Water Fluoridation:
The Neurotoxicity of Fluoride

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Calgary, Oct 29, 2019

Outline

1) Fluoride's neurotoxicity –body of evidence
2) The Bashash et al., 2017 study
3) The significance of 5 IQ point drop at the population level
4) Green et al., 2019 study
5) Factors affecting toxicity
6) Biological plausibility of fluoride lowering IQ
7) Mental development of the fetus is tied to the thyroid status of the mother

1. The body of evidence on fluoride's neurotoxicity

The body of evidence

- Over 200 animal studies show that prolonged exposure to varying levels of fluoride can damage the brain, particularly when coupled with an iodine deficiency, or aluminum excess;
- 61 human studies link moderately high fluoride exposures with reduced intelligence;
- 45 animal studies report that mice or rats ingesting fluoride have an impaired capacity to learn and/or remember;

The body of evidence (cont.)

- 12 studies (7 human, 5 animal) link fluoride with neurobehavioral deficits (e.g., impaired visual-spatial organization);
- 3 human studies link fluoride exposure with impaired fetal brain development.
- 6 Mother-Offspring studies link certain levels of fluoride in the urine of pregnant women to reduced IQ in their offspring

2. The Bashash study, EHP, Sept, 2017

- On Sept 19, 2017, the Bashash et al., 2017 study was published. This was the most important Fluoride-IQ study published up to that date.

The Bashash et al., 2017 study

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RESEARCH | SEPTEMBER 2017 | VOLUME 125 | ISSUE 9

Altmetric 143

Environ Health Perspect; DOI:10.1289/EHP655

Prenatal Fluoride Exposure and Cognitive Outcomes in Children at 4 and 6–12 Years of Age in Mexico

Morteza Bashash,[1] Deena Thomas,[2] Howard Hu,[1] E. Angeles Martinez-Mier,[3] Brisa N. Sanchez,[2] Niladri Basu,[4] Karen E. Peterson,[2,5,6] Adrienne S. Ettinger,[2] Robert Wright,[7] Zhenzhen Zhang,[2] Yun Liu,[2] Lourdes Schnaas,[8] Adriana Mercado-García,[9] Martha María Téllez-Rojo,[9] and Mauricio Hernández-Avila[9]

The Bashash et al., 2017 study

- This was a 12-year multi-million dollar study – funded by EPA, NIH and NIEHS.
- Authors came from many prestigious institutions (e.g. Universities of Toronto, McGill, Harvard, Indiana, Michigan, Mount Sinai and more)

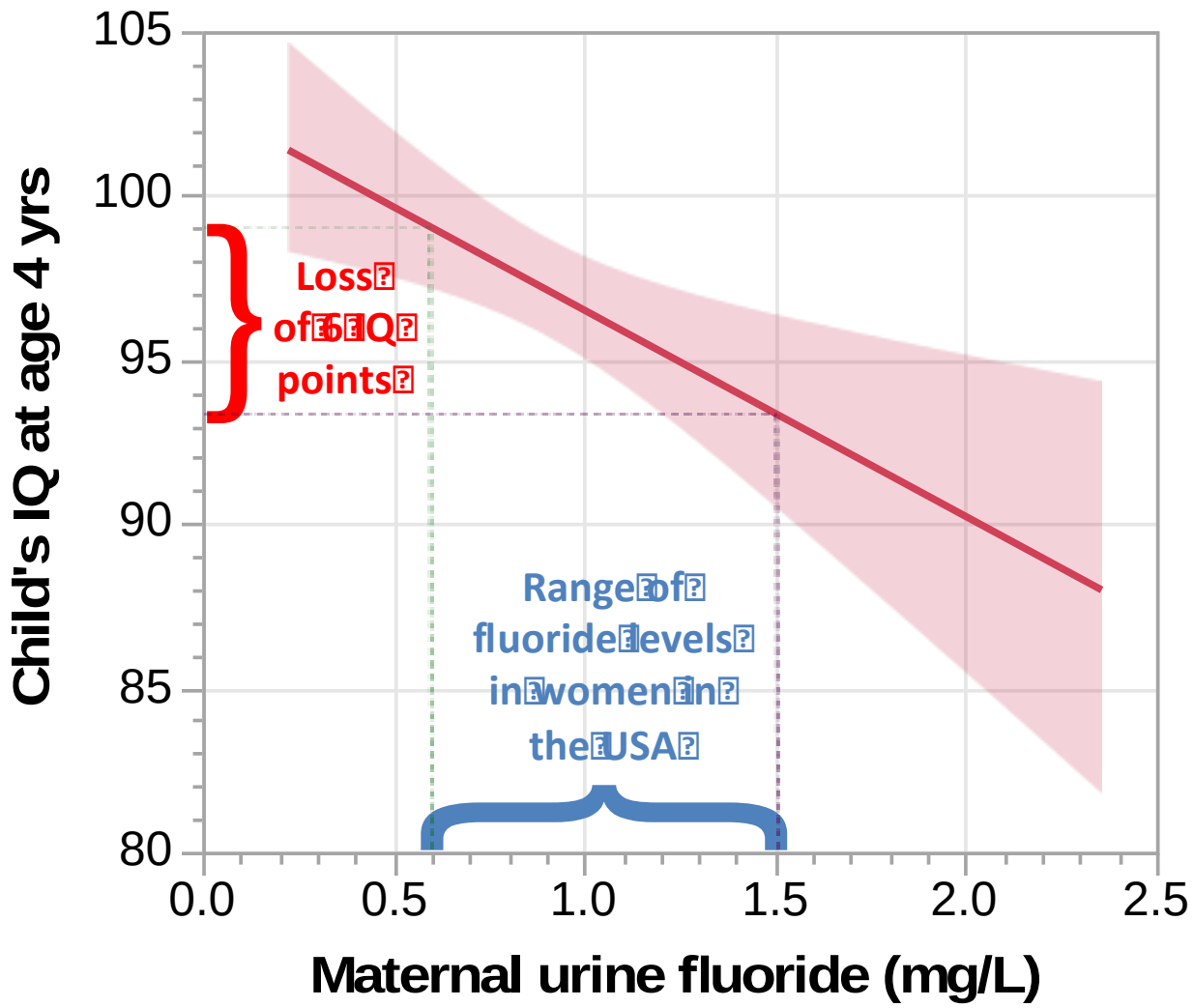
The study

- Examined approximately 300 mother-offspring pairs.
- Both exposure and outcomes were determined on an individual basis.
- The mothers' exposure to fluoride during pregnancy was determined via analysis of their urine (a measure of total fluoride exposure regardless of source).

The study results

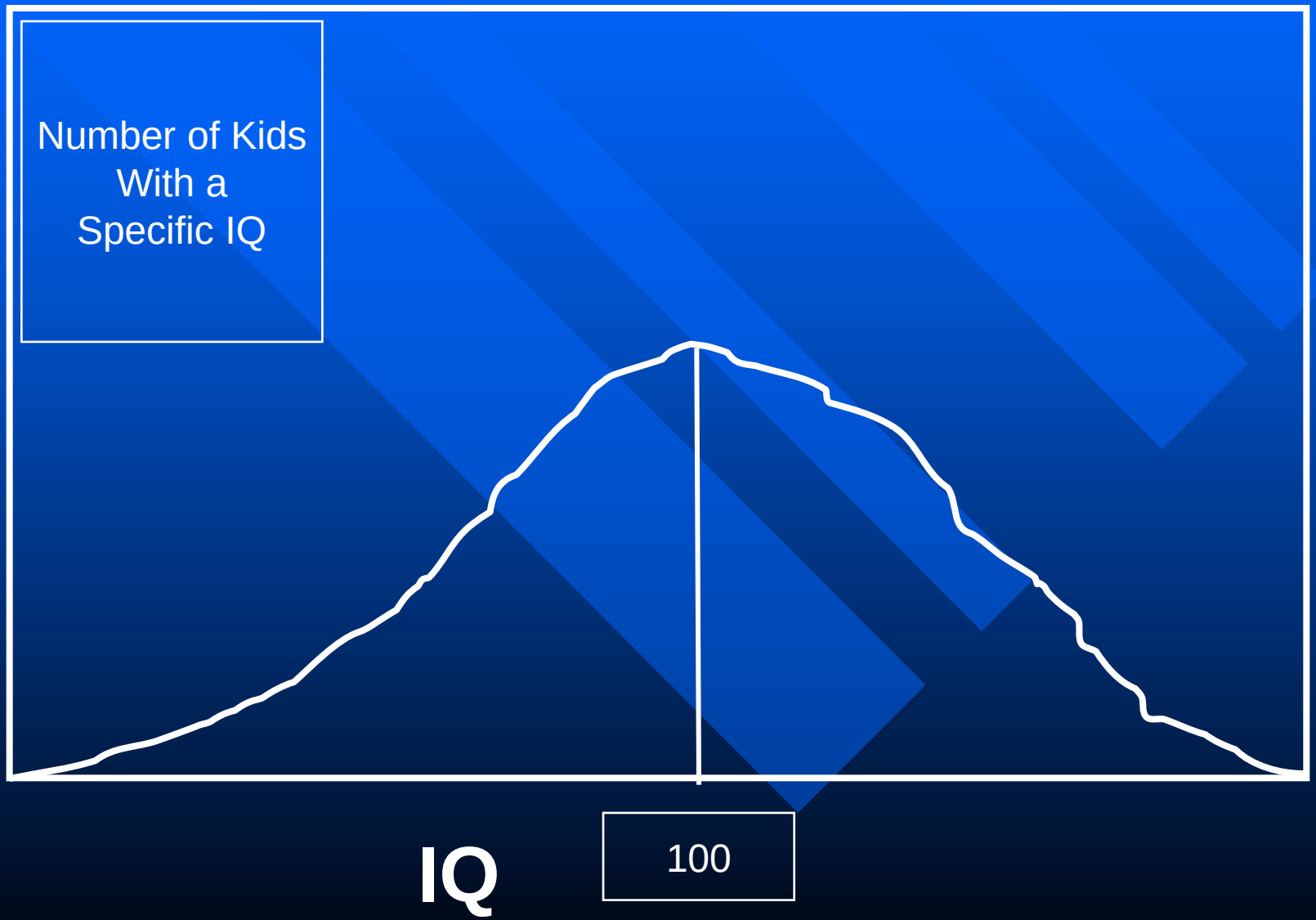
- The IQ of the women's children was measured at age 4 and again at 6-12 years
- For every 1 mg/L increase in the mother's urine F level the children lost an average of ***5-6 IQ points***, a very large effect.

Relationship between fluoride and IQ found in new study (Bashash et al. 2017)

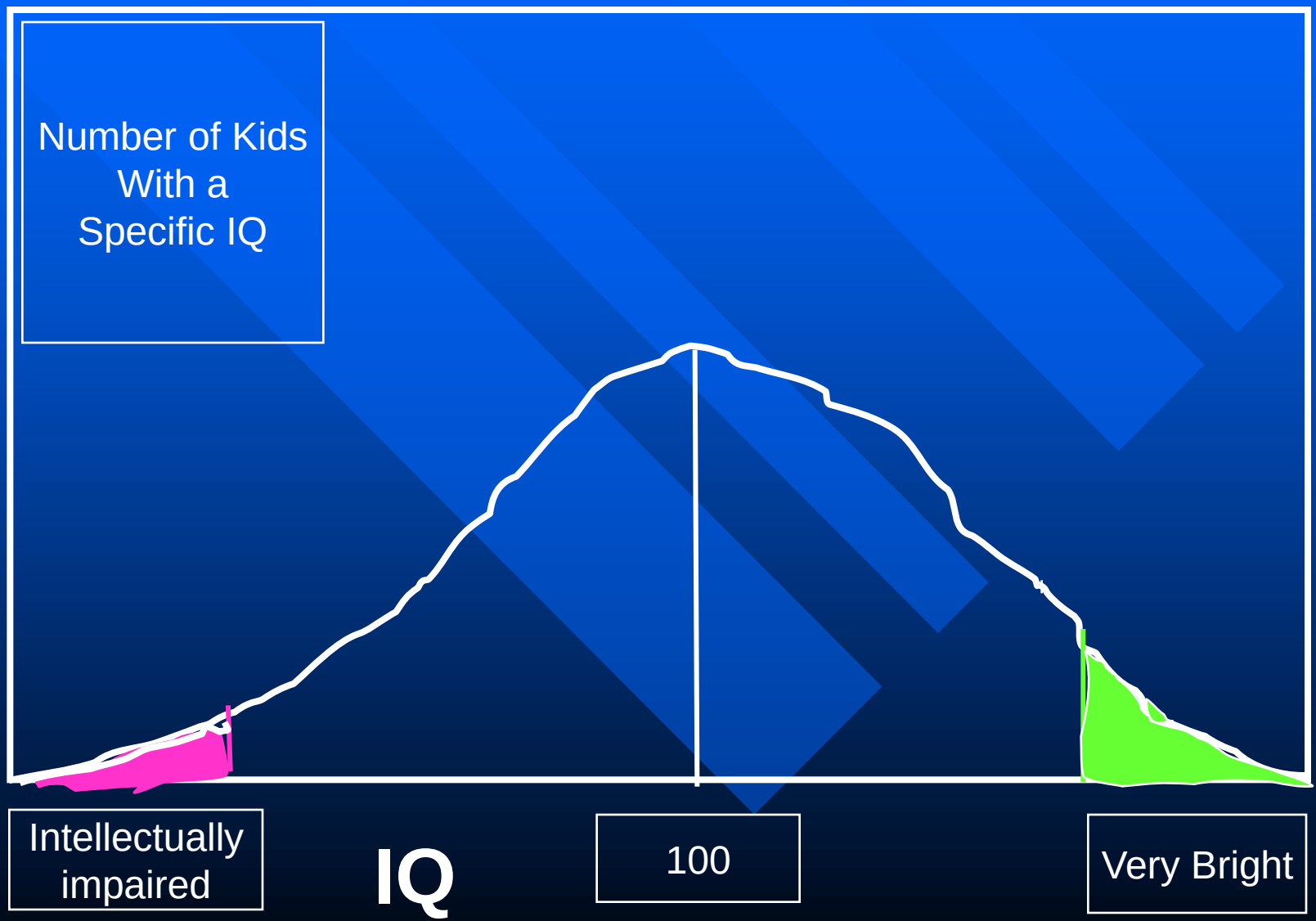


3. Why a loss of 5 IQ points is so serious at the population level

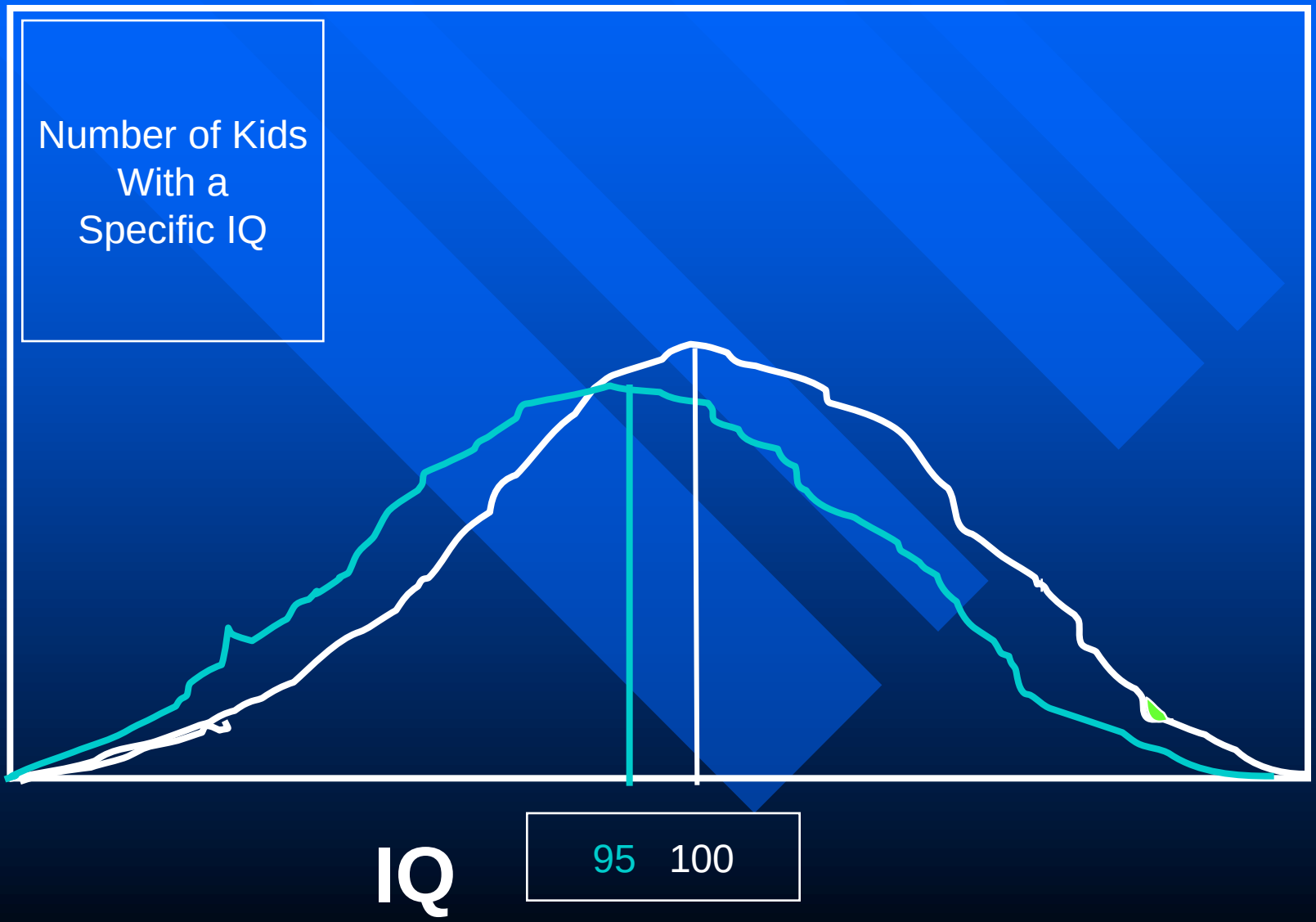
IQ and population



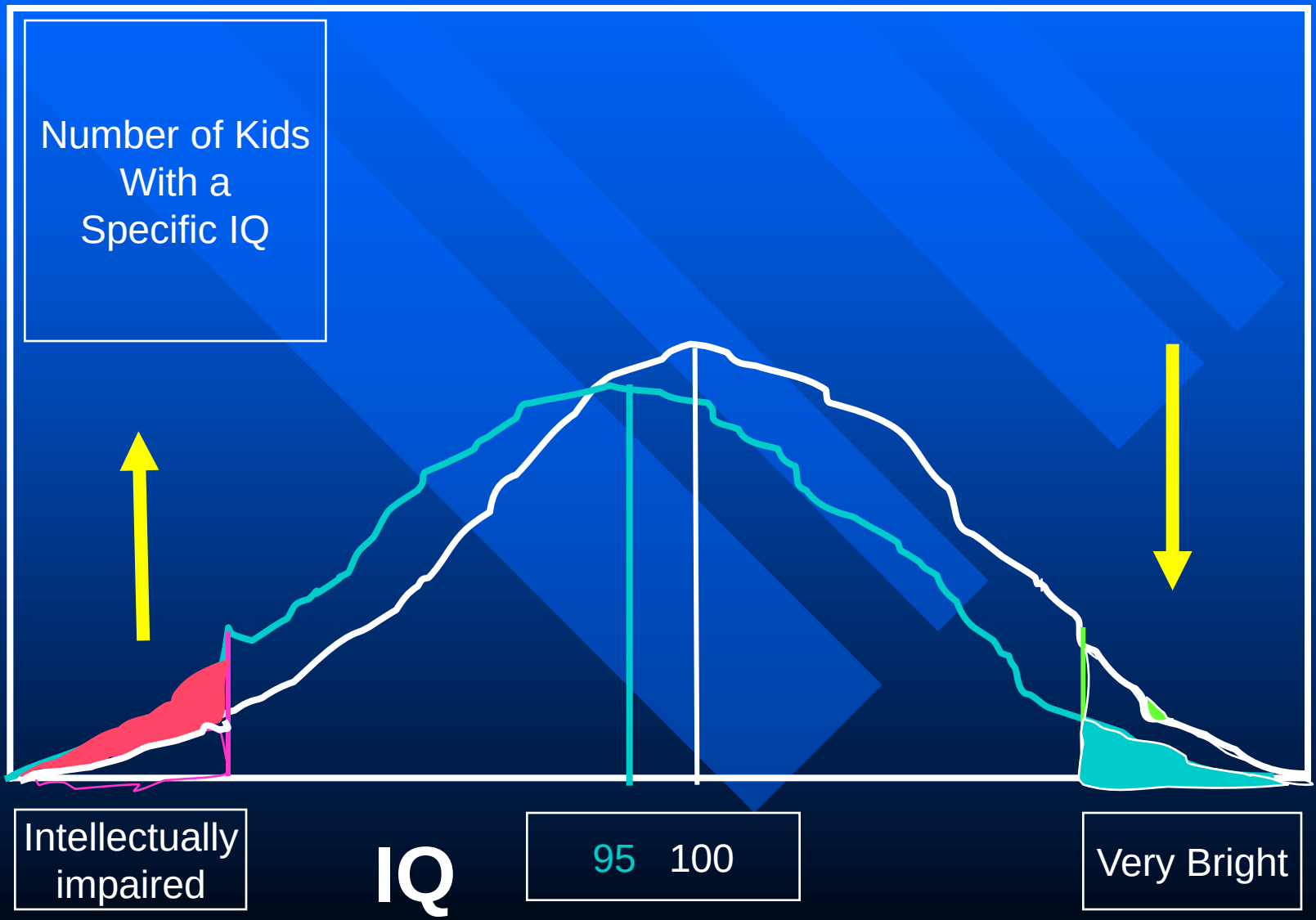
IQ and population



IQ and population



IQ and population



4. JAMA Pediatrics study (Green et al., 2019)

Green et al., 2019

This study, *Association Between Maternal Fluoride Exposure During Pregnancy and IQ Scores in Offspring in Canada.* was funded by the Canadian government and the U.S. National Institute of Environmental Health Sciences.

The study essentially replicated the Bashash study.

Green et al., 2019

The study followed 512 mother-child pairs from six major Canadian cities. As in the Bashash et al. 2017 study the researchers measured fluoride in women's urine samples during pregnancy. They found that a 1 mg per liter increase in concentration of fluoride in mothers' urine was associated with a 4.5 point decrease in IQ among boys, though not girls.

Green et al., 2019

The researchers also calculated the mother's fluoride exposure based on how much was in the city's water supply and how much women recalled drinking. Using this exposure method they found lower IQs in both boys and girls: A 1 mg increase per day was associated with a 3.7-point IQ deficit among both genders.

Green et al., 2019

The editors of JAMA Pediatrics gave this study special treatment. It was accompanied by:

- an editor's note,
- a podcast featuring the journal's editors, and
- an editorial from world-renowned neurotoxicity expert Dr. David Bellinger.

Green et al., 2019

The editor's note:

This decision to publish this article was not easy. Given the nature of the findings and their potential implications, we subjected it to additional scrutiny… Publishing it serves as testament to the fact that JAMA Pediatrics is committed to disseminating the best science based entirely on the rigor of the methods and the soundness of the hypotheses tested, regardless of how contentious the results may be…This study is neither the first, nor will it be the last, to test the association between prenatal fluoride exposure and cognitive development…

5. Factors which affect the toxicity of a substance

Toxicity depends on

a) **Total dose in (mg/day) from all sources**

b) **Stage of life when exposed.**

- **For a given dose**, toxicity (toxic effect) is
- worse for a **child** than an **adult**;
- worse for an **infant** than a **child** and
- worse for a **fetus** than an **infant.**

Please note the difference between concentration and dose

Concentration is measured in mg/Liter

Dose is measured in mg/day and depends upon a) how many of liters that are drunk per day and b) the mg/day consumed from other sources

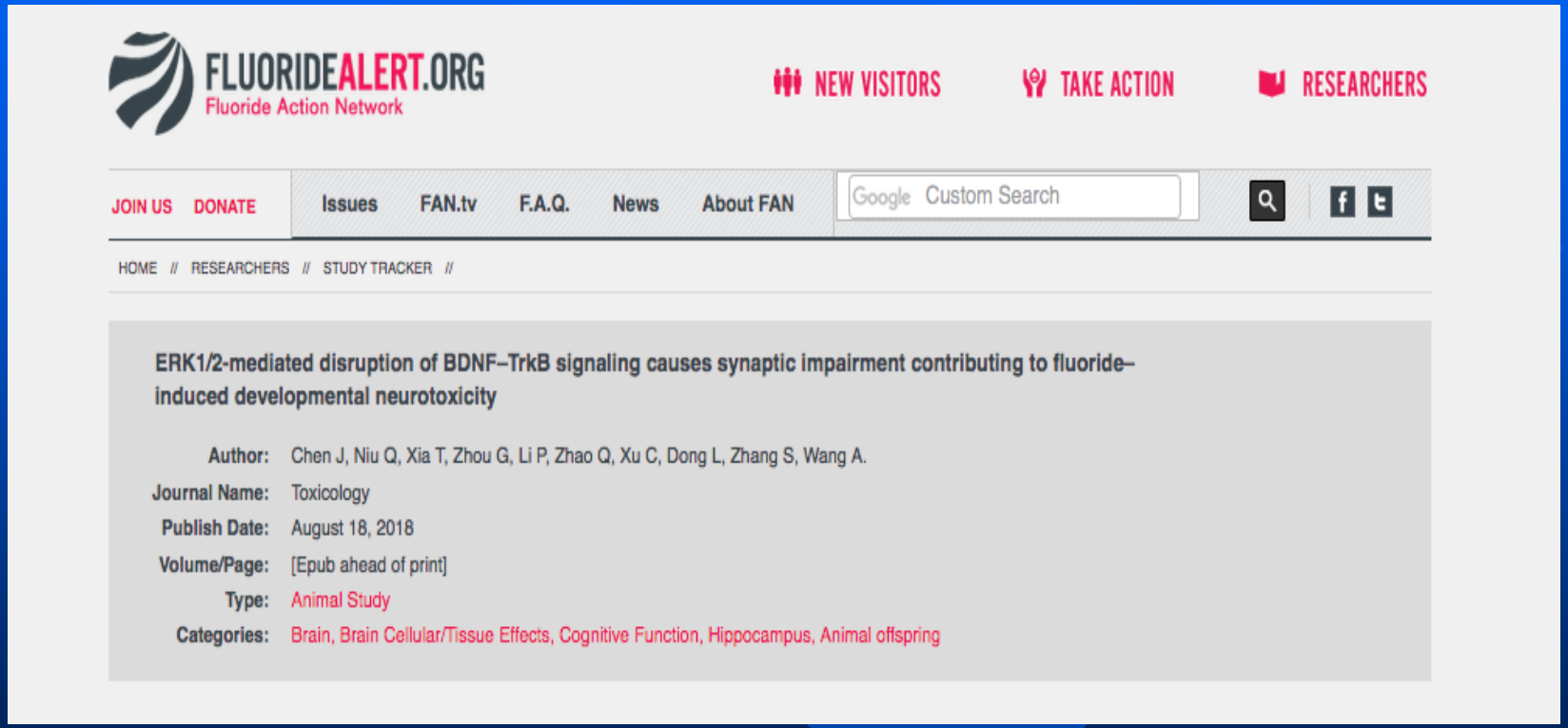
5. The biological plausibility of the fluoride-IQ findings

Biological plausibility

Animal studies have shown that many aspects of brain function are impacted by fluoride exposure. These include:

- reduction in nicotinic receptors,
- reduction in protein content,
- alterations in protein expression,
- damage to the hippocampus,
- inhibition of cholinesterase activities
- increase in oxidative stress, and
- neuronal degeneration.

Chen et al., 2018



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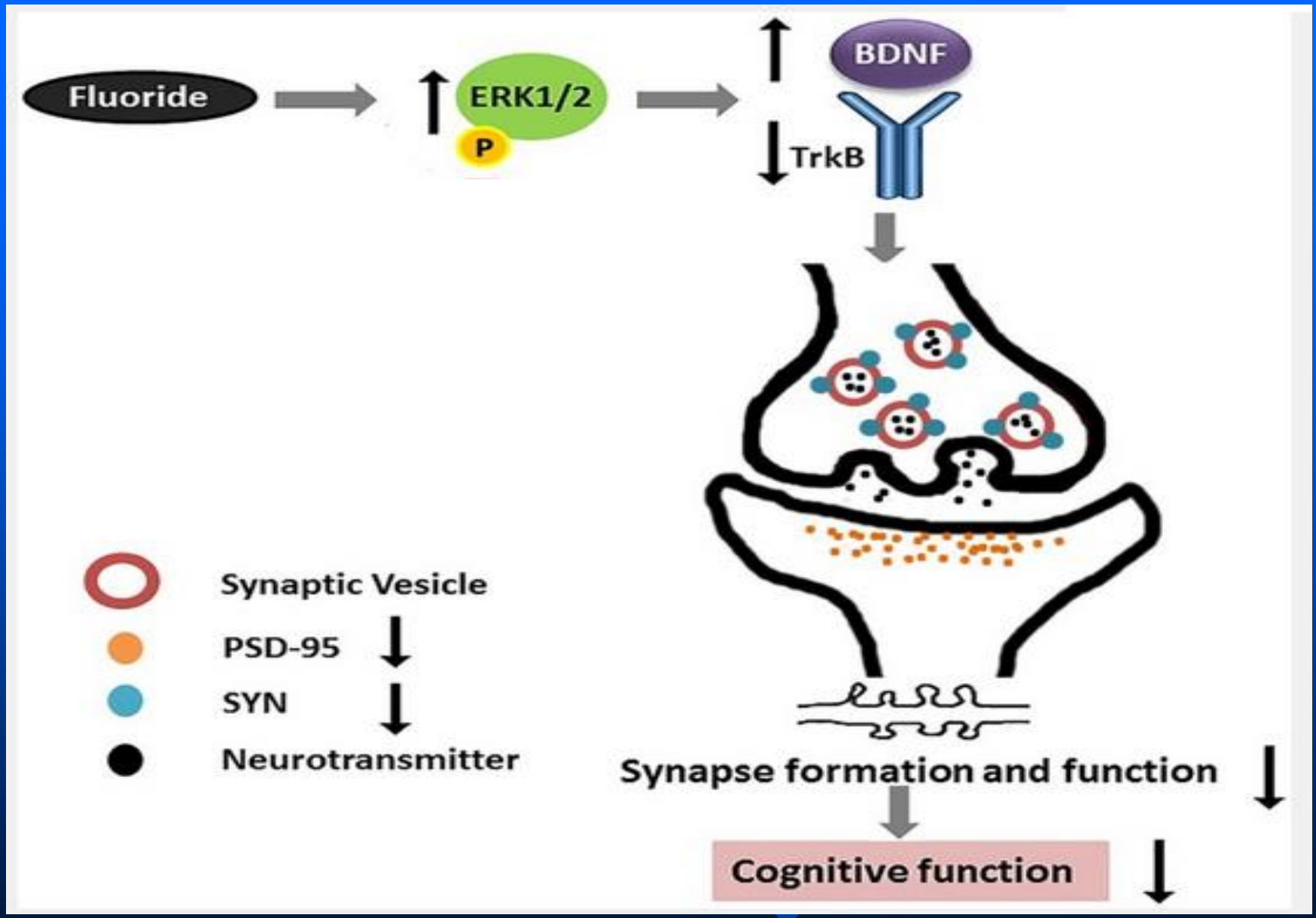
ERK1/2-mediated disruption of BDNF–TrkB signaling causes synaptic impairment contributing to fluoride–induced developmental neurotoxicity

Author: Chen J, Niu Q, Xia T, Zhou G, Li P, Zhao Q, Xu C, Dong L, Zhang S, Wang A.
Journal Name: Toxicology
Publish Date: August 18, 2018
Volume/Page: [Epub ahead of print]
Type: Animal Study
Categories: Brain, Brain Cellular/Tissue Effects, Cognitive Function, Hippocampus, Animal offspring

Chen et al. offer a possible biochemical mechanism for how fluoride damages neurodevelopment


Fluoride
ERK1/2
P
BDNF
TrkB
Synaptic Vesicle
PSD-95
SYN
Neurotransmitter
Synapse formation and function
Cognitive function

6. The importance of the thyroid status of the mother and the IQ of offspring

The fetus and thyroid function

When the fetus comes into existence it has no thyroid gland. It is totally dependent on the mother's production of thyroid hormones for the regulation of its brain development and other tissues.

It is well known that a woman with lowered thyroid function is likely to produce a child with lowered IQ.

Malin et al., 2018

Found that fluoride exposure increased TSH levels (a biomarker of hypothyroidism – underactive thyroid) in those already compromised by low iodine intake

A pregnant woman with lowered thyroid function has a greater risk of producing a child with lowered IQ

Conclusions

1. For any community to continue fluoridation with all these studies - including several US-government funded studies - on the table is reckless.

2. The risks to fetal and infant brain development far outweigh any benefit to teeth from ingestion of fluoride during fetal and infant development.

3.Other countries have shown that these benefits can be secured by other means