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Lyme Disease: A Zoonosis Tick-Borne Borrelia Bacterium [2/4]

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Editorial

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Editorial

Lyme disease is present worldwide but is most prevalent in the temperate regions of the hemisphere, where it is the primary vector-borne illness. Every year, numerous individuals in Europe and the United States receive a diagnosis and undergo treatment for Lyme disease. The transmission of tick-borne diseases is a complex process, and it is challenging to identify the factors that contribute to their spread. Epidemiology provides a means of analyzing the distribution of Lyme disease within a population and identifying risk factors. The epidemiology of infectious Lyme disease is essential for implementing preventive healthcare. The spatiotemporal dynamics of Lyme disease are associated with the spatiotemporal factors of humans, infected vector ticks, and infected hosts. The only environmental variable consistently linked to an increased risk and incidence of Lyme disease is the presence of forests. Therefore, forests are the primary variable that raises the risk of Lyme disease [1,2].

Ticks are ectoparasites of vertebrate animals and are the primary vectors of Lyme disease. Ticks have a unique body structure consisting of a fusion of the opisthosoma with the prosoma. The gnathosoma is the head region and contains mouthparts, two palps, two chelicerae, and a hypostome. The idiosoma, or body, includes the legs, digestive tract, reproductive organs, bears sclerites, and the gonopore. Ticks legs contain Haller's organ, which detects odors, temperature, moisture, and vibrations in the environment to locate potential hosts [3,4]. The tick also possesses a cephalic rostrum, a perforating organ composed of the hypostome and chelicerae, which function as macerator organs. Ticks have specialized mouthparts that allow them to insert their hypostome into the host's skin and extract blood [5,6]. When feeding on blood, ticks release an anticoagulant and anti-inflammatory substance to bite the host painlessly. Ticks transmit pathogenic infections, including bacteria, viruses, and protozoa [7,8]. There are three families of ticks: Ixodidae, Argasidae, and Nuttalliellidae. The primary vectors of Lyme disease are ticks from the family Ixodidae, specifically the genus Ixodes (Figure 1).

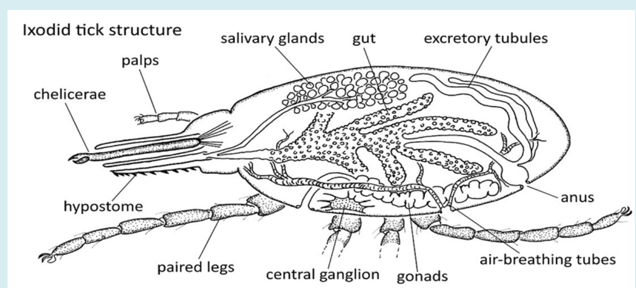

Figure 1: Anatomy of Ixodidae tick showing the major organs, legs, and feeding apparatus. This image is licensed under creative commons attribution.

Ticks female lays eggs on the ground, and these eggs hatch into larvae that survive by feeding on the blood of animals. These larvae then mature into nymphs and feed on animal blood before molting and transforming into adult ticks. Once feeding, adult ticks mate, and the female lays eggs in the environment. Depending on the species, Ixodidae ticks may have a one-host, two-host, or three-host lifecycle [9,10]. The lifecycle of the genus Ixodes is closely related to climatic conditions like temperature and humidity. Tick activity in Europe generally peaks between May and October, while in the Mediterranean region, tick activity is highest between November and January (Figure 2). Ticks are ectoparasites of various animal species. Ixodes ticks infest a variety of hosts, including amphibians, reptiles, birds, ruminants, and carnivores. Germ reservoirs for Lyme disease are generally rodents, birds, and deer. The larvae and nymphs of these ticks feed on rodents, birds, and Leporidae, while the adult females typically feed on great animals. Infestation of ticks on an infected host occurs during a blood meal. The *Borrelia burgdorferi* spirochetes move in the tick's intestinal microvilli and salivary glands of ticks. Transmission of the disease occurs when ticks bite the host during a blood meal [11,12].

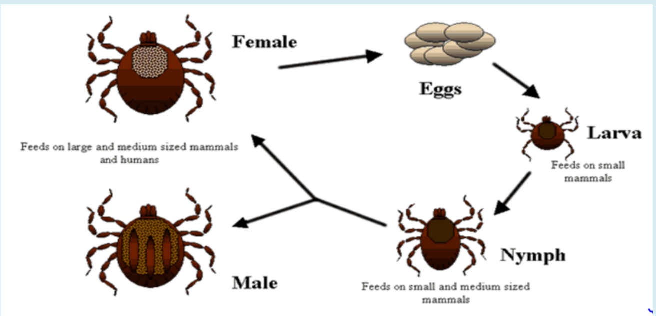

Figure 2: Life cycle of ticks Ixodidae. This image is licensed under creative commons attribution.

Environment affects geographical distribution, host diversity, and specificity of ticks. The molecular tools have made it easier to detect bacteria transmitted by arthropod vectors, such as ticks, that cause Lyme borreliosis. *Ixodes ricinus* ticks mainly transmit Lyme borreliosis, which is responsible for cases of the disease found in almost every country on the continent. Lyme borreliosis is an arthropod-borne disease that emerges and re-emerges in temperate regions of the northern hemisphere (Figure 3). It is the most prevalent vectorial disease in Europe and North America. Lyme borreliosis is a bacterial zoonosis that evolves with the changes in society, climate, and lifestyle. Factors such as human demographics, economic development, and microbial adaptation are involved in the spread of the disease [13,14]. Studies conducted in Tunisia, Algeria, and Morocco have revealed the presence of *Ixodes ricinus* in fresher and more humid areas of North Africa. Lyme borreliosis occurs in this region based on clinical and serological features. Polymerase chain reaction (PCR) assays have confirmed the existence of Lyme borreliosis in Africa [15,16]. In Asia, Lyme borreliosis-infected ticks are increasingly being found in Japan, as well as in northwest China, Nepal, Thailand, and far eastern Russia. The Borrelia species responsible for Lyme disease in northeastern China resemble those found in the far east of Russia and Japan. The clinical features of Lyme borreliosis differ from continent to continent due to the different genospecies in animal hosts [17,18]. Lyme borreliosis, a zoonotic disease spread by ticks, is prevalent in Europe and North America. The primary cause of the disease in Europe is the *Borrelia burgdorferi* infection transmitted by the *Ixodes ricinus* tick. Adult females are more susceptible than nymphs and adult males, respectively. Furthermore, significant variations exist in infection rates across European regions, with Central Europe showing the highest rates [19-21]. The prevalence of Lyme borreliosis in ticks attached to pet dogs in the United Kingdom has served as an indicator of human exposure to infected ticks [22]. Lyme disease, the most prevalent vector-borne infection in North America, has been present in these regions for thousands of years before European settlements. It is considered the most common zoonosis transmitted by vectors in temperate zones globally and is an emerging infectious disease in Canada [23,24]. In the United States, Lyme disease is one of the fastest-growing infectious diseases, and the geographic extent of endemic areas has dramatically increased. The population of Lyme disease-carrying ticks has reemerged from relict foci that have persisted since pre-colonial times. Tick-borne diseases are also becoming more recognized and prevalent in South America [25,26].

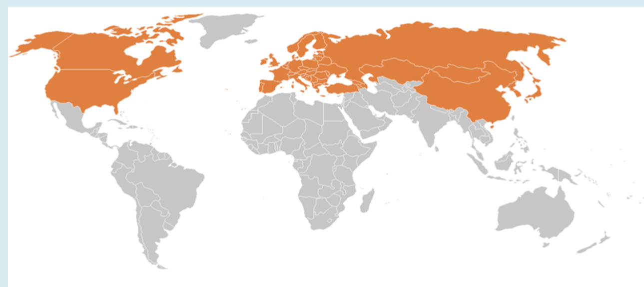

Figure 3: Geographical distribution of Lyme Disease. This image is licensed under creative commons attribution.

These editorials highlight the clinical, epidemiology, and diagnosis of tick-borne pathogenic *Borrelia*. Ticks' role in transmitting Lyme disease is significant, so highlighting the infectious agents tick-borne to humans and animals is primordial [27]. There are two barriers to tick-borne Lyme disease, the host's immunity to tick bites and the tick's immunity to pathogens [28]. In Lyme disease, exposure of the host's immune system to the bacterium *Borrelia* induces chronic immune disease. Many targeting molecules have a role in modulating the immunity system against Lyme disease [29-45].

Accurate and rapid diagnosis with high sensitivities is one of the challenges in the medical field of infectious diseases for quick treatment in infected patients. Detection of the humoral immune response to *Borrelia burgdorferi* infection depends on detecting the antibody response. The diagnosis of Lyme disease is still a significant concern.

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