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Partnering With Indigenous Communities to Improve Tribal Health

Narrator: This is the Global Environmental Health Chat, the podcast that explores environmental health issues that transcend national boundaries. This podcast is produced by the National Institute of Environmental Health Sciences.

You've perhaps heard of the California Gold Rush, sparked by the 1848 discovery of gold at a sawmill outside Sacramento. In flocking to California, gold diggers joined a metal-mining frenzy unfolding across the Western United States. For decades into the 20th century, hardrock miners sought elements like silver, lead, copper, vanadium, and, eventually, uranium. Much of that excavation occurred on lands promised to Native American Tribes who had been pushed from ancestral lands. Similar stories have played out across the globe.

In this episode, we will discuss the Tribal health implications of exposures to environmental pollutants, including metals from hardrock mining activity. Our guest is Dr. Johnnye Lewis, professor emerita and founding director of the University of New Mexico's Community Environmental Health Program. Within that program, Lewis co-directed the NIEHS-funded Center for Native American Environmental Health Equity Research, a partnership among researchers, agencies, and Crow, Sioux, and Navajo Tribal communities. Lewis also directed the university's NIEHS-funded Superfund Research Center, the first of its kind to focus on Indigenous populations.

Although each of these centers has distinct aims, they all share a common goal, Lewis explains.

Johnnye Lewis: So, all of these centers are working in partnership with Indigenous communities to answer questions largely related to environmental contamination. And we work with Tribes throughout the western U.S., mostly in the Northern Plains area, and in New Mexico and Arizona in the Southwest.

The biggest problem that I've seen in all the communities that I've worked in is that rural communities in general, and Tribal populations, I think, much more so, rely more heavily on local resources. And so that really shifts the model for how you calculate an exposure to a local contaminant source.

If you look at, you know, an urban community, in general, I think about 10% of that food is produced locally. And some of the surveys I've done in Indigenous communities — that can be 95%. There's much more reliance on growing their own food, raising their own livestock, local hunting, local fishing, burning local firewood, drinking local water sources. There's also, in many of these communities, not a really substantial infrastructure. And that can also lead to a lot more reliance on local resources that often aren't regulated. And if they're not regulated, that means often they're not monitored, and so people don't really have a clear idea of what the content and the quality of those local resources might be.

Narrator: Pollution of local resources by metals associated with hardrock mining activity is a major ongoing concern among the Tribal communities working with Lewis.

Until the 1980s in the United States, hardrock mine operators simply abandoned depleted sites. They left in their wake various health hazards, such as piles of pulverized rock from mineral extraction. Known as tailings, these remains can contain heavy metals and other toxic elements, like arsenic, that can disperse into the environment.

As of 2019, federal agencies had identified at least 140,000 hardrock mine remnants on lands they oversee. Hundreds of thousands more remnants likely exist. According to a study co-authored by Lewis, more than an estimated 600,000 Native Americans live within about six miles of an abandoned hardrock mine.

Johnnye Lewis: If we look at the kinds of metals that are in those mines, gold was, without question, the most predominant of the target ores. But next to that are uranium and vanadium. And those two often co-occur. And I think the problem is that geologically, all of these metals coexist in different concentrations and particular distributions. So, they're all complex mixture exposures, and complex mixtures are what we know the least about toxicologically.

Narrator: People can become exposed to those complex mixtures through contaminated air, soil, and water.

Johnnye Lewis: During the time of active mining, a lot of those mines had water in them, so the mining companies de-watered in order to be able to dig more tunnels, and then that contaminated water would be a water source that maybe was ephemeral before and becomes a permanent water source for that whole operational phase, and then the mine closes, and the water dries up, but the contaminants are still there in the sandy bottoms of arroyos.

Narrator: Arroyos are dry channels that seasonally fill with water. That water can pick up metals in the soil that can subsequently wind up in drinking water sources.

Johnnye Lewis: Navajo Nation, for example, has more than 500 abandoned uranium mines. And some of those are small, but some of them are very large. One of them was the largest underground mine in the country for a while, and for a time, in the world. And so, when you leave all the waste from that sitting within eyesight of a community of 40 households, or 50 households, they know it's there, and they worry about it for good reason.

Narrator: In response to community concern, Lewis's team analyzed reams of water quality data collected over 25 years in Navajo Nation by Tribal, federal, and academic groups. They found that arsenic exceeded national drinking water standards in 15% of tested water sources. Uranium surpassed those standards in nearly 13% of tested water sources. Unregulated water sources closer to abandoned uranium mines contained significantly higher concentrations of arsenic or uranium than more distant sources.

Johnnye Lewis: So we have areas where arsenic is the primary contaminant. And then we have other areas where it's a co-contaminant with uranium. And the toxicity, you might expect, will differ depending on what that particular combination of metals in any particular point would be.

Narrator: Lewis's team has investigated the potential health effects of chronic exposure to mining waste. Population studies with Navajo Tribal members have shown an association between exposure and several types of diseases. Subsequent laboratory research has bolstered those findings.

Johnnye Lewis: What we saw was an increased risk for cardiovascular disease, and an increased risk for having multiple chronic diseases if we looked at cardiovascular disease, diabetes, and chronic kidney disease as a package.

Then we were also able to go back into the lab and look for mechanisms, and we asked does that make sense if you have these exposures — do you have changes physiologically that would support atherosclerosis, for example.

Narrator: Atherosclerosis occurs when plaque builds up in the arteries, causing them to harden or thicken. By analyzing blood samples from community members, Lewis's team found connections between exposure to metals and atherosclerosis.

Johnnye Lewis: And you could see that as those exposures went up, we got an increase in the kind of biological processes that had been associated with atherosclerosis. And we could also show that that mine waste in animal models would produce an increase in contraction to a stimulus that was meant to contract vessels. And it would produce a decrease in relaxation. So again, very consistent with atherosclerosis.

Narrator: Over the years, Lewis's research has largely focused on exposures to waste from abandoned mines. But more recently, her colleagues have been investigating a different source of pollution: open burning of household trash.

Johnnye Lewis: Open burning of waste is a big issue in Tribal communities, largely due to lack of infrastructure for solid waste disposal. If you don't have a truck that's coming around and picking it up, you're left to your own resources. And often that means that you burn it because it makes it go away.

On some of the reservations we work on there are very large burn piles, in canyons, and in the same canyons that people live in. And initially, how this came to our attention was bringing back pictures of, on bad days, the smoke, just filling the whole valley and people wondering what what's happening.

Narrator: The trash that people discard hints at the combustion byproducts they might be exposed to. For example, far more plastic appears in waste piles now than in decades past.

Johnnye Lewis: Those plastics have a lot of chemicals in them that essentially, you know, they're evaporating, they're becoming volatile. A lot of those chemicals are known as endocrine disruptors, so they can throw physiological systems off in a very serious way.

Narrator: Lewis and colleagues are also concerned about pollutants called microplastics. These tiny plastic pieces can come from bigger chunks of plastic that have burned, disintegrated, or otherwise broken apart.

Johnnye Lewis: Most of these sites are very low-temperature combustion, which means you don't get a complete burn, and you leave a lot of microplastics behind. Those also then can move in the environment, they can move in the soil, they can move from soil to plants, they can become a source of potential ingestion risk for not only the human population, but also for the wildlife, and also for the plants.

Narrator: University of New Mexico researchers are studying the chemicals coming from solid waste combustion sites using a simple technology invented by an NIEHS grant recipient. The tool consists of a silicone wristband that detects chemicals from the air, water, and even skin.

The team is placing the sensor on people and their pets, as well as in places of concern in the surrounding ecosystem. Once they understand what kind of volatile chemicals communities are encountering, they can study associations between exposures and health outcomes. And they can *also* investigate the interplay between exposures to solid waste combustion byproducts and to metals from mining activity.

Johnnye Lewis: It's hard enough to understand what the toxicology is that's associated with a combination of 20 different metals that are all at fairly high concentrations, and then to think what happens if, in addition to those, we have all of these plastics, and then we have all of these volatile compounds that are coming off as well. And I think we're going to learn a lot as this continues.

Narrator: As the researchers learn, they make sure to share their findings with Indigenous partners. That means taking the time to translate scientific jargon into messages that resonate with their audiences. Based on community feedback, the researchers are improving how they communicate their results.

Johnnye Lewis: One of the things people suggested was art, that these communities thought very visually, and that art would really help them to understand what we were doing. I actually had been introduced to an Indigenous artist who also had a medical background, and so she's leading the translation of our work back to communities. We also have cultural and language specialists who work with us and can try and link what we do back to Indigenous traditions that may have changed the way exposures occur.

Narrator: Regular dialogue with Tribal members can also ensure that study designs are culturally appropriate. For example, community input was key to informing a clinical trial now underway in Navajo Nation.

Funded by NIEHS, the study is investigating the use of zinc as a dietary supplement. Zinc is a critical nutrient for neurodevelopment. Research also suggests that zinc can reduce the effects of exposure to toxic metals like uranium.

Many Navajo Tribal members are zinc deficient, largely because traditional diets have changed, says Lewis. Her team designed the zinc study around a core Tribal belief in maintaining balance among all facets of life.

Johnnye Lewis: So in Indigenous communities, that concept of balance is really an important one, a perspective that we try and learn more about. For them, the environment is a system, and it doesn't live separately from you.

And then if you look at the balance in the system, uranium didn't belong in piles on the surface, it belonged underground. And now it's getting into your system, as well, your own physiology. And so, if you can use another naturally occurring metal that's deficient, zinc, you're counteracting that exposure with something that traditionally had been part of your diet. And you're just bringing that, not to heroic levels, but to balance.

Narrator: Preliminary results from the zinc study have been encouraging, says Lewis.

However, the road to improving Tribal health and justice is long, she adds. From a scientific perspective, one of the most important things a researcher can do is to give Tribal communities a voice.

Johnnye Lewis These exposures and the variables that have affected Indigenous populations are a global issue. And, you know, I think the more we can understand about the effects, the interactions between culture and outcome, the better position it's going to put a lot of those communities in to start looking at things that may have happened there.

All of the research that we do has been driven by questions that have come back to us from communities. We don't come in with our research ideas. When we talk about community research, it's really, How do we get the people who have the expertise to answer that particular question? And you end up with this very large and very diverse team as a result of that.

We're really hopeful that by developing these kinds of partnerships, community becomes part of the solution.

Narrator: The National Institute of Environmental Health Sciences funds research to improve human health. As part of its mission, it is also working to better understand the health effects of climate change. You can learn more about the institute's research by visiting our website at www.niehs.nih.gov/GEH. Thanks again to Dr. Johnnye Lewis for joining us today. You've been listening to Environmental Health Chat, brought to you by the Global Environmental Health program at the National Institute of Environmental Health Sciences.