enforcement of the school nutrition policy. As a result, the elementary school canteens now offer only healthy foods (low-fat, low-simple sugar, high-fiber foods, and no "junk" food) and students are required to bring healthy lunches and snacks. One of the schools added an extra physical education class each week. Incentives (prizes) are provided for teachers and classes who integrate extra physical activities into their daily routine. Individual classroom teachers are undertaking additional extracurricular physical activities with their classes.

EVALUATION

The aim of the evaluation strategy was to assess the success of the overall project and not of its individual components, because individual assignment of participants to the various components was not possible given the size of the community. Furthermore, given the number of activities undertaken within the framework of the projects, we observed that most children were exposed to a variety of activities, rendering the evaluation of individual components susceptible to synergistic effects. The evaluation has three main components: outcome, proximal impact, and process evaluation. The outcome evaluation examines the relationship between exposure to the program and obesity, fitness, healthy eating, and patterns of physical activity of children in grades 1 to 6. The proximal impact evaluation assesses the intermediate variables of children's self-efficacy and the perceived parental support for healthy eating habits and physical activity. Process evaluation monitors environmental changes in schools, families, and the community.

Study Participants

The design for the outcome and proximal impact evaluation is a mixed longitudinal and cross-sectional

study with the nonequivalent comparison community of Tyendinaga. The latter is a Mohawk community of 2,200 inhabitants, situated 400 km southwest of Kahnawake, with a single English-speaking elementary school of 199 children in grades 1 to 6.

Baseline assessments were conducted in the fall of 1994 on all elementary (grades 1 to 6) school children in the experimental and comparison schools for whom a parent or guardian had provided written informed consent. Children in grades 1 and 2 at baseline in both the experimental and the comparison communities form the cohort that has been followed-up annually. In addition, children in grades 1 to 6 in both communities were reassessed in the fall of 1996, 2 years after the start of the project. This combination of cross-sectional and longitudinal surveys provides a research design that controls for many biases in addition to allowing the monitoring of changes within individuals [58].

Outcome Measures

Two sets of variables were measured for the outcome evaluation. The first set assesses fitness and body composition. Fitness was assessed with a 1-mile run/walk test (0.5 mile for children in grades 1 to 3). Children ran in groups supervised by adults on a dirt road in a safe zone. Children were instructed to run as fast as possible. Each group of children ran twice during the same session, time of distance completion was measured using a stop watch for each child, and the best time of the two runs was recorded. Intraclass correlation coefficients between the two trials ranged from 0.64 to 0.92, depending on age-sex category of children. Moderate to high correlations have been established between run/walk test performances and physical fitness among children [59].

Six anthropometric measurements were recorded for each child to assess body fatness. Weight was obtained in light indoor clothing without shoes or extra sweaters. All measures were taken using the same numeric scale (SECA Model 770 Alpha; SECA Co., Columbia, MD), to the nearest 0.1 kg. The weight of standard clothing was not subtracted from the observed weight. The scale was periodically tested for accuracy and calibrated using a set of standard weights. Height was measured with a portable wooden infant/child height measuring board (Irwin J. Shorr, Olney, MD) and measurement was recorded to the nearest millimeter (0.1 cm). Children were asked to remove their shoes and to stand straight with the head in the Frankfurt horizontal plane. Triceps and subscapular skinfold thickness were measured three times each on the right side using a Lange caliper (Beta Technology) and the method described by Lohman [60]. The precision was 0.1 cm. Children stood with their feet together and arms at their sides and clothing was lifted to expose the measurement sites. All three measures, taken for each site,

were averaged and recorded. Waist and hip circumferences were measured, with children standing and breathing normally using an inelastic tape with a precision to the closest centimeter. Waist was measured by positioning the tape horizontally on the skin, midway between the lowest rib margin and the iliac crest. Hip circumference was measured at the point yielding the maximum circumference over the buttock. All anthropometric measurements were carried out by one Native research nurse in each community.

Reliability values for all measures were very high. The intraclass correlations for the three measurements of triceps skinfold thickness were 0.98 and 0.97 in Kahnawake and the comparison site, respectively. Reliability values for subscapular skinfold thickness were the same. In order to estimate interrater reliability two complete sets of anthropometric measures were taken on 41 children. In all cases the research nurse took one set of measures and the author responsible for the data collection took the other. All intraclass correlation coefficients comparing two sets of the same measures exceeded 0.95.

The second set of variables consisted of behavioral assessments of eating habits and physical activity patterns. A 51-item self-reported food frequency questionnaire was used to estimate children's food consumption in the previous 7 days. It includes examples of traditional meals and the wide variety of foods and drinks commonly consumed in the community. A self-administered physical activity questionnaire asked children to report the number of times they performed a list of 27 activities during the previous 7 days. They were also asked about their participation in organized sports, television watching, and use of video games. The dietary and physical activity questionnaires were completed in class by children in grades 4 to 6 and at home with parental help for children in grades 1 to 3. The questionnaires were adapted from the Quebec Heart Health Demonstration Project [61] and were pretested in children from a third Mohawk community.

Proximal Impact Evaluation

Two proximal impact variables were expected to be influenced by the intervention and to lead children to healthier eating and increased physical activity. These were self-efficacy and perceived parental support. They were assessed with a self-administered questionnaire completed in the classroom with the help of a trained monitor for all children.

Perceived parental support was measured using six statements, which the child answered as never, rarely, a few times, or often. The statements included "During the past 6 months, my family (or members of my household) has: (1) encouraged me to eat healthy foods, (2) reminded me not to eat junk food, (3) complimented me on changing my eating habits, (4) exercised with me,

(5) offered to exercise with me, (6) encouraged me to exercise." Self-efficacy was assessed by 11 items asking how sure the child was that he could really try to do specific activities (eat fruit instead of cookies or candies for dessert or snack, eat plain popcorn instead of chips, play outside instead of watching TV, play outside after school). Answer categories were I know I cannot, maybe I can, and I know I can. The reliability coefficients (Cronbach's α) for these scales vary from 0.51 to 0.72.

Ethical approval for intervention and evaluation was given by the Comité d'évaluation et de déontologie du GRIS, Université de Montréal.

RESULTS

Table 2 shows that participation rates in the experimental and comparison communities were very similar, except for a lower rate of consent from the parents in the comparison community (87.1 and 70.9%, respectively). As expected the largest loss of information came from the failure of parents of children in grades 1–3 to return the home questionnaires. Prior agreements with the two participating communities stipulate that direct comparisons of raw data would not be published. Therefore, baseline data are only provided for the experimental community of Kahnawake.

Table 3 presents the means and standard deviations by age–gender categories of all anthropometric data. As expected, the mean values for most indicators increase with age. It is interesting to note that the increase of mean weight between 9 and 10 years of age is 27.2% for girls and 18.8% for boys. Such sharp increases are also to be noted for height, BMI, and triceps and subscapular skinfold thickness. It is only for weight, however, that the increase in the mean values is accompanied by as sharp an increase in standard deviations.

Results of fitness testing are presented in Fig. 1. Children in grades 1 to 3 ran half a mile, and children in grades 4 to 6 ran 1 mile. The box plots in Fig. 1 show that the girls' performances are steady. Neither the median (the horizontal bar inside the box) nor the variance change much across age groups among girls. For the boys there is a marked increase in the variance of their performance starting in grade 5, which roughly corresponds to age 10.

Two indicators of active lifestyles were reported by the children. Table 4 presents television viewing habits. For both girls and boys, television watching habits seem to shift markedly around the age of 9 when they spend more time watching television on weekends and more time watching television on school days, as shown by the number of children who reported watching more than six programs each day. The second indicator of active lifestyle (Table 5) is an index made of the sum of the number of times children reported doing a physical

TABLE 2
Response Rates by Activity and Community, KSDPP, 1994

	Kahnawake			Tyendinaga		
	No. of students	% of total No. of students	% of No. of consent	No. of students	% of total No. of students	% of No. of consent
Total students (grades 1-6)	458			199		
Parental consent (grades 1-6)	399	87.1%		141	70.9%	
Anthropometric meas. (grades 1-6)	396	86.5%	99.2%	141	70.9%	100.0%
Run/walk test (grades 1-6)	394	86.0%	98.7%	136	68.3%	96.5%
Questionnaires						
Total students (grades 1-3)	242			98		
Parental consent (grades 1-3)	206	85.1%		74	75.5%	
In-class quest. (grades 1-3)	204	84.3%	99.0%	74	75.5%	100.0%
Home quest. (grades 1-3)	157	64.9%	76.2%	57	58.2%	77.0%
Total students (grades 4-6)	216			101		
Parental consent (grades 4-6)	193	89.4%		71	70.3%	
In-class quest. (grades 4-6)	188	87.0%	97.4%	66	65.3%	93.0%

activity lasting at least 20 min during a 1-week period. For the girls, reported physical activity increases steadily from age 6 to 9 and then stabilizes. A somewhat similar pattern can be observed for boys, except for those aged 7 and 11.

Some changes in eating patterns occur around the age of 9. For both boys and girls there is a decreased percentage who report drinking juice daily, an increase in those reporting consuming soda or soft drinks daily, and an increase in those reporting eating potato chips or french fries more than four times per week.

DISCUSSION

The wide range of school and community interventions targeted all age groups. The high rates of consent indicate significant community support. Baseline re-

sults reveal that around the ages of 9 and 10, children in Kahnawake show a sharp increase in skinfold thickness, which indicates that changes in weight are accompanied by an increase in the proportion of body fat. This may be attributable to prepubertal growth. However, around this age there appears to be a decrease in fitness, increased television viewing, and increased consumption of food poor in nutrient elements like soda, chips, and french fries. It is important to point out that parents completed the children's lifestyle questionnaires for children ages 6 to 8, whereas children ages 9 to 11 completed them in class on their own. It is likely that parents are more sensitive than children to the social desirability aspects of the questionnaire. Despite this possible measurement bias the association between anthropometric measurements, fitness, and patterns of eating and television viewing

TABLE 3

Mean and Standard Deviation for Weight, Height, Body Mass Index (BMI), Triceps and Subscapular Skinfold Thickness, and Waist to Hip Ratio, by Gender and Age, Kahnawake, 1994

Age (year)	n	Weight (kg)		Height (cm)		BMI (kg/m ²)		Triceps (mm)		Subscapular (mm)		Waist to hip ratio	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Girls	197												
6	37	23.48	3.91	119.00	6.04	16.52	2.12	10.94	3.68	6.95	3.39	0.89	0.04
7	24	26.00	2.91	125.60	3.30	16.44	1.23	10.71	2.70	7.00	2.39	0.85	0.04
8	33	30.55	7.97	129.44	5.72	18.02	3.34	13.90	6.00	10.10	6.32	0.86	0.05
9	40	32.65	5.82	135.91	5.37	17.62	2.54	13.86	4.51	9.22	4.96	0.84	0.04
10	30	44.87	12.79	144.40	6.00	21.22	4.70	18.96	6.65	15.21	8.76	0.85	0.07
11	33	49.13	12.74	149.78	6.58	21.78	5.09	18.34	7.04	14.83	9.01	0.82	0.06
Boys	182												
6	31	24.94	4.57	121.09	5.17	16.94	2.56	9.13	3.42	5.96	3.21	0.90	0.04
7	31	27.67	7.02	125.45	6.43	17.45	3.30	9.89	4.89	6.56	5.99	0.88	0.04
8	41	31.34	11.07	129.50	6.03	18.39	4.66	12.50	7.54	9.07	7.62	0.88	0.06
9	31	35.58	9.33	137.06	5.22	18.78	3.85	12.85	6.19	9.46	7.53	0.87	0.09
10	25	43.84	13.58	144.57	5.51	20.70	5.17	14.25	7.14	11.71	8.47	0.94	0.34
11	23	47.02	15.22	145.69	5.75	22.01	6.69	14.86	7.37	12.01	9.23	0.89	0.15

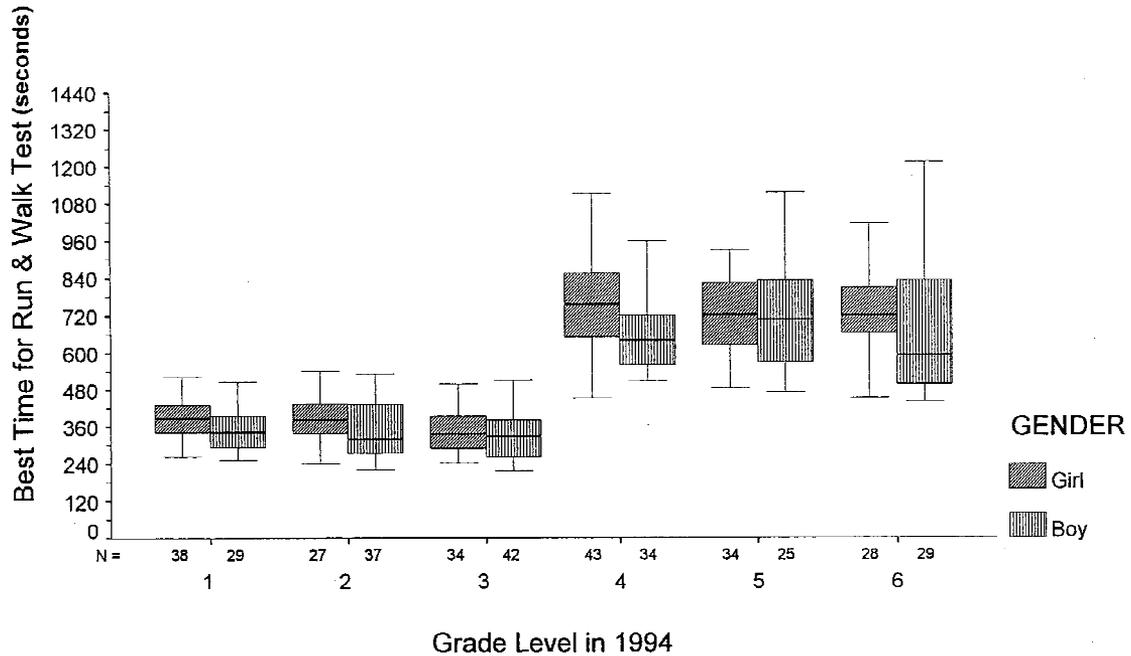


FIG. 1. Best time for run and walk test by level and gender, Kahnawake, 1994.

may indicate real lifestyle changes. If so, programs like KSDPP are extremely relevant to support children in maintaining an active lifestyle during this crucial period.

KSDPP is an innovative program using a population approach for the primary prevention of NIDDM in the Mohawk community of Kahnawake. To our knowledge it is one of the first community-based primary prevention programs for NIDDM to be evaluated in a Native

or non-Native community. KSDPP aims not only to prevent the onset of disease but also to prevent the occurrence of NIDDM risk factors. KSDPP will contribute important new information on the application of an ecological model of health promotion, the development of a participatory model of research, and the development of a culturally relevant approach to health promotion.

TABLE 4
Television Viewing by Age and Gender, Kahnawake, 1994

	Age					
	6	7	8	9	10	11
Total No. of students (n)	54	43	43	62	53	52
Girls (n)	26	20	21	34	27	28
Television viewing on Saturday morning (%)						
Part of Saturday morning	61.5	70.0	57.1	41.2	33.3	50.0
Most of Saturday morning	19.2	20.0	19.0	17.6	29.6	28.6
All morning	15.4	10.0	19.0	35.3	29.6	17.9
Television viewing on weekdays (%)						
1 program a day	19.2	0.0	14.3	11.8	3.7	3.6
2 to 3 programs on school days	53.8	75.0	42.9	14.7	29.6	39.3
4 to 5 programs on school days	11.5	15.0	28.6	29.4	37.0	32.1
More than 6 programs on school days	11.5	10.0	14.3	44.1	25.9	21.4
Boys (n)	28	23	22	27	26	24
Television viewing on Saturday morning (%)						
Part of Saturday morning	64.3	73.9	81.8	50.0	34.6	33.3
Most of Saturday morning	21.4	17.4	0.0	7.1	11.5	12.5
All morning	10.7	8.7	13.6	25.0	46.2	37.5
Television viewing on weekdays (%)						
1 program a day	11.1	17.4	9.1	22.2	11.1	0.0
2 to 3 programs on school days	22.2	60.9	59.1	29.6	26.9	25.0
4 to 5 programs on school days	25.0	13.0	18.2	22.2	23.1	25.0
More than 6 programs on school days	5.1	8.7	13.6	25.9	42.3	45.8

TABLE 5

Sum of Physical Activity Frequency Items by Age and Gender, Kahnawake, 1994

	Age					
	6	7	8	9	10	11
Girls						
Mean	16.8	20.0	21.0	22.3	22.3	22.8
Standard deviation	9.0	12.3	18.5	16.2	18.7	11.1
No. of cases	26	20	22	34	27	28
Boys						
Mean	17.3	29.4	21.4	23.2	23.3	27.6
Standard deviation	12.0	15.6	13.6	10.6	15.6	19.2
No. of cases	28	22	22	28	26	24

The models for KSDPP are cardiovascular disease prevention programs such as the North Karelia Project, the Stanford Three-Community and Five-City Projects, and the Minnesota and Pawtucket Heart Health Programs [62-66]. These programs postulate that greater benefits are accrued overall by targeting the total population with an integrated program than by attempting to screen and treat high-risk individuals [67]. KSDPP will provide information on the utility of this model in the field of NIDDM.

KSDPP also tests whether it is feasible to implement a community program in a Native population. Due to their holistic approach, total population programs appear more supportive of the culture, traditions, and value systems of Native communities. For example, KSDPP simultaneously targets several risk factors, uses multiple intervention strategies, and incorporates a variety of communication channels that act synergistically to facilitate the diffusion of health promotion messages. Community programs are also rooted in the concepts of community development and participation [68], which promote acquisition of local skills and use of local resources to foster long-term maintenance of programs.

The ecological model of health promotion postulates that social and environmental conditions constitute incentives or barriers to adopting healthy behaviors [69-71]. To achieve KSDPP goals a complex intervention that combines a health curriculum for Native school children with environmental interventions was initiated. The schools offer increased opportunities for healthy eating and regular physical activity. Improvements in the physical environment in the community (walking/bicycling path) and changes in social norms have resulted from KSDPP activities.

Participatory research requires collaboration with the community in which the research is being undertaken [72]. Native communities value this method of research to ensure cultural relevance, create local knowledge, build skills, and participate in decisions for action based on the results [73]. KSDPP was developed at the request of the people of Kahnawake who have

remained full partners in the research process. All features of KSDPP result from collaboration between the researchers and the Community Advisory Board. The Native staff control the day to day decisions for the intervention and evaluation, so the project reflects community norms, values, and priorities. The non-Native researchers provide the technical expertise in diabetes and health promotion, counsel on the strategic direction of the project, help define the operational objectives, and design the evaluation. Most importantly, the researchers have been willing to acknowledge and respect this high level of community ownership.

Cultural relevance of health promotion is seen as the degree to which a program is congruent with prevailing community culture and values. KSDPP is designed to maintain the integrity of Mohawk culture throughout the project. For example, the community selected the elementary school children to be the primary target group for the intervention, which supports the Mohawk tradition of taking responsibility for their children's future. The implementation of KSDPP purposely models Mohawk traditions to ensure that the community is fully aware of all aspects of the project. The project also promotes holistic health by incorporating physical, emotional, mental, and spiritual well-being, which are central to Mohawk traditions. If successful, other Native or non-Native populations could adapt this participatory research model to empower their community and to incorporate local skills, traditions, and culture into the delivery of diabetes primary prevention programs.

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