Effects of a Community-based Prenatal Nutrition Program on the

Oral Health of Aboriginal Preschool Children in Northern Ontario

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ABSTRACT

Background: Aboriginal preschool children across Canada are at increased risk for Early Childhood Caries (ECC) when compared with their non-Aboriginal age cohorts. Current research indicates that dental public health programs fail to prevent ECC because intervention often arrives too late. **Objectives:** To evaluate the effectiveness of the dental hygiene-coordinated prenatal nutrition program, delivered by community-based nutrition educators on First Nations reserves located in the Sioux Lookout Zone (Northwestern Ontario) on: (1) parents/caregivers' beliefs and behavioural decisions related to dental preventive practices and feeding habits of young children; (2) oral health status and treatment needs of those children; (3) early childhood obesity. **Methods:** Cross-sectional oral health surveys of Anishnaabe 2–5 year olds conducted in 2001and 2002 in 16 communities; 8 communities classified as "high" intervention and 8 as "low" intervention based on frequency of contact and content of contact between nutrition educators and prenatal women. Trained and calibrated dental hygienists examined children for dental caries and oral hygiene and measured height and weight. A questionnaire was used to assess caregiver knowledge, beliefs, and practices in relation to the oral health of the child. **Results:** 471 (72% response) and 705 (65% response) caregiver-and-child pairs participated in 2001 and 2002, respectively. Oral health knowledge in this population was high and significantly higher among caregivers in the high-intervention communities. In high-intervention communities, caregivers brushed children's teeth more frequently and started at an earlier age. Differences in feeding habits were noted with regard to bottle feeding on child's demand and the sugar-rich content of the bottle. Children in high-intervention communities required dental treatment under general anesthetic (GA) but at a later age, were less likely to have abscessed teeth and had less untreated decay by age 4 than those in the low-intervention communities. The program also had significant positive effects on the child's oral hygiene and body mass index (BMI). **Conclusion:** The prenatal nutrition program improved caregivers' knowledge of ECC. However, factors that place undo strain on the caregiver and lead to poor oral hygiene and dietary habits among children in Aboriginal communities need to be addressed. Some strategies to confront these factors are discussed in the paper.

Key words: dental caries; Canadian Aboriginal preschool children; prenatal education; dental hygienist; public health; health promotion; obesity

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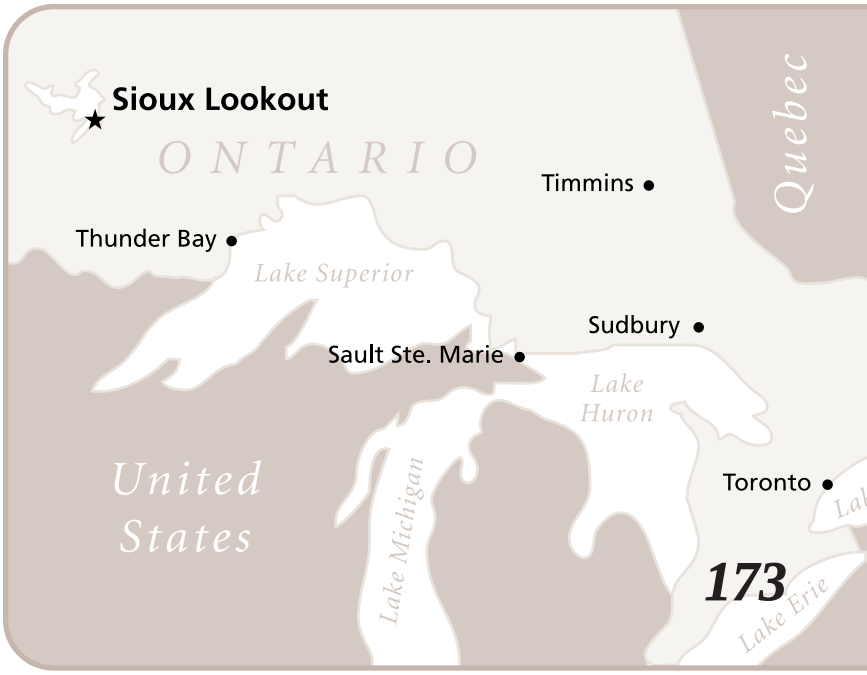
INTRODUCTION

TOOTH DECAY IN PRIMARY TEETH, KNOWN AS EARLY Childhood Caries (ECC), is currently at epidemic proportions in Canadian Aboriginal children. To date, there has been no national oral health survey of preschool-aged Aboriginal children in Canada; however, oral health data from particular localities indicate a high level of need for dental preventive services for this age cohort. Approximately 70% of Canadian Aboriginal children living on reserves have experienced tooth decay by 3 years of age,[1,2] and 87% by 5 years,[2-4] with the average dmfs for children aged 4–6 varying between 19 and 24,[5] and an average dmft of 7 at age 6.[6]

Despite its prevalence, ECC can be prevented through good oral hygiene practices and a well-balanced and nutritious diet. ECC's etiology is largely associated with feeding practices of infants and toddlers and is often referred to as nursing bottle caries. This name highlights the major dietary cause of the disease—the prolonged *ad lib* use of the bottle with sugar-containing liquids, especially at night or naptime.[7] However, factors other than bottle feeding have been found to play an important role in the etiology of ECC.[7] Information from a recent epidemiological study reinforces previous findings that identify race or ethnicity as being associated with early childhood caries.[8] Other studies focus on the infectious disease model for ECC and show that primary caregivers' oral health status is associated with the oral health of their young children.[9]

Because good oral hygiene practices and healthy eating habits are formed early in life and may be carried into adulthood, prevention programs for ECC that encourage parenting practices related to the dental health of the child should begin in the prenatal and perinatal periods. To be most effective, oral health education should be offered in tandem with programs targeting improved nutrition and decreased risk of other co-morbidities that are highly prevalent among Aboriginal children. For example, First Nations children in Northern Ontario have been reported to have higher prevalence of obesity than non-native Canadian children in the same age group.[10] Diets high in fermentable carbohydrates may increase both obesity and dental caries risk. Using a "common risk factor approach"[11] to disease prevention could provide a more effective means to promote the oral health of First Nations and Inuit children in Canada. In addition, the involvement of Canadian Aboriginal peoples in the design and implementation of community-based intervention programs is crucial to their success.[12]

Since the mid-1990s, public health dental hygienists in the Sioux Lookout Zone (SLZ) Dental Program, in partnership with the Sioux Lookout First Nations Health Authority, have been running a community-based dental preventive program for ECC through the help of Woman and Child Community Nutrition Program workers. When the program began, the SLZ, covering an area one-third the size of all Ontario, had a population of 15,000 Ojibway and Cree living in 28 communities. This community-based program was implemented to improve the nutritional status and well-being of prenatal women and their children up to 12 months postpartum. Most communities in the region have a "woman and child" nutrition educator who is trained annually in Sioux Lookout. During home visits, these health workers provide one-on-one, culturally appropriate, and community-specific nutrition and dental preventive education to pregnant women, new mothers, and elders raising children.



In October 1996 the program began distributing an ECC educational package, "Your Baby's Smile," written in both English and Oji-Cree. This package is given to caregivers 1 to 6 months after the birth of the child. Tippi-cups, toothbrushes, and dental information sheets are given to caregivers when the child is 6 to 12 months old. Other program activities include the following: promotion of healthy food choices by nutrition workers during scheduled food store visits with prenatal women and new mothers; optimal oral hygiene practices taught through the Head Start Brushing Program to toddlers, parents, and guardians; the reinforcement of healthy dental care practices by nursing staff during Well Child Clinics; biannual media campaigns run by dental hygienists and nutrition workers that include public service announcements on radio and the distribution of posters and pamphlets in public areas. More recently, the program was expanded to include smoking cessation sessions for women and the Breakfast for Learning program for children. The latter is supported in part by the Canadian Living Foundation, a national, non-profit organization dedicated to improving the nutrition of children.

This paper presents some of the findings from two oral health surveys of preschool children in the SLZ. The surveys were part of an evaluative study undertaken by investigators from the Faculty of Dentistry at the University of Toronto in 2001 and 2002. This study was to assess the effectiveness of the SLZ prenatal program on parents/primary caregivers' beliefs and their subsequent behavioural decisions related to dental preventive practices and feeding habits of infants and toddlers. Because these behaviours may ultimately affect the prevalence of ECC in these communities, oral health status data were also collected from representative samples of

preschool children in the SLZ. Looking beyond oral health issues, the study also measured the impact of the prenatal nutrition program on the prevalence of obesity in native preschool children and its potential association with levels of dental caries.

MATERIALS AND METHODS

Study design and sampling strategy

THE STUDY DESIGN USED BOTH CROSS-SECTIONAL and longitudinal approaches to compare children in communities with different levels of participation in the dental component of the prenatal nutrition program, that is, a high- and a low-intervention group. Levels of community participation in the program were determined by (1) examining quarterly site reports, which summarize the log and tracking sheets of prenatal nutrition workers that document their number of home visits to prenatal women and new mothers and the quality of their interaction with the mother and baby; and (2) monitoring the distribution of ECC educational materials and Tippi-cups. Although the program is delivered universally to all 28 communities on the reserve, high- and low-intervention groups were selected because the high turnover of local prenatal nutrition workers in some of these communities affected the program's coverage differentially. Thus a cut-off point of 70% or greater for program coverage was set for a "high" intervention community, and a cut-off point of 10% or less was set for "low" intervention communities. A total of 8 communities were classified as "high" intervention and 8 as "low" intervention. The communities in the two groups did not differ in their size or geographical isolation (distance to the main urban centre, Sioux Lookout). The Sioux Lookout Zone communities of Miskeegogamang (Osnaburgh), Weagamow (Round Lake), Frenchman's Head (Lac Seul), Wapekeka (Angling Lake), Bearskin Lake, Pikangikum, Kasabonika Lake, Sandy Lake, Kingfisher Lake, Sachigo Lake, Cat Lake, Wunnumin Lake, Poplar Hill, Deer Lake, Webequie, and Summer Beaver were contacted and all agreed to participate in the study but requested that the results not be presented by community in any reports or publications that grew out of the study. We agreed to this stipulation and it was decided that the health director and the chief of each community would receive a confidential report of the findings upon completion of our study. Scientific and ethical approval from the University of Toronto, the Sioux Lookout Zone Hospital Research Ethics Review Committee, and Sioux Lookout Zone Tribal Councils were obtained before the start of the study.

Band lists were used to identify children born in June 1996 up to February 1999. This age range was chosen because the program was targeted at prenatal women and was fully launched in mid-1996, so children aged 2 to 4½ at the begin-

Table 1. Response rates by survey year, study group, and reasons for non-response

Communities' level of exposure to the program[a]	Yr 2001				Yr 2002			
	High		Low		High		Low	
Total age-eligible	344		309		585		493	
Respondents (%)	230	(**66.9**)	241	(**78.0**)	367	(**62.7**)	338	(**68.6**)
Complete clinical examination (%)	224	(65.1)	236	(76.4)	365	(62.4)	334	(67.7)
Key sibling for questionnaire (%)	215		217		182		158	
Follow-up questionnaire (%)	—		—		156		152	
Non-respondents (%)	114	(33.1)	68	(22.0)	218	(37.3)	155	(31.4)
Reasons for non-response (%)								
- Could not be contacted	35	(10.2)	37	(12.0)	78	(13.3)	58	(11.8)
- Refusal (too far, too busy, parent at work)	8	(2.3)	10	(3.2)	5	(0.8)	16	(3.2)
- Child is sick	7	(2.0)	2	(0.6)	2	(0.3)	5	(1.0)
- Relocation	25	(7.3)	10	(3.2)	89	(15.2)	29	(5.9)
- Child is deceased	1	(0.3)	0	(0.0)	2	(0.3)	4	(0.8)
- Unknown	38	(11.0)	9	(2.9)	42	(7.2)	43	(8.7)
Participants								
2001 only (n = 134)	60		74					
2002 only (n = 369)					198		171	
2001 and 2002[b] (n = 336)					169		167	

[a] Sioux Lookout Zone Prenatal Nutrition Program for the prevention of early childhood caries (ECC): High = 8 out of 28 randomly selected communities with ≥70% distribution of program's oral health promotion materials during home visits to prenatal women and new mothers. Low = 8 out of 28 randomly selected communities with ≤10% distribution of program's oral health promotion materials during home visits to prenatal women and new mothers.

[b] Longitudinal data available but not shown.

ning of 2001 would be eligible. A total of 471 out of 653 age-eligible children participated in the 2001 oral health survey after parental informed consent was obtained in writing (72% response rate). In 2002, a new cohort of 2-year-old children were added to the study and the original cohort of 2-to-4-year-olds were re-examined and re-interviewed. A total of 705 out of 1078 (65% response rate) 2-to-5-year-old children (born between March 1999 and April 2000) participated. Out of those 705 caregiver-and-child pairs, complete oral health status data were compiled for 699 preschoolers (Table 1). Age-eligible siblings were examined but the caregiver's questionnaire was filled out only for the youngest child per caregiver in both 2001 and 2002 surveys. This is because it was observed that when the questionnaire was pilot tested, mothers were more likely to recall the feeding and oral hygiene practices of their youngest child as opposed to those for older children.

Clinical examinations of preschool Aboriginal children on reserves

Four teams of calibrated dental hygienists and recorders were flown into the participating communities for an average stay of 3 to 7 days to carry out the oral examinations and interviews. All examinations and most interviews were conducted at Health Canada's nursing stations assisted by community translators and dental assistants. A few caregiver interviews were conducted at either the child's home or over the telephone. Recruitment strategies included local radio broadcasting to promote the project and remind caregivers of their children's appointment.

Examiner calibration sessions in the use of the caries diagnostic criteria of the National Institute of Dental Research (NIDR)[13] were performed with 8–10 children over a 1½-day period in the Sioux Lookout Zone Dental Department (Sioux Lookout, ON) immediately before the two waves of data collection began. Dental hygienists were calibrated against a gold-standard dentist examiner in the use of the dmft/s indices using plane mouth mirrors. The explorer was used as a tool to remove plaque and debris and check the surface characteristics of suspected carious lesions. Carious lesions were recorded either at the non-cavitated (d_1) or the cavitated (d_3) visual level of dentinal involvement, and abscessed teeth were referred for urgent treatment. The Debris Index (DI)[14] was used to measure soft deposits on the labial surfaces of incisors or a substitute tooth before the tooth surfaces were examined for decay. Radiographs were not used. Kappa values for inter-examiner agreement ranged from 0.6 to 0.8 in both survey years. The study adopted the National Institute of Dental and Craniofacial Research's (NIDCR) ECC case definition.[15]

Caregiver survey of knowledge, beliefs, attitudes, and practices in relation to child oral health

In 2001, each child's primary caregiver was asked to complete a behavioural questionnaire developed specifically for this study and pilot tested on a sample of mothers of young children in SLZ communities. The questionnaire assessed the following: the child's dental history and dental care utilization pattern (including having dental treatment under general anesthesia in the SLZ Hospital); the child's general health, birth history, oral hygiene practices, and feeding his-

Table 2. Percent distribution of First Nations children by communities' level of exposure[a] to the prenatal nutrition program and important characteristics of the child, mother/primary caregiver, and household in the 2001 and 2002 Oral Health Surveys of Preschool Children in the Sioux Lookout Zone, Ontario

Communities' level of exposure to the program[a]	Yr 2001		Yr 2002 (*new* participants)	
	High n=230 %	Low n=241 %	High n=198 %	Low n=171 %
Child's characteristics				
Male	51.7	51.5	49.5	56.7
Age (yrs)				
2	37.0	38.6	60.6	68.7
3	47.8	44.0	22.2	17.5
4	15.2	17.4	12.1	11.7
5	N/A	N/A	5.1	2.3
Birth order	(n=215)	(n=217)	(n=182)	(n=158)
Youngest child[b]	63.9	59.8	55.7	48.5
Born prematurely (<37 wks)	17.0	13.7	10.7	12.2
Low birthweight (<2,500 grams)	4.7	3.8	1.1	4.6
Use of sweetened medications for >1 wk	64.0	70.0	71.2	71.3
Caregiver's rating of child's general health				
Excellent/very good/good	92.1	94.5	89.6	93.0
Fair/poor/very poor	7.9	5.5	10.4	7.0
Caregiver's rating of child's oral/dental health				
Are you satisfied with the way your child's teeth look?				
Very much (Excellent)	8.0	15.2	14.3	10.2
They look OK (Good)	37.3	29.0	30.2	45.9
Not much (Some problems)	38.2	35.2	36.3	31.8
Not at all (Not satisfied)	16.5	20.5	19.2	12.1
	$\chi^2 = 8.03$, $p = 0.045$		**$\chi^2 = 9.81$, $p = 0.020$**	
Birthmother's characteristics				
Age group				
≤ 20 years of age	7.3	6.4	11.6	8.4
> 20 to < 25 years	38.2	30.3	38.1	39.7
25 years and older	54.5	63.3	50.3	51.9
Educational level				
Less than high school	76.5	82.4	82.1	82.4
High school completed (Grade 12)	11.7	10.6	11.5	10.7
More than high school education	11.7	6.9	6.4	6.9
Primary caregiver's characteristics (birthmother included)				
Relationship to child				
Birthmother	83.7	88.5	86.3	82.9
Father	5.6	7.4	5.5	10.1
Foster/step/adopted mother	3.3	1.4	4.4	1.9
Grandparent	6.0	2.8	3.8	3.2
Other relative	1.4	0.0	0.0	1.9
Do you have your own natural teeth?				
Yes, most of my own teeth	N/A	N/A	91.1	74.7
Yes, I have a few of my own teeth	N/A	N/A	6.1	20.3
No, I have dentures/false teeth	N/A	N/A	2.2	3.8
No, I have no natural or false teeth	N/A	N/A	0.6	1.3
			$\chi^2 = 17.1$, $p = 0.001$	

continued…

Communities' level of exposure to the program[a]	Yr 2001		Yr 2002 (*new* participants)	
	High n=230 %	Low n=241 %	High n=198 %	Low n=171 %
When do you usually go to the dentist/dental hygienist?				
Regularly	32.7	30.0	41.5	25.2
Only when in pain	44.9	51.6	43.2	55.5
Never or rarely	22.4	18.3	15.3	19.4
			χ^2 = 9.8, *p* = 0.007	
Household characteristics				
Number of children living in the home				
Mean ± std. error	2.8 ± 0.10	3.6 ± 0.14	2.8 ± 0.11	3.5 ± 0.18
Mann-Whitney *U* test	***p* < 0.001**		***p* = 0.011**	
Number of adults (including the child's caregiver) living in the home				
Mean ± std. error	2.3 ± 0.07	2.6 ± 0.10	2.4 ± 0.08	2.6 ± 0.13

N/A = Not applicable or 'not asked' in the 2001 Oral Health Survey.

[a] High = 8 out of 28 randomly selected communities with ≥70% distribution of program's oral health promotion materials during home visits to prenatal women and new mothers. Low = 8 out of 28 randomly selected communities with ≤10% distribution of program's oral health promotion materials during home visits to prenatal women and new mothers.

[b] Key sibling for questionnaire, that is, the questionnaire was completed for the youngest child in each family.

N.B.: When *p*-values are not reported, the results are not statistically significant. This applies to all tables.

tory; the caregiver's socio-demographics, source of information regarding oral health issues, awareness of, and participation in, the components of the prenatal nutrition program; and the caregiver's oral health knowledge, beliefs, and attitudes in relation to ECC. Questionnaire items were based on a review of the literature and were adapted to reflect the content of the dental component of the prenatal nutrition program. The purpose of the pilot testing of the questionnaire was to check for face and content validity, that is, whether the instrument appears culturally appropriate for the intended purpose. Pilot testing resulted in several items being reworded and a question on the caregiver's income being deleted.

The questionnaire was used again in 2002 with the new participants in the study (n=369). In addition, a separate, similar caregiver's questionnaire was designed to detect changes since the previous year's interview and was applied to a subset of caregiver-and-child pairs who were followed for 1 year (n=336, data not presented). It also included sections on the caregiver's readiness to adopt oral health preventive behaviours, maternal depression, smoking status, pregnancy complications, oral health perception, dental status, pattern of dental services use, and perceived impact of ECC on the daily activities of the child and the family.

Other measures

The child's medical history and birthweight were confirmed through chart reviews at the nursing stations. The child's age, sex, current weight and height, from which the Body Mass Index (BMI = wt in kg/ht in m^2) was calculated, were recorded by the examiner. In children and teens, the BMI is used to assess underweight, overweight, and risk for being overweight. The BMI for children, referred to as BMI-for-age, is also gender and age specific.[16,17] The BMI-for-age was plotted on gender-specific 2000 Center for Disease Control's (CDC) growth charts.[18] Children were categorized based on percentile values of BMI-for-age (cut-off points: ≥95th percentile, ≥85th–<95th percentile, ≥5th–<85th percentile, and <5th percentile) to identify those who were underweight and those who were overweight.

Timeline of activities

Pilot testing of the caregiver questionnaire took place in November and December 2000 in Lac Seul and Osnaburgh. The first examiner calibration session was held in early February 2001 in Sioux Lookout, followed immediately by subject enrolment, baseline clinical examinations and interviews until the end of March 2001. Data entry and preliminary analyses, collection of program costs, and interviews of "key players" for purpose of process evaluation happened midway between the two cycles of data collection. The second-year training and calibration of examiners, immediately followed by data collection, started in February 2002 when the cycle of activities repeated itself. The project findings were presented annually at local and scientific meetings and at the Nishnawbe Aski Nation Health Conference held in November 2002.

Data analysis

Data analysis consisted of bivariate statistics to determine significant differences between the study groups (*i.e.*, child and caregiver from the high- or low-intervention communities) in terms of the caregiver's responses to survey questions or the child's clinical examination findings. The chi-squared test was used for differences in proportions. The two independent-samples *t* test was used for the comparison of means. If the distribution of continuous variables was skewed, the Mann Whitney *U* test was used instead of the *t* test. This was the case for dmf data that were skewed to higher values. The association between BMI-for-age categories and dmft index scores was analyzed using the Kruskal-Wallis test. All analyses were stratified by oral health

Table 3. Impact of the prenatal nutrition program on parent/caregiver's knowledge, beliefs, and attitudes in relation to infants' oral health: frequency rating (%) for each item in the oral health knowledge assessments and total scores for the parents/caregivers enrolled in the 2001 and 2002 (*new* participants) Oral Health Surveys of Preschool Children in the Sioux Lookout Zone, Ontario

Statement	% AGREE[a] 2001 High[b] n=215	% AGREE 2001 Low n=217	% AGREE 2002 High n=182	% AGREE 2002 Low n=158
1. Baby teeth are important even though they fall out.	82.3	72.3	88.9	88.0
2. Problems with baby teeth will affect adult teeth.	50.9	52.1	55.2	43.7
3. Tooth decay (rotten teeth) could affect my child's health.	78.4	76.4	75.7	69.6
4. A baby's mouth should be cleaned before the first baby tooth is in the mouth.	86.0	81.9	85.6	91.0
5. Brushing my child's teeth with fluoride toothpaste will help prevent tooth decay.	83.3	76.4	85.1	83.5
6. Baby teeth are developed before the baby is born.	48.1	33.0	43.1	29.1
7. My diet during pregnancy will affect my baby's teeth.	32.4	24.8	30.4	29.3
8. It's a good idea to give my baby a bottle to comfort him/her while teething.	17.2	21.0	18.9	24.2
9. Frequently feeding my child sweetened liquids, such as pop and fruit juice, is bad for his/her teeth.	94.9	90.6	92.8	89.9
10. Frequently feeding my child milk or formula is bad for his/her teeth.	23.0	24.2	27.6	35.4
11. As my baby gets older and can hold a bottle easily, he/she can have a bottle whenever he/she wants.	21.6	34.1	29.4	40.8
12. It's okay to let my child nurse in bed with me all night.[c]	14.0[c]	9.8[c]	25.6	29.1
13. It's okay to put my child to bed with a bottle.[c]	14.0[c]	9.8[c]	14.9	19.1
14. Bottle-feeding after my child is 1-year-old is bad for his/her teeth.	79.9	76.1	67.4	73.4
Total Score (ranges: 0–13 in 2001 & 0–14 in 2002; higher scores are indicative of increased knowledge) Mean ± std. error	**8.62[d] ± 0.14**	**7.73 ± 0.18**	**9.07[e] ± 0.18**	**8.55 ± 0.20**

[a] Respondents were given the options to agree/disagree with the statement or check "don't know."
[b] High = 8 out of 28 randomly selected communities with ≥70% distribution of program's oral health promotion materials.
Low = 8 out of 28 randomly selected communities with ≤10% distribution of program's oral health promotion materials.
[c] Statements 12 and 13 formed a single item in the 2001 oral health survey.
[d] p <0.001 (t-test); [e] p <0.05 (t-test)

survey year, 2001 and 2002. The cross-sectional data reported in this paper are just for child-and-caregiver pairs who participated in 2001 or in 2002, not in both years. Oral health status data are presented, stratified by the child's age. Since most of the new participants enrolled in 2002 were under 3 years of age, clinical exam data are reported for 2-year-olds only in the 2002 oral health survey. Statistical tests were two-tailed and interpreted at the 5% level using the SPSS statistical software (Version 11.0) for data analysis.

RESULTS

THANKS TO THE STRONG PARTNERSHIP THAT WAS forged between the public health dental hygienists co-ordinating the study and their communities, there were high response rates for an epidemiological study of this nature, both in the first- and second-year oral health surveys (Table 1). The rates and reasons for non-response did not differ significantly between the two study groups and were mainly the result of not being able to contact the caregiver during the time the research team was on the reserve.

The study groups had balanced sex and age distributions in the oral health surveys in 2001 and 2002 (Table 2). In 2002, the majority of the new enrollees were aged 2. Most primary caregivers were the birth mothers, who rated their satisfaction with their child's teeth significantly poorer in the low-intervention communities in 2001. However, the caregivers of the new participants in these communities in 2002 were generally more satisfied with the way their child's teeth looked than those in the high-intervention communities. Based on self-reporting, it appears that the caregivers in the low-intervention communities had a poorer oral health sta-

Table 4. Impact of the prenatal nutrition program on parenting behaviours related to child preventive oral health practices and dental care utilization: results from the 2001 and 2002 Oral Health Surveys of Preschool Children in the Sioux Lookout Zone, Ontario

Communities' level of exposure to the program[a]	Yr 2001 High n=215 %	Yr 2001 Low n=217 %	Yr 2002 (*new* participants) High n=182 %	Yr 2002 (*new* participants) Low n=158 %
Child's oral hygiene and other caries preventive practices				
How often do you, or someone else in your family, clean your child's teeth?				
Never	3.3	7.9	1.6	12.7
A few times per month	10.7	16.2	7.1	8.9
Once a week	12.6	10.2	13.7	7.0
A few times per week	24.3	19.4	26.9	24.1
Once a day	22.9	26.4	30.8	22.2
Two or more times per day	26.2	19.9	19.8	25.3
	χ^2 test, $p = 0.062$ (NS)		**$\chi^2 = 22.9$, $p < 0.001$**	
What do you use to clean your child's teeth?	(n=207)	(n=200)	(n=179)	(n=138)
Toothbrush	97.1	98.0	90.5	97.1
Washcloth/tender/gauze sponge	2.9	2.0	1.7	1.4
Dental floss or other	0.0	0.0	7.9	1.4
At what age did you or someone else in your family, start to clean your child's teeth?				
Mean ± std. error (months)	12.1 ± 0.63	13.0 ± 0.67	10.4 ± 0.54	12.7 ± 0.74
Mann-Whitney *U* test				**$p = 0.006$**
Toothpaste use	93.7	95.0	90.0	96.4
Child's dental care utilization				
Has your child ever been to a dentist/dental hygienist?				
Yes	58.4	56.2	55.8	40.1
			$\chi^2 = 8.27$, $p = 0.004$	
At what age was your child's first dental visit?	(n=125)	(n=122)	(n=101)	(n=63)
Before age one	11.8	5.1	2.0	3.4
Age 1 to 2	73.9	72.0	79.2	71.2
Age 3 to 4	14.3	22.9	18.8	25.4
	χ^2 test, $p = 0.063$ (NS)			
What was the reason for your child's first dental visit?				
Regular check-up	50.0	32.8	33.3	28.6
Toothache/dental pain	18.0	27.2	14.7	19.0
Cavities/rotten teeth	N/A	N/A	22.5	30.2
Concern about appearance of teeth/gums	18.8	26.4	8.8	4.8
Facial swelling/abscess/infection	1.6	4.0	4.9	9.5
Trauma/accident/injury	1.6	1.6	9.8	3.2
Other	10.2	8.0	5.9	4.8

[a] High = 8 out of 28 randomly selected communities with ≥70% distribution of oral health promotion materials.
Low = 8 out of 28 randomly selected communities with ≤10% distribution of oral health promotion materials.
N/A = category 'not asked' in the 2001 Oral Health Survey.
NS = not statistically significant at the 5% level but significant at the 6% level.

tus and lived with more children in the home than those in the high-intervention communities.

The prenatal program had a significant impact on the caregiver's knowledge, beliefs, and attitudes in relation to their infant's oral health (Table 3). Specifically, caregivers in communities where program coverage was high scored significantly better on the dental knowledge assessment. The questionnaire items that showed differences between the high and low groups were related to intra-uterine tooth formation, the impact of the prenatal diet on the baby's teeth, and bottle-feeding to "comfort the baby while teething" or "to be used whenever the baby is old enough to hold the bottle."

According to the responses from the caregivers' survey, a greater proportion of parents or caregivers in the high-intervention communities reported cleaning their child's teeth at a higher frequency, and starting at an earlier age, as compared

Table 5. Impact of the prenatal nutrition program on parenting behaviours related to breast- and bottle-feeding practices: results from the 2001 and 2002 Oral Health Surveys of Preschool Children in the Sioux Lookout Zone, Ontario

Communities' level of exposure to the program[a]	Yr 2001 High n=215 %	Yr 2001 Low n=217 %	Yr 2002 (*new* participants) High n=182 %	Yr 2002 (*new* participants) Low n=158 %
Breastfeeding practices				
Did or do you breastfeed your child?				
Yes	71.6	74.0	74.2	77.2
If yes, how long was/has your child breastfed?	(n=154)	(n=160)	(n=135)	(n=122)
Mean ± std. error (months)	15.4 ± 1.14	13.6 ± 1.07	14.8 ± 1.02	13.1 ± 1.01
At what age did you wean your child from breastfeeding?				
Mean ± std. error (months)	12.6 ± 1.00	10.1 ± 0.88	8.5 ± 0.83	7.68 ± 0.79
Still breastfeeding child (%)	16.8	26.9	22.2	20.8
	χ^2 = 4.69, *p* = 0.030			
Bottle-feeding practices				
Did you ever bottle-feed your child?				
Yes	78.4	86.0	80.1	88.6
	χ^2 = 4.19, *p* = 0.041		**χ^2 = 4.55, *p* = 0.033**	
At what age did you start bottle-feeding your child?	(n=169)	(n=186)	(n=145)	(n=140)
Mean ± std. error (months)	5.0 ± 0.54	5.7 ± 0.51	5.1 ± 0.59	6.2 ± 0.58
Other than for meals, when did/do you give your baby a bottle?				
Nap time: Never	7.3	15.2	11.7	7.9
Sometimes	43.3	49.7	49.0	52.9
Always	49.4	35.2	39.3	39.3
	χ^2 = 9.16, *p* = 0.010			
Bed time: Never	7.2	13.3	11.7	12.2
Sometimes	28.1	36.7	29.7	33.8
Always	64.7	50.0	58.6	54.0
	χ^2 = 8.03, *p* = 0.018			
Child crying: Never	16.7	15.1	14.5	13.8
Sometimes	50.0	52.3	69.7	55.1
Always	33.3	32.6	15.9	31.2
			χ^2 = 9.52, *p* = 0.009	
On average, how often does the child walk around with a bottle to sip from during the day?				
Never	N/A		23.3	27.9
Sometimes			58.2	48.6
Often			16.4	15.0
All the time			2.1	8.6
			χ^2 = 7.71, *p* = 0.052	
If the child uses a bottle, what is most often contained in the bottle?				
Cow's milk	N/A		28.1	14.3
Condensed milk (for example, Carnation milk)			23.3	48.6
Formula			25.3	18.6
Plain water			2.1	2.1
Sweetened water/tea			8.2	7.1
Soft drinks (for example, pop)			0.7	0.7
Fruit juice			12.3	8.6
			χ^2 = 24.7, *p* = 0.001	
Do you add sugar or sweeteners to your child's bottle?				
Yes	N/A		34.5	55.4
			χ^2 =12.6, *p* < 0.001	

continued…

Communities' level of exposure to the program[a]	Yr 2001		Yr 2002 (*new* participants)	
	High n=215 %	Low n=217 %	High n=182 %	Low n=158 %
At what age did you stop giving your child a bottle?				
Mean ± std. error (months)	22.5 ± 1.00	21.8 ± 1.03	20.5 ± 1.17	22.3 ± 1.23
Continue to bottle-feed (%)	52.4	51.4	53.8	61.9
Tippi-cup use				
Is the child using a Tippi-cup now?				
Yes	N/A	N/A	53.3	55.1
At what age did the child start to use the Tippi-cup?			(n=97)	(n=87)
Mean ± std. error (months)	N/A	N/A	13.9 ± 0.58	15.7 ± 0.70
Mann-Whitney *U* test			***p* = 0.048**	
Child continues to use a Tippi-cup (%)	N/A	N/A	91.5	87.0

[a] High = 8 out of 28 randomly selected communities with ≥70% distribution of oral health promotion materials.
Low = 8 out of 28 randomly selected communities with ≤10% distribution of oral health promotion materials.
N/A = item or response category 'not asked' in the 2001 Oral Health Survey or in the 2002 Oral Survey.

with those in the low-intervention communities. These results reached statistical significance in the 2002 survey sample (Table 4). Over half of the parents reported that the child had seen a dentist or a dental hygienist in the past, with the majority of children being seen for the first time between the ages of 1 and 2 years. An increased proportion of children were seen by a dentist or dental hygienist for reasons related to tooth or mouth problems in the low-intervention communities than in the high, but this difference was not statistically significant (Table 4).

Overall, children in the SLZ communities were breastfed for more than 12 months, and a higher proportion of caregivers in the low-intervention communities were still breastfeeding in 2001 (Table 5). Contrary to expectations, the bottle was used at naptime and bedtime more often by children in the high- versus the low-intervention communities in 2001. Conversely, in 2002, a greater proportion of caregivers in the low-intervention communities were "always" giving the child the bottle when she/he cried for it outside mealtime. In addition, children in the low-intervention communities

Table 6. Impact of the prenatal nutrition program on caregiver nutrition choices with respect to their children: results from the 2001 and 2002 Oral Health Surveys of Preschool Children in the Sioux Lookout Zone, Ontario

Communities' level of exposure to the program[a]	Yr 2001		Yr 2002 (*new* participants)	
	High n=215 %	Low n=217 %	High n=182 %	Low n=158 %
Sugary snacks per day				
Fewer than 2	4.7	4.7	N/A	
At least 2	95.3	95.3		
Whose advice did/do you follow when making decisions on what to feed your child?				
Child's grandparents or other relative	N/A		37.6	33.5
Nutrition educator			3.3	1.3
Doctor or health worker			9.9	7.0
Spouse			3.9	1.9
Friend			1.7	1.9
Other			0.0	1.9
"No one, I figured it out myself"			43.6	52.5
The choices you make when feeding your child are dependent on...				
Child's demands	N/A		35.4	41.6
Available time			19.9	12.1
Limited variety of groceries available			17.7	16.1
Cost of food			10.5	6.0
Child's health			11.6	15.4
Other			5.0	8.7
Do/did you ever chew the child's food before giving it to the child?				
Yes	33.3	44.0	53.6	51.9
	$\chi^2 = 3.67$, $p = 0.054$			
Do/did you and your child share the same spoons and forks, or cups and bottles, during feeding time?				
Yes	31.6	34.0	37.6	40.8
Did/does your child use a sweetened soother, for example, a pacifier dipped in sugar/honey?				
Yes	1.9	4.2	N/A	N/A

[a] High = 8 out of 28 randomly selected communities with ≥70% distribution of oral health promotion materials.
Low = 8 out of 28 randomly selected communities with ≤10% distribution of oral health promotion materials.
N/A = item or response category 'not asked' in the 2001 Oral Health Survey or in the 2002 Oral Survey.

were more likely to walk around with a bottle to sip from during the day, most often containing cariogenic liquids such as Carnation milk or sugar/sweeteners added to the contents of the bottle. The Tippi-cup was introduced later for children in the low-intervention communities, but approximately half of the caregivers in both groups continued to use the bottle after the Tippi-cups were provided.

Daily consumption of sugary snacks was widespread in all communities, whereas the habit of dipping the pacifier in sugar or honey was not common (Table 6). Caregivers reported getting information from a grandparent or another relative about feeding their child, but mostly they "figured it out by themselves." Interestingly, the majority of caregivers participating in 2002 reported that the choices they make when feeding their child depended on the child's demand. Finally, a significantly lower proportion of parents in the high-intervention communities in 2001 reported the habit of chewing the child's food before giving it to the child. This is possibly the result of the program's oral health education messages that warn against the practice.

Despite significant effects of the program on the oral health-related knowledge, beliefs, and practices of the caregiver, dental caries experience remained very high in the SLZ communities (Table 7). For example, using the proposed case definition of ECC by the National Institute of Dental and Craniofacial Research (NIDCR), over 90% of children were classified as cases, regardless of whether they were in the high- or low-intervention communities. The NIDCR definition classifies a child under 71 months with 1 or more dmf surfaces, non-cavitated or cavitated, as having ECC.[15] However, a significantly higher proportion of 2-year-olds in 2001 required dental care under general anesthesia at the Zone Hospital if they resided in low-intervention areas. However, rates of dental treatment under general anesthesia increased progressively with age regardless of study group and were slightly increased for new 2-year-olds in the 2002 survey. The guideline for hospital-based care was deemed as treatment required in 3 to 4 quadrants of the mouth in children at least 2½ years old if all 20 primary teeth had erupted. Treatment under general anesthetic consisted of extractions

Table 7. Dental care under general anesthesia (GA) and caries prevalence in 2-4 year-old, First Nations children in the Sioux Lookout Zone, Ontario by oral health survey year and communities' level of exposure to the prenatal nutrition program[a]

	Yr 2001 2-yr-olds		3-yr-olds		4-yr-olds		Yr 2002 *New* 2-yr-olds	
	High n=82	Low n=89	High n=108	Low n=105	High n=34	Low n=42	High n=120	Low n=117
Percentage who had a dental GA	**6.1**	**15.7***	32.4	29.5	62.9	45.2	15.3	12.3
Percentage with decayed tooth (d_3t)[b]								
0	8.5	13.5	14.8	9.5	20.6	11.9	12.7	11.8
1-3	6.1	13.5	10.2	5.7	23.5	16.7	14.4	15.5
4+	85.4	73.0	75.0	84.8	55.9	71.4	72.9	72.7
Percentage with 1+ abscessed tooth	6.1	1.1	**3.7**	**12.4***	0.0	9.5	4.2	8.5
Percentage with teeth missing due to caries								
0	92.7	80.9	65.7	64.8	32.4	50.0	80.5	85.5
1-3	1.2	4.5	3.7	7.6	8.8	7.1	4.2	1.8
4	4.9	12.4	10.2	13.3	17.6	19.0	11.9	11.8
>4	1.2	2.2	20.4	14.3	41.2	23.8	3.4	0.9
Percentage missing maxillary incisors/canines due to caries	6.1	13.5	29.6	26.7	55.9	42.9	18.6	14.5
Percentage with 1+ stainless steel crowns	1.2	1.1	24.1	15.2	47.1	26.2	1.7	0.9
Mean $d_{1\text{-}3}s$[b]	**26.5**	**19.8****	**22.0**	**29.3****	**15.7**	**25.2****	15.9	17.2
Standard Error	2.0	1.6	1.8	1.8	2.7	3.2	1.2	1.3
Mean $d_3$mft (w/o SSC)[b]	**10.2**	**8.0****	**10.2**	**12.2****	10.0	10.9	7.8	7.3
Standard Error	0.6	0.5	0.4	0.4	0.9	0.7	0.5	0.5
Mean % $d_3/(d_3$mft w/ SSC)	96.1	90.4	73.6	81.2	**49.1**	**67.8****	91.0	92.6
Standard Error	3.2	3.7	3.8	3.1	6.9	5.6	1.8	1.9
Percentage soft debris covering > ⅓ labial surface of tooth 61 or 21 and/or 81 or 41	**37.0**	**54.5***	42.6	51.9	29.4	42.9	**46.7**	**62.9***

[a] High = 8 out of 28 randomly selected communities with ≥70% distribution of oral health promotion materials during home visits to prenatal women and new mothers. Low = 8 out of 28 randomly selected communities with ≤10% distribution of oral health promotion materials during home visits to prenatal women and new mothers.

[b] d_3 = cavitated carious lesion. d_1 = non-cavitated carious lesion. Unless otherwise stated, the $d_3$mft index does not include stainless steel crowns.

*p<0.05, chi-squared test, **p<0.05, Mann-Whitney U test.

of severely affected teeth and the prophylactic placement of stainless steel crowns on deciduous canines and molars. As a result of treatment, the rates of missing teeth and stainless steel crowns increased with age and occurred independently of program activities. The beneficial caries-inhibiting effect of the program was observed on rates of abscessed teeth for 3-year-olds and on carious teeth and surfaces for 3- and 4-year-old children. Most of the dmf index in these children was composed of untreated caries compared with children living in communities with high exposure to the prenatal program. A higher proportion of children aged 2 in 2001 had less debris/plaque but a higher mean number of decayed surfaces and a higher mean $d_3$mft if they resided in communities with high exposure to the prenatal program. This may be the result of the confounding effect of treatment that started earlier in the low-intervention communities in the 2001 sample. These effects were not observed for the new 2-year-old subjects in 2002, except that oral hygiene was improved in the high-intervention communities.

Data presented in Table 8 indicate that the nutrition program targeted at prenatal women and their infants decreased the risk for preschool obesity in the Aboriginal population. A higher proportion of preschool children were classified as "overweight" in the low-intervention group than in the high-intervention group in the 2002 oral health survey. There was no significant difference in mean $d_3$mft values between groups categorized by BMI-for-age.

DISCUSSION

THE CARIES PREVALENCE FOUND IN THE preschool Aboriginal Canadians in this study is among the highest reported for this age cohort. In 1973 and 1983, studies assessed the caries experience in children 5 years and older in Sioux Lookout Zone communities.[19,20] Comparing the caries rates in 4-year-old children in the present investigation to those investigated in 1973 and 1983 suggests that caries rates have increased over the years. This temporal change in caries prevalence has also been reported in Apache American preschool children.[21] However, the level of treatment received by this age group was greater in 2001–2002 than that provided in 1973 and 1983.

Approximately one-third of the subjects had undergone a dental procedure under general anesthesia in 2001.

Treating ECC has proved costly due to geographical barriers that make access to dental care difficult in these isolated Northern communities and often require children and caregivers to be flown to the Sioux Lookout Zone Hospital for treatment under general anesthesia. Currently, access to dental practitioners and dental hygienists is provided under the Non-Insured Health Benefits (NIHB) Program of the Medical Services Branch of Health Canada. The mean total treatment cost per general-anesthesia case in the SLZ Hospital was estimated at CAD$2,642.50. The total cost to Health Canada for dental services for this age group was nearly half a million dollars in 2001.

By itself, access to dental care cannot eliminate the burden of dental caries. Ismail *et al.*'s study found that the disparities in caries prevalence among 6- and 7-year-old children in Nova Scotia at different socio-economic levels have not been eliminated even though children had been given access to publicly financed dental insurance programs since birth.[22] Rather, the authors concluded that a multifactorial approach is needed to address family and community determinants of oral health.[22] Our study found that broad-based programs that focus on both the child and the caregiver and that have the support of community health workers and nutritionists can produce positive outcomes. Acting as the first line of defence, the public health dental hygienist can play an important role in developing early preventive care programs that combat ECC and reduce the need for treatments under general anesthesia and in turn reduce medical care costs. The cost of ECC treatment is, in itself, sufficient reason for policy makers and other health professionals to dedicate both time and money to promote the oral health of this vulnerable pediatric population and to direct more attention to the health disparities between native and non-native children.

This community-based prenatal intervention conducted by dental hygienists and nutrition educators was found to be effective in improving children's oral hygiene and in reducing the number of children needing emergency care for abscessed teeth. It has not, at present, reduced the number of referrals for general anesthesia. The effect of the program on dental caries and pain reduction in preschool-aged children was only evidenced for 3-year-olds because at this age, most Aboriginal children have all of their primary teeth, are more independent, and their eating habits appear to worsen. By age 4, dental treatment started to reduce the untreated caries rates for both high- and low-intervention groups. Thus more intensive preventive interventions for 2- to 4-year-old children are needed to augment the existing prenatal/new mothers nutrition program. ECC preventive programs aimed at toddlers would ensure that any inroads made in the first year of life would be continued in the formative years when calcification of children's teeth is taking place. Such interventions also must be developed with full participation of the Aboriginal communities, as ownership of the program by these communities will undoubtedly enhance sustainability and future success. After all, we need to keep in mind that health promotion is "the process of enabling people to increase control over, and to improve, their health."[23]

The caries prevalence found in the preschool Aboriginal Canadians in this study is among the highest reported for this age cohort

Despite the limitation of cross-sectional study designs to demonstrate causal relationships, the study showed that more caregivers who lived in high-intervention communities adopted child-feeding practices that prevent ECC than in the low-intervention communities. In particular, risk factors associated with the development of this disease—introducing tooth cleaning habits at an older age and the inappropriate use of the baby bottle upon a child's demand—are common to other high-risk child populations in Canada and the United States.[24-28] Interestingly, however, naptime and bedtime use of the bottle were behaviours that continued in the high-intervention communities. This sug-

Table 8. Impact of the prenatal nutrition program in the Sioux Lookout Zone on percentile 'BMI-for-age'[a] category distribution for 2- to 5-year-old children by oral health survey year. Mean number of cavitated decayed, missing or filled primary teeth ($d_3$mft) according to BMI category

Communities' level of exposure to the program[b]	Yr 2001				Yr 2002 (*new* participants)			
	High n=230		Low n=241		High n=198		Low n=171	
Percentile BMI-for-age[a]	**%**	**$d_3$mft**	**%**	**$d_3$mft**	**%**	**$d_3$mft**	**%**	**$d_3$mft**
<5th *(underweight)*	6.6	8.8	7.2	9.1	**3.5**	10.3	**2.9**	6.4
≥5th to <85th	57.0	10.9	51.1	9.7	**54.5**	8.1	**40.6**	8.8
≥85th to <95th *(at risk of overweight)*	16.2	10.5	21.1	11.2	**16.2**	9.0	**24.7**	8.2
≥95th *(overweight)*	20.2	8.4	20.7	11.2	**25.8**	8.6	**31.8**	8.5
					$\chi^2 = 9.534$, $p = 0.023$[c]			

[a] Body Mass Index, or BMI = wt (kg) / ht^2 (m^2). BMI for children, also referred to as BMI-for-age, is gender and age specific.[16,17] BMI-for-age is plotted on gender-specific 2000 CDC Growth Charts.[18]

[b] High = 8 out of 28 randomly selected communities with ≥70% distribution of program's oral health promotion materials during home visits to prenatal women and new mothers. Low = 8 out of 28 randomly selected communities with ≤10% distribution of program's oral health promotion materials during home visits to prenatal women and new mothers.

[c] *P*-value for the differences in the proportion of children by BMI-for-age category versus the communities' level of exposure to the program. The differences between the mean dmft for 2- to 5-year-old subjects among the BMI-for-age categories were not statistically significant (Kruskal-Wallis, $p>0.05$).

Treating ECC has proved costly due to geographical barriers that make access to dental care difficult

gests that using the bottle to help babies fall asleep might be culturally acceptable and/or a way that young or single-parent families from poor socio-economic and educational backgrounds might cope with one of the stresses of child-rearing. In addition, the surveys in 2002 included questions related to the oral health status of the primary caregiver and showed that caregivers in the low-intervention communities have significantly poorer self-reported oral health, visit the dentist less often, and had more children living in the home than those in the high-intervention communities. Thus a strategy directed at improving the caregivers' own oral health knowledge and related health behaviours may be an important element in the prevention of caries in their children, particularly when this strategy is paired with other programs directed at improving the living conditions and educational opportunities of teens and young adults living in Aboriginal communities.

We believe the partial success of the program might be the result of the way that the transfer of knowledge takes place during home visits from health care workers. The prenatal women/caregivers surveyed in the high-intervention group appear to have responded well to peer counseling from the health workers in the SLZ. During home visits, prenatal women are instructed on the importance of healthy infant nutrition in the prevention of chronic diseases, such as diabetes and early childhood caries. The community health workers convey these messages using visual aids contained in binders that explain the various diseases that children are prone to and the means to prevent those diseases. For example, the dental binder includes pictures of ECC and culturally appropriate messages regarding child-feeding practices, notably the proper use of baby bottles. During follow-up home visits to new mothers, community nutrition workers assess whether mothers have adopted the behaviours explained at the initial home visit. The health workers use a checklist to record the mother's responses and to determine if deficiencies exist with regards to following the advice given in the binders. Once deficiencies have been determined, health workers then focus on these areas during subsequent visits.

It has long been recognized that educational interventions alone have only a limited capacity to achieve long-term sustained changes in individual behaviours.[29] However, research has demonstrated that patterns of behaviour learned during early childhood, such as tooth brushing habits, become accepted routines throughout one's life.[30] One of the goals of the dental component of the Prenatal Nutrition Program in the SLZ is the formation of good health habits in the young rather than behaviour modification later. Community health workers are in a unique position to give dental preventive advice to pregnant and nursing mothers.[31] In Canada and the United States, successful oral health promotion programs for Aboriginal populations have been implemented and showed an overall decrease in the prevalence of ECC.[32-34] These programs attempted to decrease the social acceptance of prolonged bottle-feeding by tailoring the intervention to the cultural beliefs of the community so as to make people more receptive to behavioural change. The SLZ Prenatal Nutrition Program for the prevention of ECC was founded on this theoretical basis and sees oral health promotion as integral to the health of the child, the family, and the community.

Additionally, community health workers can also be trained in the use of behavioural management skills to motivate parents/caregivers to change their child-rearing practices with respect to dental care. One such technique is Motivational Interviewing (MI),[35] which has been used effectively to deter adolescent smoking.[36] During MI, the treatment goals, negotiated between the client and the health care worker, are flexible and attainable within the client's current skill level. MI also takes into account the constraints on, and opportunities for, change that shape the everyday lives of individuals. It has been suggested that parents/caregivers are often reluctant to alter their child-rearing behaviours, especially if those behaviours are used to lessen the stress of bigger problems in the home (alcoholism, spousal abuse, overcrowding). Thus a recent measure to introduce stages of change (as with smoking cessation programs) or "readiness" for changing parenting practices related to children's dental health have been recommended for use in high caries risk populations.[37]

Because the SLZ dental component of the prenatal program also recognized the importance of sound nutritional practices, it was hypothesized at the beginning of our study that an effect would also be found on preschool-aged children's obesity rates. Accordingly, the prenatal nutrition program did have a positive impact on the prevalence of overweight children in the 2002 survey, but no relationship was found between BMI and caries levels in this preschool population, a finding similar to that of Chen *et al*.[38] among 3-year-old Chinese children. When compared with the prevalence of obesity in American Indian communities, these Canadian preschoolers had a higher prevalence rate for being overweight. From data summarized in Story *et al.*,[39] the prevalence rate of overweight (BMI > 85th percentile) in Alaska Natives aged 0–4 years participating in public health programs was 11%, while approximately 12% of American Indian preschool children in Arizona were above the 95th percentile in weight-for-height. These children had higher mean age-adjusted BMIs than white, black, or Hispanic preschoolers. Like ECC, the etiology of obesity is multifactorial; both genetics and environment are clearly determinants. Of relevance to dental public health, both ECC and children's obesity share behavioural and lifestyle decisions that parents make related to children's diet, such as overconsumption of sugary snacks.

An alternative nutrition health promotion strategy currently being considered in the SLZ is the development of the school curriculum to include nutrition, dental health, and a course on parenting skills for teenagers that will highlight dental health of infants. Attempts to increase awareness of ECC and the importance of good nutritional habits could be further enhanced in these communities through mass media oral health education campaigns and Breakfast for Learning

Our study found that broad-based programs that focus on both the child and the caregiver and that have the support of community health workers and nutritionists can produce positive outcome

Programs that work to prevent diabetes and obesity. However, the habits influencing ECC risk factors are complex and longstanding, often reinforced by culture, customs, and continual commercial advertising promoting unhealthy choices. When the public health dental hygienist designs oral health promotion programs for Aboriginal populations, it is necessary to recognize that "making healthy choices easier choices" is pivotal to the success of any prevention program.[40] This may entail going beyond asking parents to simply adopt healthy lifestyle behaviours to more drastic measures that require the assistance of provincial or local government, such as increasing the availability of lower priced fresh fruits and vegetables, as well as fresh milk rather than canned condensed milk (that has a high sugar content) in these remote communities.

CONCLUSIONS

THE SLZ COMMUNITY-BASED PRENATAL NUTRITION program improved caregivers' knowledge of ECC and oral health preventive practices. However, more needs to be done to address the factors that place undo strain on parents/caregivers and that lead to poor oral hygiene and dietary habits among children in Aboriginal communities. The program was found to be effective in reducing the number of decayed surfaces but not, at present, in reducing the number of referrals for general anesthesia. It also had significant positive effects on the child's oral hygiene and BMI. We believe that oral health education should continue to be part of prenatal and early childhood education and be offered in tandem with programs targeting improved nutrition and decreased risk of obesity. As this study has shown, dental hygienists can play a significant role in co-ordinating local oral health preventive programs and in evaluating the success or failure of those programs. To be most effective, interventions must be developed with the full participation of at-risk communities and with the support of partnerships established within those communities. In the SLZ, dental hygienists already play a very significant role in these partnerships, acting as liaisons among various groups within the community. We hope that the suggestions noted above can assist dental hygienists in promoting the oral health of all at-risk child populations and assist in reducing the oral health disparities between Aboriginal and non-Aboriginal children living in North America.

ACKNOWLEDGEMENTS

The authors would like to thank the generous support of the Toronto Hospital for Sick Children Foundation (Grant # XG 01-050) and all the children, caregivers, and bands in the Sioux Lookout Zone communities for their participation in the study. Special thanks also to the dental hygienists, Michael St. Pierre, Laura Thompson, Andrea Blakie, Tracy Kitt, and Marlene Mizzau and to the SLZ Dental Department staff, Bonita Switzer, Tina Quequish, Kim Rosche, and Jean Davies as well as all the recorders, interviewers, and community translators for their help with this study.

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