Podcast: Parkinson's Disease, Pesticides, and the Gut Microbiome

[Theme music]

Ashley Ahearn (Narrator): You're listening to Environmental Health Chat – a show from the National Institute of Environmental Health Sciences that explores the connections between our health and our world.

I'm Ashley Ahearn.

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The more scientists learn about our gut microbiome, the more connections they're seeing between the bacteria and other microbes that live in our gut and how our bodies respond to threats to our health.

Some are referring to the gut microbiome as an organ unto itself, not unlike the liver or kidney, that plays a role not only in breaking down food and nutrients – but also in supporting our immune systems.

Beate Ritz has been fascinated by the gut microbiome for years. She's a medical doctor by training, with a focus in neurology, but has devoted much of her career to environmental epidemiology. She's a professor at UCLA.

Her mixed background has put her in a sweet spot from a research standpoint. She studies the connections between our gut microbiome, environmental exposures from harmful substances like pesticides, and what that can mean for our health.

More specifically, she wants to better understand the underlying causes of Parkinson's disease.

Beate Ritz: This was one of the few diseases where it seemed like the environment could have a lot of influence on its etiology. And pesticides became a big front runner of that story, so it really hooked me.

AA: Parkinson's disease is a progressive nervous system disorder that affects mobility. Approximately 60,000 Americans are diagnosed with the disease each year, according to the Parkinson's Foundation.

Dr. Ritz has a personal connection to the disease. As a young medical student at Hamburg University in Germany, she watched as the head of the psychiatric clinic where she was training succumbed to Parkinson's.

BR: And I very much admired the intellect of this man. And he went from being a very lively, highly creative, 63-year-old to looking like an 85-year-old within two years time.

And I watched his very rapid onset Parkinson's disease over a two-year period on a daily basis. And as a young physician – I was in my 20s – I was thinking, what causes this?

AA: Her mentor's name was Jan Gross. And losing him to Parkinson's changed the course of Dr. Ritz's career.

BR: He was an amazing human being and mentor, and the head of that psychiatric department in Hamburg for a very long time. And if you don't know Parkinson's disease patients maybe it's hard to imagine but watching them suffer and watching them become completely immobile and struggling to do the things that seemed very easy even a year before – the movements, the thoughts, the everything. It's very, very, heartbreaking. And I also see that in the family members that are becoming the caregivers of Parkinson's patients.

AA: The exact causes of Parkinson's are not fully understood. There is a genetic component. It's also tied with age and sex – it affects older men primarily.

But environmental exposures are also a factor. Lead exposure has been found to contribute to elevated rates of Parkinson's. Dr. Ritz sees another culprit.

BR: The biggest contributor to risk in my mind, are the pesticides. Pesticides come in very different shapes and forms. Some of them are engineered, more or less, to be neurotoxic, because we're trying to affect the nervous system of insects. Organophosphate pesticides are made to harm the nervous system of insects.

And then of course pesticides are often mixtures. And in the mixture there are often metals. Arsenic is a big part of pesticides, copper is a big part of some pesticides. So, the exposures that humans may get from being close to pesticides, or using pesticides, inhaling pesticides, are very varied.

AA: Since 2001, Dr. Ritz has co-led a study at UCLA called the Parkinson's, Environment, and Genes study. The study has tracked more than 2,000 people in three counties of California's Central Valley.

Ritz and her colleagues used data from the California Department of Pesticide Regulation and lined that up with the home and work addresses of study participants.

BR: And then we know exactly what the poundage of applied active ingredient pesticide was in these areas, so we know what people were exposed to. And we do the same for unaffected individuals. And then we compare these exposure patterns of people who did develop Parkinson's to people who didn't.

AA: They found a correlation between exposures to certain pesticides – organophosphates in particular – and elevated risk of developing Parkinson's.

BR: There are maybe 15 different types [of pesticides], and all of them contribute in one way or another to a slight increase [in Parkinson's disease risk], that then accumulates over time and with more and more agents to a quite big risk increase in developing Parkinson's disease.

AA: Now, Dr. Ritz and her colleagues are taking it one step further and getting into the guts of the matter. (Yeah, I did that)

They are going back to study participants to try and better understand how their gut microbiomes might contribute to their susceptibility to developing Parkinson's disease.

Here's why: some research suggests that Parkinson's may originate in the gut.

People with Parkinson's disease often experience constipation and other gastrointestinal issues decades before the motor symptoms of the disease appear.

And it turns out, the gut microbiome of people with Parkinson's actually looks different.

Some scientists think that the link between Parkinson's and the gut may be a protein – called alpha synuclein. Scientists have found that in the early stages of Parkinson's it appears the protein can start to misfold in the gut.

BR: Meaning they are unshapely. These proteins, these misfolded alpha synuclein, start to aggregate with each other. They are like molds that fit into each other, and they kind of layer on top of each other.

AA: And they can make surrounding normally shaped proteins start to misfold, too. It starts to spread…

BR: And if you have enough misfolded proteins doing this misfolding and then attaching to each other, you get oligomers. And then you get big clumps of protein that we call Lewy bodies. And Lewy bodies are these big protein aggregates that you find in the brain of Parkinson's patients**.**

AA: Those protein aggregates that are found in the brain of Parkinson's patients may have their origin in the gut.

Scientists believe the misfolded alpha synuclein proteins make it through what's called the gut-brain axis. They travel from a person's gut to their brain via the autonomous nervous system where they make the Lewy bodies.

So, what's going in the gut that allows that to happen? Are those misfolded proteins getting through the gut's defenses because the gut microbiome isn't healthy enough to eliminate them?

Dr. Ritz and her colleagues have expanded their study and are now gathering new data from their original study participants to try to better understand how the gut microbiome relates to a person's susceptibility to Parkinson's disease.

BR: The reason we look at the microbiome is because it is that second metabolizing factory of your body. So, it's not just the liver trying to detoxify whatever you take in. It's also your microbiome. And the exposures that you have chronically just like diet, you might be chronically ingesting, inhaling pesticides that are in the air, that are in the water, that are in the soil, that are on your foods, right? If that chronic exposure is being taken care of by a certain type of microbe that can actually handle it and detoxify it, you might not be at risk. But your neighbor who doesn't have that bacterium, or who has another bacterium that may actually be turning this agent into something more toxic, might be the one who then comes down with Parkinson's.

AA: Now Dr. Ritz and her colleagues are adding new study participants as well as going back to 200 original study participants and their household members to collect fecal samples. That way they can analyze what's in their gut microbiomes. They'll line that up with pesticide exposures to see how the microbiome makeup might make someone more or less vulnerable to those pesticides that could then cause Parkinson's.

BR: So the idea is, maybe the household member was exposed at the same level to the same pesticides, because they also live in the same household. But why did they not have Parkinson's? Maybe because their microbiome was able to handle and detoxify, and that of the patient wasn't.

AA: Ritz and her colleagues have also expanded the study to include 120 new Latino participants. In the Central Valley, Latinos make up the majority of farm workers and they have a higher exposure to pesticides.

BR: And we can already see that they are affected worse, meaning the same kind of symptomatology that we see in white males, we're seeing almost 10 years earlier in the Latinos. So, they seem to be getting these same Parkinson's symptoms just earlier in their life. And they also seem to be ending up at with treatment in the doctor's office later. So there's definitely some health disparities and maybe also, due to the exposures, differences in the onset of Parkinson's.

AA: Dr. Ritz and her colleagues hope their research can help inform policies that will reduce human exposure to pesticides in the future. But in the meantime, understanding the gut microbiome could be a first line of defense for all of us.

BR: And I get asked by patient support groups, what can we do? What can we do? And the microbiome is a little more hopeful, because we might actually be able to offer the individuals some advice that will help them protect themselves.

AA: In a time where more and more of us use antibacterial products and live in more sterile, urban environments, our gut microbiome diversity may be suffering.

BR: I mean, the easy answer is do as your grandma told you – eat your greens and fruits and vegetables. Basically, I think the only thing we know at this point what is healthy is a microbiome that is diverse enough to adapt to change. And that diversity will then help us adapt to whatever, you know, we have to adapt to.

[Music comes up]

AA: Dr. Ritz and her colleagues are in their first year of the new study, which is funded by the NIEHS.

But so far, she can tell us this: a diverse gut microbiome is a more resilient gut microbiome. And that could help protect us from the environmental insults we encounter that can have long-term impacts on our health.

I'm Ashley Ahearn. Thanks for listening to Environmental Health Chat.

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