

Fluoride Action Network
104 Walnut Street
Binghamton NY 13905
email: ellen@fluroidealert.org

To: American Water Works Association
c/o ETS Support <etssupport@awwa.org>
Engineering & Technical Services Department

Via Email

November 20, 2017

The Fluoride Action Network submits the following comments on your document titled *Sodium Fluoride, Draft, September 2017*. While we have added links throughout our commentary, we have also listed the references separately at the end.

1. The Background section needs to be re-written to reflect a correct statement and not propaganda. For example:

- 1.1. AAWA states on page vii: **“Community water fluoridation is an effective, safe, and relatively inexpensive way to prevent tooth decay.”**
- 1.2. Below are fourteen reasons why the word **“safe”** should not be used as an adjective for community water fluoridation, which is the major route of exposure to fluoride in the U.S.
- 1.3. **1st REASON: Fluoride is not safe because it has the potential to damage a child’s brain.** (*The following is from [M. Connett, 2016](#).*) The risk to the brain posed by fluoridation additives is an unreasonable risk because it is now understood that fluoride’s predominant effect on tooth decay comes from topical contact with teeth, not ingestion. Since there is little benefit in swallowing fluoride, there is little justification in exposing the public to any risk of fluoride neurotoxicity, particularly via a source as essential to human sustenance as the public drinking water and the many processed foods and beverages made therefrom.

In 2006 the National Resource Council of the National Academies (NRC-2006) released a report on the toxicology of fluoride. With respect to the nervous system, the NRC concluded: “On the basis of information largely derived from histological, chemical, and molecular studies, it is apparent that fluorides have the ability to interfere with the functions of the brain.” ([NRC 2006, at 222](#)). The number of human studies published subsequent to the NRC review that have found significant relationships between fluoride and adverse cognitive outcomes (n = 46) dwarfs the number of such studies that were available to the NRC (n = 5).

The post-NRC human studies include:

- 54 studies investigating fluoride’s effect on cognition, including but not limited to IQ, with all but 8 of these studies finding statistically significant associations between fluoride exposure and cognitive deficits. ([Appendix A](#) at 55)
- 3 studies investigating fluoride’s effect on fetal brain, with each of the 3 studies reporting deleterious effects. ([Appendix B](#) at 60)

- 4 studies investigating fluoride’s association with other forms of neurotoxic harm, including ADHD, altered neonatal behavior, and various neurological symptoms. ([Appendix C](#) at 61)

The post- NRC animal studies include:

- 105 studies investigating fluoride’s ability to produce neuroanatomical and neurochemical changes, with all but 2 of the studies finding at least one detrimental effect in the fluoride-treated groups. ([Appendix D](#) at 62)
- 31 studies investigating fluoride’s effect on learning and memory, with all but one of the studies finding at least one deleterious effect in the fluoride-treated groups. ([Appendix E](#) at 70)
- 18 studies investigating fluoride’s impact on other parameters of neurobehavior besides learning and memory, with all but one of the studies finding effects. ([Appendix F](#) at 73)

The post-NRC cell studies include:

- 17 studies, including 2 studies that investigated and found effects at fluoride levels that chronically occur in the blood of Americans living in fluoridated communities. ([Appendix G](#) at 75)

The three post-NRC systematic reviews of the literature, include two that address the human/IQ literature, and one that addresses the animal/cognition literature. ([NTP 2016](#); [Choi et al. 2012](#); [Tang et al. 2008](#)).

- 1.4. **2nd REASON: Fluoride is not safe because it’s is a developmental neurotoxin.** Grandjean and Landrigan in 2014 classified fluoride as one of only 12 chemicals “known to cause developmental neurotoxicity in human beings.” In their 2014 paper, [Neurobehavioural effects of developmental toxicity](#), the authors state, “Disorders of neurobehavioural development affect 10–15% of all births,¹ and prevalence rates of autism spectrum disorder and attention-deficit hyperactivity disorder seem to be increasing worldwide.² Subclinical decrements in brain function are even more common than these neurobehavioural developmental disorders. All these disabilities can have severe consequences³ —they diminish quality of life, reduce academic achievement, and disturb behaviour, with profound consequences for the welfare and productivity of entire societies.”⁴

In a recent review of developmental neurotoxins by EPA scientists, only 22% of suspected neurotoxins were found to have any supporting human data ([Mundy et al. 2015, at 25](#)). The EPA team characterized chemicals, including fluoride, whose suspected neurotoxicity is backed by human data, as “gold standard” chemicals that warrant prioritization (Mundy et al. 2015, at 27). (from [M Connett, 2016](#)).

- 1.5. **3rd REASON: Fluoride is not safe because it has the potential to lower a child’s IQ.** 50 out of 57 published papers reported an association of exposure to fluoride with reduced IQ in children. Many of the IQ studies were done in communities where drinking water fluoride levels were below the U.S. EPA’s secondary standard of 2 mg/L, and even more studies had fluoride in drinking water below the EPA’s Maximum Contaminant Level of 4 mg/L. See studies online at <http://fluoridealert.org/studies/brain01/>

A meta-analysis of 27 of the IQ studies by a team from Harvard University ([Choi et al. 2012](#)) found that 26 out of 27 studies found a lowered IQ in the high-fluoride villages compared to the low-

fluoride villages. The average lowering was 7 IQ points. Despite the fact that Choi and her team found that many of these studies were small and provided inadequate information on key potential confounders, there was a remarkable consistency about the results, even though these studies were carried out by different research groups, over a period of 20 years, in different countries and over vastly different geographical areas in the case of China.

- 1.6. **4th REASON. Fluoride is not safe because a well-conducted study by Xiang et al. (2003a,b) found a dose response relationship between fluoride levels in drinking water - similar to concentrations used in fluoridated drinking water - and lowered IQ.** One of the studies in the review by [Choi et al. 2012](#) that was particularly strong was one performed by Xiang et al. ([2003a](#), [2003b](#)). Xiang and his co-workers controlled for many key variables such as lead exposure and iodine intake and retrospectively for arsenic exposure. They further strengthened their study by sub-dividing the high-fluoride exposure into 5 sub-groups with fluoride concentrations ranging from 0.75 to 4.3 ppm. They found a linear relationship between the mean fluoride concentrations in these sub-groups and the mean IQ in each group. As the fluoride concentration went up the mean IQ went down. Finding a dose response relationship within these five sub-groups (even without considering the low-F village) is far superior to just comparing the mean IQ of the low and high-F villages. Moreover, finding the relationship in one village eliminates the differences in potential confounders between the villages. Xiang found that the IQ of these children were lowered between 0.75 and 1.5 ppm, which overlaps the range of fluoride concentrations used in fluoridated communities around the world (0.6 to 1.4 ppm). Moreover, in terms of total fluoride exposure, there were two sources of fluoride that would have been actually lower for these Chinese children than in most fluoridated countries. The children were not bottle-fed and they didn't use fluoridated toothpaste.
- 1.7. **5th REASON: Fluoride is not safe is because the risks to IQ posed by fluoride in the studies in the Choi meta-analysis (2012) have been quantified and doses found to lower IQ in the Xiang study are easily exceeded in fluoridated communities.** In 2016, [Hirzy et al.](#) quantified the risks fluoride posed to IQ in the Xiang study by using standard techniques used by the US EPA. Hirzy, after converting the concentrations to dose, by including fluoride from other sources (i.e. food), found that 1.4 mg of fluoride per day lowered the IQ of the children in this study by 5 IQ points. 1.4 mg/day is easily exceeded in fluoridated communities either by high water consumers or by average water consumers if other sources of fluoride are included such as dental products and tea drinking.
- 1.8. **6th REASON: Fluoride is not safe for the fetus.** A U.S.-funded study in Mexico ([Bashash et al., 2017](#)) reported a link between fluoride in the urine of pregnant women and lower measures of intelligence in their children. The new study found a very large effect. An increase in urine fluoride of 1 mg/L was associated with a drop in IQ of 5 to 6 points. To put this into perspective with the fluoride levels ingested by the Mexican mothers and the levels ingested in fluoridated parts of the USA, the average fluoride intake in the Mexican mothers was about the same as that in women in the USA. It was not substantially higher. The range of fluoride levels in Mexico also corresponded closely to the range found in most of the USA. The higher levels were similar to what is found in areas in the USA with fluoridated water, and the lower levels were similar to what is found in most unfluoridated parts of the USA.

It should be noted that if a substance shifts downwards the IQ of a large population by 5 IQ points, it would halve the number of very bright children (IQ > 130) in the population and increase by 50% the number of mentally handicapped (IQ < 70). This would have very serious ramifications on both society and the national economy of a country like the USA.

1.9. **7th REASON: Fluoride is not safe because it's an endocrine disruptor.** The NRC-2006 report on the toxicology of fluoride reported for the first time that fluoride is an endocrine disruptor. [The report states](#): "In summary, evidence of several types indicates that fluoride affects normal endocrine function or response; the effects of the fluoride-induced changes vary in degree and kind in different individuals. Fluoride is therefore an endocrine disruptor in the broad sense of altering normal endocrine function or response, although probably not in the sense of mimicking a normal hormone. The mechanisms of action remain to be worked out and appear to include both direct and indirect mechanisms, for example, direct stimulation or inhibition of hormone secretion by interference with second messenger function, indirect stimulation or inhibition of hormone secretion by effects on things such as calcium balance, and inhibition of peripheral enzymes that are necessary for activation of the normal hormone."

1.10. **8th REASON: Fluoride is not safe for infants who are fed formula made with fluoridated water.** Infants have a very high fluid intake in relation to their body weight and formula-fed infants have above-average and unsafe fluoride exposure when their formula is made with fluoridated water. The infant will receive approximately 175 times more fluoride than a human-fed child when the level of fluoride in the water is .7 ppm. For water fluoridation schemes that use 1.0 ppm fluoride the infant will receive up to 250 times more fluoride compared to the human-fed infant. [On page 85 of the NRC-2006 report](#), **Non-nursing infants** are in the highest level of unsafe levels of fluoridated water consumption – see graph below:

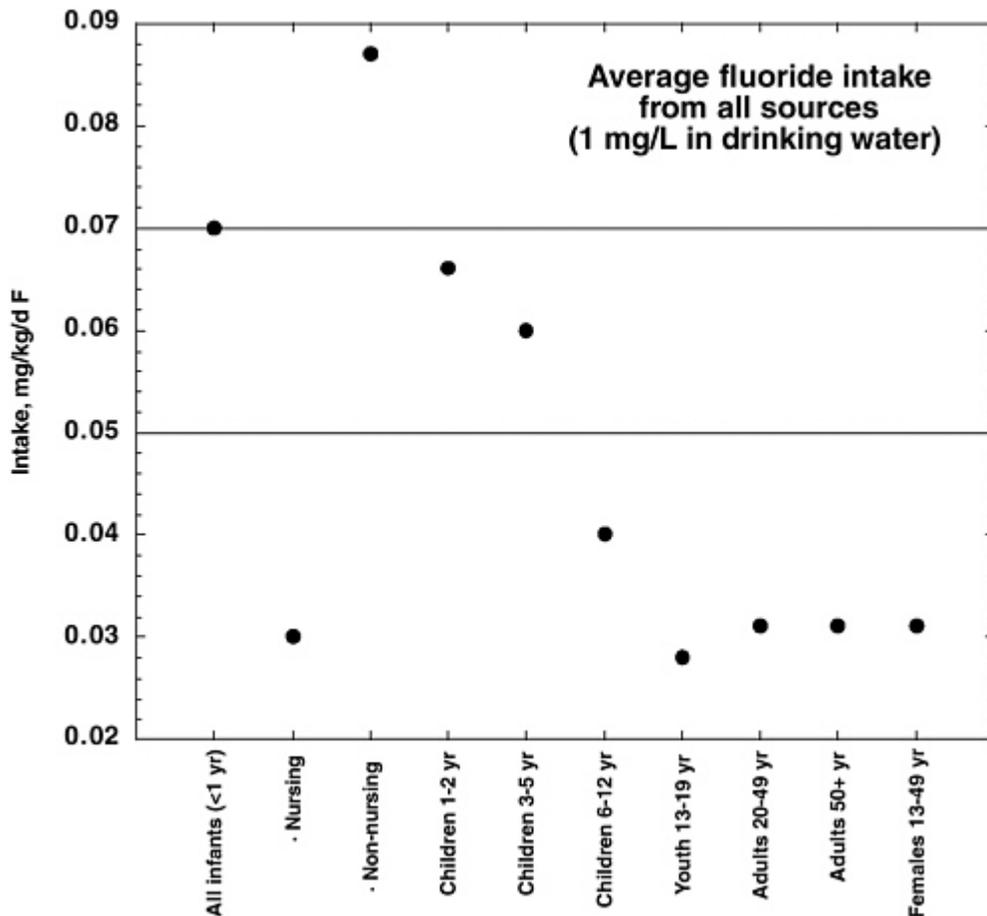


FIGURE 2-8 Estimated average intake of fluoride from all sources, at 1 mg/L in drinking water (based on [Table 2-11](#)). Horizontal lines indicate an intake of 0.05-0.07 mg/kg/day.

- 1.11. **9th REASON: Fluoride is not safe as it is linked to osteosarcoma in young boys.** The finding that [Bassin and co-workers](#) reported in 2006 has not been refuted, even though there was a 5-year concerted effort to do so by [Douglass and Joshipura](#) and others. According to Bassin et al: “Our exploratory analysis described the association of fluoride level in drinking water at specific ages and the incidence of osteosarcoma. We observed that for males diagnosed before the age of 20 years, fluoride level in drinking water during growth was associated with an increased risk of osteosarcoma, demonstrating a peak in the odds ratios from 6 to 8 years of age. All of our models were remarkably robust in showing this effect, which coincides with the mid-childhood growth spurt [30–33].”
- 1.12. **10th REASON: Fluoride is not safe because of its impact on Environmental Justice.** Officials in the U.S. Public Health Service (PHS) knew as early as 1962 that African-Americans had a higher prevalence of dental fluorosis than whites. A January 10, 1962 internal memorandum, from a top PHS official, F.J. Maier, in connection with the first fluoridation trial, revealed that, “negroes in Grand Rapids had twice as much [dental] fluorosis than others.” Based on this, Maier asked, “In a community with a larger number of negroes (say in Dekalb County, Georgia) would this tend to change our optimum fluoride levels?” (Maier,1962).

Dental researchers have continued to report this discrepancy over many decades. In [2005 the CDC reported](#) that both Blacks and Hispanic children had higher rates of dental fluorosis particularly in its most disfiguring categories (moderate and severe). . In 2012, CDC/NHANES data (unpublished) revealed that 58% of U.S. adolescents had dental fluorosis, with African- Americans experiencing fluorosis at a higher rate than whites. However, in all this time neither the Centers for Disease Control and Prevention (CDC) nor any other federal agency that promotes water fluoridation has sought to warn communities of color of their particular vulnerability with respect to this permanent visually objectionable injury from systemic over-exposure to fluoride. The failure to warn communities of color of their disproportionate harm is a clear example of Environmental Justice. For more details see this 2015 report, [Water Fluoridation and Environmental Justice](#), by the Fluoride Action Network.

- 1.13. **11th REASON: U.S. children are overexposed to fluoride and have the highest rates of dental fluorosis in the country’s history.** Dental fluorosis is due to over-exposure to fluoride. The levels have been steadily increasing and is now at an all-time high. In 2012, CDC/NHANES data (unpublished) revealed that **58% of U.S. adolescents had dental fluorosis**, with African- Americans experiencing fluorosis at a higher rate than whites. According to [Beltram and Barker](#), “Between 1999 and 2004, approximately **41% of adolescents aged 12 to 15 and 36% aged 16 to 19 years had dental fluorosis**. Moderate and severe fluorosis was observed in less than 4% in both age groups.” A December 2015 paper entitled “[A critique of recent economic evaluations of community water fluoridation](#)” concluded that there is “no cost-savings” from community water fluoridation due to “the estimated cost of treating dental fluorosis.”
- 1.14. **12th REASON: Fluoride is not safe for individuals who drink high quantities of water.** While water companies can control the level of fluoride in fluoridated drinking water, no one can control the dose of fluoride that people consume because everyone drinks different amounts. As mentioned above, the formula-fed infant in fluoridated communities receives some of the highest levels of fluoride. According to a 2006 report on the toxicology of fluoride, by the National Research Council of the National Academies, in a section titled, [High Intake Population Subgroups](#) (NRC-2006): “EPA, in its report to Congress on sensitive subpopulations (EPA 2000b), defines sensitive subpopulations in terms of either their response (more severe response or a response to a lower dose) or their exposure (greater exposure than the general population). Hence, it is appropriate to consider those

population subgroups whose water intake is likely to be substantially above the national average for the corresponding sex and age group. These subgroups include people with high activity levels (e.g., athletes, workers with physically demanding duties, military personnel); people living in very hot or dry climates, especially outdoor workers; pregnant or lactating women; and people with health conditions that affect water intake. Such health conditions include diabetes mellitus, especially if untreated or poorly controlled; disorders of water and sodium metabolism, such as diabetes insipidus; renal problems resulting in reduced clearance of fluoride; and short-term conditions requiring rapid rehydration, such as gastrointestinal upsets or food poisoning (EPA 2000a). estimate means or distributions of intake for these specific subgroups.)”

- 1.15. **13th REASON: Fluoride is not safe because it bio-accumulates in the human body over one’s lifetime and has a significantly long-half life.** According to [Luke \(2001\)](#), fluoride accumulates in the pineal gland, a calcifying organ that lies near the center of the brain but outside the blood-brain barrier. Luke reported the highest fluoride concentration ever reported in a human as between 650–21,800 mg/kg, with an average of 9,000 mg/kg, in the pineal gland. The NRC-2006 reported fluoride accumulation in the bone with a very long half-life: “Twenty years might not represent a true half-life. Recent pharmacokinetic models (see below) are nonlinear, suggesting that elimination rates might be concentration dependent.”
- 1.16. **14th REASON: Fluoride is not safe because it has the potential to adversely affect many organs in the human body.** Aside from the pineal gland and the thyroid cited example, there have been several published papers on fluoride’s adverse effect on: [Blood](#) (80 papers); [Bones and Joints](#) (580 papers); [Brain](#) (366 papers); [Diabetes](#) (83 papers); [Fetal toxicity and Teratology](#) (42 papers); [Gastrointestinal](#) (59 papers); [Heart](#) (123 papers); [Immune System](#) (90 papers); [Kidney](#) (249 papers); [Liver](#) (125 papers); [Lung](#) (59 papers); [Parathyroid Gland](#) (27 papers); [Reproductive toxicity](#) (170 papers); [Susceptible Populations](#) (489 papers); and [Mechanisms of Cellular Toxicity](#) (461 papers); Mechanisms of fluoride’s toxicity; and [Total Body Burden](#) (391 papers).
- 1.17. **This sentence in the Background** section, as well as the comment on “effectiveness” needs to be corrected: “Since the first fluoridation installation in 1945, studies have shown that this method of fluoride delivery benefits Americans of all ages and socioeconomic status. Dental decay can be reduced by 20 to 40 percent among persons who have consumed fluoridated water since birth.”
- 1.18. The risks of community fluoridation outweigh the benefits as has been shown above in the 14 reasons why fluoride is not safe to humans.
- 1.19. Water fluoridation may not be “**effective**” in preventing tooth decay. According to an independent review by [Newsweek](#) of the [Cochrane Report of 2015](#) on water fluoridation, “The review identified only three studies since 1975—of sufficient quality to be included—that addressed the effectiveness of fluoridation on tooth decay in the population at large. These papers determined that fluoridation does not reduce cavities to a statistically significant degree in permanent teeth, says study co-author Anne-Marie Glenny, a health science researcher at Manchester University in the United Kingdom. The authors found only seven other studies worthy of inclusion dating prior to 1975. The authors also found only two studies since 1975 that looked at the effectiveness of reducing cavities in baby teeth, and found fluoridation to have no statistically significant impact here, either. The scientists also found “insufficient evidence” that fluoridation reduces tooth decay in adults (children excluded). “From the review, we’re unable to determine whether water fluoridation has an impact on caries levels in adults,” Glenny says.”

- 1.20. Under Section **4.3 Impurities** the document states: **“The material supplied according to this standard shall contain no soluble materials or organic substances in quantities capable of producing deleterious or injurious effects on the health of those consuming water that has been treated properly with the material.”** This is an incorrect and misleading statement for the following reasons.
- 1.21. **There is no safe level of exposure to a carcinogen.** The impurities in the Sodium Fluoride product (in Table 1 -see below) include four substances that the International Agency for Research on Cancer (IARC) classify as known human carcinogens (Arsenic, Beryllium, Cadmium, and Radionuclides). The IARC classifies Lead as “Possibly carcinogenic to humans” while the EPA classifies it as a “Probable human carcinogen.” Uranium is classified as a “Confirmed Human Carcinogen” by the American Conference of Governmental Industrial Hygienists. Even though these substances are at trace levels in the fluoridation chemical of Sodium Fluoride, it can be said with confidence that using this chemical will cause cancer because there is no safe level of exposure to a carcinogen. As to how many cancers are caused by the trace amounts of these carcinogens in fluoridated drinking water is unknown.
- 1.22. Also identified in the impurities of the Sodium Fluoride product are five neurotoxins. Arsenic, Lead, Mercury are well-known while Selenium and Thallium are lesser known neurotoxins.
- 1.23. What we do know about these impurities is that the EPA does not know how to determine the synergistic effects of these carcinogens and neurotoxic substances in fluoridated drinking water. What we can say with confidence is that even at trace amounts, the combined effect with be additive and most likely multiplicative. See reference for studies on co-exposure for Arsenic, Cadmium, and Lead in the references below under Paragraph 1.23
- 1.24.

Table 1 Maximum Allowed Concentrations of Impurities in Sodium Fluoride

Impurity	Single Product Allowable Concentration (SPAC) in treated water	Maximum Allowed Concentrations in NaF	Comments by the Fluoride Action Network
	mg/L	mg/kg	
Regulated Metals Antimony	0.0006	219	The public needs to know the CAS number
Arsenic	0.001	366	IARC : Carcinogenic to humans Grandjean, Landrigan (2014) : Developmental neurotoxicant
Barium	0.2	73,152	

Beryllium	0.0004	146	IARC: Carcinogenic to humans
Cadmium	0.0005	183	IARC: Carcinogenic to humans
Chromium (total)	0.01	3,658	** The public needs to know if it contains Chromium (V1)
Copper (at tap)	0.13	47,549	MN DOH (2005): Children under one year old are more vulnerable to the toxic effects of copper as are those with Wilson's Disease
Lead (at tap)	0.0015	549	EPA: Probable human carcinogen IARC: Possibly carcinogenic to humans Grandjean, Landrigan (2014): Developmental neurotoxicant
Mercury (inorganic)	0.0002	73	ATSDR & EPA: Neurotoxin
Selenium	0.005	1,829	Vinceti et al. (2014): Selenium neurotoxicity
Thallium	0.0002	73	Osorio-Rico et al. (2017): Thallium neurotoxicity
Radionuclides	mrem/y	mrem/y per g	IARC:
Beta particle and photon activity	0.4	146	Carcinogenic to humans
pCi/L	pCi/g		
Gross alpha particle activity	1.5	549	
Radium 226 and 228 (combined)	0.5	183	

Uranium	1.3 mg/L	475 mg/kg	ACGIH: Confirmed human carcinogen (American Conference of Governmental Industrial Hygienists)
Uranium	0.002	732	

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Paragr aph	Reference
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<p>1.16</p>	<p>Blood (80 papers), http://fluoridealert.org/studytracker/?effect=blood&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p> <p>Bones and Joints (580 papers), http://fluoridealert.org/studytracker/?effect=bone-joints&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p> <p>Brain (366 papers), http://fluoridealert.org/studytracker/?effect=brain-2&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p> <p>Diabetes (83 papers), http://fluoridealert.org/studytracker/?effect=diabetes-2&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p> <p>Fetal Toxicity & Teratology (42 papers), http://fluoridealert.org/studytracker/?effect=fetus-2&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p> <p>Gastrointestinal (59 papers), http://fluoridealert.org/studytracker/?effect=gastrointestinal-2&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p> <p>Heart (123 papers), http://fluoridealert.org/studytracker/?effect=cardio-2&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p>

	<p>Immune System (90 papers), http://fluoridealert.org/studytracker/?effect=immune-system-2&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p> <p>Kidney (249 papers), http://fluoridealert.org/studytracker/?effect=kidney&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p> <p>Liver (125 papers), http://fluoridealert.org/studytracker/?effect=liver-2&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p> <p>Lung (59 papers), http://fluoridealert.org/studytracker/?effect=respiratory-2&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p> <p>Parathyroid Gland (27 papers), http://fluoridealert.org/studytracker/?effect=parathyroid&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p> <p>Reproductive toxicity (170 papers), http://fluoridealert.org/studytracker/?effect=reproductive-toxicity&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p> <p>Susceptible Populations (489 papers), http://fluoridealert.org/studytracker/?effect=susceptible-populations-2&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p> <p>Mechanisms of Cellular Toxicity (461 papers), http://fluoridealert.org/studytracker/?effect=cellular_toxicity&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p> <p>Total Body Burden (391 papers), http://fluoridealert.org/studytracker/?effect=body-burden&sub=&type=&start_year=&end_year=&show=10&fulltext=&fantranslation=</p>
<p>1.19</p>	<p>Main D. 2015. Fluoridation May Not Prevent Cavities, Scientific Review Shows. <i>Newsweek</i>. June 29. http://www.newsweek.com/fluoridation-may-not-prevent-cavities-huge-study-shows-348251</p> <p>Iheozor-Ejiofor Z, Worthington HV, Walsh T. 2015. Water fluoridation for the prevention of dental caries. <i>The Cochrane Database for Systematic Reviews</i>, 6:CD010856, June 18. http://fluoridealert.org/studytracker/23034/</p>
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	Lead. EPA: Probable human carcinogen, https://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=22
1.22	<p>Neurotoxins:</p> <p>Arsenic and Lead, see Grandjean P, Landrigan P. 2014. Neurobehavioural effects of developmental toxicity. <i>The Lancet Neurology</i>; 13: 330–38. http://fluoridealert.org/wp-content/uploads/grandjean-20141.pdf</p> <p>Mercury, see https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=113&tid=24</p> <p>Selenium, see https://www.sciencedirect.com/science/article/pii/S0378427413014227</p> <p>Thallium, see https://link.springer.com/chapter/10.1007/978-3-319-60189-2_17</p>
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