

# Variation in Urban and Rural Water Fluoride Levels in Ontario

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## ABSTRACT

**Objective:** To compare levels of water fluoridation in urban and rural distribution systems in Ontario.

**Methods:** A random sample of 17 urban and 17 rural municipalities was taken from a list of 445 municipalities. The Ontario Ministry of the Environment (MOE) website was used to identify the water treatment plants that supply these municipalities, and water quality reports published by each of these distribution systems for 2007 were collected. For municipal distribution systems without published reports, staff were contacted directly.

**Results:** Far more urban distribution systems (82%) fluoridate their water compared with rural systems (18%). Most urban water suppliers (14 of 17) meet the 2000 MOE fluoride level standard of 0.5–0.8 mg/L, a range that includes the recently adopted Health Canada standard of  $0.7 \pm 0.1$  mg/L. Only 3 of 17 rural distributors artificially fluoridate their water and 11 of 16 supply suboptimal levels of fluoride.

**Conclusion:** Most Ontarians who live in rural areas receive levels of fluoride that are outside MOE standards. Urban water distribution systems that regulate their fluoride content are compliant with the range recommended in 2000. The communal water supplies of some rural residents of southwestern Ontario contain levels of natural fluoride that are well above the standard for artificially fluoridated water.

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The oral health of rural populations is poorer than that of urban populations. This discrepancy was described by Vargas,<sup>1</sup> who found that adults in rural areas tend to have a greater prevalence of dental caries, as well as more untreated dental caries, periodontal pocketing and extractions than their urban counterparts. The American National Advisory Committee on Rural Health and Human Services has identified several possible contributing factors, including geographic isolation, lack of adequate transportation, lack of fluoridated community

water supplies, higher levels of poverty, larger percentage of elderly people, lack of dental insurance, acute dentist shortages and fewer dentists willing to treat government-funded patients in rural areas.

Lack of access to artificially fluoridated water exists despite solid evidence that community water fluoridation can play a significant role in reducing dental caries among both adults and children.<sup>2</sup> The Centers for Disease Control and Prevention (CDC) has reported that communities with fluoridated drinking water in the United States, Australia, Britain,

**Table 1** Presence of fluoride treatment and average fluoride levels for 17 urban distribution systems

Distribution system	Fluoridation <sup>a</sup>	Fluoride level (mg/L)
Ajax Water Supply Treatment Plant	Y	0.57
F.J. Horgan Water Treatment Plant	Y	0.76
Toronto (R.C. Harris) Water Treatment Plant	Y	0.78
Toronto Island Water Treatment Plant	Y	0.73
Toronto (R.L. Clark) Water Treatment Plant	Y	0.67
Britannia Water Treatment Plant/Lemieux Island Water Purification Plant	Y	0.74–0.75
Windsor Water Treatment Plant	Y	0.60
Elgin Area Primary Water Supply System	Y	0.63
Woodward Water Treatment System	Y	0.67
Burlington Water Treatment Plant	Y	0.61
Oakville Water Treatment Plant	Y	0.58
Lakeview Water Treatment Plant	Y	0.67
Lorne Park Water Treatment Plant	Y	0.72
Oshawa Water Supply Plant	Y	0.61
St. Catherines Decew Water Treatment Plant	N	0.08
Mannheim Water Treatment Plant & Pumping Station	N	0.07
Guelph Well Supply	N	0.30

<sup>a</sup>Y = yes, N = no.

Canada, Ireland and New Zealand have 15%–40% less tooth decay than communities that do not receive fluoridated drinking water.<sup>3</sup> Community water fluoridation has also been cited as the most cost-effective method of preventing tooth decay.<sup>4</sup> Communal water fluoridation provides the greatest support to those least able to afford preventive and restorative dental procedures.

A number of factors may account for the lower rate of community water fluoridation in rural areas. It is approximately 6 times more costly per person to fluoridate water that supplies an area with fewer than 5,000 people than an area with more than 20,000 people.<sup>3</sup> In addition, a number of political action groups object to artificial fluoridation of drinking water because of personal beliefs and evidence that excess fluoride intake may cause health problems. Despite these concerns, the Canadian Dental Association, the American Dental Association and the CDC have endorsed water fluoridation, the latter describing fluoridation as “one of the 10 greatest public health achievements of the 20th century.”<sup>5</sup>

In Canada, provincial and territorial ministries of the environment are responsible for fluoridation of communal water supplies. In 2000, the Ontario Ministry of the Environment (MOE) lowered the fluoride level

standard from 1.0–1.2 mg/L to 0.5–0.8 mg/L.<sup>6</sup> Recently a Health Canada Fluoride Expert Panel recommended the adoption of 0.7 mg/L ( $\pm$  0.1 mg/L) as the target concentration for fluoride in drinking water, and this has been accepted by Health Canada.<sup>7</sup> Currently, despite the fact that lack of community water fluoridation may be contributing to poorer oral health in rural areas, no studies have compared levels of water fluoridation in urban and rural distribution systems in Ontario.

## Methods

A sample of 17 urban and 17 rural municipalities, taken from a list of 445 municipalities in Ontario provided by the Ministry of Municipal Affairs and Housing, was chosen using a random number generator. A sample size calculation was performed to ensure generalizability of the results across Ontario. The proportion of urban municipalities assumed to have fluoridation was set at 80% and the proportion of rural communities at 50%. Because pilot standard deviation was assumed to be 20%, the required sample size was 12 per group. An additional 5 samples were added to each group to allow for missing information and drop off.

Of the 445 municipalities, 24 were urban. An urban municipality was defined as a region with a population of

**Table 2** Presence of fluoride treatment and average fluoride levels for 17 rural distribution systems

Distribution system	Fluoridation <sup>a</sup>	Fluoride level (mg/L)
Renfrew Water Treatment Plant	Y	0.52
Prescott Water Treatment Plant	Y	0.58
Wawa Water Supply System	Y	0.41
Ayr Well Supply	N	0.12
Bright Well Supply	N	0.16
Brucefield Well Supply	N	1.10
Crysler Well Supply	N	<0.10
Elk Lake Well Supply	N	0.20
Powassan Well Supply	N	0.20
Earlton Well Supply	N	0.86
Mitchell Well Supply	N	1.90
Red Rock Water Treatment Plant	N	<0.03
Beardmore Water Treatment Plant	N	<0.03
Rope Subdivision Water Treatment Plant	N	<0.06
Minden Well Supply	N	0.16
Holtyre Well Supply	N	N/A
Fauquier Water Treatment Plant	N	<0.01

<sup>a</sup>Y = yes, N = no.

100,000 people or more, whereas a rural municipality was defined as a region with 10,000 people or fewer.

The MOE website ([www.ene.gov.on.ca/](http://www.ene.gov.on.ca/)) was used to identify the water treatment plants (distribution systems) that supply potable water to residents of these municipalities. Government-legislated water quality reports for each of these distribution systems were collected from the MOE website. The most recently published report was used, except in cases where fluoride levels were presented as a range, in which case the most recent report that presented a single value was used. If a report was not available on the MOE website, staff of the distribution system were contacted directly.

## Results

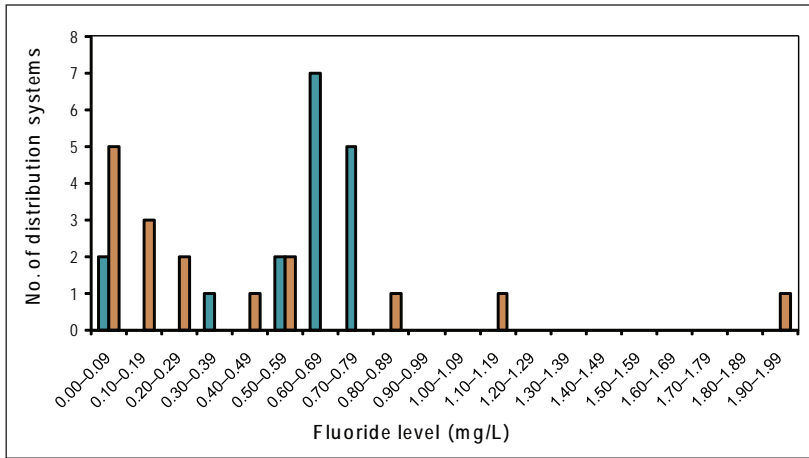
Data from the 17 urban distribution systems were used as an indicator of the level of fluoride that the estimated 9.5 million urban dwellers in Ontario are exposed to in their municipal water supply (**Table 1**). Data from the 17 rural distribution systems were used as an indicator of the fluoride exposure of the estimated 1.7 million rural dwellers in Ontario (**Table 2**). Data for 16 of the urban distribution systems were readily available on the MOE website; data for the Elgin Area Primary Water Supply System were obtained by contacting the City of

London (the municipality that receives water from this distribution system). Only 6 of the rural distribution systems had data available online. The remaining 11 had to be contacted directly.

Data from most of the urban and rural distribution systems included in this study came from 2007 water quality reports (the most recent reports available). Data from reports published before 2007 were used in 6 cases where 2007 data were presented as a range rather than a single value (Ajax, F.J. Horgan, R.C. Harris, Toronto Island, R.L. Clark, Oshawa) and in 2 cases where 2007 reports were not available (Elk Lake, Beardmore). Pre-2007 data were also used for the Oshawa Water Supply Plant where fluoride values were not provided in the 2007 report. Information on the *presence* of fluoridation was collected from all 34 distribution systems. Information on the fluoride *level* was collected for 33 systems, as these data were not available for the Holtyre Well Supply in the township of Black River-Matheson.

Most urban distribution systems (82%) artificially fluoridated their water compared with 18% of rural distribution systems ( $p < 0.005$ ).

All fluoride values were sorted into 3 categories. Optimal fluoride levels were based on the MOE standard, 0.5–0.8 mg/L, which is slightly broader than the newly



**Figure 1:** Levels of controlled and natural fluoride in 17 urban (green bars) and 16 rural (gold bars) distribution systems in Ontario.

adopted Health Canada range of  $0.7 \pm 0.1$  mg/L. A sub-optimal category was defined as fluoride level  $<0.5$  mg/L and above-optimal as fluoride level  $>0.8$  mg/L. Fourteen of the 17 urban, but only 2 of the 16 rural systems, were in the optimal range. Three trends were apparent (**Fig. 1**): an abundance of rural distribution systems had excessively low fluoride levels, a cluster of urban distribution systems had optimal fluoride levels and 3 rural distribution systems had high natural fluoride levels. No urban system exceeded the recommended range.

## Discussion

Community water fluoridation differed considerably between urban and rural areas. Fourteen of the 17 urban distribution systems artificially fluoridated their water, whereas only 3 of the 17 rural distribution systems did so ( $p < 0.005$ ). Thus, rural citizens are less likely to have access to controlled fluoridated water than their urban counterparts. This is one of a number of factors that contribute to the higher rate of caries among those living in rural areas.

This study demonstrates that urban water suppliers in Ontario had already reduced their level of fluoridation to the 2000 MOE standard of 0.5–0.8 mg/L before this survey. In contrast, lack of community water fluoridation has led to suboptimal fluoride levels in 11 of the 16 rural locations sampled. Earlton Well Supply, which did not fluoridate its water, had an above-optimal fluoride level of 0.86 mg/L. Two additional rural distribution systems (Brucefield Well Supply and Mitchell Well Supply) had fluoride levels of 1.10 mg/L and 1.90 mg/L, respectively. In some Ontario water supplies, the recommended maximum acceptable concentration of 1.5 mg/L for artificially fluoridated water is exceeded by natural fluoride levels, which may be as high as 2.4 mg/L.

## Conclusion

Distributed urban water is significantly more likely to be artificially fluoridated than water in rural systems. Consequently, citizens in urban areas are significantly more likely to receive optimally fluoridated water. Those who reside in rural areas are far more likely to receive tap water that is lower or, less frequently, higher in natural fluoride levels than currently recommended for artificially fluoridated water supplies.

Community water fluoridation is periodically a “hot topic” in Canada. This survey shows that those in charge of urban water supply management have adopted the 2000 MOE standard of 0.5–0.8 mg/L and have been largely successful.

This study did not include the estimated 20% of Ontarians who receive water from small local wells, private wells and other sources, as this information is not readily available. Many Ontarians live in rural areas where fluoride levels are well below standard, while other areas have excessive levels of natural fluoride. Property owners in rural Ontario may have their well water analyzed for fluoride levels by commercial laboratories licensed by the MOE. ✦

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