

The Microbiome

[music] Anne Johnson: Welcome to Environmental Health Chat, a podcast about how the environment affects our health, from the National Institute of Environmental Health Sciences Division of Extramural Research and Training. I'm your host Anne Johnson.

Let's start today's podcast with a little trip...into your stomach. Imagine a nice juicy apple. Now take a bite. [crunch] Swallow it and [plunk] it lands in your stomach. Here, it encounters acid, other foods, and millions of cells. But there's a good chance that most of the cells it encounters are not human. [ominous music]

No, they're not aliens—they're microbes. Your bite of apple has just entered a world dominated by bacteria, yeast and other single-celled organisms that inhabit your gut and many other areas of your body. These microbes outnumber human cells in your body 10 to 1. Together, they're called the microbiome.

Now, let's say you forgot to wash that apple, and you swallowed a dose of pesticides along with your bite. How will the pesticides affect your microbes? How will your microbes affect the pesticides? And how might that interaction affect your health?

You could ask the same questions about how microbes interact with metals, the chemicals in plastics, and the hundreds of other environmental exposures we encounter. Those are the questions we're tackling today in our podcast about the microbiome and the environment. Our guest is Dr. Lisa Chadwick. She's a Health Scientist Administrator here at NIEHS, and she directs extramural research programs on the microbiome and the environment.

Lisa Chadwick: We know that microbes do a lot of important things for us. For example, they help us digest our foods, they make things that we can't make, like some vitamins, neurotransmitters, all kinds of things. The Human Microbiome Project, which is part of the NIH Common Fund, took us a long way towards understanding what the normal human microbiome looks like. So we know that the microbiome of an individual varies from body site to body site, so the microbes that you have in your gut are different than the microbes that you have on your skin. And we also know that the microbes, even on one body site, can differ from individual to individual. So your microbiome in your gut is probably different from my gut microbiome. And finally, we know that differences in the microbiome have been associated with a variety of diseases, like obesity.

Anne Johnson: Differences in the microbiome might also lead to different effects from environmental exposures. Some microbes can alter contaminants in ways that make it easier for the body to absorb them, essentially making toxins more toxic. Other microbes might act as a sort of buffer that makes a contaminant less toxic.

Lisa Chadwick: So, that's interesting, because everybody's microbiome is a little bit different, and it may have a slightly different capacity to metabolize the chemicals that we're exposed to. So you can imagine that, if I have a microbiome that tends to push things in that more toxic direction than your microbiome

would, you and I would respond quite differently to the same exposures. So yeah, one of the big questions in environmental health research is what determines individual susceptibility to an exposure, or the differences that we see. There are a number of things that could contribute to that—it could be your genotype—but it could also be things like differences in your microbiome.

Anne Johnson: And unlike your genes, the microbiome can change. It changes in response to the food you eat, the medications you take, and even, perhaps, the environmental contaminants you're exposed to. Scientists hypothesize that some exposures could alter the makeup of your microbiome in a way that makes you more susceptible to certain diseases, or makes you more vulnerable to future exposures. These are just a few of the ideas researchers are pursuing.

Lisa Chadwick: We have a lot to learn about how environmental chemicals interact with the microbiome. There's two questions that I think are particularly interesting. One is that the effects of early life exposures can often result in disease later in life, but we don't really have a great grasp on the mechanism by which that happens. So the microbiome is also developing in that same window of time, and I think it's possible that exposures that happen during that developmental window could have lasting effects on the microbiome that could affect its function long-term and lead to disease later. And then another exciting future direction of research will be how can we manipulate our microbiome to protect us from the effects of exposure. It will be interesting to learn whether we can modify our microbiome in a way that helps us respond better to exposures, or if we can modify it to help offset the effects of exposures.

Anne Johnson: Lisa told me about a few research projects that are ongoing, with funding from NIEHS.

Lisa Chadwick: We are very interested in this and we are funding a few studies in both exposed human cohorts and animal studies that are looking at the effects of a variety of different environmental exposures on the microbiome. For example, we have two human studies that are looking at arsenic exposure, we have an interesting zebrafish study that is looking at tributyl tin, which we know is a chemical that can cause you to become obese when you're exposed to it, so they're looking at whether that is the result of changes in the microbiome.

Anne Johnson: A quick plug here: if you're interested in learning more about arsenic or tributyl tin, check out our podcast episodes titled *Arsenic in Rice and Other Foods*, and *Obesity and the Environment*.

Okay, back to microbes for one final thought before we wrap up. Although we don't yet fully understand how the microbiome influences environmental exposures, there is good evidence that the microbes living in and on our bodies have a huge, and largely positive, impact on our health. Lisa says it's time to change our mindset about microbes.

Lisa Chadwick: We think about germs as being bad. We try to kill them with antibiotics and antimicrobials, and we want to be as germ-free as possible. But we have to remember that those kinds of interventions kill the bad microbes, but they also kill the good ones. And our microbiome does so

many important things for us—including actually protecting us from pathogens—that we need to be thinking more about how we can keep our microbiome healthy.

Anne Johnson: There are a lot of scientists thinking about just that—and we're here to keep you posted as we learn more. Thanks to today's guest, NIEHS's own Lisa Chadwick.

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