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Community Water Fluoridation Programs: Clinical Effectiveness and Safety a 2020 Update

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Research Questions

1. What is the effectiveness of community water fluoridation (fluoride level between 0.4 ppm and 1.5 ppm) compared with non-fluoridated drinking water (fluoride level < 0.4 ppm) in the prevention of dental caries in children and adults?
2. What are the effects of community water fluoridation cessation (fluoride level < 0.4 ppm) on dental caries in children and adults compared with continued community water fluoridation (fluoride level between 0.4 ppm and 1.5 ppm), the period before cessation of water fluoridation (fluoride level between 0.4 ppm and 1.5 ppm), or nonfluorinated communities (fluoride level < 0.4 ppm)?
3. What are the negative effects of community water fluoridation (at a given fluoride level) compared with non-fluoridated drinking water (fluoride level < 0.4 ppm) or fluoridation at different levels on human health outcomes?

Key Findings

Five non-randomized studies were identified regarding the clinical effectiveness of community water fluoridation in the prevention of dental caries and the negative effects of community water fluoridation on human health outcomes. No relevant studies were identified regarding the effects of community water fluoridation cessation on dental caries.

Methods

Literature Search Methods

This report makes use of a literature search strategy developed for a previous CADTH report.⁶ For the current report, a limited literature search was conducted by an information specialist on key resources including Medline via OVID, CINAHL via Ebsco, Scopus, Pubmed, the Cochrane Library, the University of York Centre for Reviews and Dissemination (CRD) databases, the websites of Canadian and major international health technology agencies, as well as a focused internet search. The search strategy was comprised of both controlled vocabulary, such as the National Library of Medicine’s MeSH (Medical Subject Headings), and keywords. The main search concepts were water and fluoridation. Search filters were applied to limit retrieval to health technology assessments, systematic reviews, meta-analyses, or network meta-analyses, any types of clinical trials or observational studies. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between March 10, 2020 and August 26, 2020. Internet links were provided, where available.

Selection Criteria

One reviewer screened literature search results (titles and abstracts) and selected publications according to the inclusion criteria presented in Table 1. Full texts of study publications were not reviewed. Open access full-text versions of evidence-based guidelines were reviewed when abstracts were not available.

Table 1: Selection Criteria

Population	Human populations of any age
Intervention	Q1: Natural or artificial water fluoridation (fluoride level 0.4 ppm to 1.5 ppm) Q2: Cessation of water fluoridation (fluoride level < 0.4 ppm) Q3: Water fluoridation at any level

Comparator	<p>Q1: Non-fluoridated water (fluoride level < 0.4 ppm)</p> <p>Q2: Continued water fluoridation (fluoride level 0.4 ppm to 1.5 ppm), before cessation of water fluoridation, or non-fluoridation community</p> <p>Q3: Non-fluoridated water (fluoride level < 0.4 ppm) or different fluoride levels in drinking water</p>
Outcomes	<p>Q1-2: Clinical effectiveness: Any measure of dental outcomes including but not limited to:</p> <ul style="list-style-type: none"> • Mean DMFT • Mean DMFS • Mean DFS • Proportion of children with or without caries in primary teeth • Proportion of individuals with or without caries in permanent teeth • Hospital admissions for dental surgery under general anesthesia <p>Q3: Negative effects: Any measure of adverse health outcomes associated with water fluoridation, including but not limited to:</p> <ul style="list-style-type: none"> • Dental fluorosis • Skeletal fluorosis • Bone development and bone fracture • Thyroid function • Cancer • Neurodevelopment • Mortality • Other negative effects
Study Designs	Health technology assessments, systematic reviews, randomized controlled trials, non-randomized studies

DFS = decay, and filled (permanent) tooth surfaces; DMFS = decay, missing/extracted, and filled (permanent) tooth surfaces; DMFT = decay, missing/extracted, and filled (permanent) teeth; ppm = part per million

Results

Five non-randomized studies¹⁻⁵ were identified regarding the clinical effectiveness of community water fluoridation in the prevention of dental caries and the negative effects of community water fluoridation on human health outcomes. No relevant health technology assessments, systematic reviews, or randomized controlled trials were identified regarding the clinical effectiveness of community water fluoridation in the prevention of dental caries, the effects of community water fluoridation cessation on dental caries, or the negative effects of community water fluoridation on human health outcomes.

Additional references of potential interest that did not meet the inclusion criteria are provided in the appendix.

Health Technology Assessments

No relevant literature identified.

Systematic Reviews and Meta-analyses

No relevant literature identified.

Randomized Controlled Trials

No relevant literature identified.

Non-Randomized Studies

1. Hobbs M, Wade A, Jones P, et al. Area-level deprivation, childhood dental ambulatory sensitive hospitalizations and community water fluoridation: evidence from New Zealand. *Int J Epidemiol.* 2020;49(3):908-916.
2. Kim FM, Hayes C, Burgard SL, et al. A case-control study of fluoridation and osteosarcoma. *J Dent Res.* 2020;99(10):1157-1164.
[PubMed: PM32392084](#)
3. Lee HH, Faundez L, LoSasso AT. A cross-sectional analysis of community water fluoridation and prevalence of pediatric dental surgery among Medicaid enrollees. *JAMA Netw Open.* 2020;3(8):e205882.
[PubMed: PM32785633](#)
4. Schluter PJ, Hobbs M, Atkins H, Mattingley B, Lee M. Association between community water fluoridation and severe dental caries experience in 4-year-old New Zealand children. *JAMA Pediatr.* 2020;27:e202201.
[PubMed: PM32716488](#)
5. Thippeswamy HM, Devananda D, Nanditha Kumar M, Wormald MM, Prashanth SN. The association of fluoride in drinking water with serum calcium, vitamin D and parathyroid hormone in pregnant women and newborn infants. *Eur J Clin Nutr.* 2020 Aug 19. [online ahead of print]
[PubMed: PM32814853](#)

Appendix — Further Information

Previous CADTH Reports

6. Community water fluoridation programs: clinical effectiveness and safety. (*CADTH Rapid response report: reference list*). Ottawa (ON): CADTH; 2020: <https://cadth.ca/community-water-fluoridation-programs-clinical-effectiveness-and-safety>. Accessed 2020 Aug 27.
7. Community water fluoridation exposure: a review of neurological and cognitive effects. (*CADTH Rapid response report: summary with critical appraisal*). Ottawa (ON): CADTH; 2019: <https://cadth.ca/community-water-fluoridation-exposure-review-neurological-and-cognitive-effects-0>. Accessed 2020 Aug 27.
8. Community water fluoridation programs - tools. (*CADTH Health technology assessment*). Ottawa (ON): CADTH; 2019: <https://cadth.ca/tools/community-water-fluoridation-programs>. Accessed 2020 Aug 27.
9. Community water fluoridation programs: a health technology assessment. (*CADTH Health technology assessment*). Ottawa (ON): CADTH; 2019: <https://cadth.ca/community-water-fluoridation-programs-health-technology-assessment>. Accessed 2020 Aug 27.

Systematic Reviews & Meta-Analyses

Alternative Comparator – Fluoridation Levels Not Specified

10. Mohd Nor NA, Chadwick BL, Farnell DJ, Chestnutt IG. The impact of stopping or reducing the level of fluoride in public water supplies on dental fluorosis: a systematic review. *Rev Environ Health*. 2020 Jun 29. [online ahead of print] [PubMed: PM32598322](https://pubmed.ncbi.nlm.nih.gov/32598322/)

Non-Randomized Studies

No Comparator

11. Bazeli J, Ghalehaskar S, Morovati M, et al. Health risk assessment techniques to evaluate non-carcinogenic human health risk due to fluoride, nitrite and nitrate using Monte Carlo simulation and sensitivity analysis in Groundwater of Khaf County, Iran. *Int J Environ Anal Chem*. 2020 Mar.

Alternative Comparator

12. Dalla Nora A, Dalmolin A, Gindri LD, Moreira CHC, Alves LS, Zenkner J. Oral health status of schoolchildren living in rural and urban areas in southern Brazil. *Braz Oral Res*. 2020;34:e060. [PubMed: PM32609229](https://pubmed.ncbi.nlm.nih.gov/32609229/)
13. Fernando W, Nanayakkara N, Gunarathne L, Chandrajith R. Serum and urine fluoride levels in populations of high environmental fluoride exposure with endemic CKDu: a case-control study from Sri Lanka. *Environ Geochem Health*. 2020;42(5):1497-1504. [PubMed: PM31641912](https://pubmed.ncbi.nlm.nih.gov/31641912/)

14. Karunanidhi D, Aravinthasamy P, Subramani T, Muthusankar G. Revealing drinking water quality issues and possible health risks based on water quality index (WQI) method in the Shanmuganadhi River basin of South India. *Environ Geochem Health*. 2020 Jun 15. [online ahead of print]
[PubMed: PM32557129](#)
15. Lacerda A, Oliveira NA, Pinheiro HHC, Assis KML, Cury JA. Water fluoridation in the ten largest municipalities of the state of Tocantins, Brazil. *Cienc Saude Colet*. 2020;25(4):1507-1518.
[PubMed: PM32267451](#)

Alternative Intervention – Alternative Levels of Fluoridation

16. Garcia-Perez A, Perez Perez NG, Flores-Rojas AI, Barrera-Ortega CC, Gonzalez-Aragon Pineda AE, Villanueva Gutierrez T. Marginalization and fluorosis its relationship with dental caries in rural children in Mexico: a cross-sectional study. *Community Dent Health*. 2020 04 23. [online ahead of print]
[PubMed: PM32338469](#)

Unclear Comparator

17. Karunanidhi D, Aravinthasamy P, Subramani T, Balakumar KG, Chandran NS. Health threats for the inhabitants of a textile hub (Tiruppur region) in southern India due to multipath entry of fluoride ions from groundwater. *Ecotoxicol Environ Saf*. 2020 Aug 9;204:111071.[online ahead of print]
[PubMed: PM32784015](#)

Review Articles

18. Furness J, Oddie SJ, Hearnshaw S. Water fluoridation: current challenges. *Arch Dis Child*. 2020 Jul 15;archdischild-1029-318545. [online ahead of print]
[PubMed: PM32669264](#)
19. Srivastava S, Flora SJS. Fluoride in drinking water and skeletal fluorosis: a review of the global impact. *Curr Environ Health Rep*. 2020;7(2):140-146.
[PubMed: PM32207100](#)

Additional References

20. National Academies of Sciences, Engineering, and Medicine. Review of the Draft NTP Monograph: Systematic Review of Fluoride Exposure and Neurodevelopmental and Cognitive Health Effects. Washington (DC): The National Academies Press; 2020: <https://www.nap.edu/catalog/25715/review-of-the-draft-ntp-monograph-systematic-review-of-fluoride>. Accessed 2020 Aug 27.
21. Rodríguez I, Burgos A, Rubio C, et al. Human exposure to fluoride from tea (*Camellia sinensis*) in a volcanic region-Canary Islands, Spain. *Environ Sci Pollut Res Int*. 2020 Aug 2. [online ahead of print]
[PubMed: PM32740848](#)