What have been the effects of ceasing Water fluoridation in Calgary?

J Dickinson 12 Nov 2024

Fluoridation ln the Calgary water supply was ceased by Calgary City Counciin 2011, after being present since 1991. Edmonton, in the same province, under the same health care system, with a similar sized population and similar demography, continued water fluoridation, thus serving as a natural control for research on the effects of fluoride cessation.
Measuring the effects of discontinuing is difficult, becasue the process of tooth decay is slow, and there are residual effects from having fluoride in water during previous years. Further, tooth decay affects people differently: it is concentrated among some groups, while others have very little decay. Doing dental surveys consistently on large populations is difficult, since getting high participation rates is almost impossible, except under duress: eg schools, military conscription examinations.

The sequence of effects is: **First**, initial decay, which can be measures by assessing Decayed, Missing or Filled teeth. (dmft for primary teeth, then DMFT for permanent teeth that start to erupt from age 7 onwards. **Second**, more severe decay that requires extensive dental work: for young children, that usually needs to be performed under general anesthesia, because they cannot cooperate with a dentist. **Third,** major infection, from root abscesses. These require hospital admission for intravenous antibiotics. The number of cases is fewer as we progress along this sequence to more severe illness The severe cases act as markers for many of lesser degree.

There are now three major published studies from Alberta that demonstrate the effects, and an unpublished one.

1. A short term survey of grade 2 children, as part of the regular series of surveys of community dental health.
   McLaren, L., Patterson, S., Thawer, S., Faris, P., McNeil, D., Potestio, M., & Shwart, L. (2016). Measuring the short-term impact of fluoridation cessation on dental caries in Grade 2 children using tooth surface indices. *Community dentistry and oral epidemiology*, *44*(3), 274-282.

2. A longer-term study of fluoridation, studying the effects on grade two children, approximately half of whom had never experienced water fluoridation:
   McLaren, L., Patterson, S. K., Faris, P., Chen, G., Thawer, S., Figueiredo, R., & Potestio, M. L. (2022). Fluoridation cessation and oral health equity:

a 7-year post-cessation study of Grade 2 schoolchildren in Alberta, Canada. *Canadian Journal of Public Health*, *113*(6), 955-968. https://onlinelibrary.wiley.com/doi/10.1111/cdoe.12685

3. A re-analysis of the 7-year data, assessing whether social deprivation affects dental decay, initially when fluoridated, then after cessation whether it increases more. McLaren L, Patterson S, Faris P, Chen G, Thawer S, Figueiredo R, Wejs C, McNeil D, Waye A, Potestio M. Fluoridaiton cessation and oral health equity: A 7-year post-cessation study of Grade 2 schoolchildren in Alberta, Canada. *Canadian Journal of Public Health* (2022) 113:955-968 https://doi.org/10.17269/s41997-022-00654-4

4. A study of Alberta Medicare billing records of anesthesia for tooth removal surgery, Yazdanbakhsh, E., Bohlouli, B., Patterson, S., & Amin, M. (2024). Community water fluoride cessation and rate of caries-related pediatric dental treatments under general anesthesia in Alberta, Canada. *Canadian Journal of Public Health*, *115*(2), 305-314.

5. Measurement of increase in intravenous antibiotic adminitrations for infection caused by dental problems at the Alberta Children's hospital.
   Dr. Cora Constantinescu, Alberta Children's Hospital, 2019

McLaren et al. Fluoride cessation: 7 year follow up.

McLaren et al https://onlinelibrary.wiley.com/doi/10.1111/cdoe.12685 used a time-series design to measure dental health in samples of grade 2 students, before and after the 2011 cessation of fluoridation in Calgary.

While much of the literature on fluoridation was done a long time ago, using less rigorous methods, this project uses modern measurements. It also compares two cities that are fairly similar, over the same time period, except that Edmonton had fluoridation throughout at 0.7 parts per million (ppm), while Calgary stopped in May 2011 and only had low-level natural fluoride in the water at about 0.2 ppm.

The researchers compared routine school dental surveys in Calgary and Edmonton, performed as part of school dental programs. The measurements were performed by specially trained dental hygienists, whose skills were calibrated throughout the program to ensure they were measuring consistently. The children were in grade 2, about 7 years old in 2019, so they were born after fluoridation stopped in 2011. In Calgary there were 2650, and in Edmonton 2600, so the sample sizes were large enough to detect moderate differences. Since many people come and go, the most important group are the subset who lived all their life in either city. There were 918 in Calgary, and 778 in Edmonton, with slightly fewer for some measurements.

Children this age have a mixture of primary (deciduous, baby) teeth, and up to12 of the first permanent (adult) teeth. Measurements were made separately of each of these groups of teeth. The main measurements are the number of children with decay, and the amount of decay.

A harm of fluoride is fluorosis: which mostly presents as benign white flecks on the teeth, barely visible except to the close-up view of a trained eye. More severe fluorosis can cause pitting of teeth, and brown discolouration. Teeth with fluorosis are stronger and more resistant to decay than those without. To measure the harm from fluoride, these changes were observed on the permanent incisor teeth. Note that there are other causes of white flecks, and of staining, so these data overestimate the rates of harm caused by fluoride.

Measurements:

Decay of deciduous teeth: decay (d), extracted (e) or filled (f) teeth “deft score”

Permanent teeth: decay (D) missing (M) or filled (F) teeth “DMFT” score

Fluorosis: presence, and severity.

The table summarises some of the measurements:

Decay measurements in 7 year-old children who lived all their life in Calgary or Edmonton.

Measurement	Calgary	Edmonton	Difference
Primary teeth			
deft mean	3.2	2.0	1.2
95% CI	2.9 – 3.4	1.7 – 2.3	Sig*
Children with any *deft*	60.8%	44.5%	16.3%
95% CI	57.0 – 64.5	39.9 – 49.2	Sig*
Permanent teeth			
DMFT mean	0.26	0.19	0.07
95% CI	0.20 – 0.33	0.13 – 0.24	Sig*
Children with any *DMFT*	15.4%	12.4%	3%
95% CI	12.4 – 18.9	9.6 – 15.9	Not sig*
Fluorosis			
Any detectable	6.2%	18.8%	12.8%
Staining or pitting (severe)	0.1%	0.5%	0.4%

*Sig: statistically significantly different, Not sig: not statistically significant

In addition, a questionnaire to parents asked about behaviours relating to teeth. This survey showed that Calgary parents of participating children were slightly higher in social class (measured by education, home ownership) and more careful than Edmonton parents in care of their children's teeth. Measures included twice daily tooth brushing, visiting dentists, eating fruits and vegetables, not giving their children sugary drinks, giving fluoride treatments at home, and in the dentist's office. If anything, more of such preventive activites should mean that these children would have better teeth. Consequently the findings that they had more dental decay are more notable.

Meaning of Findings

All differences point in the same direction: that children living in Edmonton with fluoridated water have less tooth decay than those in Calgary without, both in the deciduous (baby) teeth and the permanent (adult) teeth. These differences occurred despite Calgary parents doing more to protect their children from tooth decay.

It is striking that benefits of fluoridation outweigh the harms: in their deciduous teeth, 16% more Edmonton children have no dental decay at all, and on average, 1.2 fewer teeth with decay, extraction or filled. Even though the first adult teeth have only recently appeared, already there are signs of decay and fillings. This can be expected to deteriorate over time. By contrast, higher grade incisor fluorosis was found in 0.4% more of the children in Edmonton. Since this occurs in tooth formation, this marks teeth that are more decay-resistant, and will not deteriorate over time.

Where this study fits into knowledge.

This carefully performed study confirms, and gives greater precision to prior studies that demonstrate the value of water fluoridation including studies of the introduction of fluoridation and those of its removal. As expected, the 2021 study shows greater effects than the prior study by the same authors in these two cities only three years after cessation.

Similar results have been found in Alaska, after cessation of community water fluoridation there. *Meyer, J., Margaritis, V., & Mendelsohn, A. (2018). Consequences of community water fluoridation cessation for Medicaid-eligible children and adolescents in Juneau Alaska. BMC Oral Health, 18(1), 215.* https://doi.org/10.1186/s12903-018-0684-2

Even though the difference in number of decayed missing or filled teeth appears small, these numbers are likely to increase as the children age. Further, averages are somewhat misleading: decay is skewed, that is, while many children have no decay, and a similar number have very little, a few children have multiple decayed teeth, including some who already at this age have had several fillings or had extractions.

Once a child has decayed teeth, further mouth hygiene is difficult because of pain. Thus the situation is likely to deteriorate steadily. Some of the worst decay occurs among children with behaviour difficulties, often because of other medical problems such as neurological disease, autism, or congenital disorders. Parents of such children have a difficult enough time, without having fights about cleaning their painful mouths.

Effects on health equity.

McLaren and her team re-analysed their data to asess whether material deprivation and lack of dental insurance affected the dental decay experience of these children.

They found that these two factors were strongly associated with higher rates of dmft, but there were not enough permanent teeth to show effects on DMFT. Ceasing water fluoridation made the associations stronger across most of the measures used, and they increased over time.

Dental treatments under Anesthesia

Elnaz Yazdanbakhsh [1], Babak Bohlouli [1], Steven Patterson [1], Maryam Amin [2]

Community water fluoride cessation and rate of caries-related pediatric dental treatments under general anesthesia in Alberta, Canada. Can J Public Health 2024 Apr;115(2):305-314. doi: 10.17269/s41997-024-00858-w. Epub 2024 Feb 22.

Yazdanbakhsh et al measured caries-related dental treatments under general anesthesia for children under 12 years, in Calgary (ceased fluoridation) and Edmonton (continued fluoridation) in 2010/11, 2014/5, and 2018/9. These were for mostly dental caries treatments, but 15% were for pulp and periapical problems: more advanced disease.

Their main finding (table 2 and figure 2) was that the rates of caries-related treatments in Edmonton stayed relatively constant, but rose in Calgary, especially for children under 6 years: whose teeth had not been protected by having fluoride during prenatal life in pregnancy. This result demonstrates the two modes of fluoride effect: during tooth formation, and after eruption.

Table 1. Numbers of caries-related dental treatments under General Anaesthetic

Years	Calgary	Edmonton
2010-11	355	261
2014-15	610	278
2018-19	744	381
0-5 years	1212	606
6-11 years	527	314

Table 2. Rates (per 100,000 children) of caries-related dental treatments under GA

	Calgary	Edmonton	Difference
0-5 years			
2010-11	22	18	4
2014-15	38	17	21
2018-19	45	24	21
6-11 years			
2010-11	14	11	3
2014-15	15	10	5
2018-19	19	11	8

These are rates: the raw numbers may be more impressive to some, but the rates are more easily comparable. After fluoride was removed, Calgary children under 6 doubled their rates of caries-related dental treatments, while Edmontons' rose only a little. For those over 6 the rates also rose, though less, while Edmonton was steady. It will be interesting to see whether these children who had no fluoride while in the uterus will develop higher rates than previous groups as they get older.

Intravenous antibiotic treatment

At a public meeting, Dr C Constantinescu described how the number of children receiving intravenous antibiotics for systemic infections originating in infected decaying teeth has risen by over 7 times in the years after fluoride was removed from Calgary water.

Commentary

Early studies of fluoridation were performed before widespread use of fluoridated toothpaste, dental sealants, and fluoride treatments by dentists. It would be expected that differences solely due to water fluoridation would be reduced by these actions, perhaps even to the extent that water fluoridation is unnecessary.

To the contrary, these results show the value of fluoridation in addition to dental activities. Even more important, fluoridation helps children regardless of whether their parents take care of their mouth hygiene or not. Thus these children are not starting life disadvantaged by their parents lack of knowledge, being too busy, unable to afford oral care, or with other difficulties that prevent them performing this help.