Is Roundup the Toxic Chemical that’s Destroying Our Health?

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“The price of anything is the amount of life you exchange for it.”

Henry David Thoreau

Outline

• Autism Epidemic
• Digestive Disorders and Kidney Failure
• Endocrine Disruption, Cancer and Obesity
• Are We Exposed?
• Summary
The Autism Epidemic in the U.S. (US CDC Data)

One in 150 kids diagnosed on Autism Spectrum in 2007

One in 100 kids diagnosed on Autism Spectrum in 2009

One in 50 kids diagnosed on Autism Spectrum in Mar. 2013

One in Two in 2025?

The rate was 1 in 10,000 in 1970
Some Conditions Associated with Autism

- Disrupted gut bacteria
- Depleted serotonin supply
- Deficiency in sulfur metabolites

Is there a toxic substance that is currently on the rise in our environment that could account for these comorbidities?
Glyphosate and Autism*

Pearson Correlation Coefficient = 0.99


U.S. Market is 25% of World Market of Roundup

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Pearson Correlation Coefficient = 0.99

Recent Publication

Glyphosate’s Suppression of Cytochrome P450 Enzymes and Amino Acid Biosynthesis by the Gut Microbiome: Pathways to Modern Diseases

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Abstract: Glyphosate, the active ingredient in Roundup®, is the most popular herbicide used worldwide. The industry asserts it is minimally toxic to humans, but here we argue otherwise. Residues are found in the main foods of the Western diet, comprised primarily

Brief History

- Glyphosate is now the #1 herbicide in use in the U.S. and is increasingly used around the world
  - Developed and patented by Monsanto in the 1970’s
  - Came out from under patent in 2000
  - Inhibits an enzyme in the shikimate pathway involved in synthesis of tyrosine, tryptophan and phenylalanine (the three aromatic amino acids)
- Huge expansion of GMO corn, soy, cotton, sugar beet and canola crops has led to sharp increases in glyphosate usage in the last decade
- New practice of desiccation with Roundup on wheat, sugar cane and other crops contributes as well

Is Glyphosate Nontoxic?

- Monsanto has argued that glyphosate is harmless to humans because we don’t have the shikimate pathway
- 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
Glyphosate: Some Biological Effects*

- Depletes aromatic amino acids and methionine
- Disrupts gut bacteria
  - Studies with chickens, cows and pigs show overgrowth of pathogens in gut
- Disrupts cytochrome P450 (CYP) enzymes which are involved in many biological functions
- Depletes important minerals
  - Calcium, manganese, zinc, cobalt, iron, ....
- Likely impairs sulfate synthesis and sulfate transport

* A. Samsel and S. Seneff, Entropy 2013, 15, 1416-1463
Glyphosate: Some Biological Effects (cont’d)

• Depletes aromatic amino acids and methionine
  Tryptophan $\rightarrow$ serotonin $\rightarrow$ melatonin
  – Serotonin deficiency is linked to obesity, autism, Alzheimer’s disease, depression, and violent behavior
  – Melatonin controls sleep/wake cycle
  Tyrosine $\rightarrow$ dopamine, adrenaline, melanin, thyroid hormone
  – Dopamine deficiency leads to Parkinson’s disease
  – Melanin in skin protects from UV exposure
  Methionine is an essential sulfur-containing amino acid
• Disrupts cytochrome P450 (CYP) enzymes which are involved in:
  – Activation of vitamin D, catabolism of retinoic acid
  – Bile acid production
  – Detoxifying environmental toxins
  – Stabilizing blood (hemorrhaging vs blood clots)

Some Biomarkers for Autism

• Disrupted gut bacteria; inflammatory bowel
• Low serum sulfate
• Methionine deficiency
• Serotonin and melatonin deficiency
• Defective aromatase (CYP enzyme)
• Zinc and iron deficiency
• Vitamin D deficiency
• Impaired immune function
• Chronic low-grade inflammation in the brain
Some Biomarkers for Autism

- Disrupted gut bacteria; inflammatory bowel
- Low serum sulfate

These can all be explained as potential effects of glyphosate on biological systems

- Vitamin D deficiency
- Impaired immune function
- Chronic low-grade inflammation in the brain

Aromatase

“Aromatase protein is significantly reduced in the frontal cortex of autistic subjects relative to sex- and age-matched controls”*

- Aromatase is a CYP enzyme that converts testosterone to estrogen
- Its association with autism explains the fact that boys are four to five times as susceptible as girls to autism.

*T. Sarachana et al., PLoS ONE, Feb. 2011, 6(2):e17116
Probiotics Treat Mouse Autism*

*Graphical Abstract from E.Y. Hsiao et al., Cell, Dec. 5, 2013

P-Cresol is produced by Clostridium difficile, a pathogen that is resistant to glyphosate

P-cresol

Glyphosate suppresses tryptophan synthesis by plants and gut bacteria

• Autism is associated with low activated vitamin D and low brain serotonin
  – Vitamin D activates serotonin receptors in the brain
• Estrogen rescues females by boosting serotonin levels in brain
• Recommendation is supplements in both vitamin D and tryptophan

The FASEB Journal • Review

Vitamin D hormone regulates serotonin synthesis. Part 1: relevance for autism
Rhonda P. Patrick1 and Bruce N. Ames1
Oakland, Liver

• Autism is associated with low activated vitamin D and low brain serotonin
• Estrogen rescues females by boosting serotonin levels in brain
• Recommendation is supplements in both vitamin D and tryptophan
Recapitulation

- Autism rates have been increasing at an alarming rate in recent years, in step with increases in glyphosate application to GMO crops
- Autism is associated with disrupted gut bacteria, serotonin and vitamin D deficiency, methionine deficiency, excess p-cresol, etc.
- Most of the biomarkers associated with autism can be explained by known biological effects of glyphosate
- These effects can also explain many other modern diseases and conditions, including dementia
### Outline

- Autism Epidemic
- *Digestive Disorders and Kidney Failure*
- Endocrine Disruption, Cancer and Obesity
- Are We Exposed?
- Summary

### Dr. Roy Dittman*

“If the microbial world is the substrate for life, why are we waging war on it?”

“The same chemicals we use to sterilize our environment sterilize us.”

Gut Microbes and Obesity

• Our microbes outnumber our own cells 10 to 1
• There are between 200 and 300 different species in a typical person.
• Glyphosate causes a loss of beneficial bacteria and an overgrowth of pathogens in the gut
  – Pathogens release toxic phenols (e.g., p-cresol)
  – This can lead to inflammatory bowel disease
• Gut microbes from an obese person induced obesity in mice*


Pigs Fed GMOs Develop Inflamed Gut*

• Pigs have a similar digestive system to humans
• Digestive problems observed anecdotally in GMO-fed pigs
  – inflammation in stomach and intestine, stomach ulcers, thinning of intestinal walls, increase in haemorrhagic bowel disease

Follow-on Experiment:
• 168 just-weaned pigs fed “typical diet,” soy and corn, until slaughtered
  – Half fed GMO versions, half organic.

Pigs Fed GMOs Develop Inflamed Gut*

- Blind autopsies conducted
  - Female pigs' uterus 25% larger in GMO-fed pigs
  - Female pigs 2.2x more likely to get severe stomach inflammation on GMO diet
  - Males were 4x more likely

Photos kindly provided by Howard Vlieger


“Deformities, sickness and livestock deaths: the real cost of GM animal feed?”*

"When using GM feed I saw symptoms of bloat, stomach ulcers, high rates of diarrhoea, pigs born with the deformities ... but when I switched [to non GM feed] these problems went away, some within a matter of days.”

Quote from Ib Pedersen, producer of 13,000 pigs a year supplying Europe’s largest pork company, Danish Crown

America’s Two-Headed Pig*
Treating Nutritional Deficiencies and Disease in a Genetically Modified, Antibiotic Resistant and Pesticide Dependent World


Human Digestive System Disorders

• We are seeing an alarming increase in the US in many diseases related to the gut
  – Crohn’s disease, inflammatory bowel disease, colitis, acid reflux disease, gluten and casein intolerance, celiac disease, leaky gut
• The gut-brain axis links neurological disorders with gut disorders
• I believe that glyphosate is a major cause
Celiac Disease has Quadrupled in the US in the Last 50 Years
Human Dietary Experiment on Wheat & Inflammatory Bowel Syndrome*

- Significant improvement in symptoms with dietary organic wheat from ancient source
  - Abdominal pain (P< 0.0001)
  - Bloating (P=0.004)
  - Stool consistency (P< 0.001)
  - Tiredness (P< 0.0001)

- Reduced pro-inflammatory cytokines: IL-6, IL-17, interferon-gamma, VEGF

Paper on Glyphosate and Celiac Disease

Glyphosate, pathways to modern diseases II: Celiac sprue and gluten intolerance

Anthony SAMSEL 1 and Stephanie SENEFF 2

Celiac Disease, Glyphosate and Non-Hodgkin’s Lymphoma

• Bifidobacteria are depleted in celiac disease*
  — They convert gluten to less toxic form
• Glyphosate preferentially kills bifidobacteria**
• Celiac disease is associated with increased risk to non-Hodgkin’s lymphoma***
• Glyphosate itself is also linked directly to non-Hodgkin’s lymphoma****

****M. Eriksson et al., Int J Cancer. 2008 Oct 1;123(7):1657-63.
“Herbicide Resistant Ryegrass Troubling for Wheat Growers”*

“If you see ryegrass at harvest following an Axial XL application, it may be resistant. And you can scatter seed all over the field with the combine.”

“A reduced-tillage approach, using a burndown herbicide ahead of planting in a stale seedbed, also holds promise for improved control.”

“‘We may be able to knock out 80% to 90% of the resistant ryegrass with glyphosate.’”

*Ron Smith, Western Farm Press, Mar. 23, 2013

Pseudomonas and Glyphosate*

- Pseudomonas aeruginosa, a gram negative bacterium, is a major problem today in hospitals due to its resistance to multiple antibiotics
- P. aeruginosa is one of only three bacterial species that can break down glyphosate.
  - It produces formaldehyde as a by-product
  - Formaldehyde is a well established neurotoxin

“Dramatic Increase in Hospitalization of US Children With Inflammatory Bowel Disease”*

- Study conducted at Case Western Reserve University School of Medicine
- > 11 Million hospitalization records examined
- Patients < 20 years old
  - 49% increase from 2000 to 2009 in Crohn’s disease discharges
  - 71% increase in ulcerative colitis discharges

* Science Daily, June 25, 2013

Kidney Failure in Agricultural Workers*

- Workers in sugarcane fields in Central America and in India are dying at a young age in record numbers from kidney failure
- Arsenic exposure from drinking water?
- Excess use of tylenol?

*Glyphosate disrupts the enzyme that breaks down tylenol, leading to tylenol toxicity*

*ticotimes.net, San Jose, Costa Rica, August 8, 2013.*
“What is killing the young men of Cañas?”

Abstract: “The effect of the aerial application of 0.86 kg a.i./ha of glyphosate in 75 l of water on the ripening of 3 sugar cane varieties was studied in Costa Rica. ...”

Acute Kidney Disease Death Rate Plotted Against Glyphosate and GMOs* 

*Plot prepared by Nancy Swanson from available data online


Sri Lanka is the first Country to Ban Glyphosate

Hypothesis

Glyphosate, Hard Water and Nephrotoxic Metals: Are They the Culprits Behind the Epidemic of Chronic Kidney Disease of Unknown Etiology in Sri Lanka?

This problem did not exist in Sri Lanka prior to the 1990s.
Another Country Responds to Kidney Failure in Agricultural Workers!

Recapitulation

- We depend on our gut bacteria in many ways
  - Bacteria from an obese person induce obesity in mice
- Glyphosate is an antibiotic that preferentially kills the good bacteria
  - Pigs fed GMO corn and soy develop inflammatory gut
  - Humans are experiencing an epidemic in gut disorders like inflammatory bowel disease and gluten intolerance
  - Due to herbicide-resistant rye grass, farmers use glyphosate as a desiccant at harvest time
- Kidney failure among agricultural workers can be explained by glyphosate
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“More and more studies have revealed carcinogenic and endocrine disrupting effects of Roundup at lower doses than those authorized for residues found in Genetically Modified Organisms.”

-- Dr. Nancy Swanson
Glyphosate is an endocrine disruptor that promotes breast cancer*

- Low and environmentally relevant concentrations of glyphosate possess estrogenic activity
- Glyphosate caused human hormone-dependent breast cancer cells to proliferate at concentrations of parts per trillion
- Additive effect from genistein, a phytoestrogen in soybeans


Glyphosate and Anencephaly*

- Yakima, Benton and Franklin counties in Washington State have an unusually high number of pregnancies affected by the birth defect, anencephaly
- 75 pesticides were analyzed in studying contamination due to surrounding agriculture
  - 47 (63%) of these were detected
  - Glyphosate was applied in large amounts, but was not studied
- 5% solution of glyphosate was also used heavily around irrigation ditches to control weeds
  - Main herbicide recommended due to its “low toxicity”

Glyphosate Upregulates Retinoic Acid*

Glyphosate

CYP Enzyme Repression

Retinoic Acid

inhibition of expression

Shh

Otx2

Sox9

Small Brain

* Cyclopia
* Microcephaly
* Affected cranial neural crest
* Craniofacial malformations


Glyphosate’s Effects on Sertoli Cells in Rat Testis*

- Concentrations 10-fold more diluted than that recommended for herbicide action
- Several pathologies noted:
  - Depletes glutathione (essential antioxidant)
  - Enhanced lipid and protein oxidation
  - Activates calcium channels; promotes calcium release from ER (stress response); induces cell death
  - Increases mitochondrial membrane permeability to calcium and protons

Fertility Rates are Dropping Worldwide*

- Fertility rates are falling rapidly in countries around the world, often to below 2.0.
  - Cultural changes play a role
  - But glyphosate is likely contributing as well
- Sperm depend on cholesterol sulfate for decapitation and fertilization
- Cholesterol sulfate synthesis depends on cytochrome P450 (CYP) enzymes
- Glyphosate disrupts CYP enzyme function

*A. Samsel and S. Seneff, Entropy 2013, 15, 1416-1463.*

"Male fertility under threat as average sperm counts drop"*

- Study of 26,600 men in France found sperm concentration had decreased by 32% since the 1990s.
- Numbers steadily dropped by 2% per year from 1989 to 2005.
- Proportion of normally formed sperm also declined by about 1/3.

*M. Rolland et al., Hum Reprod. 2013 Feb;28(2):462-70.*
Is Glyphosate Making Us Obese?

Figure 1 in R.J. Johnson et al., Am J Clin Nutr 2007;86:899–906.

Obesity in US over Time*

Glyphosate was introduced into the food chain in 1975

*Figure 1 in R.J. Johnson et al., Am J Clin Nutr 2007;86:899–906.
Deaths due to Obesity (ICD E 66 & 278)
plotted against % GE corn & soy (R = 0.9586, p <= 4.027e-06)
and glyphosate applied to corn & soy (R = 0.9702, p <= 9.752e-09)
sources: USDA: NASS; CDC

Nancy Swanson, http://www.examiner.com/article/
data-show-correlations-between-increase-neurological-diseases-and-gmos

Nancy Swanson’s Data: Pearson Correlation
Coefficients between Diseases and Roundup*
Recapitulation

• Glyphosate is a known endocrine disruptor
  – Contributes to infertility and birth defects
  – Glyphosate causes breast tumor cells to proliferate at concentrations of parts per trillion
• Glyphosate upregulates retinoic acid which causes microcephaly and anencephaly
  – This could explain recent high incidence of anencephaly in Yakima, WA
• Many diseases and conditions on the rise today are strongly associated with glyphosate application on corn and soy

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Is Glyphosate in Our Food?

- Wheat desiccated with Roundup
- High fructose GMO corn syrup
- GMO soy protein filler
- GMO Canola Oil
- Cows fed GMO corn and soy
- Potatoes desiccated with herbicides

Testing for Glyphosate Residues in US Foods*

- 195 page document
- Only one food item was tested for glyphosate: soy
- 271/300 samples tested contained glyphosate residues (90.3%)
- 287/300 contained AMPA (a breakdown product of glyphosate) (95.7%)

*USDA Pesticide Data Program: Annual Summary, 2011
“Determination of Glyphosate residues in human urine samples from 18 European countries”*

- 182 urine samples from 18 European countries analyzed for glyphosate
  - city-dwellers who had never handled roundup or any herbicides.
- 44% of the samples contained quantifiable amounts of glyphosate
- 7% of the participants exceed 0.8 micrograms/Liter, the reference cutoff for "safety"
- Diet seems to be the main source of exposure
- These numbers would be much worse if they were measured in the U.S.


“This testing highlights a serious lack of action by public authorities across Europe and indicates that this weed killer is being widely overused. Governments need to step-up their monitoring and bring in urgent measures to reduce its use. This includes rejecting any genetically modified crops that would increase the use of glyphosate.”


Our testing highlights a serious lack of action by public authorities across Europe and indicates that this weed killer is being widely overused. Governments need to step-up their monitoring and bring in urgent measures to reduce its use. This includes rejecting any genetically modified crops that would increase the use of glyphosate.”
Glyphosate in Air and Rain*

- Study conducted by the US Geological Survey in Mississippi
- 18-fold increase in glyphosate application since 1995

Glyphosate was the predominant new herbicide detected in both air (86%) and rain (77%) in 2007 (not measured in 1995)


Species in Stress

*R. Mason et al., Journal of Environmental Immunology and Toxicology 1:1, 3-12; 2013
Roundup herbicide enhances the growth of aflatoxin-producing fungi*

“Aflatoxins are mutagenic, carcinogenic, teratogenic, hepatotoxic, immunosuppressive, and they also inhibit several metabolic systems”*

Monarch Butterfly Decline*

*Sources: U.S. Dept of Agriculture and EPA
http://www.ers.usda.gov/data-products/agricultural-baseline-database/#.UxX3_I5kJkU
http://www.epa.gov/opp00001/pestsales

Glyphosate applied to kill milkweed which monarchs eat

*Sources: U.S. Dept of Agriculture and EPA
http://www.ers.usda.gov/data-products/agricultural-baseline-database/#.UxX3_I5kJkU
http://www.epa.gov/opp00001/pestsales
Prof. Don Huber on Glyphosate*

“When future historians write about our time, they're not going to write about the tons of chemicals that we did or didn't apply. When it comes to glyphosate, they're going to write about our willingness to sacrifice our children and jeopardize our existence, while threatening and jeopardizing the very basis of our existence; the sustainability of our agriculture.”

*Retired professor from Purdue University; Expert in plant pathology
articles.mercola.com/sites/articles/archive/2012/01/15/dr-don-huber-interview-part-2.aspx

Go Organic!
Summary

- We should be very worried about glyphosate in the food and water supplies
- Glyphosate’s disruption of gut bacteria, depletion of essential amino acids and minerals, and interference with cytochrome P450 enzymes have widespread consequences
- Glyphosate can explain health problems worldwide, including autism, diabetes, infertility, kidney failure, gluten intolerance, cancer, etc.
- Glyphosate needs to be removed from the market and we need to find the path to sustainable pesticide-free agriculture