

Ticks may cause double trouble, scientists find

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As winter turns to spring and many Northern Californians plan outdoor adventures, a mysterious, potentially debilitating threat looms.

A newly recognized human pathogen with unknown health consequences has been found to occur over a large part of the San Francisco Bay Area. A study to be published in the March issue of the journal *Emerging Infectious Disease* details how researchers including Dan Salkeld, a research associate at the Stanford Woods Institute for the Environment, found the bacterium, *Borrelia miyamotoi*, as well as *Borrelia burgdorferi*, the bacterium that causes Lyme disease, in ticks they sampled throughout the area.

The researchers were surprised to find ticks infected with one or both bacteria in nearly every park they examined. The findings raise the question of whether *B. miyamotoi* has gone undetected in California residents. They also represent "an important step toward dispelling the perception that you cannot acquire Lyme disease in California," said Ana Thompson, executive director of the Bay Area Lyme Foundation.

Known for some time to infect ticks, the first known human case of *B. miyamotoi* infection in the U.S. was discovered in 2013. Beyond Lyme-like symptoms such as fever and headache, little is known about its potential health impacts. In the Bay Area, low awareness of tick-borne diseases such as Lyme could heighten the risk of infection with *B. miyamotoi* for users of the region's extensive natural areas and trails.

"People who have difficulty getting diagnoses – maybe this is involved, " Salkeld said.

Understanding Lyme Disease

Lyme disease, named for Lyme, Conn., where the illness was first identified in 1975, is transmitted to humans via the bite of a tick bite infected with *B. burgdorferi*. In California, the culprit is the Western black-legged tick and the primary carrier is the western gray squirrel. On the East Coast, it's the black-legged tick and the white-footed mouse is the main carrier.

Lyme can be difficult to diagnose, but its early symptoms include fever, headache, fatigue and sometimes a telltale rash that looks like a bull's-eye centered on the tick bite. If left untreated, the infection can cause a range of health problems from arthritis and joint pain to immune deficiencies and a persistent cognitive fog. Most people recover with antibiotic treatment, but, for unknown reasons, some patients who suffer from a variety of Lyme-like symptoms find no relief from the normally proscribed therapy.

Although the majority of U.S. Lyme infections occur in the Northeast, incidence of the disease is growing across the country. Changes in climate and the movement of infected animals may be partly to blame. Last summer, the Centers for Disease Control and Prevention reported that as many as 300,000 Americans contract Lyme disease annually, a rate 10 times higher than previously reported. The new figure, the result of national laboratory surveys and a review of insurance information, reflects what has long been suspected: Lyme is not well diagnosed or reported by many doctors.

When someone is infected, it can take weeks before blood tests detect antibodies. Adding to the diagnostic headache, tests have been known to

return false positives and false negatives. Current testing capabilities also have a hard time determining whether the infection has been cured.

An interdisciplinary Lyme Disease Working Group at the Stanford School of Medicine is exploring ways to improve diagnostic tests and medical understanding, evaluate the effectiveness of innovative therapies, expand clinical services and and build greater public awareness.

Studying a Mystery

Salkeld is a research scientist at Colorado State University and a former lecturer at Stanford who still does disease ecology research at the Stanford Woods Institute. He started this tick research with Stanford Woods Institute Senior Fellow Eric Lambin while teaching a course in conservation medicine at Stanford.

Aided by his Stanford students, Salkeld's initial research focused on assessing the risk of Lyme disease at the university's Jasper Ridge Biological Preserve and in the neighboring towns of Portola Valley and Woodside.

Salkeld and his fellow researchers went on to test 12 Bay Area recreational areas. They found *B. burgdorferi* in about 2 percent of adult ticks, an expectedly low rate of infection for the region, according to Salkeld. By comparison, about 35 percent of adult ticks in the Northeast U.S. carry the bacterium.

Salkeld was surprised to find ticks infected with *B. burgdorferi* not only in woodlands, but also in grassland chaparral habitat far from wooded areas. He was more surprised to find that ticks were infected with *B. miyamotoi* at slightly higher rates than those infected with *B. burgdorferi*.

Concerned Citizens

Salkeld's research is funded by the Bay Area Lyme Foundation, a national nonprofit founded in 2011 by residents of Portola Valley, Calif. Alarmed at the number of people with Lyme disease in their community, the group's founding members began an informal research initiative. They read all they could about the disease and invited medical authorities to discuss Lyme at neighborhood gatherings.

"At the beginning, we were just trying to learn about Lyme disease and why people were getting it," said Bonnie Crater, the group's co-founder and vice president. Crater and others were frustrated with the apparent lack of regional medical knowledge on the issue as well as the difficulty of getting a diagnosis and treating the disease. "This is not cancer. It's bacteria, and we've had antibiotics for over 100 years."

"Diagnostics is the No. 1 thing in terms of getting care," said Kathleen O'Rourke, a co-founder and advisory board member of the Bay Area Lyme Foundation. When O'Rourke sought help for her 9-year-old son suffering from Lyme-like symptoms including intense fatigue, a pediatrician listed a range of possible issues, but not Lyme. "We were told there is no Lyme in California," she said. Five months later, when her son was almost too weak to walk, O'Rourke found a doctor who ran a battery of tests that found Lyme.

After a year and a half of heavy antibiotic doses, O'Rourke's son was back to normal. O'Rourke wasn't as lucky. After getting her own Lyme diagnosis, she suffered through four years of treatment and lingering symptoms. The pain of unmedicated childbirth "was nothing compared to this," she said. "The pain was excruciating. It was like liquid fire in the joints."

Provided by Stanford University

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