



Could glyphosate cause other health problems even if it's not carcinogenic?

Iida Rushalme | November 10, 2016 | [Genetic Literacy Project](#)

A number of different health concerns have been raised about glyphosate, not just worries that it is carcinogenic. The important question to ask is whether there are serious health risks. The best way to find guidance to that question is to rely on the collected wisdom of the best and most comprehensive recent reviews of the research (examples [here](#) and [here](#), or you can check out the collection of all glyphosate review papers in [Food And Farm Discussion Labs wiki page](#)).

There have been at least eight reviews looking at human health and glyphosate science in the last 20 years, and none of them finds any harm to human health caused by normal glyphosate use. Geneticist Anastasia Bodnar, co-founder of the independent website, has written [an overview](#) of the research landscape:

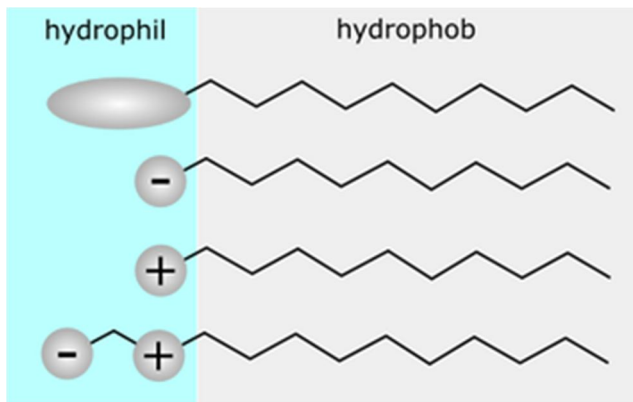
...three recent reviews that summarize the literature on glyphosate and humans: Epidemiologic studies of glyphosate and non-cancer health outcomes, Epidemiologic studies of glyphosate and cancer, and Developmental and reproductive outcomes in humans and animals after glyphosate exposure. These reviews looked at epidemiological studies, ones that look at disease incidence in large numbers of humans with varying levels of exposure to G or that look at exposure to G in a population that has a disease.

Now, epidemiology isn't perfect, but with carefully designed studies it can be a powerful way to look for connections in real human populations. Even better when we can look at reviews that put multiple studies all in one place. These reviews cover a lot of studies that find there is no correlation between glyphosate exposure and cancer or non-cancer diseases.

She urges caution in accepting claims based on studies using cell cultures:

There are occasionally alarm-inducing papers like Glyphosate induces human breast cancer cells growth via estrogen receptors. This paper, and others like it, tend to use human cells in a petri dish rather than whole animals. I had the misfortune to do some research on cultured human cells myself and let me tell you, those are some tricky buggers to work with. Even when everything is working perfectly, it's still very hard to tell if the results you are getting will hold true when repeated in a whole animal model. Something that causes a reaction in naked cells may not react the same when applied to your skin or taken in through your digestive system (both of which have evolved to keep you safe from many things).

Only a combination of animal models and cell studies can give us the full picture (even better if we can pair these up with some epidemiology).

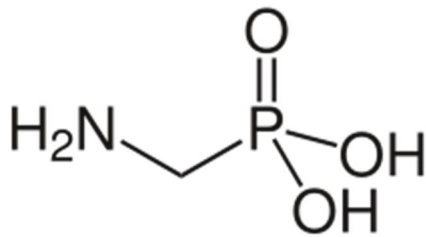


What about the surfactants (soap-like substances) included in glyphosate to make pesticides such as Roundup?

Schematic molecular structure of different kind of [surfactants](#).

To allow for better spread, glyphosate mixtures usually contain surfactants. In a wide array of studies, the substance under study is a mix of glyphosate and surfactants – most commonly one called [polyethoxylated tallow amine\(POEA\)](#). [Surfactants](#) are substances such as soaps and other amphiphilic molecules that have the ability to change surface tension properties between liquids (or liquids and solids). They also help solubilize fats and proteins—that is, they act as detergents. Sometimes there may also be other pesticides added (combination pesticide mixtures). Each agent has an effect of its own, which becomes pronounced if the target animal or cell culture is exposed to high enough concentrations for a long enough period of time.

Not surprisingly, cells do not like direct exposure to large concentrations of agents that solubilize their structural components, such as surfactants. Neither do aquatic animals. We can tolerate washing our hands with soaps because of the barrier-function of our skin, and the small amounts that might be ingested (from our own soaps, or from pesticide residue) are so vanishingly small as to be of no concern. But we would also most certainly experience some adverse effects if we actually drank soap, and we do not tend to require that our soaps should be safe if ingested in large amounts, because this is not their intended use. This is the relevance we need to look for in studies: that they look at realistic exposures (whether it's about soap or glyphosate). It is the dose that makes the poison.



Glyphosate breakdown product AMPA

The major breakdown product of glyphosate is aminomethylphosphonic acid (AMPA), which has been found to have similarly low profile of toxicity as glyphosate according to a [report from the Food and Agricultural Organization](#) of the World Health Organization. One [review from 2000](#) looked at both glyphosate, the surfactant POEA, and AMPA specifically. It concluded:

The oral absorption of glyphosate and AMPA is low, and both materials are eliminated essentially unmetabolized. Dermal penetration studies with Roundup showed very low absorption. Experimental evidence has shown that neither glyphosate nor AMPA bioaccumulates in any animal tissue. No significant toxicity occurred in acute, subchronic, and chronic studies. ...

Therefore, it is concluded that the use of Roundup herbicide does not result in adverse effects on development, reproduction, or endocrine systems in humans and other mammals. ...

It was concluded that, under present and expected conditions of use, Roundup herbicide does not pose a health risk to humans.

[One recent study of AMPA](#) looked at the substance as a prospective cancer treatment:

[T]hese results demonstrate that AMPA can inhibit prostate cancer growth and metastasis, suggesting that AMPA may be developed into a therapeutic agent for the treatment of prostate cancer.

This goes to show that single studies may raise alarm or give hope about any number of substances as either harmful or beneficial. Time and accumulating number of quality studies that either support or reject those early findings are the critical factor in making sense of the science. So far, this process

has found neither glyphosate, nor its common companion surfactants, or breakdown products, to pose risks to us or for the environment through normal exposure.



Could glyphosate be an endocrine disruptor? Enter Gilles-Éric Séralini et al.

French biologist and researcher Gilles-Éric Séralini has published a [paper](#) that claims glyphosate is an endocrine disruptor. This is a good example of what Dr. Bodnar cautioned about above: the study was done entirely on cell lines, which provides little idea about its relevance of when it comes to food residues. Exposing cells cultures directly to high levels of glyphosate and its formulations with surfactants will almost certainly have adverse effects on cell lines; in other words, Séralini observed what he intended to observe.

There are some other red flags here. Three years after this journal article, Séralini published a GMO corn feeding and glyphosate use study using a specific kind of laboratory rat breed that is naturally prone to generate tumors. He kept the rats alive and suffering well past any ethically defensible time-frame-two years. The [study was subsequently retracted](#) due to its confusing study design, flawed statistics, and a conclusion at odds with the data. If you are interested, you can read more about the affair in [Nature](#) or [Wikipedia](#).

It may come as no surprise, then, that his earlier endocrine disruption study has gotten no traction; no followup story by any researcher has found endocrine effects linked to glyphosate. [A 2015 report](#) from the US Environmental Protection Agency (EPA) concluded that there is no convincing evidence that would warrant more extensive testing:

Based on weight of evidence considerations, mammalian or wildlife EDSP Tier 2 testing is not recommended for glyphosate since there was no convincing evidence of potential interaction with the estrogen, androgen or thyroid pathways.

David Gorski, a [surgical oncologist at the Barbara Ann Karmanos Cancer Institute](#) specializing in breast cancer surgery, where he also serves as the Medical Director of the Alexander J. Walt Comprehensive Breast Center, [Associate Professor of Surgery](#) and Oncology at the Wayne State University School of Medicine, and faculty of the [Graduate Program in Cancer Biology](#) has also summarized the claims of glyphosate's health effects in his blog: [Glyphosate – The New Bogeyman](#):

Glyphosate is one of the least toxic herbicides used. It inhibits the enzyme [5-enolpyruvylshikimic acid-3-phosphate synthase](#) which interferes with the shikimic pathway in plants, resulting in the accumulation of shikimic acid in plant tissues and ultimately plant death. The enzyme and pathway do not exist in animals, which is why toxicity is so low.

...numerous published systematic reviews show clear evidence that glyphosate has very low toxicity. More careful study when it comes to any agent being used as heavily as glyphosate is always welcome. Science is complicated, and it is always a good idea to consider factors that may have been previously missed. However, failure to show any adverse effect from glyphosate in epidemiological studies is very reassuring. Given its widespread use, any adverse effect must be tiny or non-existent to be missed by the evidence we have so far. ... The evidence, however, will not stop ideologues from cherry picking, misusing evidence, presenting pure speculation as if it were evidence, assuming causation from correlation, and generally fearmongering about a safe chemical in order to grind their ideological axe.

What about studies claiming glyphosate causes celiac disease, autism, and obesity, etc? A look at Stephanie Seneff et al.

For scientists, it may be easy to navigate the landscape of scientific publications, but most people have no experience and knowledge of how to discern whether claims are far-fetched or fundamentally lacking in evidence. One such example is an analysis written by Stephanie Seneff, a former MIT computer scientist, and a retired science consultant Anthony Samsel. They used a computer science method known as Natural Language Parsing to analyze papers focusing on the ‘dangers of glyphosate’ in order, as Seneff says, to [‘help her figure out the story’](#) behind glyphosate.

Seneff and Samsel claim that they can ‘see’ in the data that glyphosate causes celiac disease. The claim is based on an Indian fish study in which fish were kept in water which was supplied with many times field-realistic levels of a glyphosate mixture continuously for weeks. Importantly, the mixture included [surfactants](#), which are not allowed in *aquatic* use because surfactants are very harmful to fish. There was no control for the surfactant. And the connection to celiac disease? There was no data to support such a conclusion; it was their ‘logical conclusion’ because the fish were seen to have seriously damaged intestines after six weeks in this surfactant and glyphosate bath. I do not need to point out that general intestinal damage in fish after a 1.5 long pesticide-and-soap-bath hardly equals proof about celiac disease. You can read more about this bonus study by scientist and consultant Steve Savage in his analysis, [A Fishy Attempt To Link Glyphosate and Celiac Disease](#).

Seneff and Samsel do not stop there. They also claim in a [2015 study](#) that glyphosate is behind a host of ‘modern diseases’. According to Seneff’s [analysis](#), glyphosate is behind the development of: gastrointestinal disorders, cancer, obesity, diabetes, heart disease, autism, Alzheimer’s disease, depression, anxiety syndrome, Parkinson’s disease, prion diseases, infertility, and birth defects. In an [interview](#), Seneff goes as far as to blame glyphosate (RoundUp) for school shootings *and* the Boston Marathon terrorism bombings. Maybe we should also blame glyphosate for climate change?

The red flags could not be much more numerous. Let’s list some:

1. Seneff is not a chemist, a biologist or a medical doctor, so she is publishing outside of her field.

2. The claim that any one specific thing is the cause of a wide variety of startlingly different kinds of diseases. (Same warning goes for any one things that supposedly cures every number of different diseases.)
3. She doesn't produce any actual new data, just reinterprets existing data.
4. She published in low-quality, pay-to-play predatory journals, some of which are not even connected to the field of biology.

Seneff's article on glyphosate and gut microbiota is actually cited on a science website as [a good example of how to spot a bogus scientific journal](#):

This article is attributing pretty much all the chronic diseases of the modern world to a single agent, glyphosate. Wouldn't it be fantastic if just by getting rid of one chemical we could be as healthy and happy as we have never been?

Need I mention, once more, that several comprehensive reviews by actual experts in human disease and biology have not found any epidemiological connection between any of these diseases and glyphosate?

To address concerns about several of these hypothetically connected diseases, the US National Academies of Science included in its [2016 report](#) a comparison of the rates of disease incidence in the US, where GMOS and glyphosate use is abundant, and other countries such as UK, where GMOs grown with glyphosate are almost nonexistent. For the prevalence of celiac disease, autism and food allergies, [the NAS found no difference](#) in autism rates between USA and UK:

Celiac-disease detection began increasing in the United States before the introduction of GE crops and the associated increased use of glyphosate; the disease appears to have increased similarly in the United Kingdom, where GE foods are not typically consumed and glyphosate use did not increase. The similarity in patterns of increase in autism spectrum disorder in children in the United States and the United Kingdom does not support the hypothesis of a link between eating GE foods and the prevalence of the disorder. The committee also did not find a relationship between consumption of GE foods and the increase in prevalence of food allergies.

A word about autism

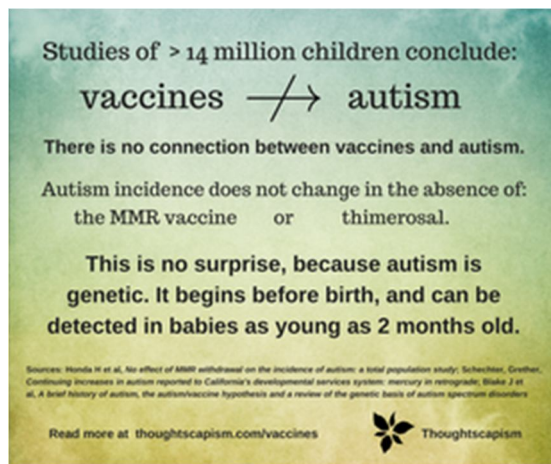
What does the scientific evidence have to say about the causes of autism? The Autism Science Foundation provides a good overview of autism research, and if you look at its reports on studies about autism [risk factors](#) and [environmental factors](#), the list of possible connections to autism is very long—and it does not contain glyphosate:

Maternal age, paternal age, mother's influenza/untreated fever during pregnancy, diabetes, air pollution, cigarette smoke, lead, methylmercury, polychlorinated biphenyls, arsenic, and toluene, manganese, fluoride, chlorpyrifos, dichlorodiphenyltrichloroethane, tetrachloroethylene, and polybrominated diphenyl ethers, organophosphate pesticides, maternal childhood abuse, placental folds...

Autism is fundamentally a genetic disease, and autism spectrum is viewed as a neural ‘type’, not a disease. It is something that is largely hereditary. It develops during gestation and it can be exacerbated by additional (related) new point mutations connected to neural development before or during fetal development. There is a lot of research into what could cause potential epigenetic and other factors that would make some of the more difficult aspects of autism more pronounced.

Considering the number and diversity of these factors, comprehensive meta-analyses or reviews on these topics offer the best way to review the data in context. One of the recent [meta-analyses](#) focused on maternal age:

The results of this meta-analysis support an association between advancing maternal age and risk of autism. The association persisted after the effects of paternal age and other potential confounders had been considered, supporting an independent relation between higher maternal age and autism.



If you would like to read more about all the wild claims and innumerable logical lapses in Seneff’s papers, there are many good places to turn to. Here are a couple: at Biofortified [Medical Doctors Weigh in on Glyphosate Claim](#), Orac on [Oh no GMOs are going to make everyone autistic](#), or even Snopes in their piece on [Glyphosatan – Unsupported claims assert that one in two children will be autistic by 2025 due to the use of glyphosate \(Roundup\) on food crops](#).

If you are interested in the other health effect claims, not discussed under the scope of this post, you can find two more topics over at: [1. Does Glyphosate Cause Cancer?](#) and [4. Does Glyphosate Harm Gut Bacteria?](#), or at the parent page [17 Questions about Glyphosate](#).

New innovative research is always welcome, especially for a substance as widely used as glyphosate, but we should always strive to honestly evaluate the evidence before forming our views on a topic. As the numerous examples above demonstrate, the greatest glyphosate-resistance around may indeed be one of a more psychological kind: it has become a fix idea in many minds that glyphosate must be behind a whole host of ills in our world. Trying desperately to fit the evidence into the idea, rather than allowing our ideas to be shaped by the evidence, is what has resulted in this process of claim-

whack-a-mole. I have no doubt that next month some new variation of glyphosate-sensationalist news will give wings to yet another far-fetched or misleading claim. The game might never come to a real conclusion, for it may be that for many, the only acceptable kind of world is one where glyphosate can only be a bad guy.

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