

Water Fluoridation in Relationship to the Prevalence of Neurodevelopmental Disorders

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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.

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

Water Fluoridation in Relationship to the Prevalence of Developmental Disabilities

There has been controversy regarding the use of fluoride basically since its implementation to prevent dental caries. 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 make appropriate decisions regarding the use of fluoride, thus confidently easing anxiety 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.

Literature Review

Methods

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.

Discussion

Fluoride Toxicity

In 2014, an article published by the U.S. National Library of Medicine from HHS, categorized fluoride as a developmental neurotoxicant. This is the same category of substances that lead, and arsenic are placed in. The fact that there were not enough studies between the beginning of the use of fluoride and this study show how little we have actually studied it. This

same article states that genetic factors only seem to account for about 30 to 40% of all neurodevelopmental disorders. (Grandjean, 2014) This means that 60 to 70% of all neurodevelopmental disorders may be attributed to environmental factors. For the most part, environmental factors can be altered, thus most neurodevelopmental disorders are preventable. Knowledge is power. Without more research to understand what environmental factors are causing this, we do not have the ability to help protect the public.

The Archives of Toxicology published an article in 2020 that recognized there are multiple publications, mostly cross-sectional studies, that demonstrate an association between high exposure to fluoride via fluoridated water and a reduced measure of intelligence. This article also concluded that, based on the currently available evidence, their review does not support the idea that fluoride is a human developmental neurotoxicant at the current levels in Europe. (Guth et al., 2020) Fluoride levels in fluoridated drinking water in Europe range from 0.2 to 1.2 mg/L, according to the European Union's Public Health Department. (EU, n.d.) This is comparable to ranges in the United States.

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, which is typically caused by drinking water and/or supplements, causes dental and skeletal fluorosis. (Aoun et al., 2018) With dental fluorosis, the enamel covering of the teeth does not crystallize properly which leads to defects that include white chalky markings, brown stains, and surface pitting. Fluorosis is due to an excess of fluoride exposure during tooth formation. Fluoride exposure during maturation disrupts enamel mineralization and changes the crystalline structure, which increases enamel porosity. (National Research Council, 2006) In more severe cases, the skeleton may become fluorosed as well. With skeletal fluorosis, the bone

becomes denser, appearing radiopaque in radiographs, but it is more fragile. (Aoun et al., 2018)

We are exposed to multiple sources of fluoride including our food, water, dental products, supplements, and most surprisingly, in the air. Urban areas have more airborne fluoride due to the production and use of fertilizers, and the production of metal, glassworks, bricks, ceramics, and adhesives. (WHO, 2019b)

Water Fluoridation and Dental Caries Prevalence

Grand Rapids, Michigan was the first city in the world to fluoridate their public water supply in 1945 after the residents voted for this change. After only 11 years, there was more than a 60% drop in caries rate in the children born after the community fluoridation change was implemented. (HHS, 2018) Evidently, water fluoridation helps prevent tooth decay by delivering frequent contact with low amounts of fluoride, which ultimately reduces tooth decay by 25% in children and adults. (CDC, 2020) This difference in percentage is mostly attributed to the use of topical fluorides. Even with our currently fluoridated communities, dental carries remain a serious and silent pandemic.

According to a cross-sectional study published in the Journal of Dental Research in 2018, water fluoridation has a greater impact on the primary dentition (Sanders et al., 2018) Unfortunately, current animal models do not appropriately cover neonatal fluoride exposure. Thus, future studies that focus on exposures prenatally, during infancy, and in later childhood may allow a more detailed assessment of the vulnerable time windows for fluoride neurotoxicity. (Grandjean, 2019)

Community water fluoridation is recommended by nearly all the United States' 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 of the objectives 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 percent 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.

Water Fluoridation and the Prevalence of Neurodegenerative Disorders

Multiple studies have associated higher fluoride content to a lower IQ. (Grandjean, 2019) A large study of 2886 children reported an 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.

Autism spectrum disorder (ASD) is a range of conditions that include impaired social behavior, communication, and language, and a narrow range of interests that are unique to the person and tend to be carried out repetitively. The World Health Organization (WHO) stated that there are probably multiple environmental and genetic factors that make a child more likely to have an ASD. With the prevalence of ASD appearing to increase globally, WHO believes there are many possible explanations for this increase, including improved awareness, expansion of diagnostic criteria, better diagnostic tools, and improved reporting meaning that the increase is only in diagnosis and not in prevalence. (WHO, 2019a)

While reviewing data from the California Department of Developmental Services (DDS), an article published in the Journal of Autism and Developmental Disorders stated that the data implicated environmental factors as the underlying etiology of ASD. (Nevison & Parker, 2020) In this literature review, only three peer-reviewed articles were found to include fluoride as a culprit for ASD etiology and two of these studies had two of the same authors. (Strunecka & Strunecky, 2019) (Strunecka et al., 2018) (Nakamoto & Rawls, 2018) Although, the possibility of this connection should not be negated simply because of the scarcity of research in this area, but more research is needed to explore possible risks of fluoride more thoroughly.

According to HHS, several studies have been conducted identifying the wider spectrum of combined ASD at a prevalence of six to seven per 1,000 children, which is approximately 0.6% to 0.7%. This estimate is more than ten times higher than estimates using earlier criteria. (Rice et al., 2012) Autism Speaks believes the supposed rise in prevalence is only due to our increased understanding and early detection by means of screening for Autism by age three and see the rise in prevalence as an exciting indicator of progress rather than as being an area for concern. (Autism Speaks, 2020).

ADHD.

Attention-deficit/hyperactivity disorder (ADHD) is identified as a pattern of inattention and/or hyperactivity-impulsivity that interferes with function or development (NIMH, 2019) According to a study in Mexico City, previous animal studies have shown that fluoride exposure may alter levels of dopamine. (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) According to a study published in *Environment International* that noted that fluoride exposure has been associated with an increased prevalence

of attention deficit disorder (ADHD) in the United States and with symptoms of inattention in children in Mexico. This same article mentioned a 6.1 times higher odds of ADHD diagnosis with an increase of 1 mg/L of water. (Riddell, 2019)

Currently, 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 visually serve as a sensitive indicator of prenatal fluoride exposure. (Grandjean, 2019)

No link between fluoridation and the rise in prevalence of neurodevelopmental disorders

There may be no link between water fluoridation and neurodegenerative disorders. Since the evidence of this is recent and limited, we may find that evidence in future studies that 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 it looks like there is a rise in prevalence at all. Human beings have always been exposed to fluoride. It has been in our food and water since long before we were even aware of its presence, let alone its use to protect against caries.

Conclusion

There is insufficient evidence to clearly conclude if there is a link between the prevalence of 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 and non-fluoridated communities. Fluoride may have an effect on both ADHD and Autism prevalence, but as previously mentioned, more research is needed to more thoroughly identify any connections between the rise in developmental disabilities and water fluoridation.

Fluoride has been 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. Community water fluoridation 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 pharmacology 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) Until further research is conducted to fully understand the effects of fluoride on the human nervous system it may be advisable to exercise caution with the intake of systemically absorbed fluoride.

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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