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Prevalence and risk factors for parental-reported oral health of Inuit preschoolers: Nunavut Inuit Child Health Survey, 2007-2008

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ABSTRACT

Introduction: Studies from the early 20th Century suggest that Inuit had a low prevalence of dental caries. However, Inuit children now experience a high prevalence of tooth decay and dental caries. The main objectives of this study were to provide an estimate of the prevalence and correlates of parental-reported oral health among Inuit preschool-aged children in Nunavut.

Methods: Inuit preschool-aged children aged 3 to 5 years from 16 of Nunavut's 25 communities were randomly selected to participate in the Nunavut Inuit Child Health Survey conducted in 2007 and 2008. The parent/primary caregiver was asked to give written informed consent for their child's participation. Caregivers were asked to rate their child's oral and dental health and if their child had any 'decayed, extracted or filled baby teeth': an affirmative response designated a child as having reported-caries experience (RCE). Interviewer administered questionnaires included household characteristics, nutritional supplements, past-month qualitative food frequency questionnaire (FFQ), and a 24 hour dietary recall with repeat 24 hour recalls on a 20% sub-sample.

Results: The overall participation rate was 72.3% (388 children). Among the participating children, 53% percent were female and the mean age was 4.4 ± 0.9 years. The weighted prevalence of RCE was 69.1% (95% CI: 63.7–74.4%). Caregivers rated their

child's oral and dental health as: 'very good' (9.5%), 'good' (44.5%), 'fair' (29.5%) and 'poor' (16.6%). Very few children were taking a fluoride supplement (4.6%, 95% CI: 2.3–6.9%) or a vitamin D supplement (4.9%, 95% CI: 2.4–7.4%). Sixteen percent of children (95% CI: 12.3.–20.1) were taking a multivitamin and multimineral supplement containing vitamin D and calcium but not fluoride. In univariate analyses using data from the qualitative FFQ, children with RCE drank milk less often than children without RCE (1.6 ± 0.1 vs 2.2 ± 0.2 times per day, respectively, *t*-test $p \leq 0.01$). Also, children with RCE drank more soda pop compared with children without RCE (0.8 ± 0.1 vs 0.5 ± 0.1 times per day, respectively, *t*-test $p \leq 0.05$). Consistent with findings from the FFQ, children with RCE drank less milk in the previous day than children without RCE (225.9 ± 17.0 vs 325.6 ± 44.8 g/day respectively, $p \leq .01$). Reported-caries experience was also more common among children who did not take any nutritional supplements containing vitamin D, calcium or fluoride than among those who did (75.5% vs 60.0% respectively, χ^2 $p \leq 0.01$). Multivariable logistic regression revealed that a higher frequency of milk intake was independently protective against having RCE (OR = 0.84, 95% CI: 0.73–0.97). A higher frequency of high-sugar food intake was independently associated with having RCE (OR = 1.11, 95% CI: 1.02–1.12).

Conclusions: A high prevalence of RCE was found among Inuit preschool-aged children in Nunavut Territory, Canada. In this cross-sectional health survey, milk intake showed protective associations while sugar intake showed deleterious associations with RCE, which is compatible with emerging literature on milk in animal- and population-based research, and with existing literature on the deleterious effects of acidic sugary drinks on dental health. This study emphasizes the likely importance of nutritional health education and better access to nutritious foods for promoting oral health. It also demonstrates the continued importance of oral health initiatives that are currently in place in Nunavut.

Key words: Aboriginal health, cross-sectional study, dietary supplements, early childhood caries, nutrition, oral health, preschool child, self-report.

Introduction

In children under 6 years of age, early childhood caries (ECC) is a condition characterized by the presence of one or more decayed, missing, or filled primary teeth[1]. Among young Canadian Inuit children, the prevalence of ECC has been reported to range from 50 to 97%, but recent statistics are not available[2-5]. Overall, caries are a considerable problem among Canadian Aboriginal children in contrast to the general population who experience much lower rates of ECC[6-10].

Early childhood caries has a complex etiology. It is affected by the amount of cariogenic bacteria, the presence of cariogenic foods, and the susceptibility of host tooth[11,12]. Other environmental and behavioural factors such as oral hygiene habits, socioeconomic status, enamel hypoplasia, fluoride exposure, previous caries experience, access to dental care and other dietary factors also impact caries development[10-12]. Early childhood caries may lead to pain, improper speech development, reduced ability to chew, low weight-for-age, lower self-esteem and sleep disturbances; however, the evidence for many of these associations is only weak or moderate[6,13].

Historical evidence suggests that dental caries were rare among Alaska Natives in the early 20th Century[14-17]. An Arctic nutrition transition, particularly the reduced intake of traditional food and an increased consumption of high-sugar foods, likely contributed to widespread ECC in Inuit communities[18]. Various studies as early as the 1970s have reported that commercially available market food makes up a significant proportion of the Inuit diet, especially among young children[19-21]. In addition, studies among Canadian Inuit adults and Dene/Métis adults and children show that diets higher in market foods are also higher in simple carbohydrates[22,23]. Among Dene/Métis children and Inuit

women, percent energy from sucrose was reported to be 18–19% and 12–17%, respectively[22]. It is likely that the Arctic nutrition transition has been exacerbated by other oral health risk factors common in these regions, including the practice of giving bottles to children at bedtime, lack of fluoridated water, inadequate access to dental health care, and lack of education about preventative measures[7,24,25].

Smaller studies reported that children in Nunavut experience a high prevalence of tooth decay and dental caries. The main objective of this study was to provide the prevalence and correlates of parental-reported oral health of Inuit preschoolers, with a focus on dietary and socioeconomic risk factors.

Methods

Study population and ethics

The data presented in the current report were from the Nunavut Inuit Child Health Survey, and details of the methodology have been presented elsewhere[26]. In brief, 16 of the 25 communities in Nunavut were selected to participate in the survey, representing all three regions of the territory. Communities were selected based on region, population size, latitude, and logistic feasibility due to flight routes and financial costs relative to the number of age-appropriate children. Inuit children, ages 3 to 5 years, were randomly selected to participate in the survey. Recruiters were instructed to make three attempts to reach each household with a 3-5 year old. Written informed consent was obtained from the child's primary caregiver, the majority of which were either a biological parent (68.4%) or an adoptive parent (21.6%). Of the 537 households successfully contacted, 75 (11.6%) refused on initial contact and 74 (13.8%) accepted but later cancelled or did not show for the interview, providing a participation rate of 72.3% (388) over the 2 years of data collection.

Certification of Ethical Acceptability for Research Involving Human Subjects was obtained from the McGill Faculty of Medicine Institutional Review Board. A Scientific Research License was obtained from the Nunavut Research Institute.

Participatory research methods

Participatory research methods were implemented through all stages of the survey work. The Nunavut Inuit Child Health Survey was developed by a steering committee made up of representatives from partner Inuit, community, and territorial organizations and McGill University and University of Toronto. Research agreements were signed between communities and the research centers before commencing research.

Questionnaires

After giving written, informed consent, interviews were conducted with parents and primary caregivers about their child's health history, home environment and dietary habits. Because the questionnaires were long, to minimize research burden the oral health history was limited to two questions:

1. How would you rate your child's oral and dental health – very good, good, fair, poor?
2. Does your child have any decayed, extracted or filled baby teeth?

Caregiver's rating of a child's oral health has been used successfully in a previous study with young children[27]. The answers to these questions were given by the parents and caregivers and no objective clinical assessments were made. When caregivers reported that their child had 'decayed, extracted or filled baby teeth', children were classified as having reported-caries experience (RCE). Finally, caregivers were asked if their child was taking any nutritional supplements such as fluoride, vitamin D or multivitamin and multimineral supplements. Brands were recorded to allow ingredients to be determined.

Dietary intake questionnaires

Each caregiver was asked to complete a qualitative food frequency questionnaire (FFQ) for their child. The FFQ was designed to capture past-month information about common traditional foods that are available in the three regions of Nunavut. It also captured past-month frequency of milk and various high-sugar food consumption. One 24 hour dietary recall was also conducted for each child participant by training interviewers on a four-stage, multiple pass interviewing technique. Food model kits were used to estimate portion sizes. A second repeat 24 hour dietary recall was collected on a 20% sub-sample of participants. Food frequency information was entered using EpiInfo (CDC, USA; http://www.cdc.gov/epiinfo/) and data were double verified. Twenty-four hour dietary recall information was entered using CANDAT (Godin London Inc; London, ON, Canada; http://www.candat.ca/) and was double verified.

Statistical analyses

Weighted-prevalence rates and 95% confidence intervals (CI) for RCE as well as for caregiver-reported oral health ratings were calculated. From the qualitative FFQ, the percent of children who consumed traditional food, milk and various high-sugar food/beverages was determined. The mean number of times per day these foods were eaten was also calculated. Milk and sugar intake in grams per day was also determined from the 24 hour recall. In univariate and multivariate analyses, the outcome variable of interest was whether or not the child had RCE. Frequencies of milk, high sugar food and traditional Inuit food intake were examined as risk factors using Student's *t*-test. Other factors such as nutritional supplement use, daycare attendance and socioeconomic variables, including type of housing (public vs private) and recipient of income support in the household were examined using a χ^2 test; relative risks (RR) and 95% CI were calculated. When risk factors were significantly associated with RCE, they were included in a multiple logistic regression model to examine independent associations. For all analyses, a p-value ≤ 0.05 was considered significant. Twenty-four hour recall analyses and weighted prevalence estimates were performed in SAS v9.2 (SAS Institute Inc; Cary, NC, USA), while all other analyses were performed using Stata 10 (Stata Corp; TX, USA; http://www.stata.com/stata10/).

Results

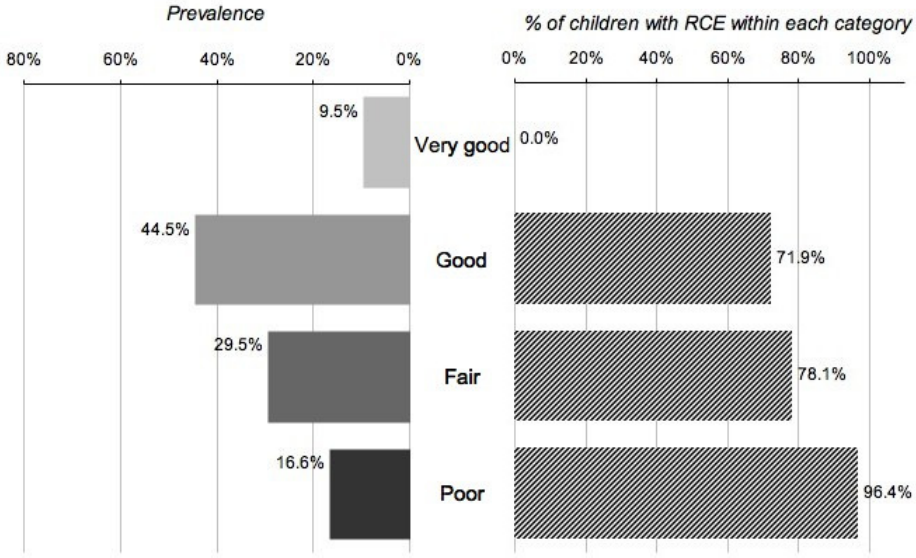
Population characteristics

Fifty-three percent (204/388) of the participating children were female and the mean age was 4.4 ± 0.9 years. Cultural, socioeconomic, and health indicator characteristics have been presented elsewhere[26]. Unweighted and weighted prevalence estimates were similar. A weighted 69.1% (95% CI: 63.7–74.4%) of children had RCE (Table 1). No differences were found in the prevalence of RCE by region (χ^2 p = 0.41). While 23% of children currently took any vitamin or supplement, very few children took a fluoride supplement (4.6%, 95% CI: 2.3–6.9%) or a vitamin D supplement (4.9%, 95% CI: 2.4–7.4%). Sixteen percent of children (95% CI: 12.3.–20.1%) were taking a multivitamin and multimineral supplement containing vitamin D and calcium but not fluoride. Very few parents rated their child's oral and dental health as 'very good': 9.5% (95% CI: 6.0–13.0%); whereas, the majority rated their child's health as 'good': 44.5% (95% CI: 38.9–50.1%), 'fair': 29.5% (95% CI:24.3–34.7%), or 'poor': 16.6 (95% CI:12.3–20.9%). The percentage of children with RCE varied by parental-reported oral health rating category ($\chi^2 = 92.57$, $p < 0.001$) (Fig1). Children reported to have 'very good' oral health had no RCE, but there was no significant difference in the percentage of children with RCE between the 'good' and 'fair' categories, while more children had RCE in the 'poor' oral health category.

Table 1: Weighted prevalence of reported caries experience and other related oral health indicators among Inuit preschoolers: Nunavut Inuit Child Health Survey, 2007-2008

Oral health indicator	*n*/ *N*	Weighted %	95% CI
RCE†	255/ 355	69.1	63.7–74.4
Taking fluoride supplement	17/ 378	4.6	2.3–0.9
Taking vitamin D supplement	18/ 377	4.9	2.4–7.4
Taking a multivitamin/mineral supplement containing calcium and vitamin D	57/ 376	16.4	12.3–20.6
Reporting staying in hospital overnight for dental work or tooth infection	16/ 351	3.5	1.6–5.3

RCE, Reported caries experience.
†As reported by parent or primary care giver.



children with reported caries experience, as reported by parent or primary care giver. Nunavut Inuit Child Health Survey, 2007-2008; (*n* = 354).

Food frequency information

Using the qualitative FFQ information, 88.7% (378/380) of caregivers reported that their child drank milk in the past month. Among consumers, the mean frequency of intake was 2.0 times per day. Many children also drank sweet drinks (88.7%, 337/380) on average 3.2 times per day, while 68.2% (259/380) drank regular soda pop on average 1.0 times per day. A few children drank diet soda pop (4.2%, 16/380) on average 0.9 times per day. Finally, 93.2% consumed chocolate or candy and mean intake frequency was 1.1 times per day. When asked what their child's preferred brand of breakfast cereal was, 72.6% (276/380) reported a high-sugar brand.

Univariate analyses revealed that children with RCE drank milk less often and soda pop more often than children with no RCE (Table 2). Children with RCE drank milk

1.6 ± 0.1 times per day, whereas children without RCE drank milk 2.2 ± 0.2 times per day ($p \leq 0.01$). Children with RCE drank regular soda pop 0.8 ± 0.1 times per day compared with children without RCE who drank soda pop 0.5 ± 0.1 times per day ($p \leq 0.05$). Children with RCE consumed slightly higher sweet drinks (3.0 ± 0.2 times per day) than children with no RCE (2.4 ± 0.2) but this difference only approached statistical significance ($p = 0.06$). No differences were seen in chocolate or candy consumption ($p = 0.17$) or in overall traditional food intake ($p = 0.09$). However, when all high-sugar foods from the FFQ were combined, children with RCE consumed high-sugar foods more often than children without RCE (4.9 ± 0.3 vs 3.7 ± 0.3 times/day, respectively, $p \leq 0.01$).

Twenty-four hour dietary recall information

Milk intake was also higher among children without RCE than with RCE, based on data from the 24 hour recall, which provided quantitative information. Children without RCE drank 325.6 ± 44.8 g/day of milk, whereas children with RCE drank 225.9 ± 17.0 g/day ($p = 0.01$). However, there were no differences in past-day sugar intake between the two groups (RCE: 109.3 ± 5.3 g/day, no RCE: 110.0 ± 6.6 g/day, $p = 0.944$).

Socioeconomic characteristics, vitamin/supplement use, and daycare attendance were evaluated (Table 3). Children living in public housing were more likely to have RCE than those living in private housing (74% vs 61.5%, respectively, $p < 0.05$), and children taking vitamins or supplements containing either vitamin D, calcium, or fluoride were less likely to have RCE than children not consuming these vitamins/supplements (60.0% vs 75.5%, respectively, $p < 0.01$).

The multiple logistic regression model predicting an outcome of RCE contained frequency of milk intake, frequency of high sugar food intake, nutrition supplement use, child's age, and housing type (Table 4). In these analyses, taking a fluoride, vitamin D or multivitamin supplement was no longer significant. However, frequency of milk consumption remained significantly associated with RCE (OR = 0.84, 95% CI: 0.73–0.97) where an increase in milk consumption by 1 glass per day reduced the odds of having RCE by 16%. Frequency of high sugar food intake also remained significantly positively associated with the prevalence of RCE (OR = 1.11, 95% CI: 1.02–1.12) where an increase of one item per day of high-sugar food corresponded to an 11% increase in the odds of having RCE.

Discussion

The current study identified a high prevalence of caries-experience among Inuit preschoolers (69.1%), as reported by parents and caregivers. Studies from the early 1990s in Nunavut report high rates of ECC among young Inuit children[2,3,5]. This is consistent with findings from other Inuit regions. Among Alaska Yup'ik (Natives), 77.4% of 2 to 5 year-olds had caries[28]. Among Inuit in Nunatsiavut Labrador, 97% of the population aged 5 to 22 years had dental caries, and among children 5 to 6 years, 68% were affected by severe tooth decay[4]. Our findings are also consistent with more recent findings from Canadian First Nations communities. Among 3–5 year-old Ontario First Nations' children, 74% had one or more caries[29]. Another randomized control trial conducted in First Nations communities in northern Ontario reported a baseline prevalence of caries among children aged from 6 months to 5 years of 69–73%[25]. In a study of 408 preschoolers in two disadvantaged and two First Nations communities in Northern and Southern Manitoba, there was a 53.7% prevalence of ECC, as determined by clinical examination[30]. In contrast, the prevalence of ECC among young children in two major Canadian urban areas ranged from 4.6 to 11%[6,7]. Among US pre-schoolers, the prevalence of ECC was 27.9% in 1999–2000[31]. In northwestern Ontario, non-Aboriginal preschoolers experienced a 31.1–35.2% prevalence of ECC, whereas off-reserve Aboriginal preschoolers experienced rates of 73.8–81.6% and rates were even higher among on-reserve preschoolers[9]. Overall, caregiver reports have revealed that Inuit preschoolers across Nunavut experience high rates of caries, as is the case in many other Canadian Aboriginal communities, while the general population experience much lower rates.

Table 2: Differences in mean frequency of milk, high-sugar food and traditional food intake among preschoolers with and without reported caries experience. Nunavut Inuit Child Health Survey, 2007-2008

Food or drink	No. times per day the food or drink was consumed (M ± SE)		*P*-value¶
	RCE† (*n* = 254)	No RCE (*n* = 97)	
Milk	1.6 ± 0.1	2.2 ± 0.2	0.006
Sweet drinks	3.0 ± 0.2	2.4 ± 0.2	0.056
Pop (regular)	0.8 ± 0.1	0.5 ± 0.1	0.041
Pop (diet)	0.1 ± 0.0	0.0 ± 0.0	0.110
Chocolate/candy	1.1 ± 0.1	0.8 ± 0.1	0.167
Traditional food	1.1 ± 0.1	0.8 ± 0.1	0.098

RCE, Reported caries experience.
†As reported by parent or primary care giver; ¶ *t*-tests for differences in means.

Table 3: Univariate analyses of risk factors for having reported caries experience among Inuit preschoolers: Nunavut Inuit Child Health Survey, 2007-2008

Risk factor	RCE†	
	n/ *N* (%)	RR (95% CI)
Attended day care		
Yes	103/ 137 (75.2)	1.06 (0.93–1.21)
No	151/ 213 (70.9)	
Takes fluoride, vitamin D or multivitamin supplement¶		
Yes	48/ 80 (60)	0.80 (0.66–0.96)*
No	200/ 265 (75.5)	
Lives in public housing		
Yes	181/ 242 (74.8)	1.22 (1.01–1.47)*
No	48/ 78 (61.54)	
Household member received income support		
Yes	112/ 148 (75.7)	1.12 (0.98–1.28)
No	131/ 194 (67.5)	

RR, Relative risk; RCE, reported caries experience.
†As reported by parent or primary care giver; ¶multivitamin and multimineral supplement containing calcium and vitamin D but not fluoride.
*$P < 0.05$.

Table 4: Multiple logistic regression to examine risk factors for having reported caries experience, as reported by parent or primary care giver (*n* = 310)

Risk factor	OR	95% CI	*P*-value
Milk intake (no. times/day)	0.84	0.73–0.97	0.014
High sugar food intake (no. times/day)	1.11	1.02–1.21	0.015
Taking fluoride, vitamin D or multivitamin supplement	0.56	0.31–1.02	0.061
Age (months)	1.04	1.01–1.07	0.005
Housing type	1.55	0.86–2.79	0.145

OR, Odds ratio.

It was noted that when parents classified their child's oral health as 'very good' no RCEs were reported, and that among those who rated their child's oral health as poor, 96.4% had RCEs. In contrast, the terms 'good' and 'fair' were associated with similar prevalence rates of RCEs. As the number of teeth affected by caries was not assessed, it is difficult to determine the validity of the terms 'good' and 'fair' using the prevalence of any RCE. In a small sample of US preschoolers, children whose mothers' gave them an oral-health rating of fair to poor had a significantly higher prevalence of ECC (66%) than those who were given a rating of good to excellent (29%)[32]. In a study evaluating attitudes toward caries in two First Nations communities and two disadvantaged communities in urban areas in Manitoba where the prevalence of ECC is high, 78.3% of caregivers whose children had ECC disagreed that rotten teeth could affect their child's health, whereas only 21.7% of caregivers whose children were caries-free disagreed[30,33]. These findings lead to an interesting hypothesis that a high prevalence of caries in a population may result in caregivers' easier acceptance of sub-standard oral health among preschoolers, which in turn would represent a challenge for dental health and nutritional educational campaigns.

Higher milk intake was independently and significantly associated with having no RCE. In other studies, evidence is available for a protective mechanism of milk for good oral health. In a pediatric population, children with caries, when compared with those without, had lower median intakes of milk at 2–3 years of age[34]. In another study, preschoolers from a Canadian Arctic region had significantly lower odds of severe tooth decay when they drank milk regularly[7]. Milk and milk product consumption was also protective against the development of root caries in an elderly Japanese population[35]. Vitamin D is important in bone mineralization and, although the mechanisms are still unclear, vitamin D was found to affect enamel and dentin mineral densities in a study comparing vitamin D receptor deficient and receptor positive mice[36]. Milk and milk products are also a source of casein and an in-vitro study found that natural casein phosphopeptides contained in yoghurt inhibited demineralization and promoted remineralization of dental enamel[37]. Casein phosphopeptides may be protective by stabilizing calcium phosphate on tooth surfaces. Thus, further research is warranted on the association of milk and/or its constituents with dental health.

While soda pop intake was significantly associated with RCE, sugar-sweetened beverages, chocolate and candy intake were not when considered separately. When all high-sugar foods were combined, however, there was a strong independent association between frequency of high-sugar food intake and RCE. It has been reported that children who consume more high -sugar beverages are more at risk for dental caries[7,34]. Sucrose helps stimulate cariogenic bacteria to colonize and adhere permanently to tooth surfaces via α-1-3-rich, water insoluble glucans, allowing acids formed by cariogenic foods easier access to tooth enamel[11].

Historical literature on Alaska Natives suggests that the prevalence of caries in the early 1900s was low. For example, little evidence of caries was found in teeth from preserved Alaska Native human remains housed at the Smithsonian Institution[14]. Prevalence studies in the 1930s among Alaska Native adults and children also reported low rates of caries[15-17]. The historical data makes for an interesting comparison with today's high prevalence of poor dental health. One possible explanation for the discrepancies in oral health over time lies in the Arctic nutrition transition, where a high percentage of the diet is made up of carbohydrates, particularly in the form of high-sugar foods. It is possible that the historically high traditional food intake combined with low intake of high-sugar foods protected Inuit against dental caries in the past.

Prior to 1973, the residents of Nunavut did not have in-community access to dental care[38]. From the 2006 Aboriginal Children's Survey, only 57% of Inuit children under 6 years in Nunavut had received dental care in the past 12 months[39]. Nunavut has experienced one of the largest increases in dental expenditures in comparison with other regions of Canada, and in 2003 the Government of Canada

reported that various oral health programs were in place that involved dietary counselling, oral health promotion, education at the prenatal level as well as in the classroom and well-baby clinics, oral hygiene instruction and the use of chemical sealants[40-42]. Preventative measures are particularly important because the isolation of the communities remains a deterrent to good dental care, including shipping of equipment and supplies and retaining qualified Inuit and non-Inuit dental professionals[43]. There is evidence that water fluoridation and fluoride varnishes may reduce the prevalence of ECC among Canadian Aboriginal preschoolers[7,25]. The identification of lower milk intake and higher intake of sugary foods as risk factors for RCE adds to evidence that dietary counselling is also an important component of prevention. Given the success in smoking education messages, where now the majority of homes with preschoolers have restrictions against smoking in the home, this provides some evidence that public health education can have a meaningful impact on health behaviours[26] and that the same success could be achievable for oral health with renewed dental health education efforts developed and shaped by communities.

Limitations

The present study was limited by its cross-sectional design and reliance on parent/caregiver-reported oral health rather than clinically assessed oral health. While the question 'Does your child have any decayed, extracted, or filled primary teeth?' could also potentially include teeth which naturally exfoliated or teeth lost due to trauma, the parental reports cannot be validated with the current data. The strength of the study involves the use of both an FFQ and 24 hour recall to assess dietary habits. However, multiple 24 hour recalls would have strengthened the study by better characterizing usual intake. This was not conducted due to concerns of research burden.

Conclusions

Evidence of a high prevalence of reported caries experience was found among Inuit preschoolers in Nunavut. This helps to confirm the suspected severity of this health problem among young Inuit children. Evidence is reported that low milk and high-sugar food and beverage intake are independently associated with having RCE. This supports the need for continuation of established initiatives in Nunavut that aim to reduce the consumption of soda pop and sugar-sweetened beverages. Inuit-specific information can provide relevant data for communities and public health campaigns aimed at reducing the burden of early childhood caries.

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References

1. American Academy of Pediatric Dentistry. *Definition of Early Childhood Caries*. (Online) 2008. Availabble: http://www.aapd.org/media/policies.asp (Accessed 20 March 2010).

2. Albert R, Cantin R, Cross H, Castaldi C. Nursing caries and the Inuit children of the Keewatin. *Journal of the Canadian Dental Association* 1988; **54(10):** 751-758.

3. Houde G, Gagnon P, St-Germain M. A descriptive study of early caries and oral health habits of Inuit pre-schoolers: preliminary results. *Arctic Medical Research* 1991; **(Suppl):** 683-684.

4. Zammit M, Torres A, Johnsen D, Hans M. The prevalence and patterns of dental caries in Labrador Inuit Youth. *Journal of Public Health Dentistry* 1994; **54(3):** 132-138.

5. Young T, Moffatt M, O'Neil JD, Thika R, Mirdad S. The population survey as a tool for assessing family health in the Keewatin region, NWT, Canada. *Arctic Medical Research* 1995; **54(Suppl1):** 77-85.

6. Weinstein P, Smith W, Fraser-Lee N, Shimono T, Tsubouchi J. Epidemiologic study of 19-month-old Edmonton, Alberta children: caries rates and risk factors. *ASDC Journal of Dentistry for Children* 1996; **63(6):** 426-433.

7. Leake J, Jozzy S, Uswak G. Severe dental caries, impacts and determinants among children 2–6 years of age in Inuvik Region, Northwest Territories, Canada. *Journal of the Canadian Dental Association* 2008; **74(6):** 519.

8. Schroth R, Harrison R, Lawrence H, Peressini S. Oral health and the Aboriginal child: a forum for community members , researchers and policy-makers. *Journal of the Canadian Dental Association* 2008; **74(5):** 429-432.

9. Lawrence HP, Binguis D, Douglas J, McKeown L, Switzer B, Figueiredo R et al. Oral health inequalities between young Aboriginal and non-Aboriginal children living in Ontario, Canada. *Community Dentistry and Oral Epidemiology* 2009; **37:** 495-508.

10. Schroth R, Harrison R, Moffatt M. Oral health of Indigenous children and the influence of early childhood caries on childhood health and well-being. *Pediatric Clinics of North America* 2009; **56(6):** 1481-1499.

11. Seow W. Biological mechanisms of early childhood caries. *Community Dentistry and Oral Epidemiology* 1998; **26(Suppl1):** 8-27.

12. Reisine S, Douglass J. Psychosocial and behavioral issues in early childhood caries. *Community Dentistry and Oral Epidemiology* 1998; **26(Suppl1):** 32-44.

13. Moynihan P, Peterson P. Diet, nutrition and the prevention of dental diseases. *Public Health Nutrition* 2004; **7(1A):** 201-226.

14. Leigh R. Dental pathologies of the Eskimo. *Dental Cosmos* 1925; **September:** 884-889.

15. Rosebury T, Karshan M. Dental Caries among Eskimos of the Kuskokwim Area of Alaska. III. A dietary study of three Eskimo settlements. *American Journal of Diseases in Children* 1939; **57(6):** 1343-1362.

16. Rosebury T, Waugh L. Dental caries among Eskimos of the Kuskokwim Area of Alaska. I. Clinical and bacteriological findings. *American Journal of Diseases in Children* 1939; **57(4):** 871-893.

17. Siegel E, Waugh L, Karshan M. Dietary and metabolic studies of Eskimo children with and without dental caries. *American Journal of Diseases in Children* 1940; **59(1):** 19-38.

18. Kuhnlein H, Receveur O, Soueida R, Egeland G. Arctic Indigenous Peoples experience the nutrition transition with changing dietary patterns and obesity. *Journal of Nutrition* 2004; **143:** 1447-1453.

19. Kuhnlein H, Soueida R, Receveur O. Dietary nutrient profiles of Canadian Baffin Island Inuit differ by food source, season, and age. *Journal of the American Dietetic Association* 1996; **96(2):** 155-162.

20. Moffat M, Young T. Nutritional patterns if Inuit in the Keewatin region of Canada. *Arctic Medical Research* 1994; **53:** 298-300.

21. Verdier PC, Eaton RD. A study of the nutritional status of an Inuit population in Canadian High Arctic. Part 2: some dietary sources of vitamins A and C. *Canadian Journal of Public Health* 1987; **78(July/August):** 236-239.

22. Kuhnlein H, Receveur O. Local cultural animal food contributes high levels of nutrients for Arctic Canadian Indigenous adults and children. *Journal of Nutrition* 2007; **137(4):** 1110-1114.

23. Receveur O, Boulay M, Kuhnlein H. Decreasing traditional food use affects diet quality for adult Dene/Métis in 16 communities of the Canadian Northwest Territories. *Journal of Nutrition* 1997; **127:** 2179-2186.

24. Tiberia M, Milnes A, Feigal R, Morley K, Richardson D, Croft W et al. Risk factors for early childhood caries in Canadian preschool children seeking care. *Pediatric Dentistry* 2007; **29(3):** 201-208.

25. Lawrence H, Binguis D, Douglas J, McKeown L, Switzer B, Figueiredo R et al. A 2-year community randomized controlled trial of fluoride varnish to prevent early childhood caries in Aboriginal children. *Community Dental and Oral Epidemiology* 2008; **36:** 503-516.

26. Egeland G, Faraj N, Osborne G. Cultural, Socioeconomic, and Health Indicators among Inuit Preschoolers: Nunavut Inuit Child Health Survey, 2007-2008. *Rural and Remote Health* **10: 1368**. (Online) 2010. Available; www.rrh.org.au (Accessed 18 June 2010).

27. Schroth R, Moffatt M. Determinants of Early Childhood Caries (ECC) in a rural Manitoba community: a pilot study. *Pediatric Dentistry* 2005; **27(2):** 114-120.

28. Indian Health Service. *The 1999 Oral Health Survey of American Indian and Alaska Native Dental Patients: findings, regional differences and national comparisons*. (Online) 2002. Washington, DC: Dept of Health and Human Services, Indian Health Service. Available: www.dental.ihs.gov/downloads/Oral_Health_1999_IHS_Survey.pdf (Accessed 18 April 2010).

29. Peressini S, Leake J, Mayhall J, Maar M, Trudeau R. Prevalence of early childhood caries among First Nations children, District of Manitoulin, Ontario. *International Journal of Paediatric Dentistry* 2004; **14(2):** 101-110.

30. Schroth R, Moore P, Brothwell D. Prevalence of early childhood caries in 4 Manitoba communities. *Journal of the Canadian Dental Association* 2005; **71(8):** 567.

31. Beltrán-Aguilar E, Barker L, Canto M, Dye B, Gooch B, Griffin S et al. Surveillance for dental caries, dental sealants, tooth retention, edentulism, and enamel fluorosis - United States, 1988-1994 and 1999-2002. *Morbidity and Mortality Weekly Report Surveillance Summaries* 2005; **54(3):** 1-43.

32. Roberts C, Warren J, Weber-Gasparoni K. Relationships between caregivers' responses to oral health screening questions and early childhood caries. *Journal of Public Health Dentistry* 2009; **69(4):** 290-293.

33. Schroth R, Brothwell D, Moffatt M. Caregiver knowledge and attitudes of preschool oral health and early childhood caries (ECC). *International Journal of Circumpolar Health* 2007; **66(2):** 153-168.

34. Marshall T, Levy S, Broffitt B, Warren J, Eichenberger-Gilmore J, Burns T et al. Dental caries and beverage consumption in young children. *Pediatrics* 2003; **112(3,pt1):** e184-e191.

35. Yoshihara A, Watanabe R, Hanada N, Miyazaki H. A longitudinal study of the relationship between diet intake and dental caries and periodontal disease in elderly Japanese subjects. *Gerodontology* 2009; **26(2):** 130-136.

36. Zhang X, Rahemtulla F, Zhang P, Beck P, Thomas H. Different enamel and dentin mineralization observed in VDR deficient mouse model. *Archives of Oral Biology* 2009; **54(4):** 299-305.

37. Ferrazzano G, Catile T, Quarto M, Ingenito A, Chianese L, Addeo F. Protective effect of yogurt extract on dental enamel demineralization in vitro. *Australian Dental Journal* 2008; **53(4):** 314-319.

38. Bedford W, Davey K. Indian and Inuit dental care in Canada: the past, the present, and the future. *Journal of the Canadian Dental Association* 1993; **59:** 126-132.

39. Tait H. *Aboriginal Peoples Survey, 2006: Inuit health and social conditions*. (Online) 2008. Available: http://www.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=89-637-XWE2008001&lang=eng (Accessed 14 October 2009).

40. Government of Canada, Parliamentary Standing Committee on Health. First Nations and Inuit Dental Health. In: B Brown (Ed.). *Fifth report of the standing committee on health*. (Online) 2003. Available: http://www2.parl.gc.ca/CommitteeBusiness/ReportsResponses.aspx?Cmte=HEAL&Language=E&Mode=1&Parl=37&Ses=2 (Accessed 15 October 2009).

41. First Nations and Inuit Health Branch Non-Insured Health Benefits Directorate Program. *Non-Insured Health Benefits Program Annual Report 2003/2004*. Ottawa, Ontario: Program Analyses Division, First Nations and Inuit Health Branch Non-Insured Health Benefits Directorate, 2005; 1-106.

42. Health Canada First Nations and Inuit Health Branch. *Government response to the 5th report of the Standing Committee on Health: First Nations and Inuit Dental Health*. (Online) 2003. Available: http://www.hc-sc.gc.ca/fniah-spnia/pubs/nihb-ssna/_dent/2003-gvt-rps/index-eng.php (Accessed 15 October 2009).

43. Quiñonez C. A political economy of oral health services in Nunavut. In: Proceedings, 12th International Congress on Circumpolar Health; 10-14 September 2003; Nuuk, Greenland. *International Journal of Circumpolar Health* 2004; **63(Suppl2):** 324-329.

