Fluoride Exposure: Neurodevelopment and Cognition

https://ntp.niehs.nih.gov/go/fluoride

The State of the Science Monograph is now available.

Topic Overview

CASRN: 16984-48-8
Status: Evaluation completed

BACKGROUND INFORMATION

Since 1945, the use of fluoride has been a successful public health initiative for reducing dental cavities and improving general oral health of adults and children. There is a concern, however, that some pregnant women and children may be getting more fluoride than they need because they now get fluoride from many sources including treated public water, water-added foods and beverages, teas, toothpaste, floss, and mouthwash, and the combined total intake of fluoride may exceed safe amounts.

Therefore, the National Toxicology Program (NTP) conducted a systematic review of the published scientific literature on the association between fluoride exposure and neurodevelopment and cognition. The NTP released their findings in a State of the Science Monograph (available below under Documents). A corresponding meta-analysis on children's IQ has been accepted by a scientific journal for publication later in 2024.

The NTP started this work in 2016. As with all research documents intended for publication, the NTP fluoride monograph and meta-analysis underwent rigorous scientific evaluation. The evaluation process has involved many steps. The draft fluoride monograph received critical feedback during peer-review by the National Academies of Science, Engineering and Medicine (NASEM), from other external experts, and from experts in several federal health agencies. After modifications were made, additional evaluation following a rigorous scientific framework was conducted by subject matter experts organized by the NTP Board of Scientific Counselors. This document is now complete and available for reference.

The monograph represents a thorough review of the data, and the various interpretations of the data, to accurately reflect what we know and where additional research is needed.

Findings

The NTP monograph concluded that higher levels of fluoride exposure, such as drinking water containing more than 1.5 milligrams of fluoride per liter, are associated with lower IQ in children. The NTP review was designed to evaluate total fluoride exposure from all sources and was not designed to evaluate the health effects of fluoridated drinking water alone. It is important to note, however, that there were insufficient data to determine if the low fluoride level of 0.7 mg/L currently recommended for U.S. community water supplies has a negative effect on children's IQ.

The NTP uses 4 confidence levels - high, moderate, low, or very low - to characterize the strength of scientific evidence that associates a particular health outcome with an exposure. After evaluating studies published through October 2023, the NTP Monograph concluded there is moderate confidence in the scientific evidence that showed an association between higher levels of fluoride and lower IQ in children.

The determination about lower IQs in children was based primarily on epidemiology studies in non-U.S. countries such as Canada, China, India, Iran, Pakistan, and Mexico where some pregnant women, infants, and children received total fluoride exposure amounts higher than 1.5 mg fluoride/L of drinking water. The U.S. Public Health Service currently recommends 0.7 mg/L, and the World Health Organization has set a safe limit for fluoride in drinking water of 1.5 mg/L. The NTP found no evidence that fluoride exposure had adverse effects on adult cognition.

Application

Many substances are healthy and beneficial when taken in small doses but may cause harm at high doses. More research is needed to better understand if there are health risks associated with low fluoride exposures. This NTP monograph may provide important information to regulatory agencies that set standards for the safe use of fluoride. It does not, and was not intended to, assess the benefits of fluoride.

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DOCUMENTS

Date	Document
Aug 21, 2024	NTP Monograph - Final (Abstract) **Preferred Citation:** National Toxicology Program (NTP). 2024. NTP monograph on the state of the science concerning fluoride exposure and neurodevelopment and cognition: a systematic review. Research Triangle Park, NC: National Toxicology Program. NTP Monograph 08. https://doi.org/10.22427/NTP-MGRAPH-8
Aug 21, 2024	Interactive Reference Flow Diagram (NTP Monograph Figure 2)
Aug 21, 2024	Interactive Reference Flow Diagram for Updated Literature Search (NTP Monograph Addendum Figure 1)
May 18, 2023	Transmittal Letter Final Version of the NTP Board of Scientific Counselors Working Group Report
Mar 15, 2023	Table of Contents Documents Provided to the NTP Board of Scientific Counselors (BSC) and BSC Working Group
Sept 16, 2020	Literature Search Results
Sept 16, 2020	NTP Protocol for Systematic Review of Human, Animal, and Mechanistic Evidence - Second Revision
May 29, 2019	NTP Protocol for Systematic Review of Human, Animal, and Mechanistic Evidence - First Revision
Jun 01, 2017	NTP Protocol for Systematic Review of Human, Animal, and Mechanistic Evidence
Jul 01, 2016	Completed Systematic Review (Abstract) **Preferred Citation:** NTP (National Toxicology Program). 2016. Systematic literature review on the effects of fluoride on learning and memory in animal studies. NTP Research Report 1. Research Triangle Park, NC: National Toxicology Program. Research Report 1. https://doi.org/10.22427/NTP-RR-1
Dec 02, 2015	Presentation: NTP Evaluation of Fluoride Exposure and Potential for Developmental Neurobehavioral Effects
Nov 19, 2015	Proposed NTP Evaluation on Fluoride Concept
Oct 07, 2015	Federal Register notice requesting information on nominated substances

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MEETINGS & EVENTS

Date	Event	Event Type	Materials
May 16, 2023	Board of Scientific Counselors Meeting	Board of Scientific Counselors	• Final Documents • Agenda • Meeting Materials • Members • Minutes • Presentations • Videos
May 04, 2023	Board of Scientific Counselors Meeting	Board of Scientific Counselors	• Agenda • Meeting Materials • Members • Minutes • Presentations • Videos
Oct 19, 2020	Peer Review of the Revised NTP Monograph on Fluoride Exposure and Neurodevelopmental and Cognitive Health Effects by the National Academies of Science, Engineering, and Medicine	Expert Panels - Other Panels	• Final Documents • Meeting Webpage • Response to NASEM Review for NTP Monograph Only
Nov 06, 2019	Peer Review of the Draft NTP Monograph on Systematic Review of Fluoride Exposure and Neurodevelopmental and Cognitive Health Effects by the National Academies of Science, Engineering, and Medicine	Expert Panels - Other Panels	• Meeting Webpage • Response to NASEM Review
Dec 01, 2015	NTP Board of Scientific Counselors Meeting	Board of Scientific Counselors	• Agenda • Meeting Materials • Minutes

Supplemental materials for some events, meetings, and workshops prior to 2021 have been archived. These archived materials frequently include presentations, background materials, and public comments. Email us or use our contact form to request a list or copy of archived materials.

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