Early Childhood Caries and Indigenous Children in Canada: Prevalence, Risk Factors, and Prevention Strategies
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Introduction

Early childhood caries (ECC) is a major public health concern, negatively affecting not only the oral health of infants and young children but also their general health, quality of life, and well-being.¹ Even though, the caries prevalence in the permanent dentition in developed countries is declining, there is evidence that dental decay in primary teeth in North America is on the rise.² Dental caries disproportionately affects disadvantaged communities including children and Aboriginal peoples in Canada.² Although not a formal systematic review, this paper will address this topic by the first reviewing some of the key terms and concepts related to ECC and by providing prevalence rates of ECC in Aboriginal children in Canada.

Risk factors associated with ECC, consequences of untreated carious lesions in children, and some recommended strategies proposed to compete this “silent” disease are then delineated to help health-care professionals understand risk factors, consequences, and prevention approaches. Early involvement of health professionals and caregivers will minimize the ECC devastating consequences on children, families, and community at large as the first step toward complete elimination, which requires effective interventional strategies from federal and provincial policy makers and health policymakers and planners.

Definitions

The key terms with regard to dental caries, ECC, and Aboriginal peoples in Canada will be reviewed here. Definitions from scholarly publications and agencies that focus their attention on this issue will be primarily cited. In this review, we use the terms Aboriginal and Indigenous interchangeably.

ECC

The American Academy of Pediatric Dentistry⁴ defines ECC as the following:

“Caries is a biofilm (plaque)-induced acid demineralization of enamel or dentin, mediated by saliva. The disease of ECC is the presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child 71 months of age or younger. In children younger than 3 years of age, any sign of smooth-surface caries is indicative of severe ECC (S-ECC). From ages 3 through 5, 1 or more cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth or a decayed, missing, or filled score of ≥4 (age 3), ≥5 (age 4), or ≥6 (age 5) surfaces constitutes S-ECC” (p. 1).

Aboriginal people

Aboriginal Affairs and Northern Development Canada⁵ states that “Aboriginal peoples” is a collective name for the original peoples of North America and their descendants. The Canadian constitution recognizes three groups of Aboriginal peoples: Indians (commonly referred to as First Nations), Métis, and Inuit. These are three distinct communities with unique histories, languages, cultural practices, and spiritual beliefs. Aboriginal communities are...
located in urban, rural, and remote locations across Canada, with a total number of 1.4 million people, representing 4.3% of the total Canadian population. The three distinct peoples include First Nations or Indian Bands, located on lands called reserves in most cases; Inuit communities located in Nunavut, NWT, Northern Quebec (Nunavik), and Labrador; Métis communities located mainly in Alberta, British Columbia, Ontario, Manitoba, and Saskatchewan; and urban communities of Aboriginal people (including Métis, non-status Indians, Inuit, and First Nation individuals) in cities or towns which are not part of reserves or traditional territories (for example, the Aboriginal community in Regina, the capital city of Saskatchewan).

The Aboriginal population increased 20% between 2006 and 2011, compared with 5.2% for the non-Aboriginal population. In 2011, the largest numbers of Aboriginal people lived in Ontario and the western provinces (Manitoba, Saskatchewan, Alberta, and British Columbia); they made up the largest shares of the population of Nunavut and the Northwest Territories. Aboriginal children aged 14 and under made up 28% of the total Aboriginal population (7% of all children in Canada). In contrast, non-Aboriginal children aged 14 and under represented 16.5% of the total non-Aboriginal population. This is due to higher fertility rates (2.6 vs. 1.6 children) and shorter life expectancy (76.8 vs. 82 years).

Prevalence of ECC
The poor oral health of Aboriginal children in Canada is a major public health concern, with caries prevalence exceeding 90% in some Aboriginal communities. Several recent studies (as cited below) have reported the prevalence of dental caries among Aboriginal children living in urban, rural, and remote areas in Canada. The prevalence rates of ECC are provided here in accordance with province/territory. The data provided are not exhaustive, but clearly demonstrate the severity of the problem.

Manitoba
Schroth et al. selected four Manitoba communities, two of them were located in the southern region of the province (urban) and the other two were northern communities (on-reserve First Nations), to determine the prevalence of ECC in Aboriginal Manitoba communities. The following clinical examination of 408 children, the authors found an overall prevalence of 53.7%, with no statistically significant difference between the four communities. The mean deft (that is, the count of the number of decayed [d], extracted [e], and filled [f] deciduous teeth [t] of an individual) was 4.2 (standard deviation [SD] 5.0).

In another study, Schroth et al. (2005) reported higher ECC prevalence (89.9%) and higher deft (13.7 [SD 3.2]) in Garden Hill First Nation community in northern Manitoba. In a rural Manitoba community (Carman), non-Aboriginal preschool children exhibited less ECC prevalence rate compared to other Canadian preschool children. Schroth and Moffatt (2005) reported a prevalence rate of 44% and deft of 2 (SD 3.3).

Ontario
Several studies assessed the caries prevalence in First Nations preschoolers in Sioux lookout zone (SLZ) communities in Ontario. It has been noticed temporal changes in caries prevalence over the years to reach its peak in 2004’s study (prevalence 85.3%, deft 10). In another First Nations community (district of Manitoulin), the prevalence rates of ECC were 67% and 78% in 3-year-old and 5-year-old children, respectively.

British Columbia
Harrison and Davis (1993) analyzed the surveys of the dental health of native children in British Columbia conducted in 1988. They reported caries in 87.5% of children at age 5 (deft 7.5 [SD 4.9]). In another study, Harrison et al. (2006) reported similar high prevalence rates of caries in children from a tribe of the Tsimshian Nation (Hartley Bay, Gitga’at).

Northwest territories
In the region of Keewatin, the prevalence rates of ECC in Inuit children ranged between 50% and 100% depending on community. The deft ranged between 1.8 in children up to age 2-8 in 3-5-year-old children. In a more recent study, Leake et al. (2008) reported a prevalence rate of 66% after examining 514 preschool children from the Inuvik Region, Northwest Territories, in 2004-2005. The deft was 4.8.

Nunavut territory and Labrador
A high prevalence of ECC was found among Inuit preschool-aged children in Nunavut Territory. The weighted prevalence of ECC was 69.1% in children aged 3-5 years from 16 of Nunavut’s 25 communities randomly selected to participate in the Nunavut Inuit Child Health Survey conducted in 2007 and 2008. The prevalence of caries in Inuit 5-6-year olds from Northern Labrador was reported to be 68% by Zammit et al.

Summarizing, Aboriginal preschool-aged children across Canada are suffering from dental decay which is currently at epidemic proportions. To date, national oral health survey of preschool-aged Aboriginal children in Canada is not available; however, data from different localities indicate high prevalence rates of ECC for this cohort. Urban and on-reserve First Nations and other Aboriginal children are reported to have high rates reaching 80-90% of the population. Other groups, such as immigrant children from Asia, are exhibiting rates above 40%. These high rates can be contrasted to 5%, the rate of ECC in children who are mainly from Saskatoon Health Region, and 25%, the rate of ECC at the national level.

Risk Factors for ECC
Dental caries is a chronic, transmissible, and multifactorial disease, in which host, microbes, diet, and time play major
roles in its development. Dental literature reports many risk factors (more than 100), but these can be categorized into four major types: Demographic (e.g., age, gender, race/ethnicity, and socioeconomic status [SES]), dietary (e.g., sugar consumption, bottle feeding, and infant formula), microbiological (e.g., presence of Streptococcus mutans), and behavioral (e.g., tooth brushing, use of fluoridated toothpaste).

ECC is the form of dental caries that develops rapidly soon after a primary tooth erupts. Original terms given to this diseases include nursing caries, nursing bottle caries, and baby bottle tooth decay, which suggest that inappropriate feeding habits are the main cause of this disease. The current used terminology, ECC, reflects the current understanding of multi-factorial pathogenesis of the disease. Here, we present some salient risk factors associated with ECC as reported in studies involving Aboriginal children.

**Socioeconomic status (SES)**

Kendall (2001) stated that, "Characteristics of socioeconomic concepts in First Nations communities are: Education, employment, income, housing, industrial structure, population structure, and percent speaking an Aboriginal language at home" (p. 43). Poverty is the single greatest risk factor for ECC. The strength of association between social class and caries experience in children aged 1.5-4.5 years was twice that between tooth brushing and caries, and three times that between sugar consumption and caries. The average child poverty rate for Aboriginal children is 40%, more than twice that of all children in Canada (17%). Most shocking, however, is the poverty rate in all status First Nations children (50%). More than half of Status First Nations children live below the poverty line in Manitoba (62%) and Saskatchewan (64%). Those who are below the poverty line are three times more likely to live in bad conditions, such as an overcrowded house or a house requiring major repairs. Epidemiological studies in Canada and the U.S. clearly show that ECC is most prevalent among children who are from low SES families. SES is linked to low parental education and increased family size, both are associated with higher caries experience in children.

Schroth et al. (2013) reported that Manitoba First Nations children whose fathers did not complete high school were significantly more likely to have S-ECC, as well as children whose fathers did not work for pay. Interestingly, children whose paternal grandmother attended residential school were significantly more likely to have S-ECC (odds ratio \( OR = 2.16, P = 0.009 \)). Those whose paternal grandfather attended residential school also had a higher prevalence of S-ECC (\( OR = 2.0, P = 0.022 \)).

**Dietary factors**

Dietary factors have double effect on the model of caries: First, they influence the availability of fermentable carbohydrates required for acid formation to initiate caries; second, they influence host susceptibility because primary teeth enamel development is affected by prenatal and early infant nutrition.

In the study of Schroth et al., breastfed Manitoba First Nations children were less likely to have S-ECC compared with those who had never been breastfed (17.4% vs. 31.5%), while consuming drink crystal beverages in bottles, and daily intake of soft drinks, juices, sweets, and fast food were associated with increased risk (\( OR = 2.5, P = 0.001 \)). Although those data were collected based on caregivers’ self-reported, they are associated with data collected from direct clinical assessment. For example, similar results were reported by Leake et al. (2008) who found children in Inuvik Region were in significant risks when consuming drinks made from flavor crystals (\( OR = 2.4 \)). Schroth et al. (2005) reported that 50% of First Nations preschool-aged children from Northern Manitoba (Garden Hill) had enamel defects, which were related to vitamin D deficiencies both in children and their mothers during pregnancy.

**Tobacco smoke**

The effect of environmental tobacco smoke and maternal smoking status on increased risk of caries among children is very much relevant to Aboriginal peoples, who have a markedly higher smoking rate than the non-Aboriginal peoples (40% vs. 20%). What is significant is that many Aboriginal mothers smoke during pregnancy. The association of ECC with paternal smoking (\( OR = 1.52 \)) and maternal smoking (\( OR = 2.25 \)) is well-documented. In Schroth et al.’s (2013) study, Aboriginal children whose mothers smoked during pregnancy were 1.7 times more likely to have S-ECC.

**Other factors**

Many other factors are reported to be associated with ECC in non-Aboriginal as well in Aboriginal children. For example, parental and children tooth brushing habits have been associated with caries experience in children. Parental attitudes and knowledge toward children’s oral health have been associated with caries development in children. Lack of health-care services or not culturally appropriate healthcare services in Aboriginal communities are associated with S-ECC; the OR reported by Schroth et al. (2013) was 2.63 (\( P = 0.001 \)). Parker et al. in their review of the oral health of Indigenous children in Australia, New Zealand, Canada and the USA considered colonization as the source reason for Indigenous people suffering in those 4 nations because historically colonization established disparities between Aboriginal and non-Aboriginal peoples.

**ECC Consequences and Prevention Strategies**

The consequences of caries in children can be dire, leading to life-threatening conditions or even death in some rare cases. Less severe consequences include pain, difficulty eating and sleeping, speech difficulties, and poor self-image. There is
solid evidence that severe forms of caries in children affect their growth, development, and ability to concentrate and function; children’s quality of life is seriously impaired.1,39 Schroth, Harrison, and Moffatt noted that although few studies relating ECC to general health involved Indigenous children, results from studies with non-Aboriginal children can be extrapolated to Indigenous children.1

Comprehensive full mouth dental treatment under general anesthesia (DTGA) is an accepted approach for treating severe dental caries in children. Each year approximately 19,000 day surgery operations are performed to treat cavities (due to caries) among children in Canada (excluding Quebec), making it the leading cause of day surgery for young children.40 Proportions of children who are Aboriginal from among those receiving DTGA are high. In the province of Saskatchewan, the use of dental caries-related day surgery among children in 2012 was 35 per 1,000, with a total of 3886 operations.40

Considering the high cost, health risks, logistic difficulties (e.g., families reside in remote areas away from hospitals providing DTGA) associated with DTGA, and high recurrence of disease, prevention should take precedence over restorative or surgical treatment of ECC.41 ECC prevention is likely to be the most cost-effective alternative; for every dollar spent on prevention in oral health care, as much as $50 is saved on restorative and emergency dental procedures.8 Long-term solutions to ECC in Aboriginal communities require collaboration among Aboriginal communities; dental, primary care, and public health practitioners; as well as decisions makers, policy makers, and researchers interested in young children health. This collaboration should address the risk factors of ECC including oral bacteria, substrate, and host; in addition to family, economic, social conditions, and other determinants of health.30 Recommended prevention strategies include oral health promotion, disease prevention using fluoride and sealants, and access to publicly funded oral health programs and services.

Oral health promotion
The dental program should promote the fact that dental caries is preventable. Pregnant women, parents, caregivers, teachers, and healthcare professionals (e.g., pediatricians and public health nurses) should understand that dental decay is an infectious and transmissible disease that can transmit vertically from mother (or father) to child and horizontally within families (e.g., among siblings) or from the carious tooth to the intact ones.42 There is newer evidence suggesting the transmission between unrelated nursery school children.42

Public health awareness campaigns focusing on the transmission and prevention of dental caries can be led by the Ministry of Health, working collaboratively with provinces/territories and Aboriginal communities. Prowse et al. (2014) recognized many challenges involved in promoting oral health to high-risk groups, including Aboriginal peoples and newcomers such as the difficulty associated with reaching these populations and distinct culture.21 However, they provided certain recommendations to aid in promoting oral health such as involving grandparents in oral health promotion activities and moving toward family-centered care.

Evaluation should be an essential part of any dental programs to assess the effectiveness of oral health promotion activities on knowledge/behavior and ultimately on the prevalence of ECC in Aboriginal communities. The following evaluation of SLZ Dental Program involving Cree living in 28 communities in Ontario, Lawrence et al. (2004) found that the SLZ’s prenatal nutrition program improved caregivers’ knowledge of ECC.13 However, more needs to be done to address the factors that place undo strain on parents/caregivers and lead to poor oral hygiene and dietary habits among children in Aboriginal communities.

Indigenous communities are distinct groups with different cultures and cultural contexts and, therefore, the ECC prevention efforts that have been used as pan Canadian approaches are not appropriate. Systemic level interventions to address the social determinants associated with ECC in Indigenous communities such as cultural traditions, economic security, food security, and housing status are needed.42 These interventions not only contribute to overall health but also enable the necessary conditions to promote and sustain oral health. The recent work by Cidro et al., The Baby Teeth Talk Study, exploring the use of four interventions (motivational interviewing, anticipatory guidance, fluoride varnish (FV) and dental care to expectant mothers) aims to reduce the prevalence of ECC in infants within Aboriginal communities.44 They suggest that restoring cultural childrearing skills (i.e., breastfeeding) within a contemporary context, promoting traditional knowledge (i.e., traditional medicine), and teaching transcultural skills are an essential component in rebuilding and enhancing skills to support the healthy development of Aboriginal babies.44 The Manitoba Dental Association’s Free first visit program (FFV) is another intervention that increased the number of young children (infants and toddlers) who have had an FFV by 36 months of age, particularly for those from households at a lower SES (mainly, Aboriginal).45 However, there is a need to evaluate the impact of the FFV program on reducing the incidence of severe caries in young children, reducing the number of dental surgeries for severe ECC, and whether this intervention lead to better and sustained access to dental care for preschool children.45 There is preliminary evidence that the annual cost for children, who were non-Aboriginal, privately insured and had their first dental visit by age one, was significantly less than for children who waited until and older age.46,47 Nash argued that evidence supporting early dental visits is equivocal, and therefore, more studies are warranted to evaluate the recommendation of the early visit in both non-Aboriginal and Aboriginal children.48
Fisher-Owens et al. argue that health promotion models should be a multilevel approach by targeting not only the individual and family factors but also factors at the community level.49 In this conceptual model, the individual and family levels are situated within the community level because the community factors have a broader and more dominant role in shaping children’s health, including their oral health. Social capital is one of the community-level factors that has been demonstrated to be positively affecting dental caries as well as other general health and oral health conditions.50-52 Because little is known about the role of social capital and its potential role in the oral health of preschool children in general and in First Nations children in particular, Salehyar et al. conducted individual and focus group interviews with members of a First Nations community in Alberta which aim to better understand the concept of social capital and its role in developing a health promotion model to address oral health issues in this community. The authors found that although the “close-knit nature” of the community can be considered as one of its strengths, it may create a backlash by encouraging unhealthy behaviors and resistance to change, which is one of difficulties faced when changing unhealthy behaviors.53,54 More issues related to the social capital role for the First Nations communities such as the power and gender issues, need more focused investigations.55

Disease prevention (fluoride and sealants)
The Canadian Dental Association, the Canadian Academy of Paediatric Dentistry, and the Canadian Paediatric Society endorse the use of fluoride for the prevention and control of caries.30 Multiple modalities provide fluoride both systemic (e.g., water fluoridation, salt fluoridation) and topical (e.g., toothpastes, FV). The effectiveness of fluoride requires adherence (toothpaste) or access to dental care or funding (water fluoridation, FV).

A recent preliminary evidence suggests that community fluoridation help reduces caries by 30-50% in Alaska whose inhabitants (Alaska Natives) suffer from a high prevalence of dental caries similar to Aboriginal peoples in Canada.30 In Canada, less than 10% of First Nations people live in areas which have access to fluoridated water, whereas 45% of Canadians benefit from access to fluoridated water.48 Unfortunately, there is a new trend of fluoridation cessation in some Canadian areas. A new study revealed that cessation occurred in May 2011 in Calgary, Alberta, has resulted in increased children’s tooth decay, 2.3-3 years post-cessation, compared to another similar city in Alberta (Edmonton) where fluoridation continued.55 More work needs to be done to increase access to fluoridated water and monitor trends of fluoridation cessation, taken into consideration that the fluoridation of drinking water supplies is a decision that is made by each municipality in collaboration with the appropriate provincial or territory authority and in consultation with residents. Because of public controversy regarding the uptake of water fluoridation, Aboriginal communities should be consulted before adding fluoride to their water supply.

Introduced in the 1960s, FV and dental sealants substantially reduce dental caries in both primary and permanent teeth in children and adolescents.56,57 However, both require active participation by the client and are more expensive than fluoridation of the water supply. An example of a program that applied FV is the one involved 1275 Aboriginal children living in the SLZ and Thunder Bay (northern Ontario) who received FV twice per year. Lawrence et al. (2008) found that children who received FV exhibited 18% reduction in dental caries over a 2-year period compared to a negative control group. Based on these findings, Lawrence et al. (2008) suggested the expansion of FV applications to include more children by involving primary care providers in administering FV.13

Sealants have been included in limited numbers of free preventive dental services, along with FV and scaling, to low-income children in Canada.3 There is a consensus among Canadian experts in caries prevention that all children at high risk of dental caries, including First Nations and Inuit populations, should receive sealants on both primary and permanent molars.58

Access to Publicly Funded Oral Health Programs and Services
A lack of access to dental care significantly contributes to the oral health disparities experienced by Canadian Aboriginal children. Dental therapists are commonly used in some northern communities in Canada because there are inadequate numbers of dentists serving in these areas.59 Recruiting (and retaining) dentists in remote Aboriginal communities is a real challenge that requires innovative solutions. Some suggest that dental schools should graduate more Aboriginal students. The University of Saskatchewan College of Dentistry’s Aboriginal Equity Access Program aims at recruiting, retraining, and graduating more Aboriginal students. Started in 1996, the program so far has admitted 22 students in the predoctoral program.60 However, the efficacy of the program in increasing access to dental care in Aboriginal communities needs to be established.

Readily available solutions to the workforce problem include involvement of primary care providers (e.g., pediatricians, family physicians, nurse practitioners, and community health nurses) in various Aboriginal communities in oral health care to complement the work of dental professionals. Appropriate funding for increasing access to dental prevention programs and treatment services to Aboriginal populations should be advocated. More community-based participatory research should be supported with the focus on the epidemiology, prevention, and management of ECC unique to Canadian context.
Conclusion

ECC is a growing public health problem because a trend has been noticed over the last 25 years indicating a significant increase in primary tooth decay rates in preschool children in North America. Aboriginal Canadian preschool children are reported to have a higher burden of ECC. If untreated, ECC may impact on childhood health and well-being. ECC is a complex disease involving multiple risk factors, both social and biomedical. Therefore, ECC control requires multiple, complementary prevention strategies, with active participation from dental professionals, Aboriginal communities, researchers, and policy makers. The Canadian Dental Association’s (2010) Committee on Clinical and Scientific Affairs stated in its Report on ECC that, “Although a number of innovative multidisciplinary programs have been developed in Canada, these occur in relative isolation and are not widely known. These initiatives need to be identified, recognized, supported and, most importantly, leveraged to implement successful strategies across many populations by a variety of health care professionals” (p. 5). These strategies include oral health promotion, caries prevention, and access to publicly funded oral health programs and services. In a broader perspective, the social determinants of health and social disadvantages affecting Indigenous communities, including poverty, poor housing, and low levels of education, should be addressed in order to improve Indigenous children’s oral health.

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