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Exploring the short-term impact of community water fluoridation cessation on children's dental caries: a natural experiment in Alberta, Canada



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ABSTRACT

Objectives: Dental caries (tooth decay) is common and can be serious. Dental caries is preventable, and community water fluoridation is one means of prevention. There is limited current research on the implications of fluoridation cessation for children's dental caries. Our objective was to explore the short-term impact of community water fluoridation cessation on children's dental caries, by examining change in caries experience in population-based samples of schoolchildren in two Canadian cities, one that discontinued community water fluoridation and one that retained it.

Study design: We used a pre-post cross-sectional design.

Methods: We examined dental caries indices (deft [number of decayed, extracted, or filled primary teeth] and DMFT [number of decayed, missing, or filled permanent teeth]) among grade 2 schoolchildren in 2004/05 and 2013/14 in two similar cities in the province of Alberta, Canada: Calgary (cessation of community water fluoridation in 2011) and Edmonton (still fluoridated). We compared change over time in the two cities. For Calgary only, we had a third data point from 2009/10, and we considered trends across the three points.

Results: We observed a worsening in primary tooth caries (deft) in Calgary and Edmonton, but changes in Edmonton were less consistent and smaller. This effect was robust to adjustment for covariates available in 2013/14 and was consistent with estimates of total fluoride intake from biomarkers from a subsample. This finding occurred despite indication that treatment activities appeared better in Calgary. The worsening was not observed for permanent teeth. For prevalence estimates only (% with >0 deft or DMFT), the three data points in Calgary suggest a trend that, though small, appears consistent with an adverse effect of fluoridation cessation.

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Conclusions: Our results suggest an increase in dental caries in primary teeth during a time period when community fluoridation was ceased. That we did not observe a worsening for permanent teeth in the comparative analysis could reflect the limited time since cessation. It is imperative that efforts to monitor these trends continue.

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Introduction

More than half of children in Canada (aged 6–11 years) and the US (aged 5–11 years) are affected by dental caries (tooth decay).^{1,2} Children with extensive caries could require treatment in the hospital.^{3–5} Social inequities in oral health problems are significant.^{2,6,7} Dental caries in childhood can affect the growth of adult teeth and contribute to sleeping problems, behavioral and learning problems, and poor school performance.^{5,8}

Caries is largely preventable, and one avenue for prevention is appropriate exposure to fluoride. Community water fluoridation (CWF) refers to the controlled addition of a fluoride compound to a public water supply for the purpose of preventing tooth decay in the population.⁹ Early studies of CWF in the 1940s and 1950s showed significant positive impact in preventing tooth decay.¹⁰ However, important changes have occurred. First, unlike the 1940s and 1950s when drinking water was the only significant source of fluoride, we are now exposed to multiple sources, most notably fluoride toothpaste.¹¹ Second, although tooth decay was previously nearly universal and quite extensive for most, it is now less widespread and the distribution is skewed with a minority of children accounting for a majority of problems.¹² Systematic reviews support the benefits of CWF for the prevention of tooth decay; however, the quantity and quality of contemporary evidence is recognized to be the modest.^{13,14}

Another feature of the contemporary CWF landscape is instances of cessation. A systematic review¹⁵ identified published research on 15 instances of CWF cessation in 13 countries. Overall, results were mixed; however, of the nine studies with the highest methodological quality of those included in the review, five showed an increase in dental caries post cessation. The effect was apparent within 2–3 years of cessation in two of those studies.^{16,17}

Overall, our knowledge of the dental caries impact of fluoridation cessation in different contexts is limited. This is problematic because the number of communities in some regions, such as Canada, that are reconsidering CWF appears to be increasing.^{18,19} If CWF is contemporarily effective in reducing the tooth decay, it is important to document it, so that informed debates can take place during instances of CWF decision-making. If it is no longer effective, it is important to know that too, so that alternative options to improve oral health can be identified.

The purpose of this study was to explore the short-term impact of CWF cessation in Calgary, Canada, compared with Edmonton, Canada. In Calgary, CWF was discontinued in May

2011, following a City Council vote, after having been in place since 1991. In Edmonton, CWF began in 1967 and remains in place. Our selection of comparison community was informed by a related study²⁰ wherein local fluoridation stakeholders expressed that a comparative study of Calgary and Edmonton would provide the most credible evidence for local decision-making. Based on existing cessation research^{16,17} and the time frame of our study, we hypothesized that we would see some indication (not necessarily statistically significant) of an increase in dental caries in Calgary, where CWF was stopped, relative to Edmonton where CWF remains in place.

Methods

Design and study locations

We used a pre-post cross-sectional design with comparison community. Calgary ('CWF cessation') and Edmonton ('CWF continued') are well matched: as the two largest cities in the province of Alberta, they are both large urban centers (2011 populations approximately 1.1 million for Calgary and 810,000 for Edmonton) with diverse demographic profiles. Based on 2011 census data, the percentage of children aged 5–9 years living in single parent families was 15.1% in Calgary and 19% in Edmonton;²¹ and the percentage who mainly speak a language other than English or French at home was 14% in Calgary and 9% in Edmonton.²² Based on the 2011 National Household Survey,⁸ the percentage of children aged 5–9 years of visible minority status was 38.1% in Calgary and 28.7% in Edmonton,²⁴ and the percentage of children aged 0–9 years^h who live in a household with an education level of a bachelor's degree or higher was 53.6% in Calgary and 40.6% in Edmonton.²⁵ The percentage of children aged 5–9 years living in families that moved within the last 5 years was similar: 53.1% (Calgary) and 53.6% (Edmonton).²⁶

Annual water quality reports obtained from the two cities for 2005–2013 confirm generally the optimal levels of fluoride in Calgary drinking water (range 0.59–0.89 mg/L) up until cessation in 2011 when levels declined (range 0.07–0.30 mg/L). In Edmonton, average and median values mostly confirm optimal levels of fluoride in water, with some important short-term exceptions where fluoridation was lower than the

^g Following the 2006 national census, the mandatory long-form census was discontinued, and its replacement (the National Household Survey) was voluntary and may have some bias.²³

^h An estimate for the 5–9 year age group could not be generated for the household education variable.

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