Environmental Toxicants and Autism: How to Safeguard Your Children.

Stephanie Seneff
AutismOne
May 20, 2015
“It's difficult to get a man to understand something if his salary depends on his not understanding it.”

Upton Sinclair
A Frightening Trend*

Exponential Growth!

Almost 1.5% of US children are now diagnosed with autism, according to data from 11 regions in the United States.

Percentage of children with Autism in the US

![Graph showing the percentage of children with Autism in the US over time. The graph indicates a steep rise in the percentage, reaching 50% by 2032.](image-url)
A linear extension of the trend line says that 1 in 2 children born in 2032 will end up on the autism spectrum.
Last Year’s Talk

Video (no slides):
http://www.autismone.org/content/autism-explained-synergistic-poisoning-aluminum-and-glyphosate-stephanie-seneff

Slides:
http://people.csail.mit.edu/seneff/glyphosate/Seneff_AutismOne_2014.pptx
Outline

• Glyphosate
• Toxic Food
• Glyphosate and Folic Acid
• Glyphosate, Oxalate and Anemia
• How to Protect Yourself and Your Family
• Summary
Glyphosate
Autism Prevalence: 6 year olds

*Plot provided by Nancy Swanson, with permission

Data sources: autism: US Department of Education; Glyphosate: US Department of Agriculture
Adoption of “Roundup Ready” Crops*

Figure 1. Adoption of GE crops in US.

Is Glyphosate Toxic?

• Monsanto has argued that glyphosate is harmless to humans because our cells don’t have the shikimate pathway, which it inhibits

• However, our gut bacteria DO have this pathway
  – We depend upon them to supply us with essential amino acids (among many other things)

• Other ingredients in Roundup greatly increase glyphosate’s toxic effects

• Insidious effects of glyphosate accumulate over time
  – Most studies are too short to detect damage
Main Toxic Effects of Glyphosate*

• Kills beneficial gut bacteria and allows pathogens to overgrow
• Interferes with function of cytochrome P450 (CYP) enzymes
• Chelates important minerals (iron, cobalt, manganese, etc.)
• Interferes with synthesis of aromatic amino acids and methionine
  — Leads to shortages in critical neurotransmitters
• Disrupts sulfate synthesis and sulfate transport

*Samsel and Seneff, Entropy 2013, 15, 1416-1463
The Enhancing Effect of Adjuvants*

“Adjuvants in pesticides are generally declared as inerts, and for this reason they are not tested in long-term regulatory experiments. It is thus very surprising that they amplify *up to 1000 times* the toxicity of their APs [Active Principles] in 100% of the cases where they are indicated to be present by the manufacturer.”

Some Biomarkers for Autism

- Disrupted gut bacteria; inflammatory bowel
- Low serum sulfate
- Methionine deficiency
- Serotonin and melatonin deficiency
- Defective aromatase
- Excess serum oxalate
- Urinary p-cresol
- Mitochondrial disorder
- Glutamate toxicity in the brain
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These can all be explained as potential effects of glyphosate on biological systems
Original Article

Glyphosate, pathways to modern diseases III: Manganese, neurological diseases, and associated pathologies

Anthony Samsel, Stephanie Seneff

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*Corresponding author

Received: 22 September 14   Accepted: 21 January 15   Published: 24 March 15
Manganese and Autism*

- Glyphosate chelates manganese

- Manganese disruption leads to:
  - Disrupted gut bacteria → anxiety
  - Impaired dopamine synthesis → thyroid disease
  - Glutamate and ammonium toxicity in the brain
  - Mitochondrial damage
  - Impaired bone development and osteoporosis
  - Impaired development of perineuronal nets

- Many of these pathologies are associated with autism

It’s not just deficiency!

Too much manganese in the brain stem

Too little manganese in the cortex

Vagus Nerve

Bile acids
Balancing the Scales

Glyphosate disrupts the body’s ability to distribute the minerals safely: Everybody walks a tight rope between deficiency and toxicity

Autism

Alzheimer’s

ADHD

Parkinson’s
Glyphosate and Vaccines*,**, 

- Vaccines containing glutamate (MMR) and aluminum (Hep-B, DTaP) have been linked to autism
- Glyphosate enhances transfer of aluminum across the blood brain barrier and enhances uptake of aluminum into cells
- Glyphosate prevents detoxification of glutamate due to manganese deficiency

*A Samsel and S Seneff, Surgical Neurology International 2015, 6:45.
**S Seneff et al., Agricultural Sciences Jan. 12, 2015, 6, 42-70.
Varivax and Hepatitis A Vaccines: Linked to Autism*

Recapitulation

• Monsanto claims glyphosate is nontoxic to humans, but this is not true
  – Gut microbes are damaged by shikimate pathway disruption
  – Adjuvants increase toxicity to plants but glyphosate is usually studied in isolation
• Many features of autism can be explained by glyphosate's known effects
• Impaired mineral management is key
  – Disrupted manganese and iron homeostasis
  – Aluminum and glutamate toxicity
  – These effects can explain increased frequency of severe adverse reactions to vaccines
Toxic Food
Health Care Costs: US

Health care spending has grown much faster than the rest of the economy in recent decades.

Why??


THE HUFFINGTON POST
Toxic Food!!
Poison Spring

• Author E.G. Vallianatos worked for the US EPA for 25 years.
• Corruption and misuse of science and public trust has turned EPA into a "polluters' protection agency."
• Repeatedly endorsed deadly chemicals, often against the advice of their own scientists.
• Botched field investigations.
• Turned a blind eye to toxic disasters.
Soy Protein Products*

- Heavily used in processed foods for emulsification, water and fat absorption, aeration and increasing protein content
  - Derived from "white flakes" made by defatting soybeans by extraction
  - Milled into defatted flours that are turned into soy protein isolates by further chemical processing
- These are added to infant soy formula!

* EW Lusas and MN Riaz, J Nutr 1995, 125(3 Suppl): 573S-580S.
Soy Formula Linked to Seizures in Autism*

"There was a 2.6-fold higher rate of febrile seizures, a 2.1-fold higher rate of epilepsy comorbidity and a 4-fold higher rate of simple partial seizures in the autistic children fed soy-based formula"

* CJ Westmark, PLOSOne March 12, 2014, DOI: 10.1371/journal.pone.0080488.
Protein Bars!

“Most soy protein ingredients in meat analogs and nutrition bars, which are listed on labels as soy protein isolate, soy protein concentrate or textured vegetable protein, have undergone *hexane* processing.”*

*http://www.berkeleywellness.com/healthy-eating/food-safety/article/hexane-soy-food*
Toxic Effects of Inhaled Hexane*

• Low: Dizziness, headache, nausea, vomiting
• High: Death from asphyxiation
• Chronic: Peripheral neuropathy, pain, weakness, loss of sensation, impaired gait, muscle atrophy, visual disturbances

• Allowable amounts in food:
  – 10 parts per million in Europe
  – 500 parts per million in China
  – No restrictions in US

* N-HEXANE. Toxicology data network Hazardous Substances Data Bank. US National Library of Medicine
"Another claim of Monsanto's has been that residue levels of up to 5.6 mg/kg in GM-soy represent "...extreme levels, and far higher than those typically found" (Monsanto 1999)."
Polysorbate 80*

- Food additives (emulsifiers) like polysorbate 80 induce inflammatory gut in mice
  - This is due to disruption of the gut microbes’ cell wall
  - It leads to increased risk to obesity and diabetes
  - Exposed gut microbes can be transferred to germ-free mice and they too get fat and diabetic

Organochlorine Pesticides & Obesity in Women*

• Polychlorinated biphenyls (PCBs) and organochlorine insecticides (e.g., DDT) are xenoestrogenic
  – Linger a long time in the environment
  – Accumulate in fat tissue and lead to obesity (especially in premenopausal women)

• *They depend on CYP enzymes for breakdown*

*D Teixeira et al., Journal of Clinical and Endocrinology & Metabolism [Epub ahead of print, Apr. 8, 2015]*
Mercury Levels can be High in Rice, Fish, and High Fructose Corn Syrup

Mercury is probably the most toxic metal on earth
Mercury and Desulfovibrio

• Desulfovibrio is a gut microbe that reduces sulfate to hydrogen sulfide gas
  – It is over-represented in association with autism*
• Desulfovibrio also reduces nitrate to ammonia
• Desulfovibrio converts mercury to methyl mercury, a much more toxic form**

Aspartame*

• Aspartame is the sweetener in NutraSweet, Equal, Spoonful, and Equal-Measure
  – Accounts for over 75% of the adverse reactions to food additives reported to the FDA
  – Aspartame breaks down to methanol (wood alcohol) and then to formaldehyde (neurotoxic)

Recapitulation

• The EPA is not safeguarding our health
• Soy protein products are unsafe to eat due to both hexane and glyphosate
• Polysorbate 80 can cause disruption of gut microbes' cell walls leading to obesity and diabetes
• PCBs and insecticides are estrogen disruptors and their breakdown is inhibited by glyphosate
• Mercury levels can be high in fish and rice
• Aspartame is a dangerous sugar substitute, breaking down to formaldehyde
Glyphosate and Folic Acid
A Bit of History

The US first considered adding folic acid supplements to grains in 1996, and introduced the mandate in 1998.

GMO “Roundup Ready” crops were just beginning to be introduced in 1996 and had obtained widespread adoption by 1998.

Spina bifida is a very rare genetic disorder that is linked to folate deficiency.
Adoption of “Roundup Ready” Crops

Figure 1. Adoption of GE crops in US.

Inverse Correlation Between Neural Tube Defects and Autism Trends*

- Proposed mechanism involves increased GABA receptor activity (neuronal inhibition)
- GABA increase has been linked to autism
- Asthma is implicated as well

Folic Acid and/or Iron Fortification!!*

*B Handforth and S. Zimmerman, Sight and Life 27 (1); 70-75, 2013
Europe has steadfastly refused to adopt policy of folic acid supplementation!

*B Handforth and S. Zimmerman, Sight and Life 27 (1); 70-75, 2013
Folic Acid is Complex

• Folic acid is a synthetic, oxidized form of folate
• It induces oxidative stress in the liver
• This can lead to folic acid build-up (unnatural) in the blood
• This interferes with nitric oxide release which is important for promoting blood flow
• Folic acid in the blood may also cause the antibodies to folate receptors in the brain associated with cerebral folate deficiency
Generating Methionine from Homocysteine

Folate trap: One or more of these requirements are missing; Methyl group stays stuck on folate (inactive)

Requirements:
Working MTHFR enzyme
Cobalamin
Zinc
Vitamin B6
*Methyl* tetrahydrofolate

There is a belief that elevated serum homocysteine is bad, but the homocysteine is desperately needed to produce sulfate
Nitrous Oxide Inhibits Methionine Synthesis

- Methionine synthase is inhibited by nitrous oxide
- Excess serum ammonia is a source of nitrous oxide
- Glyphosate likely induces ammonia synthesis by gut microbes (disrupts uptake of nitrogen into proteins)*

Transsulfuration Pathway*

- Homocysteine
- Cystathionine
- Glutathione
- Cysteine
- Taurine
- Sulfate

*Figure 1, DA Geier et al., Neurochem Res (2009) 34:386–393.
Transsulfuration Pathway*

Three very important molecules!!!

Homocysteine

Glutathione  \(\xrightarrow{\text{Cysteine}}\)  Taurine

Sulfate

*Figure 1, DA Geier et al., Neurochem Res (2009) 34:386–393.
What’s the difference between folic acid and folate???

- Folic acid is a *synthetic* molecule, and it’s stable
- Folate is typically methylated
- Folic acid is missing four hydrogen ions – *THIS IS VERY IMPORTANT***!!

Folic acid is *oxidized*, and to convert it to folate is costly for the body
A Problem with Folic Acid

Excess folic acid drives biopterin towards the reduced form, which is not good!

**Diagram:**

- **BH4**: Tetrahydrobiopterin
  - **REDUCED**: HHHH
  - **OXIDIZED**: HH

- **Dihydrobiopterin**: +HH
- **Dihydrofolate**: -HH

**Label:**

- **Folic Acid 800 mcg**
A Problem with Folic Acid

Low BH4 in the cerebrospinal fluid is linked to autism*

A Problem with Folic Acid

BH4 is essential for nitric oxide release, which promotes blood flow

**REDUCED**

<table>
<thead>
<tr>
<th>BH4</th>
<th>Tetrahydrobiopterin</th>
</tr>
</thead>
<tbody>
<tr>
<td>HHHH</td>
<td></td>
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**OXIDIZED**

<table>
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<td></td>
</tr>
</tbody>
</table>

“High folic acid consumption leads to pseudo-MTHFR deficiency, altered lipid metabolism, and liver injury in mice”*

- Fed mice excessive amounts of folic acid
- *Reduced* methylation capacity in liver
- CYP7A1 level was dramatically reduced. (rate limiting enzyme in bile acid synthesis)
- Caused liver damage and fatty liver disease

“Cerebral folate deficiency with developmental delay, autism, and response to folinic acid”*

Folinic acid is a form of TETRAHYDRO-folate

* P Moretti et al., Neurology March 22, 2005 vol. 64 no. 6 1088-1090
“Cerebral folate deficiency with developmental delay, autism, and response to folinic acid”*

Fol

in

ic acid is a form of TETRAHYDRO-folate

Folate receptor antibodies due to excess folic acid in the blood???

* P Moretti et al., Neurology March 22, 2005 vol. 64 no. 6 1088-1090
Recapitulation

• The timing of mandatory folic acid enrichment is uncanny: hide pending epidemic in spina bifida?
• Folic acid is synthetic, and it leads to excessive oxidation in the liver and/or depleted BH$_4$
• Glyphosate depletes methionine
  – Folate converts homocysteine to methionine, depleting sulfate supplies
  – This causes severe systemic sulfate deficiency
• Folate receptor antibodies in the brain may be an attempt to protect the brain from sulfate deficiency
Glyphosate, Oxalate and Anemia
Autism Linked to Oxalate Crystals*

- Crystals of oxalate form kidney stones and cause great discomfort
- Study has shown at least 3-fold higher serum and urinary levels of oxalate in autistic kids**

*William Shaw, The Role of Oxalates in Autism and Chronic Disorders WAPF, March 26, 2010

“Oxalate crystals in the bone may crowd out the bone marrow cells, leading to anemia and immunosuppression”*

*http://www.greatplainslaboratory.com/home/span/oxalates.asp
“Cerebral edema, and perhaps injury to other organs, could result from oxalate crystal deposition in small blood vessels in the brain and other organs.”*
Oxalate Metabolism*

*http://www.greatplainslaboratory.com/home/eng/oxalates.asp
Glyphosate Metabolism*

*Figure 3 in L. Polligioni et al., FEBS Journal 278 (2011) 2753–2766
“[origin: WO02069718A2] Pesticidal concentrate and spray compositions are described which exhibit enhanced efficacy ... More particularly, the present invention relates to a method of enhancing the herbicidal effectiveness of glyphosate concentrate and tank mix formulations containing one or more surfactants through the addition of oxalic acid.”
Monsanto Patents: 2002-2010: Pesticide Compositions Containing Oxalic Acid

“[origin: WO02069718A2] Pesticidal concentrate and spray compositions, wherein oxalic acid is used to enhance... 

Monsanto Technology, St. Louis, MO

Oxalic acid and oxalate are essentially the same thing!
Oxalate Enhances Glyphosate’s Toxicity to Plants at Small Concentrations*

*Figure 1, Monsanto Patent #US 7,771,736 B2, Aug. 10, 2010
**Hypothesis**: flooding with oxalate prevents metabolism of glyoxylate to oxalate. Glyoxylate is a very potent glycating agent, leading to widespread damage. This also inhibits glyphosate breakdown to glyoxylate.
Roundup Brand Leadership Driven by Continuous Innovation

1975
- Classic
  - Standard for post emergent perennial weed control
  - Improved environmental profile

1980
- Rodeo
  - Aquatic market
  - Outstanding environmental profile (licensed to Dow)

1985
- Accord
  - Forestry Market
  - Excellent environmental profile (licensed to Dow)

1990
- Roundup D-Pak
  - Super-high formulation for big volume users in southern U.S.

1995
- Roundup DRYpak
  - Solution to packaging issues
  - First of high-load products

2000
- Ultra
  - Introduction of Transorb technology
  - Safe on Roundup Ready crops

2005
- Ultra Max
  - High load version of Ultra
  - Excellent Roundup Ready crop safety

- Weather Max
  - Transorb II technology
  - 50% more concentrated
  - Rainfast warranty
  - Best Roundup Ready crop safety to date

Active Ingredient Loading (g/L glyphosate)

- Monsanto continually innovates, creating breakthrough formulation technology
- Results:
  - More than 300 worldwide patents, 50 in U.S.
  - Faster launch of new formulations
Roundup Brand Leadership Driven by Continuous Innovation

WEATHERMAX!!

- Monsanto continually innovates, creating breakthrough formulation technology
- Results:
  - More than 300 worldwide patents, 50 in U.S.
  - Faster launch of new formulations

sec.gov/Archives/edgar/data/1110783/000103570403000400/c77652exv99w2.htm
“In 2004, this powerful new formulation was chosen by more western Canadian growers than any other non-selective herbicide on the market. Grower satisfaction with the performance in the field has reached new heights - 99% of growers who used Roundup WeatherMAX were satisfied with their experience.”

*www.highbeam.com/doc/1P2-13686824.html

JANUARY 3, 2005
Hospital Discharge Diagnoses of Anemia (ICD 280-85) & Glyphosate applied to corn & soy crops

R = 0.8952, p <= 0.00018
Sources: CDC; USDA

Anemia per 1,000 Total glyphosate / total acreage (lb/acre; corn & soy)

Year

Plot produced in collaboration with Dr. Nancy Swanson from US Government data
This Detoxification Scheme is Essential in Red Blood Cells

- Inhibited by glyphosate
- Depleted by glyphosate
- Depends on selenium
- Product of shikimate pathway
- Induced by excess folic acid

- Glucose-6-phosphate → 6-Phosphogluconate
- NADP → NADPH
- G6PD
- Glutathione reductase
- GSH → GSSG
- Glutathione peroxidase
- H₂O₂ → H₂O
Anemia is also Caused by Damage to Red Blood Cells

G6PD Deficiency Leads to Hemolysis and Anemia

- Inhibited by 
- Depleted by glyphosate
- Depends on selenium

Glucose-6-phosphate $\rightarrow$ 6-Phosphogluconate

$\text{Glutathione reductase} \rightarrow \text{GSH} \rightarrow \text{GSSG}$

$\text{Glutathione peroxidase} \rightarrow \text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O}$

- Depends on selenium

- Depleted by glyphosate
Anemia leads to low oxygen which induces chronic low grade encephalopathy linked to autism
Review

Is Encephalopathy a Mechanism to Renew Sulfate in Autism?

Stephanie Seneff¹,*  Ann Lauritzen²  Robert M. Davidson³ and Laurie Lentz-Marino⁴
Oxalate, Iron and Autism

• Agricultural workers exposed to glyphosate suffer from high rate of kidney failure due to tubular interstitial diseases*
  – Tubules depend on transferrin to supply iron
  – Oxalate interferes with transferrin iron delivery**

• Autistic children also have intractable iron deficiency

• Child with defective gene for transferrin receptor had developmental delay and intractable seizures***

*C Jayasumana et al., Int. J. Environ. Res. Public Health 2014
**AN Luck et al., Biochemistry. 2013 November 19; 52(46)
Children with autism have low levels of transferrin, which protects from oxidative damage due to free iron in the cells.
Recapitulation

• Serum oxalate is elevated in association with autism
• Oxalate can cause crystals to form in tissues which is very damaging (especially in brain)
• Monsanto has patents on oxalate as an additive to enhance toxicity to plants
• Oxalate can work synergistically with glyphosate to cause essential iron deficiency
• Anemia can lead to low oxygen supply and encephalopathy (linked to autism)
• Oxalate interferes with delivery of iron to the tissues, and Impaired transferrin receptors are linked to autism
How to Protect Yourself and Your Family
Go Organic!
Avoid Foods that are Enriched in Folic Acid
Eat Foods that Contain Folate
Eat Foods that Contain Folate

These foods are also rich in manganese and sulfur
Extracts from Common Plants Can Treat Glyphosate Poisoning*

• Roundup is toxic to hepatic and embryonic cells at doses far below those used in agriculture and at residue levels present in some GM food.

• Extracts from common plants such as dandelions, barberry, and burdock can protect from damage, especially if administered prior to exposure.

*C Gasnier et al. Journal of Occupational Medicine and Toxicology 2011, 6:3
Treating Glyphosate Poisoning in Animals (e.g., cows) *

Activated charcoal, bentonite clay, humic and fulvic acids, and sauerkraut juice have been shown to be effective in reducing urinary levels of glyphosate and improving animal health.

*H Gerlach et al., J Environ Anal Toxicol 2014, 5:2
Eat Foods High in Sulfur
Eat Foods Containing Manganese
Summary

• Autism rates are growing exponentially, and this trend will destroy the nation if we stay the course.

• Our cheap food supply is making us sick.
  – Mercury, aspartame, polysorbate 80, PCBs, organochlorine pesticides, hexane, folic acid, oxalate and glyphosate!! are all contributing.

• Autism and ADHD are intimately related and may differ just by the balance of manganese and iron in a toxic environment.

• We need to return to sustainable organic agricultural methods and we need to spend more time in the kitchen cooking whole foods!