

# Water Fluoridation in Relationship to the Prevalence of Neurodevelopmental Disorders

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## Introduction

There has been controversy regarding the use of fluoride basically since its use to prevent dental caries was implemented. More recently in 2014, the United States Department of Health and Human Services (HHS) published an article that placed fluoride in the same category as lead, as a developmental neurotoxicant.

(Grandjean, 2014) It is absolutely crucial that we study this more closely. Thorough research on this topic is vital for the health and safety of our communities which is of the utmost importance. We need to be well informed to confidently ease anxiety regarding fluoride and to make appropriate decisions regarding the use of fluoride. More data must be collected on this subject to fully understand the implications of fluoridating our public water supplies as this impacts everyone. This study explores possible connections between water fluoridation and the prevalence of developmental disabilities as well as the prevalence of dental caries since its implementation by way of a literature review.

**Keywords:** fluoride, water fluoridation, fluoride toxicity, developmental neurotoxicant, fluorosis, dental caries prevention, neurodevelopmental disorders, Autism spectrum disorder, ASD, Autism, attention-deficit/hyperactivity disorder, ADHD

## Fluoride Toxicity

- ❖ Human beings have always been exposed to fluoride as it is ubiquitous in our environment. It has been in our food and water long before we were aware of its presence. We are exposed to **multiple sources of fluoride** including our food, water, dental products, supplements, and most surprisingly, fluoride in the air. Urban areas have more airborne fluoride due to the production of fertilizers, metal, glassworks, bricks, ceramics and adhesives. (WHO, 2019)
- ❖ Fluoride categorized as a **developmental neurotoxicant**. Same category as lead, and arsenic.
- ❖ Not all studies support the evidence that fluoride is a developmental neurotoxicant.
- ❖ Genetic factors account for about 30 to 40% of all neurodevelopmental disorders. (Grandjean, 2014)
  - Thus **60 to 70%** of all neurodevelopmental disorders may be **attributed to environmental factors**.
- ❖ Most environmental factors can be altered, thus most **neurodevelopmental disorders are preventable**
- ❖ Multiple publications, mostly cross-sectional studies, demonstrate an association between high exposure to fluoride via fluoridated water and a reduced measure of intelligence. (Guth et al., 2020)
- ❖ **Acute fluoride toxicity** may cause gastrointestinal pain, nausea, vomiting, and diarrhea. Severe cases have included renal and cardiac dysfunction as well as death.
- ❖ **Chronic fluoride toxicity** is typically caused by drinking water and/or supplements and leads to dental and skeletal fluorosis. (Aoun et al., 2018)
- ❖ **Dental Fluorosis** - excess of fluoride exposure **during tooth formation** which **disrupts enamel mineralization** and changes the crystalline structure, increasing porosity. The enamel does not crystallize properly which leads to white chalky markings, brown stains, and surface pitting. (National Research Council, 2006) More severe cases, the skeleton may become fluorosed as well. With **skeletal fluorosis**, bone becomes denser, and more fragile. (Aoun et al., 2018)

## Abstract

Over many years, the prevalence of dental caries has generally declined where the prevalence of neurodevelopmental disorders has increased. Is there a possible connection to water fluoridation?

Is this increase in prevalence due to our ability to diagnose these conditions, or a different environmental factor? This study covers fluoride toxicity, caries prevention, and fluoride's possible correlation to cognitive impairments utilizing a literature review. Fluoride has undeniably been shown to reduce dental caries but is now considered a developmental neurotoxicant according to the United States Department of Health and Human Services. This study found multiple conflicting results for and against fluoride contributing to the prevalence of neurodevelopmental disorders such as Autism and attention-deficit/hyperactivity disorder. There is currently insufficient evidence to conclude whether there is a link between water fluoridation and neurodevelopmental disorders. Fluoride's classification as a developmental neurotoxicant requires us to further research its systemic effects on the human body to thoroughly identify any connections between the rise in developmental disabilities and water fluoridation. Since we already have many communities with an established fluoridated water supply, and many without added fluoride, this subject may be studied using retrospective data comparing statistics of the prevalence of multiple conditions from fluoridated versus non-fluoridated communities.



Fig. 1 Fluorosis Questionable (CDC, Fluorosis, 2019)



Fig. 2 Very Mild Fluorosis (CDC, Fluorosis, 2019)



Fig. 3 Mild Fluorosis (CDC, Fluorosis, 2019)



Fig. 4 Moderate Fluorosis (CDC, Fluorosis, 2019)



Fig. 5 Severe Fluorosis (CDC, Fluorosis, 2019)

Dental fluorosis is considered to be a cosmetic effect only, but the association of dental changes and intellectual deficits may suggest that dental fluorosis should no longer be ignored as non-adverse. This may serve as a sensitive indicator of prenatal fluoride exposure. More research is needed to determine how dental fluorosis development in different tooth types overlap with vulnerable periods of brain development. (Grandjean, 2019)

## Water Fluoridation and Dental Caries Prevalence

- ❖ Grand Rapids, Michigan was the first city in the world to fluoridate their public water in 1945. **60% drop** in caries rate in 11 years (HHS, 2018)
- ❖ Water fluoridation helps prevent tooth decay by delivering **frequent contact** of fluoride, which **today reduces tooth decay by 25%** in children and adults. (CDC, 2020)
- ❖ Even with fluoridated communities, dental caries remain a serious and silent pandemic.
- ❖ Water fluoridation has a greater impact on the **primary dentition** (Sanders et al., 2018)
- ❖ Community water fluoridation is **recommended** by almost all U.S. public health, medical, and dental organizations including the American Dental Association (ADA), American Academy of Pediatrics (AAP), US Public Health Service (USPHS), and World Health Organization (WHO). (CDC, 2020)
- ❖ One objective of **Healthy People 2030** is to increase the proportion of people whose water systems have the recommended amount of fluoride. Their target is 77.1 % of the US population. (HHS, 2021)
- ❖ To put this into perspective, in 2018, 73% of the US population, were served by community water fluoridation systems that contain enough fluoride for adequate protection of dental caries. (CDC, 2021) For this percentage to increase from 73 to 77 percent, that would be an **increase in over 13.5 million people** that would gain access to fluoridated water in the US and that is with the US population on March 6th, 2021 of 330.1 million people (Census, 2021) and this is not accounting for the projected and inevitable population increase.
- ❖ Is there a trade off between dental health and mental health?

## Water Fluoridation and Neurodegenerative Disorders

- ❖ Multiple studies have associated higher fluoride content to a lower IQ. (Grandjean, 2019) **IQ drop of 4.29** for each 0.5 mg/L increase of fluoride in water with a 95% confidence interval. (Yu et al., 2018)
- ❖ **Autism spectrum disorder (ASD)** is a range of conditions that includes impaired social behavior, communication, language, with a narrow range of interests unique to the person which tend to be carried out repetitively. (WHO, 2019)
- ❖ Data implicated **environmental factors** as the underlying etiology of ASD. (Nevison & Parker, 2020)
- ❖ **Attention-deficit/hyperactivity disorder (ADHD)** is identified as by a pattern of inattention and/or hyperactivity-impulsivity that interferes with function or development (NIMH, 2019)
- ❖ One study reported a **6.1 times higher odds of an ADHD diagnosis** with an increase of 1mg/L of water in Canadian youth. (Riddell, 2019)
- ❖ Animal studies have shown that fluoride exposure may **alter dopamine levels**. (Bashash et al., 2018) Dopamine plays an important part in our brains with motor responses, and processing of reward. It is believed that dopamine levels may be affected in patients with ADHD. (Faraone, 2018)
- ❖ Exposure to fluoride has been linked with increased prevalence of attention deficit disorder (ADHD) in the US & symptoms of inattention in Mexican children. (Riddell, 2019)
- ❖ It is very possible that there is **no link** between water fluoridation and neurodegenerative disorders. Evidence of this is recent and limited. We may find evidence in future studies that suggest this correlation was incorrect. We are getting better at recognizing signs of neurodegenerative disorders like ADHD and Autism which may be the only reason why there appears to be a rise in prevalence at all.

## Conclusion

There is insufficient evidence to clearly conclude if there is a link between the prevalence of neurodevelopmental disorders like Autism and ADHD with exposure to fluoride. Since we already have many communities with an established fluoridated water supply and many without fluoridation, this subject may be most conveniently studied using retrospective data comparing statistics of the prevalence of multiple conditions from fluoridated versus non-fluoridated communities. Fluoride has shown to have a positive impact on the dental caries rates of those exposed for many years. This study found no evidence of fluoride having no effect or an increase in dental caries as a result of fluoride exposure. CWF has been decreasing the prevalence of dental caries for 76 years now but it may be advantageous to promptly conduct studies on this subject to deepen our understanding of the pharmacodynamics of fluoride. Another literature review concluded that "since the fluoride benefit is mainly topical, perhaps it is better to deliver fluoride directly to the tooth instead of ingesting it." (Aoun et al., 2018) Fluoride has been known to cause toxicity for many years but only more recently was it categorized as a neurotoxic agent. More data is absolutely necessary to better understand this ubiquitous soluble ion in order to have the ability to confidently advise the public regarding its use to protect against dental caries.

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