



## How Does Exposure to Toxic Waste Sites Before Birth Affect Children's Development?

November 2017 podcast episode transcript

Featuring [Claudia Persico](#), Assistant Professor, Educational Leadership and Policy Analysis, University of Wisconsin-Madison

Hosted by Dave Chancellor

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Chancellor Hello and thanks for joining us for the 60th episode of the Poverty Research and Policy Podcast from the Institute for Research on Poverty at the University of Wisconsin-Madison. I'm Dave Chancellor.

This is our November 2017 episode and we're going to be hearing from Claudia Persico about a study she did on how toxic waste sites might impact the cognitive development of the kids who live near them. Dr. Persico is an IRP affiliate and an assistant professor in the Department of Educational Leadership and Policy Analysis here at the University of Wisconsin-Madison.

Persico says her interest in the ways that pollution may affect children grew out of a question that she has been wrestling with since she was a research assistant at the Boston University School of Medicine.

Persico I used to work at the BU School of Medicine in the Department of Anatomy and Neurobiology studying autism, and I became really interested in why low-income children have higher incidences of learning disabilities than their higher income peers because of the fact that that doesn't make sense necessarily from a neuroscience standpoint. So I started thinking about what low income children might be exposed to that might increase their likelihood of having a learning disability and came up with the idea to study toxic waste sites. In this paper, I was trying to determine the extent to which local federal toxic waste sites, Superfund sites, actually impact children's cognitive development and their human capital formation.

Chancellor I asked Professor Persico to tell us more about Superfund sites and the Superfund program itself, which is managed by the United States Environmental Protection Agency, known as the EPA.

Persico Superfund sites are the worst of the worst federal toxic waste sites. They're on what's called the national priority list. There are other toxic waste sites that aren't as bad, like brownfields and Cercla sites, and those don't make it on the national priority list. But Superfund sites, the most famous example I think is Love Canal -- are these really, really bad toxic waste sites. The Superfund program was created as part of the Comprehensive Environmental Response and Liability Act in the early 1980s as most expensive federal program to clean up toxic waste. It actually accounts for a very large portion of the EPA's budget. It's a billion dollar program. That's why it's called Superfund, because the fund is very large, because it's very expensive to clean this stuff up. One of the other reasons I was interested in writing this paper was that we know a lot about the costs of this program, but we know relatively little about the actual benefits, and I was concerned that they might not end at reduced cancer rates.

Chancellor Superfund sites are actually more numerous than many people might guess and according to a 2012 publication from the EPA, about 80 million Americans live within three miles of a Superfund site. And, in Florida, where Persico completed her study, there were 94 Superfund sites at the end of 2016.

Persico Essentially the neighborhoods where Superfund sites exist really vary. Some of them are actually in middle class neighborhoods. But a lot of them are in cities. So, the vast majority of these sites are toxic waste sites that existed because there used to be a factory operating in that district and one of the interesting findings of the paper is that low-income and black children and Hispanic children are all more likely to live next to Superfund pollution than higher income peers or white peers. And so, it's not to say that no white children live next to Superfund sites, because actually about 50 percent of the sample was white, but that there's a disproportionality in who ends up living next to these things. That's a kind of legacy of residential segregation because often industrial zones were sort of redlined to be African American neighborhoods.

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Chancellor Persico says Superfund pollution is complex, in part because there is usually a mix of toxicants -- some that we know quite a bit about and others that we don't.

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Persico We know an awful lot about lead pollution and we know an awful lot about air pollution. We know relatively less about a number about a number of the other toxic compounds that exist within Superfund sites and most of the reason -- most of the research that has been done up to date has been done on rats or using longitudinal studies of children living next to this stuff and trying to get at the etiology of what's been going on. But we know that lead is extremely toxic and demyelinates neurons, which means that it actually -- neurons have this coating that allows the electrical signal to run within the neuron, but not just scatter all over the brain every time a neuron fires. And that's called myelin and what lead does is it actually removes that myelin coat from neurons and so it's one of the known causes of learning disabilities for that reason and there have been a number of really interesting studies showing that decreases in the amount of lead that kids are actually exposed to actually track with massive decreases in crime. So the crime dropping in the 1990s, there are three recent studies suggesting that that was all from taking lead out of gasoline. But lead still exists in a lot of these Superfund sites because they're often sites where there been lead smelters or there had been other kinds of heavy metal-using factories, so factories that had been manufacturing a wide variety of different things. Lead is very, very commonly used in industrial production of just a wide variety of different kinds of stuff like paint. Old paint factories and things like that. Lead has also been taken out of paint. There are also other things, like volatile organic compounds and a variety of other kinds of heavy metals and other sorts of stuff that the EPA has classified as developmental neurotoxins because there is sufficient evidence that when organic beings like rats are exposed that they suffer cell death in their brains. There's reason to think that this stuff could be really poisonous to local children and that there would be a substantial benefit to actually cleaning it up, even just on a moral level.

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Chancellor Professor Persico says that, just as there's a lot of variation in the types of contaminants found at these Superfund sites, there's also quite a bit of variation from site to site in how people might be exposed to the pollution.

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Persico We know from one recent paper that during cleanup, there can be an increase in particulate matter in the air if they're removing soil. But, really, what gets polluted depends on the Superfund sites. And they kind of vary. So in some cases, entire lakes or rivers are Superfund sites. Like the Passaic River in New Jersey which goes right next to Newark, is actually a designated Superfund site and they're right now trying to clean it. People can get exposed when this stuff enters the water, they can be exposed when it gets stirred up. Pregnant women who might be gardening. Sometimes there were people actually living within these Superfund sites. So there was one very large Superfund site in Florida that had a number of houses in it. These things can be quite large and the way that people get exposed, I think, just really varies depending on what specific thing got polluted.

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Chancellor Despite how widespread and varied Superfund sites are, Persico says we know relatively little about the effects of exposure to high levels of industrial toxicants in developed places like the United States. So, to learn more about these effects, in her study, she and her coauthors David Figlio and Jeffrey Roth compare siblings living near Superfund sites where the first sibling is gestating before the site is cleaned up and later siblings are gestating after the cleanup.

Persico And that provides a nice natural experiment where kids are living essentially in the same place, but the only thing that changed is that the toxic waste in their neighborhood got cleaned up by the EPA. I can see the zip code in which they live and I basically mapped the local Superfund sites to where they live and so I was looking at all children living within 2 miles of a Superfund site, and then I also restricted the analysis to just one mile and the results are stronger.

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Chancellor In Persico's analysis, she looked at several indicators related to learning and cognitive development and compared outcomes between the siblings.

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Persico We measured essentially whether or not children might repeat grades in school. We measured test scores. We looked at the likelihood of behavioral incidents at schools since that's an interesting outcomes that could relate to other kinds of inhibitory control or brain development and also the likelihood of different kinds of cognitive disabilities. So we looked at cognitive disabilities overall and then we broke them out by individual categories. So we looked at the likelihood of autism, intellectual disability, speech and language disabilities and learning disabilities, specific learning disabilities. And what we find is that when you compare these siblings where one is born before the EPA cleans up the toxic waste site and the other is born after, that really they have increases in the likelihood of disabilities, lower test scores, increases in the likelihood that they'll be suspended from school and this shows up in the school records, and also increases in grade repetition. And the increase in behavioral incidence was actually surprising to me when I found it because I had not been familiar with this literature on how lead impacts crime, but now that I am familiar with the literature, it seems pretty plausible to me and that it might be a lead story. We try to investigate that in a newer version of the paper, but we also find big effects when lead is not one of the contaminants in the Superfund site so it seems like there could be maybe a toxic stew or some other compounds that might also produce similar negative effects.

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Chancellor And, despite the relatively large differences between siblings that Persico finds, it's possible that those results may actually underestimate the negative effects of this exposure to toxic waste.

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Persico So one of the things about the paper that is a little bit scary is that you could, if you don't believe that the EPA completely cleaned up the toxic waste when they said that the reconstruction was finished and they were going to wait at that point -- that's the point at which they said the site was clean -- I did actually kind of a conservative thing and cut it off a little bit early. And if you don't think that the EPA had completely cleaned the site at that point, then the second child born would also have been exposed to toxic waste, or that those environmental toxicants could have stayed around in the body of the mother because we know that some of them don't leave the body so easily. I think lead is a good example of that. It tends to bind to bones because it mimics calcium so it stays in the body for longer periods of time. So you could think of these estimates, which are relatively large estimates, as underestimates of the truth. But it's not entirely clear and I think we need more research on this kind of stuff before we can make an absolute statement about that.

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Chancellor But, with that said, Persico says that the large effect sizes she finds are consistent with other studies looking at comparable types of exposure.

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Persico For example, there's this Almond, Edlund, and Palmer paper about nuclear fallout after Chernobyl that compares these cohorts of children where one is exposed to the fallout and the other isn't. There are similar papers on lead that shows these large test score results and so one of the things -- we find about a 10th of a standard deviation lower test scores, which is pretty big. And also this increase in learning disabilities, but what most papers don't look at is the kind of learning disabilities piece of this. It's not surprising that there would be this increase in the diagnosis of learning disabilities given the decreases in test scores, but it's interesting to see that that actually exists, and across disability categories, and specifically in the ways that you would expect. We also checked to see if physical disabilities or disabilities you wouldn't expect to be affected by Superfund pollution exist across the kids in the same family. So, for instance, is the first born kid more likely to have head trauma or some-

Persico, continued thing like that? You wouldn't expect that a Superfund site would cause that. We actually don't see any differences except for these disabilities that could potentially be the result of the mother being next to the Superfund site while the child was gestating and while the brain was really forming. I guess I just wanted to suggest that there is a small literature that is all kind of showing very similar point estimates when it comes to test scores and things like that even though they are large. That made me a little bit more confident in my results.

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Chancellor As Persico already mentioned, the children living near Superfund sites -- in Florida at least -- are disproportionately more likely to be black or Latino, and also more likely to be vulnerable in other ways.

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Persico The children who are living are next to these things are particularly disadvantaged already. They tend to be more low income for instance and already have lower test scores and so local public schools have been bearing some of the brunt of this burden because they have had increased special education costs because of this sort of environmental policy issue. So you could imagine this as sort of environmental justice, as education justice, but the essential idea is that these children are pretty vulnerable and they're being exposed to pollution and their higher income peers are not. It does seem like something that could perpetuate the cycle of poverty and be a mechanism through which poverty produces intergenerational disadvantage.

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Chancellor So far, we've been looking at this in light of the very negative effects on cognitive development of already vulnerable for children, but Persico says the flip side of this is that her results show that the EPA cleanup of these Superfund sites makes a big difference and that her results add another dimension to thinking about the benefits of the Superfund program, especially for disadvantaged kids.

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Persico Previous cost benefit analyses of Superfund sites typically were looking at things like reduced cancer incidences and also the effect that designating something a Superfund site has on housing values. It tends to actually kind of a negative effect to have a local toxic waste site be designated Superfund. And that makes some amount of sense, right? But there are maybe other positive benefits that hadn't previously been fully explored and one such benefit is the reduced incidence of learning disabilities. And so what we did as a sort of way to conservatively estimate a cost benefit analysis was we looked at how long the Superfund program would take to pay for itself in terms of reduced special ed costs alone. So, special ed kids cost about 1.6 times as much to educate as typically developing kids and that's also kind of conservative because that's the cost for specific learning disabilities and some of these children might have more costly needs than that. But we find that the Superfund program would pay for itself in about 38 years just in terms of reduced special ed costs. And that doesn't include cancer or any of the health benefits or any of the moral things, we don't include things like dropouts -- so kids with learning disabilities are more likely to drop out of high school. We don't include crime. So, the 38 years is a really, really conservative cost benefit analysis but we just wanted to point out that this program actually might be significantly more cost effective than we had previously imagined.

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Chancellor Many thanks to Claudia Persico for sharing this work with us. If you would like to learn more, the paper, called "Inequality Before Birth: The Developmental Consequences of Environmental Toxicants" is NBER working paper, No. 22263, and is available online.

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