CAMPAIGN FOR DENTAL HEALTH

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Fluoride & IQ Scores:
What the Research Shows

(June 2014)

In 2012, anti-fluoride activists began posting articles online linking fluoridation to lower IQ scores

But are these scary headlines a distortion of the facts?

Harvard Study Confirms Fluoride Reduces Children's IQ

August 14, 2012 | 324,174 views | Disponible en Español

Spread the Word to Friends And Family By Sharing this Article

By Dr. Mercola

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HARVARD STUDY: FLUORIDE LOWERS CHILDREN'S INTELLIGENCE BY 7 IQ POINTS

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Washington's Blog
February 10, 2014

The Harvard School for Public Health reports:

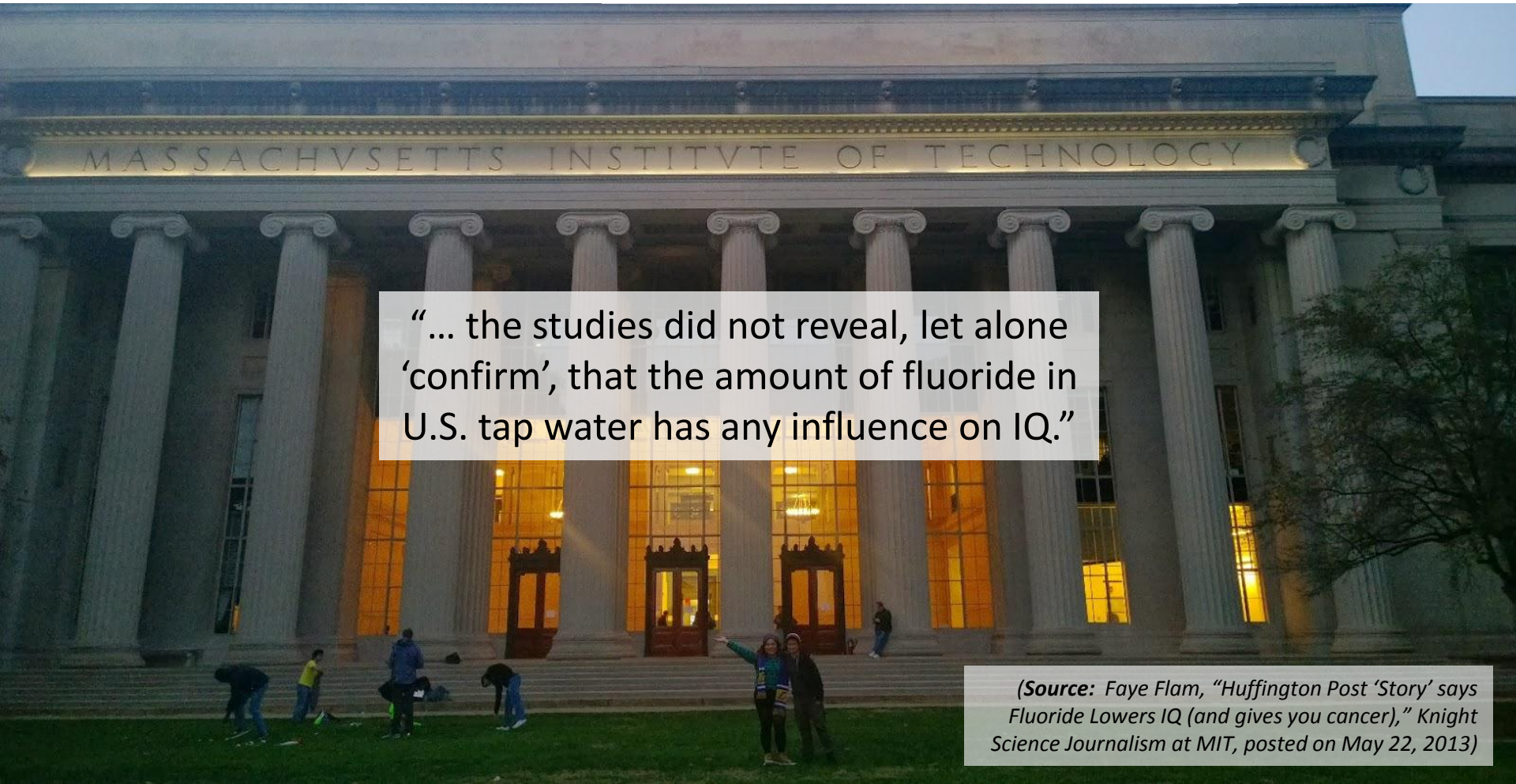
In a meta-analysis, researchers from Harvard School of Public Health (HSPH) and China Medical University in Shenyang for the first time combined 27 studies and found strong indications that fluoride may adversely affect cognitive development in children. Based on the findings, the authors say that this risk should not be ignored, and that more research on fluoride's impact on the developing brain is warranted.

The study [click for abstract] was published online in Environmental Health Perspectiveson July 20, 2012.

(***Source:*** *Washington's Blog, InfoWars.com, February 10, 2014; "Harvard Study Confirms Fluoride Reduces Children's IQ," Mercola's website, August 14, 2012)*

KNIGHT SCIENCE JOURNALISM AT MIT

A journalist at Knight Science Journalism at MIT examined these claims and found that:



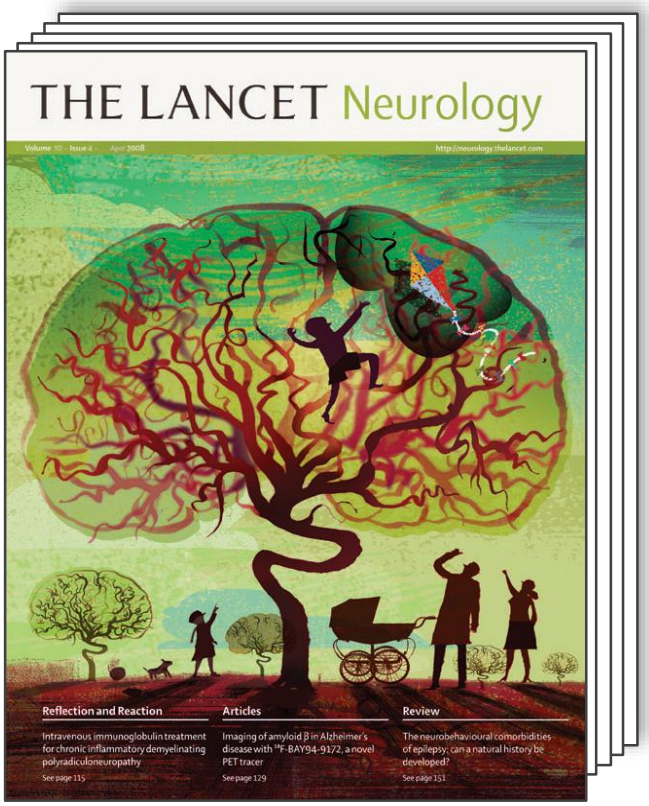
"… the studies did not reveal, let alone 'confirm', that the amount of fluoride in U.S. tap water has any influence on IQ."

*(**Source:** Faye Flam, "Huffington Post 'Story' says Fluoride Lowers IQ (and gives you cancer)," Knight Science Journalism at MIT, posted on May 22, 2013)*

1. How Anti-Fluoride Activists Misrepresent Data and Science about Fluoridation and IQ

***The Lancet* article** (March 2014):

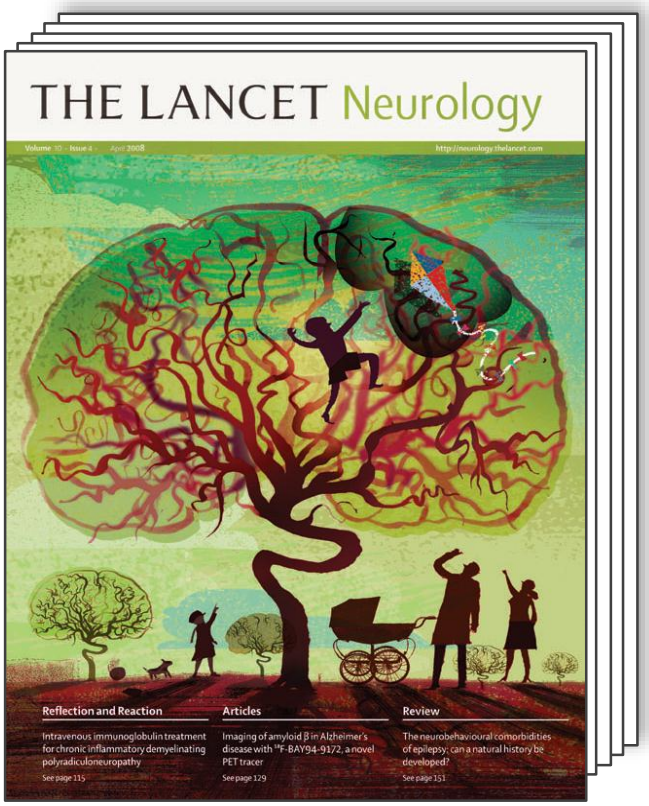
- Anti-fluoride activists cite an article from this journal but distort its conclusions.
- Let's take a closer look at the article — what it said and what it didn't say.



(***Source:*** *P. Grandjean and P.J. Landrigan, "Neurobehavioural effects of developmental toxicity," The Lancet, March 2014, Vol. 13.)*

The Lancet **article** (March 2014):

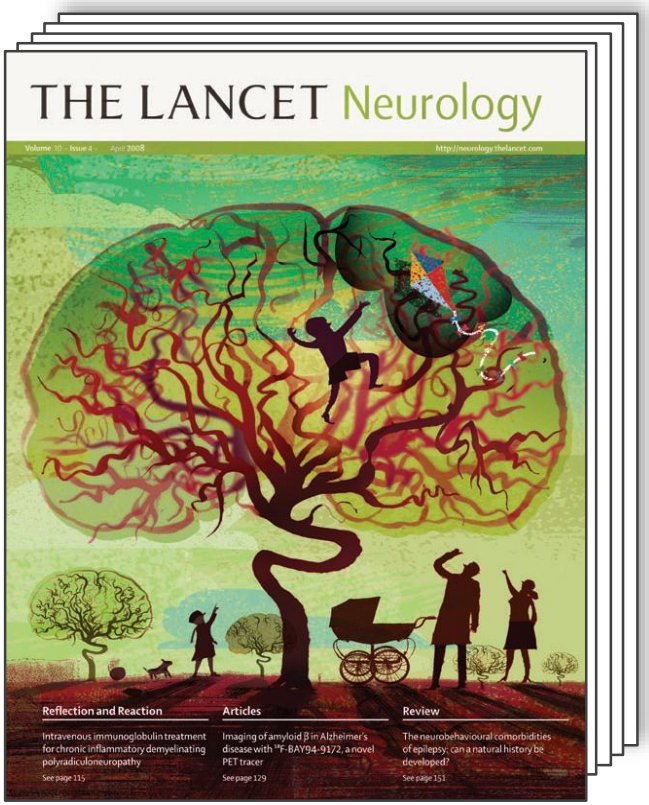
- The co-authors voiced concern about a "pandemic of developmental neurotoxicity" that is harming children's cognitive development.
- They presented a list of 11 neurotoxicants that included **fluoride**.
- Although the article *never* refers to the concentration of fluoride used to fluoridate community water systems, anti-fluoride activists are citing the article to raise fear.



(***Source:*** *P. Grandjean and P.J. Landrigan, "Neurobehavioural effects of developmental toxicity," The Lancet, March 2014, Vol. 13.)*

***The Lancet* article** (March 2014):

- It provides no new scientific evidence about fluoride.
- Its only citation for fluoride is to a 2012 **review** of studies that were conducted in Asia, primarily in China. Most of these studies are at least 10 years old.
- These studies contain serious flaws because they did not adequately rule out arsenic, lead, and other factors that could have affected the IQ results.



(***Source:*** *P. Grandjean and P.J. Landrigan, "Neurobehavioural effects of developmental toxicity," The Lancet, March 2014, Vol. 13.)*

Philip Grandjean was a co-author of both *The Lancet* article and the 2012 research review

The 2012 article stated that "each of the [IQ studies] reviewed had deficiencies, in some cases rather serious ones, that limit the conclusions that can be drawn."

Review

Developmental Fluoride Neurotoxicity: A Systematic Review and Meta-Analysis

Anna L. Choi,[1] Guifan Sun,[2] Ying Zhang,[3] and Philippe Grandjean[1,4]

[1]Department of Environmental Health, Harvard School of Public Health, Boston, Massachusetts, USA; [2]School of Public Health, China Medical University, Shenyang, China; [3]School of Stomatology, China Medical University, Shenyang, China; [4]Institute of Public Health, University of Southern Denmark, Odense, Denmark

Background: Although fluoride may cause neurotoxicity in animal models and acute fluoride poisoning causes neurotoxicity in adults, very little is known of its effects on children's neurodevelopment.

Objective: We performed a systematic review and meta-analysis of published studies to investigate the effects of increased fluoride exposure and delayed neurobehavioral development.

Methods: We searched the MEDLINE, EMBASE, Water Resources Abstracts, and TOXNET databases through 2011 for eligible studies. We also searched the China National Knowledge Infrastructure (CNKI) database, because many studies on fluoride neurotoxicity have been published in Chinese journals only. In total, we identified 27 eligible epidemiological studies with high and reference exposures, end points of IQ scores, or related cognitive function measures with means and variances for the two exposure groups. Using random-effects models, we estimated the standardized mean difference between exposed and reference groups across all studies. We conducted sensitivity analyses restricted to studies using the same outcome assessment and having drinking-water fluoride as the only exposure. We performed the Cochran test for heterogeneity between studies, Begg's funnel plot, and Egger test to assess publication bias, and conducted meta-regressions to explore sources of variation in mean differences among the studies.

Results: The standardized weighted mean difference in IQ score between exposed and reference populations was −0.45 (95% confidence interval: −0.56, −0.35) using a random-effects model. Thus, children in high-fluoride areas had significantly lower IQ scores than those who lived in low-fluoride areas. Subgroup and sensitivity analyses also indicated inverse associations, although the substantial heterogeneity did not appear to decrease.

Conclusions: The results support the possibility of an adverse effect of high fluoride exposure on children's neurodevelopment. Future research should include detailed individual-level information on prenatal exposure, neurobehavioral performance, and covariates for adjustment.

Key words: fluoride, intelligence, neurotoxicity. *Environ Health Perspect* 120:1362–1368 (2012). http://dx.doi.org/10.1289/ehp.1104912 [Online 20 July 2012]

A recent report from the National Research Council (NRC 2006) concluded that adverse effects of high fluoride concentrations in drinking water may be of concern and that additional research is warranted. Fluoride may cause neurotoxicity in laboratory animals, including effects on learning and memory (Chioca et al. 2008; Mullenix et al. 1995). A recent experimental study where the rat hippocampal neurons were incubated with various concentrations (20 mg/L, 40 mg/L, and 80 mg/L) of sodium fluoride *in vitro* showed that fluoride neurotoxicity may target hippocampal neurons (Zhang M et al. 2008). Although acute fluoride poisoning may be neurotoxic to adults, most of the epidemiological information available on associations with children's neurodevelopment is from China, where fluoride generally occurs in drinking water as a natural contaminant, and of fluoride from drinking water. Such circumstances are difficult to find in many industrialized countries, because fluoride concentrations in community water are usually no higher than 1 mg/L, even when fluoride is added to water supplies as a public health measure to reduce tooth decay. Multiple epidemiological studies of developmental fluoride neurotoxicity were conducted in China because of the high fluoride concentrations that are substantially above 1 mg/L in well water in many rural communities, although microbiologically safe water has been accessible to many rural households as a result of the recent 5-year plan (2001–2005) by the Chinese government. It is projected that all rural residents will have access to safe public drinking water by 2020 (World Bank 2006). However, results of the published studies have not been widely disseminated. Four studies

Registry 2003). Fluoride exposure to the developing brain, which is much more susceptible to injury caused by toxicants than is the mature brain, may possibly lead to permanent damage (Grandjean and Landrigan 2006). In response to the recommendation of the NRC (2006), the U.S. Department of Health and Human Services (DHHS) and the U.S. EPA recently announced that DHHS is proposing to change the recommended level of fluoride in drinking water to 0.7 mg/L from the currently recommended range of 0.7–1.2 mg/L, and the U.S. EPA is reviewing the maximum amount of fluoride allowed in drinking water, which currently is set at 4.0 mg/L (U.S. EPA 2011).

To summarize the available literature, we performed a systematic review and meta-analysis of published studies on increased fluoride exposure in drinking water associated with neurodevelopmental delays. We specifically targeted studies carried out in rural China that have not been widely disseminated, thus complementing the studies that have been included in previous reviews and risk assessment reports.

Methods

Search strategy. We searched MEDLINE (National Library of Medicine, Bethesda, MD, USA; http://www.ncbi.nlm.nih.gov/pubmed), Embase (Elsevier B.V., Amsterdam, the Netherlands; http://www.embase.com), Water Resources Abstracts (Proquest, Ann Arbor, MI, USA; http://www.csa.com/factsheets/water-resources-set-c.php), and TOXNET (Toxicology Data Network; National Library of Medicine, Bethesda, MD, USA; http://toxnet.nlm.nih.gov) databases to identify studies of drinking-water fluoride and neurodevelopmental outcomes in children. In addition, we searched the China National Knowledge Infrastructure (CNKI; Beijing, China; http://www.cnki.net) database to identify studies published in Chinese journals only. Key

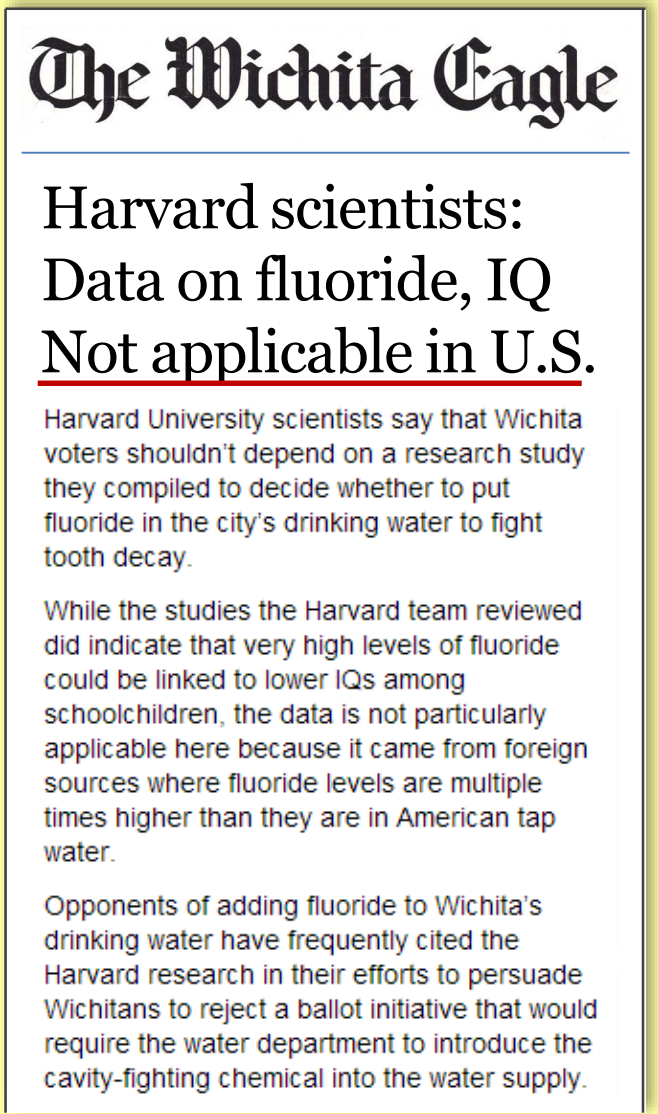
Address correspondence to A.L. Choi, Department of Environmental Health, Harvard School of Public Health, Landmark Center 3E, 401 Park Dr., Boston,

*(**Source:** Choi et al., "Developmental Fluoride Neurotoxicity: A Systematic Review and Meta-Analysis," Environmental Health Perspectives, Vol. 120, No. 10, October 2012)*

Grandjean was interviewed soon after he co-authored the 2012 review of the IQ studies.

The newspaper: Grandjean and another co-author *"noted that the fluoride levels they studied were much higher than what is found in fluoridated water in the United States"* and they recommended more research.

*(**Source:** Dion Lefler, The Wichita Eagle, Sept. 11, 2012)*



The Wichita Eagle

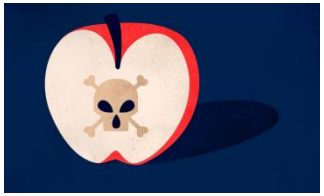
Harvard scientists: Data on fluoride, IQ Not applicable in U.S.

Harvard University scientists say that Wichita voters shouldn't depend on a research study they compiled to decide whether to put fluoride in the city's drinking water to fight tooth decay.

While the studies the Harvard team reviewed did indicate that very high levels of fluoride could be linked to lower IQs among schoolchildren, the data is not particularly applicable here because it came from foreign sources where fluoride levels are multiple times higher than they are in American tap water.

Opponents of adding fluoride to Wichita's drinking water have frequently cited the Harvard research in their efforts to persuade Wichitans to reject a ballot initiative that would require the water department to introduce the cavity-fighting chemical into the water supply.

the Atlantic



"Fluoride is very much a two-edged sword," Landrigan said. "There's no question that, at low doses, it's beneficial." Flouride has been shown to

"There's no question that, at low doses, it's beneficial."

exposure has negative effects on brain growth.

"Are the exposure levels in China comparable to what we have in our drinking water and toothpaste?" I asked.

"No, they're probably higher," Landrigan said. "In some places in China, there are naturally high levels of fluoride in the groundwater, which picks it up because it's water-soluble."

"So your advice isn't to take it out of our toothpaste?"

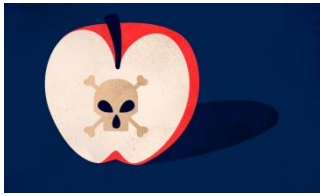
"Not at all," Landrigan said. "I think it's very good to have in toothpaste."

Dr. Philip Landrigan was a co-author of *The Lancet* article.

In this magazine interview, he recognized fluoride's value in preventing tooth decay.

*(**Source:** Excerpts from J. Hamblin, "The Toxins That Threaten Our Brains," The Atlantic, March 18, 2014)*

the Atlantic



"Fluoride is very much a two-edged sword," Landrigan said. "There's no question that, at low doses, it's beneficial." Flouride has been shown to prevent dental cavities and aid skeletal growth. At higher levels, though, it causes tooth and bone lesions. The epidemiologic studies cited by Grandjean and Landrigan, which came from China, imply that high fluoride exposure has negative effects on brain growth.

"Are the exposure levels in China comparable to what we have in our drinking water and toothpaste?" I asked.

"No, they're probably higher," Landrigan said. "In some places in China, there are naturally high levels of fluoride in the groundwater, which picks it up because it's water-soluble."

"So your advice isn't to take it out of our toothpaste?"

"Not at all," Landrigan said. "I think it's very good to have in toothpaste."

He distinguished between the exposure levels in the U.S. and the high natural levels that are common in many areas of China.

*(**Source:** Excerpts from J. Hamblin, "The Toxins That Threaten Our Brains," The Atlantic, March 18, 2014)*

Assessing the Chinese IQ studies:

***Dr. Steven Novella**, assistant professor of neurology at the Yale School of Medicine*

"There are many rural areas of China that have naturally high levels of fluoride in the well water. The studies were largely looking at this exposure."

*(**Source:** S. Novella, "Anti-Fluoride Propaganda as News," NeuroLogica, July 27, 2012; one typographical error was corrected in Novella's original blog post.)*

Assessing the Chinese IQ studies:

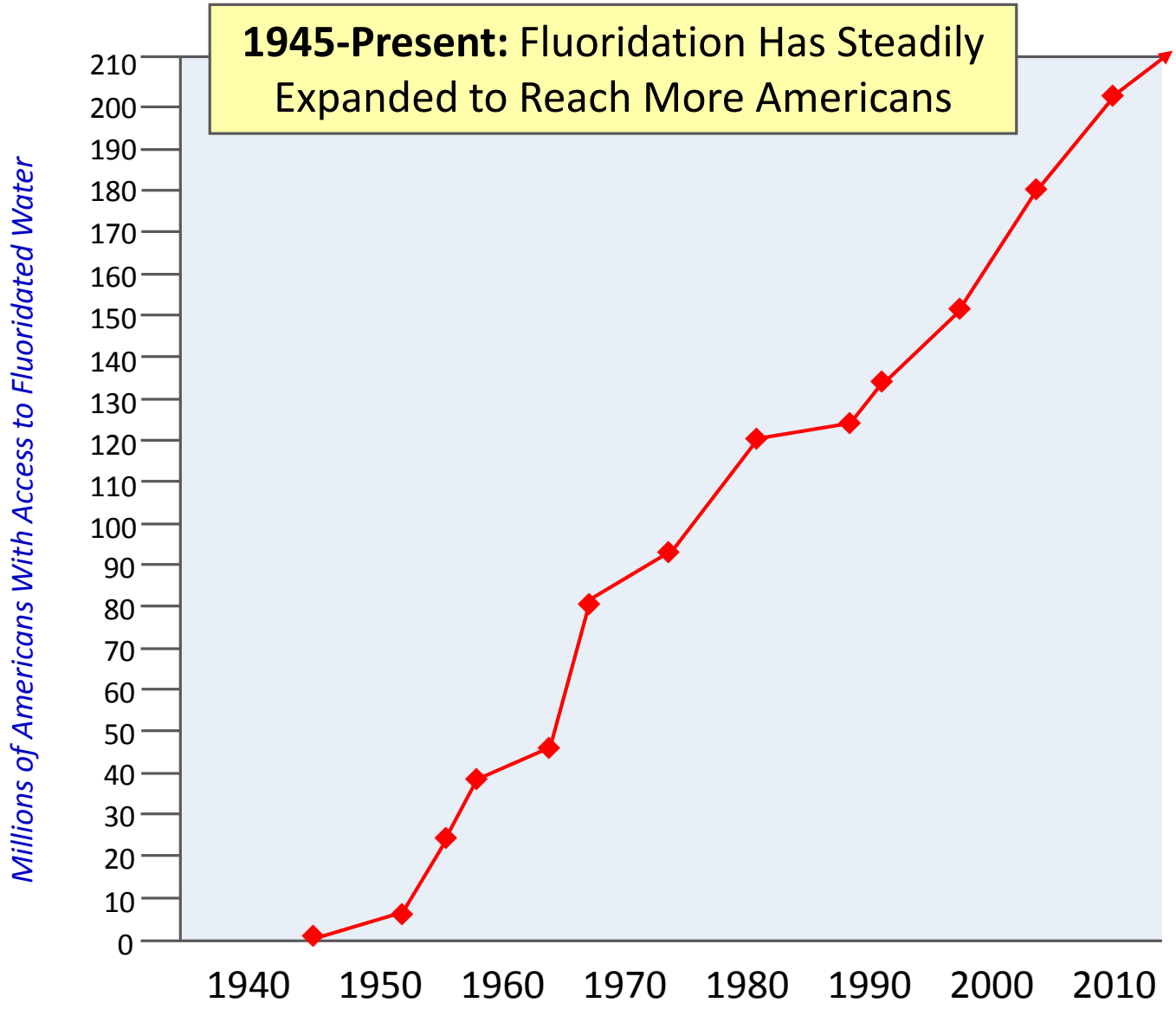
***Dr. Steven Novella**, assistant professor of neurology at the Yale School of Medicine*

"There are many rural areas of China that have naturally high levels of fluoride in the well water. The studies were largely looking at this exposure."

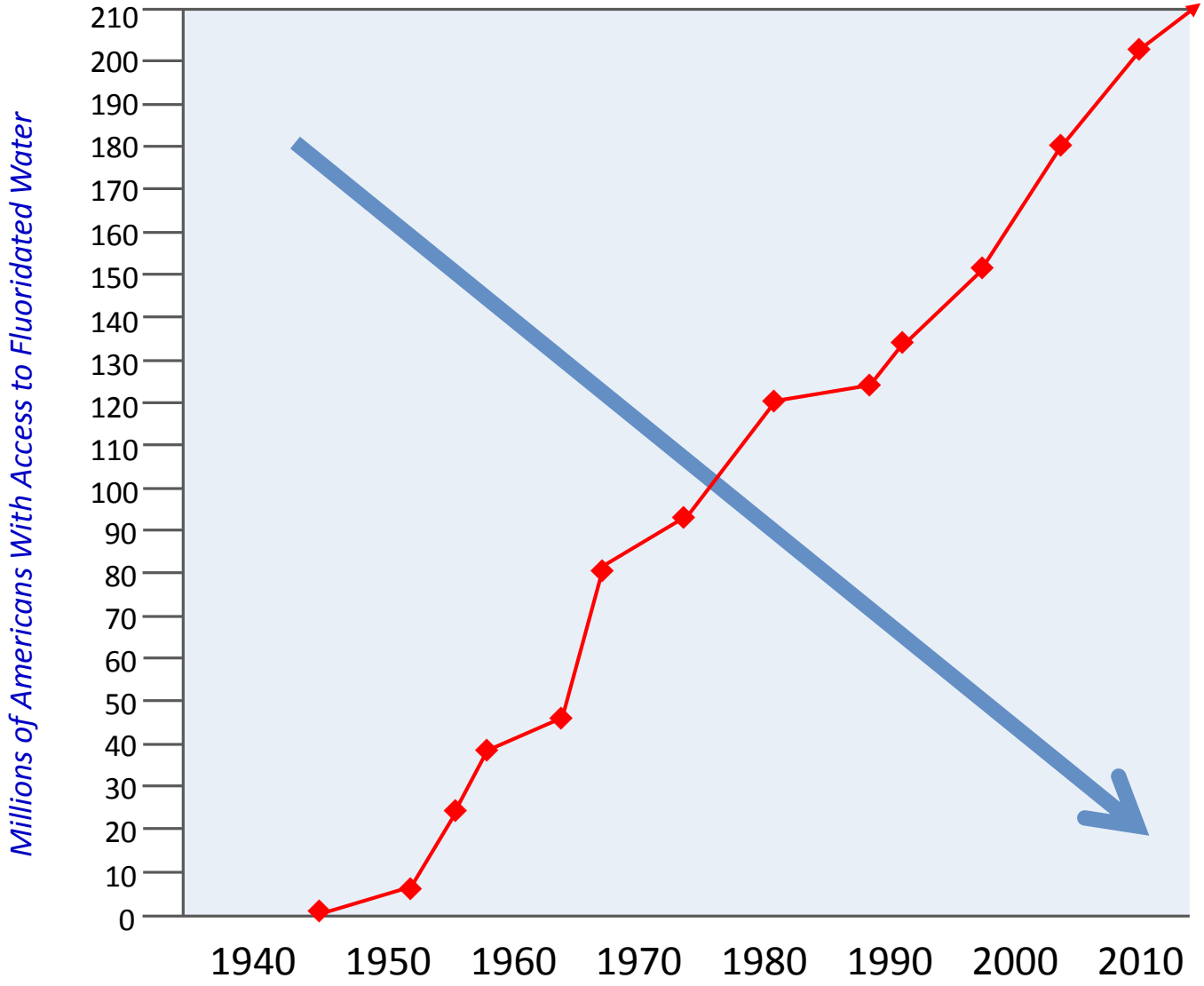
"But even taken at face value [these studies] **do not** indicate any association between lower IQ and the fluoride levels added to drinking water in the U.S."

*(**Source:** S. Novella, "Anti-Fluoride Propaganda as News," NeuroLogica, July 27, 2012; boldface was used to emphasize the conclusion Novella makes in his 2nd quote, and one typographical error was corrected in Novella's original blog post.)*

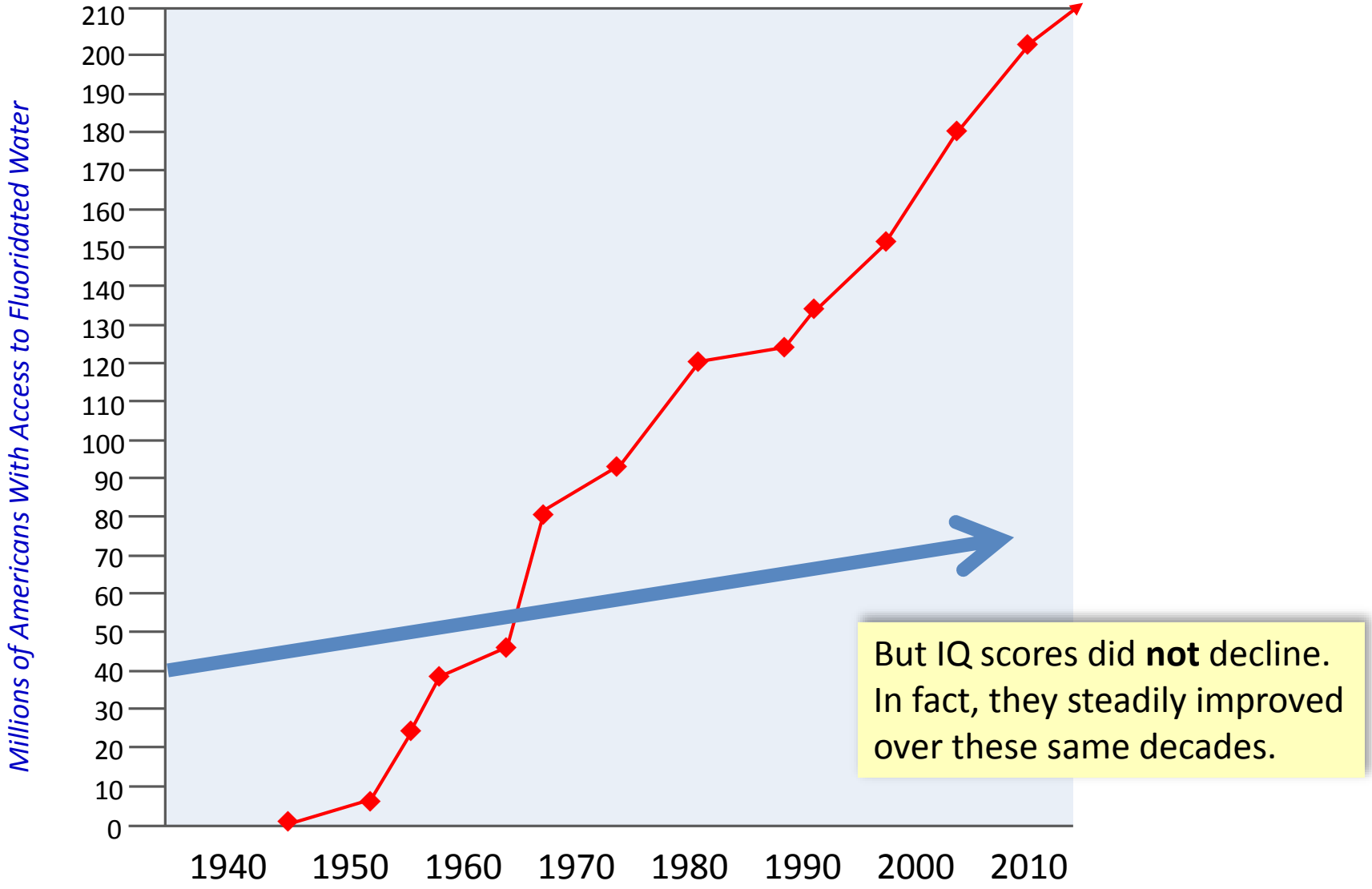
2. Does the U.S. Trend of IQ Scores Support Claims of a Fluoride Link?



*(**Source:** Fluoridation data is from the Centers for Disease Control and Prevention, "Reference Statistics on Water Fluoridation Status," updated November 22, 2013 and accessible at cdc.gov.)*



If fluoridated water were linked to low IQ scores, the average IQ score in the U.S. likely would have **fallen steadily** over these same decades.


Millions of Americans With Access to Fluoridated Water
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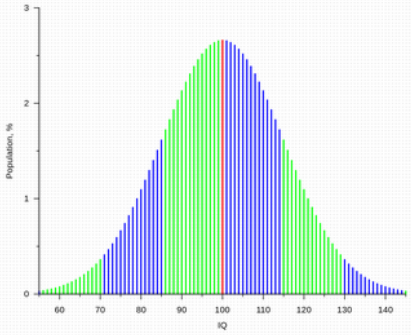
1960
1970
1980
1990
2000
2010
But IQ scores did **not** decline.
In fact, they steadily improved
over these same decades.

Dartmouth Undergraduate Journal of Science

Is Our Collective IQ Increasing?

Posted by Na Eun Oh '16 / In News, Questions / February 13, 2013



Psychologists revise the IQ test every couple years in order to maintain an average score of 100. Source: Damato, Alessio and Mikhail Ryazanov. Creative Commons.

The Flynn Effect is the observation that intelligence quotient (IQ) test scores have, on average, increased significantly from the 1930s to the present day.

IQ tests are intended to have an average score of 100. However, psychologists revise the test every couple years in order to maintain this numerical average. Almost invariably, new samples of test takers record average scores of well over 100 when administered an older version of the IQ test (1).

Richard Zynn was actually the first to note this effect when he observed the pattern in Japanese people in 1982 (2). However, the trend bears the name of James Flynn, as he documented and publicized the effect

The U.S. population have shown an increase of about 3 points in the average IQ score every decade. The Flynn Effect seems to be more pronounced in populations that are typically considered to be from "more developed" areas, such as in Scandinavia. Recent studies show that the Flynn effect may soon fail to hold for a few developed nations. If this trend continues, and nations with lower average IQ scores continue to show improvement in scores according to the Flynn effect, then discrepancies between average IQ scores among different nations could eventually disappear (3).

Researchers debate whether increases in IQ test scores really correlate to an increase in intelligence, or

Since the 1930s, Americans "have shown **an increase of about 3 points** in the average IQ score **every decade**."

(***Source:*** *Na Eun Oh , "Is Our Collective IQ Increasing?" Dartmouth Undergraduate Journal of Science, February 13, 2013)*

3. Is There Any Research Planned to Study the Alleged IQ-Fluoride Link?

Actually, a new study has been published by the American Journal of Public Health (AJPH)

"No significant differences in IQ because of fluoride exposure were noted. These findings held after adjusting for potential confounding variables …"

*(**Source:** J.M. Broadbent et al., "Community Water Fluoridation and Intelligence: Prospective Study in New Zealand," American Journal of Public Health, 2014.)*

American Journal of PUBLIC HEALTH

Community Water Fluoridation and Intelligence: Prospective Study in New Zealand

Jonathan M. Broadbent, PhD, W. Murray Thomson, BSc, PhD, Sandhya Ramrakha, PhD, Terrie E. Moffitt, PhD, Jiaxu Zeng, PhD, Lyndie A. Foster Page, BSc, PhD, and Richie Poulton, PhD

Objectives. This study aimed to clarify the relationship between community water fluoridation (CWF) and IQ.

Methods. We conducted a prospective study of a general population sample of those born in Dunedin, New Zealand, between April 1, 1972, and March 30, 1973 (95.4% retention of cohort after 38 years of prospective follow-up). Residence in a CWF area, use of fluoride dentifrice and intake of 0.5-milligram fluoride tablets were assessed in early life (prior to age 5 years); we assessed IQ repeatedly between ages 7 to 13 years and at age 38 years.

Results. No significant differences in IQ because of fluoride exposure were noted. These findings held after adjusting for potential confounding variables, including sex, socioeconomic status, breastfeeding, and birth weight (as well as educational attainment for adult IQ outcomes).

Conclusions. These findings do not support the assertion that fluoride in the context of CWF programs is neurotoxic. Associations between very high fluoride exposure and low IQ reported in previous studies may have been affected by confounding, particularly by urban or rural status. (*Am J Public Health.* Published online ahead of print May 15, 2014: e1–e5. doi:10.2105/AJPH.2013.301857)

Community water fluoridation (CWF) is a cost-effective,[1,2] safe,[3] and environmentally friendly[4] means of reducing dental caries rates[3] and social inequalities.[5] However, CWF has recently been criticized as a cause of IQ deficits among children,[6] despite a lack of evidence to support that claim. This claim was considered pivotal in the recent rejection of CWF by voters in Portland, Oregon,[7] and by local government politicians in Hamilton, New Zealand. It is likely that such claims may continue to be lobbied against CWF worldwide.

Since the 1960s, about half of New Zealand's population has had access to CWF. Nationally, average fluoride intakes remain below the adequate intake level for dental caries protection, and CWF schemes are only 1 (albeit important) source of exposure to fluoride.[8] The New Zealand Ministry of Health supports CWF in policy, but implementation of that policy is decided upon and undertaken by Territorial Local Authorities (local government) mandated[9] to supply water services to people in their areas (and improve the health of their populations).

Hamilton city (New Zealand's fifth-largest metropolitan area) has had CWF since 1966 and has recently become a target for CWF opponents. Despite a binding 2006 referendum that showed 70% support for CWF among voting Hamiltonians,[10] Hamilton's City Council chose to relitigate CWF and held a tribunal on fluoridation in early 2013. The councilors voted to cease CWF, leading to an outcry from members of the public and health officials. A new referendum was then held (accompanying a local government election), which again and voted in February 2014 to reintroduce CWF to Hamilton in April 2014.

In the tribunal submissions and hearings, CWF opponents relied heavily on 2 studies as the basis for linking CWF with IQ deficits. The first was a 2006 review article in which fluoride was included in a list of "compounds known to cause neurotoxicity in man"[12p2160]; however, the text of the same article stated that this had been inconclusive.[12p2173] The second study was a 2012 meta-analysis that compiled the findings of studies from China and Iran, which related IQ and naturally occurring fluoride in water and other sources of exposure, but none were in the context of CWF. The meta-analysis conceded that the included studies were of low quality and that potential confounders were not investigated.[13] Furthermore, the fluoride

a press release issued by the authors in September 2012 had to emphasize the fact that their research was irrelevant to CWF.[14]

The EU Scientific Committee on Health and Environmental Risks has reported on these fluoride–IQ studies and found them to be of simplistic methodological design with no (or at best little) control for confounders such as nutrition, exposure to iodine or lead, or socioeconomic status.[15] A New Zealand review also considered many of the same studies and found them to be of low quality and with a high risk of bias.[16]

Despite these problems, several public anti-CWF submissions that were made to the Hamilton City Council Fluoridation Tribunal cited these studies; for example, one submission stated "recent research findings show that fluoride can be toxic to children's brain development"[17];

Why the AJPH study is much more reliable than the Asian studies:

- It measured intelligence multiple times over a much wider span of years.
- It used a consistent test to measure intelligence in all of those who were studied.
- It took careful steps to ensure that other factors did not distort the study results.

*(**Source:** J.M. Broadbent et al., "Community Water Fluoridation and Intelligence: Prospective Study in New Zealand," American Journal of Public Health, 2014.)*

American Journal of PUBLIC HEALTH

Community Water Fluoridation and Intelligence: Prospective Study in New Zealand

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In the tribunal submissions and hearings, CWF opponents relied heavily on 2 studies as the basis for linking CWF with IQ deficits. The first was a 2006 review article in which fluoride was included in a list of "compounds known to cause neurotoxicity in man"[12(p2169)]; however, the text of the same article stated that this had been inconclusive.[12(p2173)] The second study was a 2012 meta-analysis that compiled the findings of studies from China and Iran, which related IQ and naturally occurring fluoride in water and other sources of exposure, but none were in the context of CWF. The meta-analysis conceded that the included studies were of low quality and that potential confounders were not investigated.[13] Furthermore, the fluoride

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What we know:

The original IQ studies have significant flaws. They were designed poorly and did not adequately account for other factors (such as lead, arsenic and parents' educational levels) that are known to affect IQ scores.

New peer-reviewed research shows no link between fluoridated water and IQ scores. This new study was designed and carried out in a way that makes it much more reliable than the Asian studies that anti-fluoride activists cite.

For accurate information about fluoridation, you can visit **iLikeMyTeeth.org/fluoridation**

life is better WITH TEETH