

Let's Talk Fluoride!

Friday, February 14, 2025

Featuring: Dr. Tim Wright, Dr. Steven Levy, & Dr. Jessica Lee

https://www.aapd.org/research/policy-center/webinars/

Water Fluoridation: Communicating Evidence to the Public







Tim Wright, DDS, MS Pediatric Dentistry and & Dental Public Health



Conflict of Interest

Neither my immediate family nor I have any financial interests that would create a conflict of interest or restrict my independent judgment concerning the content of this course.



Key Learning/Discussion Points

- What are the controversies related to water fluoridation and safety?
 - What is the evidence?
 - How do we communicate the issue and evidence to patients and parents?



https://www.dental-update.

Why the heightened interest in water fluoridation?

- Controversy around fluorides is not new.
- National Toxicology Program report published 1/6/2025 JAMA Pediatrics
- Cochrane Report Water fluoridation and caries 10/2024
- Politics: Robert Kennedy Jr. fluoride causes arthritis, bone cancer, thyroid damage....
- Media NY Times, CBS News, Journals, Social Media etc



California Federal Judge Ruled Sept. 24, 2024

Rule there was the potential for harm from community water fluoridation and the EPA would need to respond.



Fluoride Action Network

International coalition to end water fluoridation and alert people to fluoride's environmental and health risks.

QUICK FACT:

64 studies have linked fluoride with reduced IQ in children.

http://www.fluoridealert.org/

Fluorine



13th most abundant compound in earth's crust

- Most reactive element on earth.
- Atomic number 9
- Halogen

Discovered 1771 and isolated in1886

46.6% Oxygen (O)
27.7% Silicon (Si)
8.1% Aluminum (Al)
5.0% Iron (Fe)
3.6% Calcium (Ca)
2.8% Sodium (Na)
2.6% Potassium (K)
2.1% Magnesium (Mg)

Colorado Brown Teeth (Fluorosis)

People in Colorado and other high-fluoride drinking water areas had developmental dental defects that were resistant to dental caries.



Fluoride – Caries - Fluorosis



Grand Rapids Michigan Water Fluoridation Study (1945)



Fluoride and Remineralization?

- Remineralization considered most important caries prevention mechanism
- Highly reactive fluoride ion attracted to demineralized crystallites
- Interacts with Ca and P ions to initiate remineralization.



Sources of Ingested Fluoride

- Water and Beverages
- Dental Products
 - Dentifrice, Rinse
 - Supplements
 - Professional
 - Treatments
- Food
- Other (Air, Industrial)





Water Fluoridation

~ 80 year history of community water fluoridation in US.
Caries reduction is approximately 5-25% primary/permanent dentitions



~ 72% of US population drinking fluoridated water

~ 10% is natural fluoridation

 \blacktriangleright (CDC data 2022)



Examining recent trends in the racial disparity gap in tap water consumption: NHANES 2011–2018

Asher Y Rosinger^{1,2,*}, Anisha I Patel³ and Francesca Weaks⁴ ¹Department of Biobehavioral Health, Pennsylvania State University, 219 Biobehavioral Health Building, University Park, PA 16802, USA: ²Department of Anthropology, Pennsylvania State University, State College, PA, USA: ³Department of Pediatrics, Stanford School of Medicine, Stanford, CA, USA: ⁴Health Department, National Association for the Advancement of Colored People, Baltimore, MD, USA

- Approximately 61.4 million people in the USA did not drink tap water, an increase of 19 million since the Flint Water Crisis
- Approximately 63 % and 40 % more Black and Hispanic children and adults did not drink their tap water in 2017–2018 compared to 2013–2014



Cochrane Database of Systematic reviews Review - Intervention

Water fluoridation for the prevention of dental caries

Zipporah Iheozor-Ejiofor, Tanya Walsh, Sharon R Lewis, Philip Riley, Dwayne Boyers, Janet E Clarkson, Helen V Worthington, Mane-Marie Glenny, Lucy O'Malley Authors' declarations of interest Version published: 04 October 2024 Version history https://doi.org/10.1002/14651858.CD010856.pub3 ☑

Data since 1975: small number of studies

CWF showed greater change over time in the proportion of caries-free children. These low-certainty findings (a 4 percentage point difference and 3 percentage point difference for primary and permanent dentition, respectively) favored CWF.

Optimal Water Fluoridation Level





Level of fluoride 0.7 ppm

Level modified in 2015 from previous range of 0.7 - 1.2ppm

Community Water Fluoridation

- EPA National Primary Drinking Water Regulation

 Fluoride regulated as an inorganic contaminant
 2+ ppm F community water system must notify consumers
 - 4+ ppm F upper limit for potable water
- CDC- HHS Recommendation for optimal fluoridation
 0.7 ppm F
- 13 States have fluoride regulations



National Toxicology Report Aug 2024

There were limited data and uncertainty in the dose-response association between fluoride exposure and children's IQ when fluoride exposure was estimated by drinking water alone at concentrations less than 1.5 mg/L



59 total studies included in meta-analysis

C	ountry			
	China	41	-0.42 (-0.51 to -0.33)	<.001
	India	8	-1.09 (-2.23 to 0.06)	<.001
	Iran	4	-0.68 (-0.99 to -0.38)	.08
	Canada	2	0.01 (-0.14 to 0.16)	NA
	Pakistan	2	0.10 (-0.57 to 0.77)	.01
	New Zealand	1	0.01 (-0.19 to 0.22)	NA
	Taiwan	1	0.10 (-0.10 to 0.29)	NA

California Fluoride Lawsuit

Ruled on 9/24/24 there was the potential for harm from community water fluoridation and the EPA would need to respond.

EPA Appeals

January 10, 2025

Sincerely,

	American Dental Association			
The Honorable Jane Nishida	Academy of General Dentistry			
Acting Administrator	American Academy of Oral and Maxillofacial Pathology			
U.S. Environmental Protection Agency	American Academy of Pediatric Dentistry			
1200 Bonnovlyania Avanua NW	American Academy of Periodontology			
	American Association of Dental, Oral, and Craniofacial Research			
Washington, DC 20460	American Association of Endodontists			
	American Association of Oral and Maxillofacial Surgeons			
Re: Food & Water Watch v. EPA, Case No. 17-CV	-02162 American Association of Orthodontists			
	American Association of Public Health Dentistry			
	American Dental Education Association			
	American Fluoridation Society			
ar Acting Administrator Nishida:	American Student Dental Association			



Contents lists available at ScienceDirect

Public Health 219 (2023) 73–84 Public Health

journal homepage: www.elsevier.com/locate/puhe

Original Research

Association between low fluoride exposure and children's intelligence: a meta-analysis relevant to community water fluoridation

Jayanth V. Kumar ^{a, *}, Mark E. Moss ^b, Honghu Liu ^c, Susan Fisher-Owens ^d

No IQ difference in children with mean of 0.9 vs 0.3 ppm F drinking water

The association observed at higher fluoride levels (mean 3.7 high fluoride vs 0.7 ppm F) in endemic areas requires further investigation.





Article The Impact of Exposure to Iodine and Fluorine in Drinking Water on Thyroid Health and Intelligence in School-Age Children: A Cross-Sectional Investigation

Siyu Liu¹, Xiaomeng Yu^{1,2}, Zhilei Xing¹, Peisen Ding¹, Yushan Cui^{3,*} and Hongliang Liu^{1,*}

High Iodine/ high fluoride associated reduced IQ and thyroid function: Low levels no association

Is there a mechanism to explain an IQ change from fluoride exposure?

Fluoride exposure and indicators of thyroid functioning in the Canadian population: implications for community water fluoridation

Amanda M Barberio,^{1,2} F Shaun Hosein,³ Carlos Quiñonez,⁴ Lindsay McLaren²

No evidence of a relationship between fluoride exposure (from urine and tap water) and the diagnosis of a thyroid condition

Fluoride Blood Brain Barrier

Journal of Neurology, Neurosurgery, and Psychiatry 1988;51:1591-1593

Short report

Fluoride in cerebrospinal fluid of patients with fluorosis

Table CSF, blood and urine fluoride (ppm)

	No	Range	8	S
CSF of Control G	roup 32	0-14-0-23	0.17	0·03
CS	SF 40	0-10-0-36	0.20	0·062
Fluorosis Bl	ood 39	0-10-0-38	0.20	0·065
Ut	rine 41	1-20-22	5.87	3·82

No significant difference in fluoride Levels in CSF fluid in subjects drinking <1ppm vs 10 ppm water

1 ppm F 10 ppm F

Sweden Natural Water Fluoride Study

J Political Econom 2021 129:2, 465-491



- No drop in IQ or math scores
- No increase ADHA or neurobehavior
- Stronger labor market





January 13, 2025 > Health Conditions > Science > News

TOXIC EXPOSURES

Breaking: 6 Lawsuits Filed Today Accuse Makers of Children's Fluoride Toothpaste of Violating Federal Law

Six major dental product manufacturers accused of deceptively marketing products containing fluoride to young children, and misleading parents to believe the products are safe for toddlers.



https://childrenshealthdefense.org/defender/class-action-lawsuits-kids-fluoride-toothpaste-makers/



Dr. Mark Burhenne co-founder of <u>Fygg</u>, a toothpaste that offers a fluoride alternative with hydroxyapatite.

DENTAL SPECIALTIES | PEDIATRICS | FLUORIDE

Opinion: It's time to reevaluate the fluoride conversation

Dr. Mark Burhenne Jan 24, 2025





Fluoride has long been hailed as a miracle ingredient for preventing tooth decay. But as a dentist with more than 40 years of experience, I'm here to tell you that it's time to reevaluate the conversation. For years, fluoride's benefits have been sold as a one-size-fits-all solution, especially in water fluoridation, yet the recent federal court ruling challenges this status quo.

Latest in Fluoride

Are you living among those states with the best dental health? FEBRUARY 10, 2025

Fluoridated Dentifrice for Children under Three years of Age

- Recommend fluoridated dentifrice in children of all ages.
- Use only lateral smear on tip of brush for all dentate children.







What about fluoride alternatives

- Casein phosphoproteins + Amorphous Calcium Phosphate
- Curodont
- Silver Nitrate
- Nanohydroxyapatite Toothpaste
- Nanohydroxyapatite Varnish

Assess the evidence critically and discuss empathetically

- What is the nature and quality of the evidence?
- Does the evidence seem generalizable to the populations you treat?
- Do studies consider the complexity of the question and confounders?

Person Centered Prevention

- Based on risk of developing caries.
- Dialog with patient/caregiver.
- What are their desires.
- What fits in their lifestyle and belief system.



Questions and Discussion



https://www.medicalnewstoday.com/articles/154164

Water Fluoridation Today: Challenges in Understanding the Science Steven M. Levy, DDS, MPH Wright-Bush-Shreves Endowed Professor of Research, Department of Preventive and Community Dentistry and Professor, Department of Epidemiology University of Iowa February 14, 2025

Note: I have no conflicts to declare.

Outline

- Brief history and current status of fluoride and community water fluoridation (CWF) –by Dr. Wright
- Fluoride and IQ (NTP, JAMA Peds, other)
 - Media
 - Science
 - JAMA Peds meta-analysis
 - My JAMA Peds editorial
 - Other JAMA Peds editorial
 - Do et al. (2024 J Dent Res)
 - Policy

Fluoride and IQ

Selected Fall 2024 Media Coverage


Washington Post-Leanna Wen-11/12/24

RFK Jr.'s Views on Fluoride Aren't As Crazy As You Might Think

• "Kennedy is wrong about many public health issues. Questioning fluoridation isn't one of them...."

New York Times-Emily Oster-11/13/24

There's a Better Way to Talk About Fluoride, Vaccines and Raw Milk

Finally, water fluoridation. Fluoride has been shown in numerous <u>studies</u> to reduce dental problems in kids. While evidence on the impact of municipal water in the United States is more limited than ideal, <u>recent data from Israel</u> — where water fluoridation was ended in 2014 — shows an increase in dental work for 3- to 5-year-olds.

Nezihovski et al. Israel Journal of Health Policy Research (2024) 13:50 https://doi.org/10.1186/s13584-024-00637-5 Israel Journal of Health Policy Research

ORIGINAL RESEARCH ARTICLE

Open Access

The effect of cessation of drinking water fluoridation on dental restorations and crowns in children aged 3–5 years in Israel – a retrospective study





Studies from Alaska and Calgary also Show More Caries and Treatment after CWF Cessation

Fluoride and IQ

Some Science

Possible Effects on IQ and Related Outcomes

Several aspects to consider:

- 1) Mostly lower quality studies earlier—were mostly discounted due to methodological limitations/locations
- 2) Then the studies from Mexico (ELEMENT) and Canada MIREC)
- 3) National Toxicology Program Monograph (8/24)
- 4) Federal district court case to stop Community Water Fluoridation (CWF) (9/24)
- 5) JAMA Peds meta-analysis and editorials (1/25)

Guichon et al., 2024



COMMENTARY 🔂 Open Access 💿 🛈

Flawed MIREC fluoride and intelligence quotient publications: A failed attempt to undermine community water fluoridation

Juliet R. Guichon 🔀, Colin Cooper, Andrew Rugg-Gunn, James A. Dickinson

First published: 25 March 2024 | https://doi.org/10.1111/cdoe.12954 | Citations: 1

Conclusions: The MIREC fluoride-IQ articles' results should be considered unacceptable for legal and policy purposes; other water fluoridation studies and systematic reviews show no effect of fluoridation on cognition.

Other Recent Articles of Importance

Another well-done cohort study from Spain:

- Found better IQ in boys with more F. (Ibarluzea, et al., Prenatal exposure to fluoride and neuropsychological development in early childhood: 1-to 4 years old children, Environ Res, 2022 - <u>10.1016/j.envres.2021.112181</u>)

Recent important meta-analysis of studies: -Found no association of lower IQ with F in areas with levels close to CWF levels—elevated risk only in high F situations, (Kumar, et al., Association between low fluoride exposure and children's intelligence: a meta-analysis relevant to community water fluoridation, Public Health, 2023 - 10.1016/j.puhe.2023.03.011)

Just Published:

Early Childhood Exposures to Fluorides and Cognitive Neurodevelopment: A Population-Based Longitudinal Study

L.G. Do, et al.

Journal of Dental Research Online First December 2024 https://doi.org/10.1177/00220345241299352 (in print March 2025)

Their conclusion:

"The study provided consistent evidence that early childhood exposure to fluoride does not have effects on cognitive neurodevelopment."

Table 3: Unadjusted full-scale IQ scores by exposures and multivariable regression models
for adjusted full-scale IQ scores by percent lifetime exposure to fluoridated water

	Full scale IQ score	Multivariable	Multivariable
	(n=357)	Model 1	Model 2
	Mean (95%CI)	β (95%Cl)	β (95%Cl)
Model Intercept		109.4 (105.3, 113.5)	110.7 (106.3, 115.2)
Lifetime exposure to			
fluoridated water			
100%	109.1 (107.3, 110.9)	1.12 (-2.81, 5.05)	1.07 (-2.86, 5.01)
>0 -<100%	110.7 (107.6, 113.7)	2.24 (-2.17, 6.66)	2.52 (-1.92, 7.00)
0%	108.6 (105.6, 111.5)	Ref	Ref

95% CI: 95% confidence intervals of estimates.

Study sample: The NCOHS 2012-14 sample who were aged 16+years and have completed IQ test for the Follow-up 2022-23.

Toothbrushing frequency: Frequency of toothbrushing with fluoride toothpaste at the age of two years per day. Estimates of covariates are presented in Appendix Table 1. Model 1: Multivariable regression models controlling for socioeconomic factors, neurodevelopmental diagnosis.

and age at IQ test. Model 2: Model 1 plus covariates (breastfeeding duration, and toothbrushing frequency at age two years).

Neurodevelopmental diagnosis: Study participants who reportedly had at least one diagnosed condition (ADHD, Autism Spectrum Disorder, dyslexia, dyscalculia).

From Jay Kumar

Studies at Community Water Fluoridation Levels

Mean IQ or Cognition Scores (unadjusted) by Fluoridation Status





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About

Decision in EPA Case: As Flawed As the Analysis It's Based On

Posted October 04, 2024 & filed under Facts about Fluoride, Fluoride Dangers, Fluoride in the News, Fluoride in water.

On Tuesday, September 23, 2024, Judge Edward M. Chen of the US District Court for the Northern District of California ruled that the Environmental Protection Agency (EPA) must issue new rules related to fluoride levels in tap water.

The court wrote that "this finding does not conclude with certainty that fluoridated water is injurious to public health," but it found that the plaintiffs had adequately demonstrated an "*unreasonable risk*" of harm.

This assertion is deeply concerning, for many reasons.

Reliance on a Troubled Report

The lawsuit, brought in April of 2017, took over seven years to conclude, a period that included waiting four years for the recently released *NTP Monograph on the State of the Science Concerning Fluoride Exposure and Neurodevelopment and Cognition: A Systematic Review.* This is the report that twice failed peer review by the National Academies of Science, Engineering and Medicine (NASEM), required additional scientific review by an NTP Board of Scientific Counselors (BSC), and which underwent a significant number of revisions and edits before it was finally released on August 21, 2024.

In concluding its two peer reviews, NASEM cautioned that the NTP "should make it clear that the monograph cannot be used to draw any conclusions regarding low fluoride exposure concentrations, including those typically associated with drinking-water fluoridation." Why? The monograph's conclusions applied to water that contained \geq 1.5 mg/L of fluoride – more than twice the amount used to fluoridate water in the U.S.

Legal versus Scientific Expertise

To reach his opinion, the court drew heavily on the widely criticized monograph. In fact, the court did so despite explicit declarations by the NTP that its document was not designed to evaluate a potential risk of harm from drinking water containing fluoride at the optimal US level of 0.7 mg/L.

American Academy of Pediatrics:

"Tooth decay is the most common chronic disease of childhood, and water fluoridation is one of the most important public health initiatives in the 20th century.

CATEGORIES

Campaign for Dental Health News Children's Oral Health Children's Oral Health and Fluoride Communities Supporting Fluoride Facts about Fluoride Fluoride and Public Health Fluoride Dangers Fluoride in the News Fluoride in water Fluoride, Oral Health, and Access to Care Health Equity Infographics Partners in Fluoride Video What the Experts Say about Fluoride Experts from around the world have reviewed the same body of research and continue to find that the data support the safety of fluoride in water at recommended levels. While some studies suggest an association between high fluoride exposure and cognitive development, other analyses, some quite recent, show no such association. Organizations that follow the published research carefully, including the American Academy of Pediatrics, the American Academy of Pediatric Dentistry, the American Dental Association, the American Association for Dental, Oral, and Craniofacial Research, and many respected health

The AAP agrees that water fluoridation is beneficial for reducing and controlling tooth decay and promoting oral health in children and adults."



authorities, continue to attest to and support community water fluoridation and fluoride use to prevent tooth decay.

Inconsistent Findings

Studies on fluoride exposure and neurodevelopment have yielded inconsistent findings, as reported in several recent research reviews. Analyses of data from Australia, Denmark, New Zealand, Spain, and Sweden have revealed no association between fluoride and cognitive deficits.

- In 2021, a study from Spain found that mothers' prenatal fluoride exposure was associated with higher cognitive scores in boys at age 4, not lower. There was no difference in girls' IQ.
- A large 2022 study in Australia determined fluoride exposure of boys and girls from birth to age 5, then their emotional / behavioral development was assessed through age 18. Exposure to fluoridated water in the first 5 years was *not associated* with altered measures of child emotional / behavioral development or executive function.

Confounding Factors

Finally, there are many confounding factors that affect IQ and measuring it, especially in children. Socioeconomic, physical, familial, cultural, genetic, nutritional, and environmental factors are all possible confounders. There has been only one fluoride-IQ study that followed people over a significant period of the lifespan. Published in 2020, this study tested the IQ of people in New Zealand at multiple ages to determine if a link existed. That 30-year study found *no link* between fluoride and IQ scores.

"There is nothing about the current decision that changes my confidence in the safety of optimally fluoridated water in the U.S.," said Dr Charlotte Lewis. "Water fluoridation is a public health policy based on a solid foundation of evidence. When new research is published, health experts scrutinize it to make sure it meets high standards for public safety. That's how it works."

Dental disease in children continues to be the most common chronic disease, and it has significant effects on a child's overall health and success.

Based on an enormous body of research and decades of experience, the American Academy of Pediatrics continues to support the use of fluoride and fluoridated drinking water to prevent tooth decay.

Jama Peds Meta-Analysis and Editorials (Published online on 1/6/25)

- Fluoride Exposure and Children's IQ Scores: A Systematic Review and Meta-Analysis - Original Investigation Kyla W. Taylor, et al. doi:10.1001/jamapediatrics.2024.5542
- Caution Needed in Interpreting the Evidence Base on Fluoride and IQ - Editorial Steven M. Levy . doi:10.1001/jamapediatrics.2024.5539
- Time to Reassess Systemic Fluoride Exposure, Again-Editorial Bruce P. Lanphear; Pamela Den Besten; Christine Till; 10.1001/jamapediatrics.2024.5549

Recent Media Headlines on the Meta-Analysis

The New York Times

T https://www.nytimes.com > 2025/01/08 > health > fluor...

Study Links High Fluoride Exposure to Lower I.Q. in Children

Jan 8, 2025 — Higher fluoride exposures were linked to lower IQ scores, concluded researchers working for the National Institute of Environmental Health Sciences.

Missing: media | Show results with: media



American Dental Association

https://www.ada.org > about > press-releases > commun...

Community Water Fluoridation at Recommended Levels ...

Jan 6, 2025 — CHICAGO, January 6, 2025 — The American Dental Association (ADA) ... fluoride exposure can lower children's IQ levels, are deeply flawed.



https://www.nbcnews.com > health > health-news > fluo...

Fluoride once again scrutinized for possible effect on ...

Jan 6, 2025 — The analysis found a statistically significant association between higher fluoride exposure and lower children's IQ scores. It showed that "the ...

JAMA Peds Meta-Analysis

Taylor and colleagues reported:

- "inverse associations and a dose-response association between fluoride measurements in urine and drinking water and children's IQ" and
- "limited data and uncertainty in the dose-response association between fluoride exposure and children's IQ when fluoride exposure was estimated by drinking water alone at concentrations less than 1.5mg/L."
- They conducted a number of different meta-analyses at different water and urine F thresholds (all studies, <4, <2, <1.5 mgF/L)

JAMA Peds Meta-Analysis

- "52 studies were rated high risk of bias (70%) and 22 were rated low risk of bias.
- 64 studies reported inverse associations between fluoride exposure measures and children's IQ.
- Analysis of 59 studies with group-level measures of fluoride in drinking water, dental fluorosis, or other measures of fluoride exposure (47 high risk of bias, 12 low risk of bias; n = 20 932 children) showed an inverse association between fluoride exposure and IQ (pooled SMD, -0.45; 95%CI, -0.57 to -0.33; *P* < .001).
- In 31 studies reporting fluoride measured in drinking water, a dose-response association was found between exposed and reference groups (SMD, -0.15; 95%CI, -0.20 to -0.11; P < .001), and associations remained inverse when exposed groups were restricted to less than 4mg/L and less than 2mg/L; however, the association was null at less than 1.5mg/L.
- In analyses restricted to low risk-of-bias studies, the association remained inverse when exposure was restricted to less than 4mg/L, less than 2mg/L, and less than 1.5mg/L fluoride in drinking water." –NOT TRUE FOR <1.5

JAMA Peds Meta-Analysis

- All analyses with urinary F exposures showed statistically significant relationships
 - "In 20 studies reporting fluoride measured in **urine**, there was an inverse dose-response association (SMD, -0.15; 95%CI, -0.23 to -0.07; *P* < .001).
 - Associations remained inverse when exposed groups were restricted to less than 4mg/L, less than 2mg/L, and less than 1.5mg/L fluoride in urine; the associations held in analyses restricted to the low risk-of-bias studies.
 - Analysis of 13 studies with individual-level measures found an IQ score decrease of 1.63 points (95%CI, -2.33 to -0.93; P < .001) per 1-mg/L increase in urinary fluoride.
 - Among low risk-of-bias studies, there was an IQ score decrease of 1.14 points (95%CI, -1.68 to -0.61; P < .001).
 - Associations remained inverse when stratified by risk of bias, sex, age, outcome assessment type, country, exposure timing, and exposure matrix."

JAMA Peds Meta-Analysis – Levy Editorial –Selected Key Points

- "This editorial provides an alternative perspective about the findings by Taylor et al. Due to the limitations of available data and authors' choices about study inclusion and exclusion criteria, analysis, and interpretation, their results and conclusions do not properly present our current knowledge about possible associations of fluoride with neurodevelopment and cognition, especially related to community water fluoridation (CWF)."
- Lack of Transparency they do not adequately explain about this being the culmination of 9 years of NTP work and the basis for the NTP Monograph
 - "Moreover, the NTP removed the "presumed neurodevelopmental hazard determination" from earlier drafts of their report that were closely linked to this article. This change was based on 2 rounds of review by an independent National Academies of Science, Engineering, and Medicine (NASEM) committee that found many deficiencies in this meta-analysis that could make the findings invalid."
 - They do not mention the comprehensive animal studies review that found no evidence of concern ("at appropriate fluoride levels, there were "…no exposure-related differences in motor, sensory, or learning and memory performance....")

JAMA Peds Meta-Analysis – Levy Editorial –Selected Key Points

- Most publications at high risk of bias
- Inadequate Justification of Studies and Lack of Clarity About Effect Sizes
- Lack of Substantive Discussion of Important Recent Publications
- Concerns With Validity Deriving Point Estimates With High Data Heterogeneity
- Questionable Validity of the Studies Using Urinary Fluoride Measures of Fluoride Exposure
- Lack of Context for Fluoride Exposures
- Several Other Important Concerns and Limitations to Consider
 - Effect sizes doubled by using differences of 1 mgF/L;
 - Recent studies generally higher quality and no effect;
 - Factual error in abstract

JAMA Peds Meta-Analysis – Levy Editorial –Selected Key Points Public Health Aspects

I tried to emphasize that there is very little valid data from which to conclude that the very important benefits of CWF should be taken away due to these flawed analyses and conclusions.

JAMA Peds Meta-Analysis – Lanphear et al. Editorial

- Unfortunately, in editorial and on TV, he appeared reasonable and not too extreme, so more believable.
- He "told a good story" and emphasized several things that are sort of true, but misled readers also:
 - Always were questions about F (JADA 1944).
 - Reduced effectiveness in caries prevention.
 - Mostly topical, so not need CWF—but CWF is also topical!
 - Consistent inverse relationships with IQ.
 - Total F intake important, not just water.
 - Dose-response results support concerns for vulnerable populations....
 - So 4 mgF/L is too high

JAMA Peds Meta-Analysis -Lanphear et al. Editorial

"The absence of a statistically significant association of water fluoride less than 1.5 mg/L and children's IQ scores in the dose-response meta-analysis does not exonerate fluoride as a potential risk for lower IQ scores at levels found in fluoridated communities.

Water fluoride concentration does not capture the amount of water ingested or other sources of ingested fluoride."

"NTP's meta-analyses show that fluoride may be associated with cognitive function at concentrations found in fluoridated communities.

It is time for health organizations and regulatory bodies to reassess the risks and benefits of fluoride, particularly for pregnant women and infants."





What Should We Do?

- Best "solution is to have "broad based support" from many well beyond dentistry:
 - Medicine, nursing, etc.
 - Public health nurses, WIC, etc.
 - Education leaders
 - Community leaders
- Emphasize **benefits to all**, especially the "underserved" at highest risk
- Emphasize the **great cost-effectiveness** vs. all other dental caries prevention modalities
- True cost-savings!

Dentists and Community Water Fluoridation

- The **Pediatric Dentistry/Dental Public Health communities** need to **remain well-informed** about issues affecting fluoridation and abreast of scientific literature
- Stay informed of relevant state and community **policy initiatives**.
- **Provide accurate information** to patients and policymakers
- Understand forces that affect public attitudes, the policy process, and the strategies employed by anti-fluoridationists.

Conclusion – Community Water Fluoridation

- There is no clear evidence of harmful effects of fluoride related to optimal water fluoridation except the potential to increase the prevalence of mild dental fluorosis.
- Although the currently measured percentage level of effectiveness of water fluoridation in many areas is lower than in previous eras due to more widespread use of other fluoride modalities, it is still extremely important for the general population and high-risk sub-groups.

Thinking of you-thanks for everything, Gary!



Questions and Discussion – Led by Dr. Lee

Questions?

Thank you!



AAPD Research & Policy Center



RPC Webinars (slides, future dates)



Extra Slides

1) Lower Quality Studies

- Several dozen studies have been conducted:
 - Generally with lower quality
 - Some found associations of F with lower IQ
 - Mostly from China and other places with environments very different from U.S., including F, mercury, lead, etc.
 - Had mostly been discounted in terms of relevance to the U.S. context until recently

2) More recent studies from Mexico and Canada

1) Mexico- ELEMENT project (Early Life Exposures in Mexico to Environmental Toxicants) (Bashar et al., 2017) 2) Canada-MIREC study (Maternal-Infant Research on Environmental Chemicals)(Greene et al., 2019) 3) Both are observational, prospective birth cohort studies 4) Both had no plans to study F, but F focus was added much later as a "secondary analysis" 5) Published in more prestigious journals 6) Both reported associations of higher F with lower IQ -with flawed analyses

7) Lots of publicity by opponents of F

Mexico and Canada

-Both found significant associations between maternal urinary F and lower IQ:

a) ELEMENT- IQs at ages 4 and 6 reduced ~2- 3 points on average for 0.5 mg/l more F in maternal urine

b) MIREC-

 1) 1-mg/L increase in urinary F was significantly associated with ~4.5 point lower mean IQ in boys
2) but there was no statistically significant association in girls (non-significant mean increase of 2.4 points)

Mexico and Canada

1) Opponents of CWF are arguing hard that these results mean that F and CWF are bad

- 2) However, there are many methodological questions that remain, including the validity of IQ measures, statistical analysis approaches, etc.
- 3) Caution is needed in changing longstanding public policy based on these studies, since they were not designed optimally to address these questions
Kumar et al. 2023 Meta-Analysis



Contents lists available at ScienceDirect

Public Health

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Original Research

Association between low fluoride exposure and children's intelligence: a meta-analysis relevant to community water fluoridation



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PUBLIC

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	Hi	igher F		Lo	wer F		:	Std. Mean Difference		Std. Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	Year	IV, Random, 95% CI
1.1.1 Higher F (Mean 3.7	7 mg/L) v	s. Lowe	er F (Me	ean 0.7m	g/L)					
An 1992	75.9	13.6	121	84	12.1	121	3.5%	-0.63 [-0.89, -0.37]	1992	
Xu YL 1994	79.3	2.25	97	83.8	9.1	32	2.7%	-0.91 [-1.33, -0.50]	1994	
Li XS 1995	80.3	12.9	230	89.9	10.4	226	3.9%	-0.82 [-1.01, -0.63]	1995	
Yao L 1996	92.5	12.3	78	98.5	13.2	270	3.6%	-0.46 [-0.71, -0.21]	1996	
Zhao LB 1996	97.7	13	160	105	15	160	3.7%	-0.52 [-0.74, -0.30]	1996	
Yao & Yang S 1997	94.9	11.1	183	100	12.2	314	3.9%	-0.43 [-0.62, -0.25]	1997	
Wang XH 2001	76.7	7.75	30	81.7	12	30	2.2%	-0.49 [-1.00, 0.03]	2001	
Xiang Q 2003	92	13	222	100	13.2	290	3.9%	-0.61 [-0.79, -0.43]	2003	
Seraj B 2006	87.9	11	41	98.9	12.9	85	2.8%	-0.89 [-1.28, -0.50]	2006	.
Wang ZH 2006	107	15.4	202	112	15.2	166	3.8%	-0.33 [-0.53, -0.12]	2006	
Fan ZX 2007	96.1	12	42	98.4	14.8	37	2.6%	-0.17 [-0.61, 0.27]	2007	
Wang SX 2007	101	16	253	105	15	196	3.9%	-0.26 [-0.44, -0.07]	2007	
Lu Y (Shulin Liu) 2008	92.3	20.5	60	103	13.9	58	2.9%	-0.61 [-0.97, -0.24]	2008	(
Wang GJ 2008	95.6	14.3	147	101	15.8	83	3.5%	-0.36 [-0.63, -0.09]	2008	
Chen YX 2008	100	14.5	320	104	15	320	4.0%	-0.27 [-0.43, -0.12]	2008	
Hong FG 2008	80.6	2.28	85	82.8	8.98	32	2.7%	-0.43 [-0.84, -0.02]	2008	
Pourelami HR 2011	91.4	15.6	60	97.8	15.9	60	3.0%	-0.40 [-0.77, -0.04]	2011	
Eswar P 2011	86.3	12.8	68	88.8	15.3	65	3.1%	-0.18 [-0.52, 0.16]	2011	
B. Seraj 2012	88.6	16	96	97.8	18.9	91	3.4%	-0.52 [-0.82, -0.23]	2012	_ .
Trivedi MH 2012	92.5	18.25	34	97.2	17.96	50	2.6%	-0.26 [-0.70, 0.18]	2012	
Karimzade S 2014	81.2	16.2	19	104	20.7	20	1.6%	-1.20 [-1.89, -0.51]	2014	
Sebastian ST 2015	80.5	12.7	135	86.4	13.6	135	3.6%	-0.45 [-0.69, -0.21]	2015	
Yu 2018	106.4	12.3	1250	107.4	13	1636	4.3%	-0.08 [-0.15, -0.01]	2018	
Subtotal (95% CI)			3933			4477	75.2%	-0.46 [-0.58, -0.35]		•
Heterogeneity: Tau ² = 0.0	06; Chi² =	118.72	, df = 22	2 (P < 0.0	00001);	l ² = 819	⁶ Pred	liction Interval -0.95 to 0	0.02	
Test for overall effect: Z =	= 7.80 (P ·	< 0.000	01)							
1.1.2 Recomminded F (M	lean 0.90	ma/L)	vs. Lov	ver F (M	ean 0.3	0 ma/l	`			
Xu 1994	83.83	9.1	32	80 21	8 27	21	21%	0.41 [-0.15, 0.96]	1994	<u> </u>
Zhang JW 1998	85.6	13.2	51	87.7	11	52	2.8%	-0 17 [-0 56 0 22]	1998	_ _
Xiang 2003	99.56	14 13	ä	100 41	13 21	290	1.7%	-0.06 [-0.73, 0.60]	2003	
Broadbent (Child) 2015	100	15.1	891	99.8	14.5	- 99	3.8%	0.01 [-0.19 0.22]	2015	_ _
Sebastian 2015	88.6	14.01	135	86.37	13.58	135	3.6%	0.16 [-0.08, 0.40]	2015	+ -
Bashash 2017	96.8	11.16	112	95.37	10.31	77	3.4%	0.13 [-0.16, 0.42]	2017	- -
Green 2019	108.2	13.72	162	108.07	13.31	238	3.8%	0.01 [-0.19, 0.21]	2019	_
Ibarluzea 2021	101.47	15.5	124	98.67	15.7	123	3.6%	0.18 [-0.07, 0.43]	2021	+ -
Subtotal (95% CI)		.0.0	1516	00.07		1035	24.8%	0.07 [-0.02, 0.17]		•
Heterogeneity: Tau ² = 0.0	00: Chi ² =	5.15. di	f = 7 (P	= 0.64)	$ ^2 = 0\%$					-
Test for overall effect: Z =	= 1.49 (P	= 0.14)	(0.0 .),						
Total (95% CI)			5440			5512	100.0%	0 33 [-0 44 -0 22]		
	7. 01.2 -	170 50	3449		00041	12 - 000	100.076	-0.33 [-0.44, -0.22]	_	▼ ·
Test for everall effects 7	- E 06 /D	1/8.53	, ar = 30	J (P < 0.0	;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;	-= 839	/o Droc	diction Interval -0.96 to (0.20	-2 -1 0 1 2
Test for overall effect: Z =	= 5.96 (P	< 0.0000	01)		0004	12 - 07	Prec	arction interval -0.80 to 0	0.20	Favours [Lower F] Favours [Higher F]
lest for subgroup differer	nces: Chi	- = 48.23	3, af = '	I (P < 0.0	0001),	r = 97.	9%			

Fig. 2. Random effects analysis of standardized mean difference (SMD) and 95% CI of children's IQ score associated with exposure to higher fluoride. Forest plot of standardized mean difference (SMD) and 95% confidence interval of children's IQ scores according to endemic fluorosis and non-endemic fluorosis study communities. In the endemic areas, the mean F concentration in water or urine for higher and lower exposure groups was ~3.9 mg/l and ~0.7 mg/l, respectively. In the non-endemic areas, the mean F concentration in water or urine for higher and lower exposure groups was ~0.9 mg/l and ~0.3 mg/l, respectively. For each study, squares represent the point estimate, and the horizontal line shows the 95% CIs. Solid diamonds show the pooled estimate. The \vec{P} and *P* values for heterogeneity, test for overall effect, respectively, and prediction intervals are shown. The prediction interval reflects the uncertainty we expect in the pooled effect if a new study is included in the meta-analysis.

Α						
			Regr	ession Coefficient		Regression Coefficient
Study or Subgroup	Regression Coefficient	SE We	ght	IV, Random, 95% CI Year		IV, Random, 95% Cl
Bashash 2017	-0.77	0.9 10	.2%	-0.77 [-2.53, 0.99] 2017		
Yu 2018	0.36	0.33 76	.0%	0.36 [-0.29, 1.01] 2018		
Farmus 2021	-0.23 0	.775 13	.8%	-0.23 [-1.75, 1.29] 2021		
Total (95% CI)		100	.0%	0.16 [-0.40, 0.73]		•
Heterogeneity: Tau ² =	0.00; Chi ² = 1.69, df = 2 (P =	0.43); I ² =	0%			2 0 2 4
Test for overall effect:	Z = 0.57 (P = 0.57)				Fav	ours [Lower Fluoride] Favours [Higher Fluoride]
_						
В				Regression Coefficient		Regression Coefficient
Study or Subgroup	Regression Coefficier	nt SE	Weight	IV, Random, 95% C	l Year	IV, Random, 95% CI
3.1.1 Community W	ater Fluoridation					
Green 2019	-0.97	5 0.825	38.4%	-0.97 [-2.59, 0.64]	2019	-
Ibarluzea 2021	1.68	5 1.393	28.9%	1.69 [-1.05, 4.42]	2021	
Subtotal (95% CI)			67.3%	0.12 [-2.45, 2.68]		
Heterogeneity: Tau ²	= 2.23; Chi ² = 2.70, df = 1 (P = 0.10); l² = 63%	0		
Test for overall effect	t: Z = 0.09 (P = 0.93)		,			
3.1.2 Salt Fluoridat	ion					
Bashash2017	-3.1	5 1.161	32.7%	-3.15 [-5.43, -0.87]	2017	_
Subtotal (95% CI)			32.7%	-3.15 [-5.43, -0.87]		◆
Heterogeneity: Not a	applicable			• • •		-
Test for overall effect	et: Z = 2.71 (P = 0.007)					
Total (95% CI)			100.0%	-0 92 [-3 29 4 461		
	- 2 44. 052 - 7 42 - 16 - 24	D - 0.00	100.070	-0.32 [-3.23, 1.40]	_	
Heterogeneity: Tau*	= 3.14; Chi ^e = 7.13, df = 2 (P = 0.03); 1* = 72%	0		-10 -5 0 5 10
lest for overall effect	C = 0.76 (P = 0.45)			4.000		Favours [Lower F] Favours [Higher F]
lest for subgroup di	fferences: Chi ² = 3.49, df =	1 (P = 0.0	06), I² = 7	1.3%		

Fig. 3. (A) Random effects analysis of regression coefficients and 95% CI of children's IQ score associated with 0.5 mg/l increase in children's urinary fluoride in non-endemic areas. Forest plot of change in IQ score expressed as regression coefficient for every 0.5 mg/l increase in children's spot urinary fluoride concentrations in non-endemic fluorosis study communities. (B) Random effects analysis of regression coefficients and 95% CI of children's cognition and IQ score associated with 0.5 mg/l increase in maternal urinary fluoride in non-endemic areas. Forest plot of change in IQ score expressed as regression coefficient for every 0.5 mg/l increase in spot MUF concentrations in non-endemic fluorosis study communities according to source of fluoride.

Kumar et al. Meta-Analysis: Conclusions

- 1-These meta-analyses show that **fluoride exposure at the concentration used in CWF is not associated with lower IQ scores**.
- 2-However, the reported **association** observed at **higher fluoride** levels in endemic areas **requires further investigation**.
- **3-Uncritical acceptance of fluoride-IQ studies**, including non-probability sampling, inadequate attention to accurate measurement of exposure, covariates and outcomes, and inappropriate statistical procedures, has **hindered methodological progress**.
- 4-Therefore, the authors urge a more scientifically robust effort to develop valid prenatal and postnatal exposure measures and to use interventional studies to investigate the fluoride-IQ hypothesis in populations with high fluoride (endemic) exposure.

4. Federal Court Case against CWF

Food & Water Watch, Inc. et al. vs. Environmental Protection Agency, et al.

1) U.S. Federal District Court-northern California District Judge Edward M. Chen

San Francisco Courthouse, Courtroom 5

2) First court case under 2016 bipartisan TSCA amendments under the Frank R. Lautenberg Chemical Safety for the 21st Century Act
3) Trying to get ruling that EPA cannot allow CWF due to reductions in IQ

-If successful, also could eventually preclude F in dentifrice (toothpaste) –and recent lawsuits filed on F dentifrice and mouthrinse about marketing to children and misrepresenting risk
4) Court had been waiting on NTP report

Federal Court Case against CWF (continued)

5) The September 24, 2024 <u>ruling</u> from Judge Edward M. Chen **requires the EPA to respond to those safety concerns,** even though the science is <u>far from settled</u>.

-"It should be noted that this finding does not conclude with certainty that fluoridated water is injurious to public health," Chen wrote.

-But, he added, "there is an unreasonable *risk* of such injury, a risk sufficient to require the EPA to engage with a regulatory response."

Federal Court Case against CWF (continued)

6) EPA appealed the court decision on 1/17/25
-To Ninth Circuit Court of Appeals (just before the extended deadline of 1/20/25), but the Trump administration can reverse it

- 7) Probably will take several years for court decision
- 8) If EPA loses (or stops appealing), then would be a multiple step process over several years to do the required steps to do required rulesmaking (to possibly lower MCL and

Jama Peds Meta-Analysis – Levy Editorial-Background

- When I was asked to do this, I was told the manuscript was conditionally accepted/not final and they already had an editorial being written endorsing the meta-analysis, but I did not see it until the pre-publication embargo period.
- When I did a quick skimming of the manuscript, I saw major concerns and asked them to delay acceptance to get them addressed, but then they said it was accepted fully and too late.
- I also was told by a colleague who was a reviewer that that they disregarded his recommendations (2 months earlier) almost entirely.
- So I decided it was very important to write this to provide a "balancing perspective" in print.

Overall Challenges

- We can never "prove" safety
- Opponents often only need to raise a "small question of doubt" for a prudent person to avoid exposure
- Internet often has very poor quality information about fluoridation
- Anti-fluoridationists are very effective at using internet/social media
- ADA is trying to improve their presence
- Small towns often have more challenges with CWF, since vocal opponents can have even more influence.

Many Characteristics/Trends in "Modern U.S. Society" Work Against Effective Scientific Communication

- **Public distrust** of government, authority, and "mainstream media"
- Relatively **low levels of scientific knowledge**
 - Little understanding of the "scientific method"
 - As a result, **all voices often are considered equal** and confusion ensues.
- "Confusion" since so much information coming at people all the time from so many directions
- Growth of and belief in "conspiracy theories"

Many Characteristics/Trends in "Modern U.S. Society" Work Against Us

- Intense allegiance to "one's group" and resultant constant reinforcement of the group's beliefs
 - Strong **polarization**
 - Generally speak to/hear from all or almost all "**like-minded**' individuals
 - Social media intensifies and exaggerates all of this
- These trends make things like Covid-19 prevention, vaccination programs, and CWF very difficult propositions
 - Luckily, most larger communities already have CWF-since would be much more difficult to initiate now

Water Fluoridation Strategies

- Must be tailored to the types of decision-makers:
 - City council (small leadership group)
 - Board of health (small leadership group)
 - Water board (small leadership group)
 - Water operator (individual)
 - Referendum vote (large general population)
- Best to enlist as many "partner advocates" outside dentistry as possible:
 - Educators-teachers/principals/counselors
 - School nurses
 - Social services staff
 - Public health department (non-dental) staff
 - Children's advocates (e.g., Head Start, WIC, Children's Defense Fund)

National Toxicology Program (NTP) Review of Fluoride

- NTP is part of federal HHS (3-agency collaboration)
- Process was ongoing from 2015-2024
- Reviewed animal and human evidence about neurodevelopment
- **Two drafts were disseminated for comment and reviewed** by a panel from the National Academies of Science, Engineering, and Medicine (NASEM) who identified many deficiencies
- Controversial since they initially said F was a "**presumed neurotoxicant**"
- **Final report** published August 2024:
 - "NTP Monograph on the **State of the Science** Concerning Fluoride Exposure and Neurodevelopment and Cognition: A Systematic Review"
 - Meta-analysis also is in press for probable January 2025 publication
 - Removed "presumed neurotoxicant"
 - Did <u>not</u> properly consider study biases <u>nor</u> separately consider high vs. low F levels

Timetable Considerations

- **Initiation** of CWF
 - Successful campaigns to initiate CWF generally require many years to plan and execute.
- **Preservation** of CWF when challenged
 - Often must be done on **very short notice** when challenges occur suddenly.
 - This happened ~15 years ago when there were challenges in Iowa City, Davenport, Dubuque, and Des Moines.
 - Thus, ongoing foundational efforts are recommended to be ongoing.
 - Dentists can remind all their patients who have CWF at home and/or work how fortunate they are

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RESEARCH

Open Access



Urinary fluoride levels and metal co-exposures among pregnant women in Los Angeles, California

Ashley J. Malin^{1*}, Howard Hu², E. Angeles Martínez-Mier³, Sandrah P. Eckel², Shohreh F. Farzan², Caitlin G. Howe⁴, William Funk⁵, John D. Meeker⁶, Rima Habre², Theresa M. Bastain² and Carrie V. Breton²

linkemyteeth.org/maternal-urinary-fluoride-not-a-valid-measure-for-studys-conclusion/

Maternal Urinary Fluoride: Not a Valid Measure for Study's Conclusion

Posted May 21, 2024 & filed under Facts about Fluoride, Fluoride and Public Health, Fluoride Dangers, Fluoride in the News.

A new study in JAMA Network Open (Malin, et al.) claims to have found an association between maternal urinary fluoride (MUF) levels and later deficiencies in children's executive function. This study used urine "spot samples" to measure a pregnant woman's overall exposure to fluoride.

Why Spot Samples Are Not Valid for this Study

Experts in assessing exposure to fluoride have determined that MUF can be a valid way to understand exposure on a community level, but not for an individual. Why aren't spot samples a valid measure of an individual's overall fluoride exposure? Fluoride levels vary throughout the day – and from day to day, too. If fluoride concentration in urine is measured at *only one point in*

the day, it is just that -a measure of fluoride level at that moment in the day.

Most of our exposure to fluoride comes from food, beverages and dental products. About 50% is excreted from the body within 24 hours of consumption. Say the urine was collected less than 24 hours after someone consumed foods that are naturally high in fluoride. An MUF level would likely be higher than the level usually found in urine. Likewise, if the previous days' diet was low in these foods and beverages, the level would probably be lower than usual. In either scenario, the information from a spot sample is limited. When medical tests of urine are used for an individual's results, they show "if a person has been exposed recently to higher-than-normal levels of fluorides."



Convenience Samples

Urine samples are routinely collected during pregnancy. Conveniently available data are common sources of information for studies like this one, hence the term "convenience sample". It may seem intuitive that MUF is a sound way to measure a pregnant woman's exposure to fluoride. It is not. To associate a subsequent outcome in children with an exposure during pregnancy, the all contributing factors must be properly measured. The scientific community is clear on this. A convenience sample cannot be used to infer statistical significance that applies to the general population. Any recommended changes to medical practice or policy should be made based upon statistically significant results.