

Sympatric Ehrlichiosis and Lyme Disease in New Jersey

[Announcer] This program is presented by the Centers for Disease Control and Prevention.

[Sarah Gregory] Today, I'm talking with Dr. Andrea Egizi, a tick specialist, about Ehrlichiosis and Lyme disease in New Jersey. Welcome Dr. Egizi.

[Andrea Egizi] Thank you.

[Sarah Gregory] Your article discusses sympatric ehrlichiosis and Lyme disease. What does sympatric mean?

[Andrea Egizi] "Sympatric" means that they're occurring in the same place. Not all parts of the country have Lyme disease, and not all parts have ehrlichiosis, but Monmouth County, where we did the study, has both, so we can compare them.

[Sarah Gregory] Probably most people have heard of Lyme disease and they know you get it from the little deer tick. What is ehrlichiosis and how is it different from Lyme disease?

[Andrea Egizi] Ehrlichiosis is the name of a human disease caused by a particular species of bacteria, in the genus *Ehrlichia*. It has some things in common with Lyme disease, which is also caused by a bacterium. For example, they're both transmitted by ticks, although by different species of ticks. *Ehrlichia chaffeensis* and *Ehrlichia ewingii*, the species that cause human ehrlichiosis, are transmitted by the Lone star tick, while *Borrelia burgdorferi*, which causes Lyme disease, is transmitted by the blacklegged tick, which is also known as the deer tick, but that's actually a bit of a misnomer, since they feed on much more than deer. Some of the symptoms of Lyme and ehrlichiosis can be similar, ones common to a lot of tick-borne diseases, like fever, headaches, muscle aches, etc. However, ehrlichiosis doesn't really present with any 'dead giveaways' like the bulls-eye rash of Lyme disease. People may get a nonspecific rash or none at all. Lastly, both Lyme and ehrlichiosis are treated similarly with antibiotics.

[Sarah Gregory] Where did you do this study and why did you pick that area?

[Andrea Egizi] We did the study in Monmouth County, New Jersey. It was one of the first places in the state to have large numbers of Lyme cases, back in the 1980s, and as a result of the high continued prevalence, the county established a tick-borne disease program, the only one in the state. Our program includes ongoing research on tick populations and tick-borne diseases, as well as a passive surveillance program, where people bring in ticks to us to identify. So we were fortunate to have data available for Monmouth, not only on tick populations in the field and tick infection rates from prior studies, but also on the numbers of ticks people were finding on themselves and bringing in to us. So, we kind of had the 'perfect storm' of data to be able to address the questions we were interested in.

[Sarah Gregory] So tell us about your study. How did you conduct it and what did you find?

[Andrea Egizi] So, as I mentioned, we had all of this great data available to us, either published or in the process of getting published as part of other studies, and what it was showing was that

lone star ticks were very abundant in Monmouth, actually more abundant than blacklegged ticks. So, to calculate the relative risk of getting ehrlichiosis compared to Lyme disease, we multiplied the abundance of lone star ticks times the chance of their being infected with *Ehrlichia*, and then divided that by the abundance of blacklegged ticks times their chance of their being infected with *Borrelia burgdorferi*. And we found that ehrlichiosis cases should occur .6 times as often as Lyme disease. In other words, for every two people that might be infected with Lyme disease, there is at least one person out there potentially infected with ehrlichiosis. And this is far less than what we actually see in terms of human cases. In 2014, for example, in Monmouth county there were 439 confirmed cases of Lyme disease. So, based on our calculations, we would have expected to see about 265 cases of ehrlichiosis. But there were only two.

[Sarah Gregory] Do you have any explanations for this lower-than-expected number.

[Andrea Egizi] Well, we have some ideas of what would be causing this, but they're just guesses as there's no way to really know for sure. One possibility is that doctors aren't really as familiar with ehrlichiosis in areas that have historically had a lot of Lyme disease. They're very familiar with Lyme, it's a huge deal in these areas, tons of cases, and so they could be more likely to diagnose it. As I mentioned earlier, ehrlichiosis doesn't really have any one symptom that screams "this is ehrlichiosis." It has more of a general flu-like illness presentation that, like many tick-borne diseases, can be mistaken easily for other things.

Another possibility is that a large proportion of ehrlichiosis cases are asymptomatic, meaning when people get infected, they don't show any symptoms. If they don't have symptoms, they won't go to the doctor, they won't get tested, and they won't be counted in the case reports that get sent to the health department. So, there's some evidence, based on a few studies in other states, that if you actively screen people for ehrlichiosis antibodies, many have the antibodies, which is evidence of prior infection, yet they don't recall ever having the disease.

[Sarah Gregory] So, what are the implications of the numbers you discovered? Does this mean that ehrlichiosis cases may actually be going undiagnosed?

[Andrea Egizi] Yeah, our calculations show that it is likely that many cases are undiagnosed, though, as mentioned before, we don't know whether this is because people don't show symptoms, or because the symptoms are not specific and people and physicians are less familiar with it.

[Sarah Gregory] How many different species of ticks are there in the U.S. and how many different diseases?

[Andrea Egizi] Boy, what a question. Well, first of all, there are a lot of species of ticks that don't transmit anything to humans, or even bite humans, that are just parasites of wildlife. So I'm not sure what the total count of those are. But in terms of ticks that are vectors of human disease, for hard ticks, like the blacklegged and lone star ticks, I would say there are at least eight, but no one part of the country has all of them.

As far as diseases go, in the U.S. probably 11 or 12. There's, of course Lyme disease and ehrlichiosis that we've been talking about, but also Anaplasmosis, Babesiosis, Tularemia, Rocky Mountain spotted fever, and other spotted fever group illnesses; Powassan virus, Deer tick virus, Colorado tick fever, Heartland and Bourbon viruses. There are also several bacteria that have

been discovered in ticks whose pathogenicity is still being evaluated, or who have only been linked to one or a few human cases. At least half a dozen or so species fall in this category, meaning that new diseases, or new pathogens that can cause familiar diseases, are being discovered all the time.

Also I should add that apart from those I've just said, there's another group of ticks called 'soft ticks' that are very different from the hard ticks we've been discussing, in terms of life cycle and biology, and these transmit species of *Borrelia* that cause relapsing fever in the mountainous regions of the western U.S. So add a couple more to the above totals and that should do it...for now.

[Sarah Gregory] Mosquitoes seem to be producing more and more diseases—or at least the strains seem to be becoming stronger and more prevalent—dengue, chikunguna, Zika, malaria—is this true of ticks, too?

[Andrea Egizi] So, I'm not sure I would say the strains are becoming stronger, but what is happening is that these diseases are moving into new areas and infecting new populations, both on a global scale, such as moving into new countries, and on a more local scale, such as diseases that previously circulated mostly in wildlife populations now moving into humans or diseases formerly associated with the 'backwoods' starting to occur more in cities and populated areas. Sometimes this is because they develop a mutation that makes them able to infect a new population or become better at infecting the current population, or because of ecological and environmental changes or human movement. Regardless, whenever a disease starts infecting a population with no prior exposure or immunity, there'll be a large number of cases, what we observe as an outbreak.

This is true, both for tick and mosquito diseases, though mosquito-borne diseases tend to emerge and cause outbreaks on a much shorter time scale, due to the nature of their life cycle. So, most hard ticks have a two-year life cycle, whereas mosquitoes can have a generation in just a couple weeks during the summer. This is, I think, why mosquito-borne diseases make more of a splash in the news, because they go from 0 to 60 pretty quickly. Tick-borne disease patterns change more slowly, and are not as splashy, but they're still changing. As I mentioned earlier, new pathogens and diseases transmitted by ticks are continually being identified, and case rates of existing diseases inch their way up each year.

[Sarah Gregory] What needs to be done to protect people from tick bites and the resultant infections?

[Andrea Egizi] There's a lot we don't know about ticks and host populations and their dynamics over space and time that really limits our ability to successfully intervene against tick-borne diseases. For example, at what spatial scale do you need to do the control to have an effect on disease transmission? Do you need to treat every single backyard? Is that even affordable or feasible? Will the methods that work in one area, for example, control-targeted at hosts, work in another area, if the hosts are different? How much insecticide resistance is there in tick populations? I could go on, but basically, the short answer is we don't know, but there're a lot of smart people working on this question, including at the CDC, and I'm optimistic we'll know a little better each year. In the meantime, what can be done is work on educating people about tick-borne diseases and empowering them to protect themselves and their family from tick bites.

[Sarah Gregory] So what are the best ways for people to protect themselves?

[Andrea Egizi] The best advice is to wear repellents when you go out in tick habitats. Unfortunately, for many people, this is their backyard. Repellents that have been shown to work against ticks contain DEET or oil of lemon eucalyptus as active ingredients, but like sunblock, they eventually wear off and need to be reapplied. So make sure to read and follow the label instructions to get the most effective and continuous protection. You can also treat your clothes, but not skin, with sprays containing permethrin.

Other advice is, try to stay on trails and avoid crashing through bushes and tall grass. Perform tick checks right when you come in from outside and wash your clothes, since ticks can hitch-hike in on your clothes. Treat pets that go outside with tick preventatives recommended by your veterinarian so ticks don't hitch-hike on them either.

Lastly, there're some landscaping techniques that are recommended to reduce ticks in your yard. This includes things like keeping your grass mowed and your bushes trimmed, removing leaf litter, basically anything that keeps the soil drier will make it harder for ticks to survive, and you can also adopt measures that make your yard less appealing to critters that carry ticks, like rodents and deer.

[Sarah Gregory] Would you like to tell us about your job and how it relates to ticks?

[Andrea Egizi] Sure. I run the tick-borne disease lab for Monmouth county, and we have several ongoing research projects to understand the prevalence of pathogens in Monmouth ticks, including how it varies across habitats and over time and how that relates to human risk of disease transmission.

[Sarah Gregory] Ok, one last question. We have scientists here at CDC who are every absorbed in their tick investigations to the point that at least one of them has a tick tattoo on his arm. Do you have one of those too?

[Andrea Egizi] No tick tattoo, but I'd totally wear tick jewelry, if it existed.

[Sarah Gregory] Thank you very much, Dr. Egizi. Listeners can read the entire June 2017 article, "Relative Risk for Ehrlichiosis and Lyme Disease in an Area where Vectors for Both Are Sympatric, New Jersey, USA," online at CDC.gov/eid.

I'm Sarah Gregory for *Emerging Infectious Diseases*.

[Announcer] For the most accurate health information, visit cdc.gov or call 1-800-CDC-INFO.