APA-style research project

Running head: POST-LYME MYSTERY 1

Running head (fifty characters or fewer) appears flush left on first line of title page. Page number appears flush right on first line of every page.

The Mystery of Post-Lyme Disease Syndrome

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Title, name, and affiliation centered and double-spaced.

Author Note: This paper was prepared for College Writing 130C, taught by Professor Eads.

Author's note lists specific information about course (and can include contact information).

Annotations indicate APA-style formatting or effective writing.

Source: Lunsford Handbooks (Boston: Bedford/St. Martin's, 2015).
This project follows the style guidelines in the *Publication Manual of the American Psychological Association,* 6th ed. (2010).

Running head appears in all capital letters flush left on each page.

Abstract

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Lyme disease, prevalent in parts of the United States, is a preventable illness spread by tick bites. Lyme disease is considered treatable with a course of antibiotics in the early stages of infection. In some cases, however, symptoms of Lyme disease persist in individuals who have completed antibiotic treatment. The causes of post-Lyme disease syndrome, sometimes called "chronic Lyme disease," are unknown, and treatment of those suffering post-Lyme disease syndrome is controversial, with some physicians arguing for long-term antibiotic treatment and others convinced that such treatments are harmful to patients. There is a need for more research with a focus on developing the technology to perform replicable studies and eventually an effective treatment algorithm for post-Lyme disease syndrome.

No indentation for abstract.

Use of passive voice appropriate for social sciences.

Double-spaced text.

Source: Lunsford Handbooks (Boston: Bedford/St. Martin's, 2015).

The Mystery of Post-Lyme Disease Syndrome

Full title centered.

Paragraphs indented.

The Centers for Disease Control and Prevention (CDC) estimates a total of 300,000 cases of Lyme disease annually. Many medical professionals believe Lyme disease can be cured in a matter of weeks with a simple antibiotic treatment. In some cases, however, patients develop post-Lyme disease syndrome, sometimes called "chronic Lyme disease," exhibiting persistent symptoms of Lyme after initial treatment is completed. The scientific community, divided over the causes of post-Lyme disease syndrome, cannot agree on the best treatment for the syndrome. Although Lyme disease is preventable, people are still vulnerable to infection; consequently, there is a need for more research and collaboration with a focus on developing the technology to perform replicable studies, which may subsequently lead to an effective treatment algorithm for post-Lyme disease syndrome.

Background information supplied.

Prevention

Boldface headings help organize review.

Ixodes ticks, also known as blacklegged and deer ticks, are infected with the bacterium *Borrelia burgdorferi*, responsible for Lyme disease (Hawker et al., 2012). Since being bitten by an infected tick is the only known way of contracting Lyme disease, evading Ixodes ticks is an effective measure. According to M'ikanatha et al. (2013), "Lyme disease is acquired peridomestically and the risk is highest in residential settings abutting areas with forests, meadows, and high prevalence of deer" (p. 168). While adult ticks are more active in the cooler months, developing Ixodes ticks, called nymphs, feed the most during the spring and summer months (Centers for Disease Control and Prevention [CDC], 2011b).

Reference to work with six or more authors uses *et al.*

First reference to organization gives abbreviation for later references.

Source: Lunsford Handbooks (Boston: Bedford/St. Martin's, 2015).

Therefore, avoiding areas such as meadows and grasslands in the spring and summer seasons aids in preventing Lyme disease.

Using permethrin repellent on clothes and 20 to 30 percent DEET insect repellent on the skin also keeps ticks away (U.S. Department of Health and Human Services [HHS], 2012). Other measures include wearing light-colored clothing to make ticks more visible, wearing long sleeves and long pants, tucking shirts into pants and pants into socks, and taping closed open areas of clothing when spending time outdoors in areas where ticks are prevalent (Hawker et al., 2012; HHS, 2012). Additionally, individuals should keep yards and houses clean to avert mammals, such as deer and rodents, that carry Ixodes ticks, and should check pets for ticks (HHS, 2012).

More than one reference included in citation.

Though all of these measures greatly reduce the chance of receiving a tick bite, they are not foolproof. The bacterium *B. burgdorferi* takes approximately 36 to 48 hours to become infectious after the tick has bitten an individual (Hawker et al., 2012). A bull's-eye rash called erythema migrans is the only unique symptom of Lyme disease (HHS, 2012). It appears 3 to 32 days after infection (Hawker et al., 2012). According to one study, only 70 to 80 percent of Lyme disease victims develop erythema migrans; therefore, other symptoms must be assessed (Steere & Sikand, 2003). Other characteristics of Lyme disease include fevers, headaches, stiff neck, swollen lymph nodes, body aches, fatigue, facial palsy, polyarthritis, aseptic meningitis, peripheral root lesions, radiculopathy, and myocarditis (CDC, 2011a; Hawker, 2012; HHS, 2012).

Source: Lunsford Handbooks (Boston: Bedford/St. Martin's, 2015).

On average, it takes a few weeks for infected individuals to produce antibodies against *B. burgdorferi* (HHS, 2012). Consequently, most cases of Lyme disease have better outcomes and recovery rates when antibiotics are administered quickly (Steere & Sikand, 2003). Administered in the beginning stages of Lyme disease, antibiotics help speed recovery and prevent more serious symptoms, such as heart and nervous system problems, from developing (HHS, 2012).

Erythema migrans is not always present, and other symptoms of Lyme disease are similar to other illnesses. Therefore, Lyme disease may be misdiagnosed and untreated. Raphael B. Stricker (2007), a doctor at the University of California at San Francisco, explained that "in the absence of typical features of Lyme disease, patients may go on to develop a syndrome with multiple nonspecific symptoms that affect various organ systems, including the joints, muscles, nerves, brain, and heart" (p. 149). Conversely, even when patients receive proper antibiotic treatment of two to four weeks they can continue to experience symptoms.

Parenthetical citation for quotation from print source includes page number.

Post-Lyme Disease Syndrome

The majority of Lyme disease patients are cured after multiple weeks of antibiotics; however, 10 to 15 percent of patients acquire relapsing nonspecific symptoms such as fatigue, arthritis, and short-term memory problems that can persist for months or even years (Brody, 2013). When there is no other possible origin of the nonspecific symptoms, and the individual has had proper treatment for Lyme disease, the patient is classified as having post-Lyme disease syndrome (Lantos, 2011). Adriana Marques (2008) of the Laboratory of Clinical Infectious diseases explains, "The

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appearance of post-Lyme disease symptoms seems to correlate with disseminated diseases, a greater severity of illness at presentation, and delayed antibiotic therapy; but not with the duration of the initial antibiotic therapy." The medical community is unsure of how to treat the nonspecific symptoms or what causes them (Lantos, 2011).

Possible Sources of Post-Lyme Disease Syndrome

Scientists are unable to identify the exact source of post-Lyme disease syndrome for several reasons. Identifying patients is difficult because of the general nature of the symptoms. Several surveys demonstrate that a relatively high percentage of the overall population reports nonspecific symptoms, such as fatigue, chronic pain, or cognitive dysfunction after a tick bite (Lantos, 2011). In addition, researchers struggle to find participants for their studies (Marques, 2008). Study participants must have previous documentation of contracting Lyme disease, which significantly diminishes the testing population (Lantos, 2011).

Scientists and physicians suspect the source of post-Lyme disease syndrome to be multifactorial (Marques, 2008). Plausible causes of reoccurring nonspecific symptoms include persistent infection of *B. burgdorferi*, other tick-borne infections, a natural healing process after infection, post-infective fatigue syndrome, autoimmune mechanisms, and inter-current conditions (Marques, 2008). Nevertheless, only a few ideas have been thoroughly explored thus far by the scientific community. The majority of scientists believe remaining damage to tissue and the immune system from the infection causes post-Lyme disease syndrome;

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however, some believe persistent infection of the bacteria is the source (CDC, 2014).

Despite complications, a majority of the medical community considers persistent symptoms as a result from residual damage to the tissues and the immune system that occurred during the infection. These "auto-immune" reactions, which the body uses against foreign elements, occur in infections similar to Lyme disease such as Campylobacter, Chlamydia, and Strep throat (CDC, 2014). Patients report their nonspecific symptoms improving over time after the typical antibiotic treatment (Marques, 2008). Physicians who followed their patients with post-Lyme disease syndrome for extended times also see nonspecific symptoms resolve without further antibiotic treatment (Marques, 2008). Consequently, post-Lyme disease syndrome may be a natural evolution of the body healing after an intense infection.

A smaller portion of the medical community considers persistent infection of the microorganism *B. burgdorferi* as the cause of post-Lyme disease syndrome. Recently published studies performed on animals show signs of ongoing infection of the bacterium. One scientific study infected mice with *B. burgdorferi* and gave them intense treatment of antibiotics that should wipe out the bacterium (Bockenstedt, Gonzalez, Haberman, & Belperron, 2012). Bockenstedt et al. observed the mice over a period of time and found "that infectious spirochetes are rapidly eliminated after institution of antibiotics, but inflammatory *B. burgdorferi* antigens persist adjacent to cartilage and in the enthuses" (2012). This is one of the first studies to show continuous effects of the harmful microorganism in post-Lyme

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disease syndrome. Another recent scientific study was conducted on nonhuman primates, Rhesus macaques. Once again the scientists infected the animals with *B. burgdorferi* and then four to six months later administered an antibiotic treatment to half of the monkeys (Embers et al., 2012). Their results also confirmed that *B. burgdorferi* could withstand antibiotic treatment in Rhesus macaques and proceed to cause post-Lyme disease syndrome (Embers et al., 2012). Nonetheless, these results showing perpetual infection as the cause of post-Lyme disease syndrome have yet to be replicated in humans.

In contrast, many studies over the years contradict the theory of ongoing infection, though these studies have not been confirmed true in humans. Lantos (2011), an MD Medical Instructor in the Department of Medicine at Duke University School of Medicine, clarifies that "[n]o adequately controlled, hypothesis-driven study using a repeatable method has demonstrated that viable *B. burgdorferi* is found in patients with persistent post-Lyme symptoms any more frequently than in those with favorable outcomes" (p. 790). Most scientific studies trying to prove persistent infection of *B. burgdorferi* have not been replicated because their procedures and techniques are at fault (Marques, 2008). The problem derives from the technology that detects the microorganism (Lantos, 2011). PCR and *B. burgdorferi* culture are commonly used to find evidence of the bacteria in the body; however, both have "low sensitivity in most body fluids from patients with Lyme disease" (Marques, 2008). Even though other methods, such as finding antibodies in immune complexes, changes in C6 antibody levels, and PCR in urine samples, have

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been tried, none prove helpful (Marques, 2008). Therefore, the persistent infection of *B. burgdorferi* has not yet successfully been proven as the cause of post-Lyme disease syndrome.

Post-Lyme Disease Syndrome Treatment

Since the cause of post-Lyme disease syndrome is controversial, treatment for the infection varies from patient to patient and physician to physician. Treatment is still in the experimental stages, meaning no set treatment algorithm currently exists. Numerous patients rely on long-term antibiotic medication, despite the overwhelming defying scientific evidence against this treatment (CDC, 2014). The research studies that focus on prolonged antibiotic treatment observe no dramatic difference in benefits or recoveries of those who had the treatment and those who did not (Marques, 2008). On the contrary, many long-term antibiotic research studies found that post-Lyme disease syndrome patients develop harmful side effects (Lantos, 2011). These adverse health effects include "catheter-associated venous thromboembolism, catheter-associated septicemia, allergic reactions and ceftriaxone-induced gallbladder toxicity" (Lantos, 2011, p. 792). Therefore, most of the scientific community considers long-term antibiotic treatment for chronic Lyme disease a harmful, risky, and unbeneficial plan.

Most of the scientific community advises against the use of long-term antibiotics because of potential adverse effects. Nevertheless, a small minority of physicians has observed improvements with long-term antibiotics. Because numerous studies show a lack of benefit to long-term antibiotics, these hopeful patients may be experiencing a placebo effect, which

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occurs when patients improve because they believe they are receiving an effective treatment (Marques, 2008).

Solving the Mystery

Individuals can take various simple preventive measures to avoid contracting Lyme disease. If the infection is contracted, those who seek prompt treatment increase the chance of full recovery and decrease the chance of developing post-Lyme disease syndrome. However, these steps do not guarantee complete avoidance of post-Lyme disease syndrome. Finding the source of post-Lyme disease syndrome will lead to a specific treatment plan that effectively heals patients. Many scientists deem the source of post-Lyme disease syndrome to be a natural autoimmune reaction; conversely, a few other scientists consider persistent infection as the cause. Both theories, however, need better technology to prove their accuracy. Since scientists disagree about the source of post-Lyme disease syndrome, a variety of experimental treatments have arisen. Replicable studies are needed so that an effective treatment for post-Lyme disease syndrome can be found.

Conclusion indicates need for further research.

Source: Lunsford Handbooks (Boston: Bedford/St. Martin's, 2015).

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References begin on a new page.

Article from an online newspaper.

Two works by the same author in the same year.

Work with more than seven authors.

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