

Lyme Disease in New Jersey, 1978-1982

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From 1978 to 1982, 117 cases of Lyme disease were reported in New Jersey. The number of cases increased each year from four in 1978 and 1979 to 56 in 1982. Forty-eight percent of cases occurred in a four-township area in central Monmouth County. The proportion of cases with arthritis decreased in 1982 because of early antibiotic treatment and better reporting of milder cases. The proportion of cases with positive serology increased with severity of the clinical syndrome. About 25 percent of patients had exposure to ticks because of occupations that required outdoor activities. Lyme disease is a growing public health problem in New Jersey.

INTRODUCTION

Lyme disease was first discovered in New Jersey in 1979 when a cluster of three cases was recognized in children living in a housing development near Colt's Neck, Monmouth County, New Jersey [1]. Subsequently, four cases were found to have occurred in 1978. Since then, the number of reported cases has increased each year, particularly in a four-township endemic zone in Monmouth County. We present here the descriptive epidemiology of human cases of Lyme disease in New Jersey and the possible reasons for an endemic focus in Monmouth County.

METHODS

The majority of cases of Lyme disease were reported to the New Jersey State Department of Health (NJSDH) by interested physicians statewide or by the medical officer at Naval Weapons Station, Earle (NSWE), after they had received an informational mailing from the NJSDH and after Lyme disease became a reportable disease in New Jersey in 1980. In 1981, oral presentations on the clinical spectrum of Lyme disease were made to several physician groups and several at-risk occupational groups by personnel of the NJSDH.

Cases discussed here had one or more of the following:

1. Erythema chronicum migrans
2. Large-joint inflammatory arthritis without other etiology following rheumatologic work-up within four months of tick bite in the spring or summer in the endemic zone of Lyme disease in New Jersey
3. Bell's palsy without other etiology within two months of tick bite in spring or summer in the Lyme disease endemic zone in New Jersey

4. Fourfold titer increase or single serum at least one month after onset with indirect fluorescent antibody (IFA) titer $\geq 1:256$

We reviewed medical records and interviewed patients or patients' families for all cases. Site of most probable exposure to tick bites was obtained by patient interview. Maps were prepared showing the geographic distribution of Lyme disease cases by site of probable exposure. If no history of travel during the period one month before onset was obtained, the site of most probable exposure was the place where the persons engaged in the majority of his/her outdoor activities (at work or at home).

Incidence rates (IR) for Lyme disease from 1980 to 1982 were calculated for all New Jersey counties. Within Monmouth County, the IR was calculated by township if two or more cases were recognized. Population figures for denominators in the IR calculations were obtained from a summary of the 1980 census data. No data were available to estimate populations more reliably for 1981 and 1982. The observed number of cases of Lyme disease in each county was compared with the expected number based on the attack rate for the entire state, and the level of significance for each county was analyzed according to a Poisson distribution.

During the early summer of 1981, five cases of Lyme disease were recognized at Naval Weapons Station, Earle (NWSE), Monmouth County, where all military personnel, their dependents, and civilian employees were evaluated and treated at the base dispensary. Subsequently, an additional 25 cases were recognized there. Because such a large number of cases came from NWSE, studies were initiated to characterize some of the risk factors associated with Lyme disease at the base.

We divided persons at the base in 1981 into several categories, based on occupation or presumed reason for being exposed to ticks at NWSE. The number of persons employed at the base in each occupation who worked indoors or outdoors was determined. IR for Lyme disease were calculated for each occupation and for all persons with indoor jobs and outdoor jobs. An indoor job was defined as one in which all of the person's day was spent in an office; outdoor movement between offices was confined to paved or lawn areas. An outdoor job was one in which the person regularly worked in woods, brush, and tall grass away from lawns and paved areas. In 1982 we were unable to obtain an exact count of base employees classified by location of usual work activity. However, no significant personnel changes were carried out during the year to materially alter the figures obtained for 1981, and the number of personnel at the base did not change.

A chi-square analysis of a 2×2 contingency table was used to compare IR by location of workplace at NWSE.

Testing serum for antibody to Lyme disease spirochete was done at the Centers for Disease Control (CDC) [Sampson J: unpublished data]. IFA titers for acute-phase and convalescent-phase serum samples were determined by the method of Russell et al. [2]. Convalescent-phase titers of $\geq 1:256$ were considered to be evidence of probable infection by the Lyme disease agent. Titers of 1:128 were considered to be possible evidence of infection only and not confirmatory.

RESULTS

The clinical manifestations [3] of the 117 Lyme disease cases reported in New Jersey from 1978 to 1982 (Fig. 1) are shown in Table 1. They are similar to those previously reported by Steere et al. [4]. The proportion of cases with arthritis diminished in 1982 because of early antibiotic therapy and better reporting of milder cases. Results of limited serologic testing at CDC by the IFA tests are shown in Table 2.

TABLE 1
Clinical Manifestations of Lyme Disease in New Jersey*

Clinical Presentation	Number of Cases	(%)
Erythema chronicum migrans ^b	109	93
Non-specific febrile ^c or "flu" syndrome (all had ECM)	53	45
Arthritis (7 without definite history of ECM)	31	26
Arthralgia (no arthritis; all had ECM)	25	21
Meningitis syndrome ^d (all had ECM)	12	10
Cranial nerve palsy (3/9 also had previous meningitis syndrome and all had ECM)	9	8
Peripheral neuropathy (1/3 also had previous meningitis syndrome; all had ECM and cranial nerve palsy)	3	3
Encephalitis (1/1 also had previous meningitis syndrome)	1	1

*N = 117 cases from 1978-1982

^bECM along in 29 (25 percent) patients

^cThree of following: fever, chills, malaise and fatigue, backache, or generalized myalgia

^dFever, headache, stiff neck; includes three people with meningitis syndrome prior to development of Bell's palsy

The proportion of cases with positive or presumptive serology (fourfold increase in paired sera or single serum collected at least 30 days after onset with titer $\geq 1:256$) increased with severity (from 40 percent for ten patients with ECM alone to 86 percent of 21 patients with severe disease). The age and sex distribution of Lyme disease are shown in Table 3. The male-to-female ratio was 1.9:1. Thirty-two cases (27 percent) were more than 16 years of age; 48 percent were from 21 to 40 years of age. From 1978 to 1982, cases occurred only from March to December, but one case

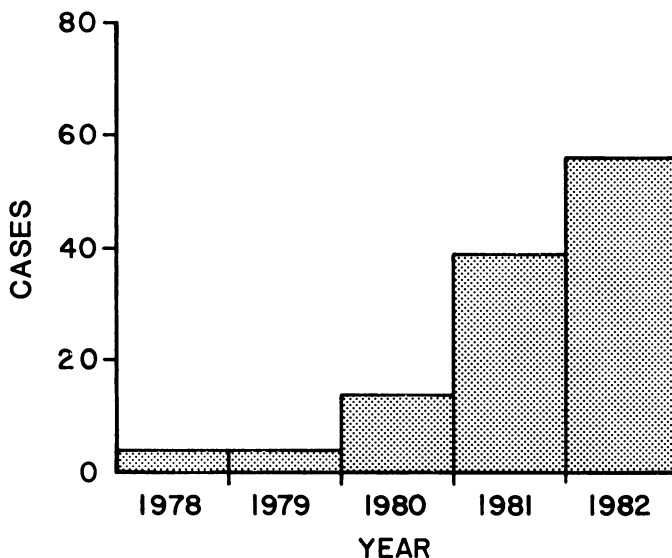


FIG. 1. Reported cases of Lyme disease, New Jersey, 1978-1982.

TABLE 2
Serologic Testing^a of Lyme Disease Patients in New Jersey,
by Clinical Syndrome, 1978-1982

Syndrome	Number Positive/ Number Tested	% Positive
Erythema chronicum migrans alone	4/10	40
ECM plus viral syndrome or arthralgia	12/18	67
Arthritis	10/12	83
Bell's palsy without arthritis	4/5	80
Arthritis and Bell's palsy	4/4	100

^aResults of indirect fluorescent antibody testing (fourfold titer rise in paired sera or single serum collected at least one month after onset with titer \geq 1:256).

occurred in February in 1983 as a result of extremely warm winter weather. Seventy-four percent of the cases occurred from May to July (Table 4).

In 1981 and 1982, 60 of 95 (63 percent) Lyme disease cases had definite history of single or multiple tick bite. Fifty had a single bite at the site of their ECM lesion and recalled the time interval from bite to rash. Thirty-five (70 percent) became ill within one week after tick bite.

As shown in Fig. 2, Lyme disease in New Jersey occurs primarily in the southern two-thirds of the state from Somerset and Middlesex Counties south. This is precisely the distribution of *I. dammini* in the state [5]. Of particular interest is the large cluster of 57 cases in a four-township area whose dimensions are approximately 17 \times 18 miles in central Monmouth County. From 1978-1982 nearly half (48 percent) of the cases of Lyme disease occurred in this area in which the population is only 1 percent of the total for the state. This four-township endemic focus [6] has gradually been recognized over a five-year period. In the center of the four-township area is a military base whose dimensions are about five by four miles. Table 5 shows the annual incidence rates for Lyme disease in Monmouth County as a whole, in the endemic area, and at the military base. A second, smaller cluster of cases is located in northwest Burlington County. Three cases also occurred near each other in Atlantic County near Egg Harbor.

TABLE 3
Age and Sex Distribution of Persons with Lyme Disease,
New Jersey, 1978-1982

Age	Male	Female	Total (%)
0-5	5	5	10 (8.5)
6-10	7	3	10 (8.5)
11-15	7	5	12 (10.3)
16-20	3	2	5 (4.3)
21-30	21	8	29 (24.8)
31-40	19	8	27 (23.1)
41-50	7	4	11 (9.4)
51-60	6	4	10 (8.5)
>60	2	1	3 (2.6)
Total	77	40	117 (100.0)

TABLE 4
Onset of Lyme Disease, by Month, New Jersey, 1978-1982

Month	Number of Cases	Percentage
January	0	0
February	0	0
March	1	1
April	4	3
May	17	15
June	31	26
July	39	33
August	7	6
September	8	7
October	3	3
November	5	4
December	2	2
Total	117	100

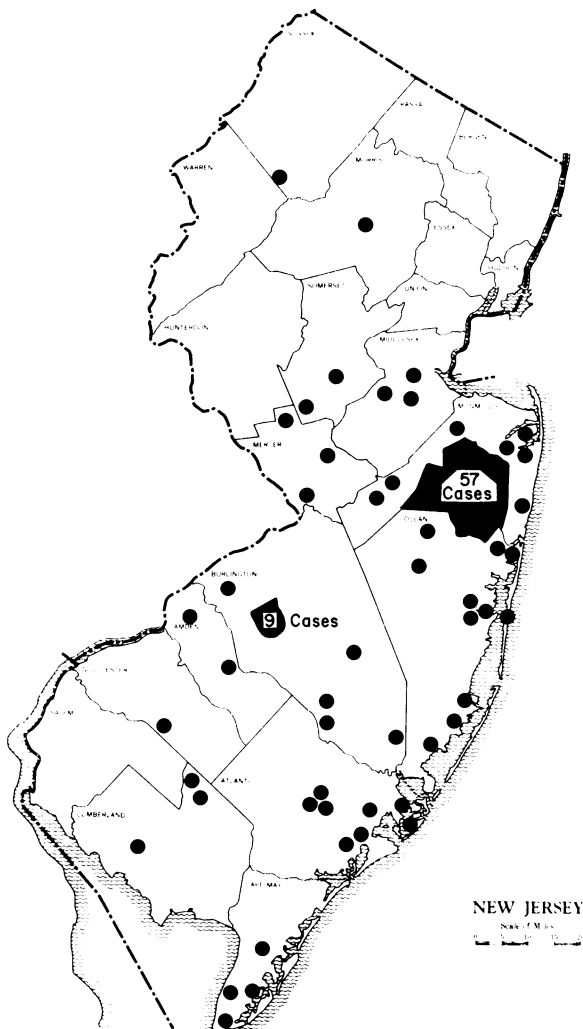


FIG. 2. Geographic distribution of Lyme disease, by location of exposure, New Jersey, 1978-1982.

TABLE 5
Incidence Rates for Lyme Disease Within Monmouth County, New Jersey, 1981 and 1982

Area	Population	1981		1982	
		Cases	IR per 100,000	Cases	IR per 100,000
Entire county	503,173	22	4.4	33	6.6
County excluding total endemic area	420,682	4	0.9	2	0.5
Total endemic area including military reserve	82,491	18	21.8	31	37.6
Colt's Neck and Howell Townships, including military reserve	34,317	18	52.5	21	61.2
Colt's Neck and Howell Townships, excluding military reserve	32,953	4	12.1	6	18.2
Military Reserve (NWSE)	1,364	14	1,026.4	15	1,099.7
Wall Township	29,222	0	0.0	5	17.1
Freehold Township	18,952	0	0.0	5	26.4

From 1981 to 1982, 29 of the 95 cases of Lyme disease in New Jersey occurred on the military base in the center of the endemic focus. These cases accounted for 29/49 = 59.2 percent of the cases which occurred in the four-township area in 1981-1982. In addition, five cases occurred from 1979 to 1982 in the nineteen-family house development mentioned previously, which is located immediately outside the fence of the military base. The attack rate for housing development residents during the last five years is 1 percent per year, which is identical to the attack rate for 1981 and again for 1982 for the 1,364 civilian employees, military personnel, and dependents at the military base (Table 5). This attack rate is equal to, if not greater than, that reported by Steere et al. in the literature [4,7] for the hyper-endemic focus in Lyme, Old Lyme, and Haddam during 1976 and 1977. As shown in Table 6, military and civilian employees who have outdoor occupations (marines, road maintenance workers, foresters, wildlife personnel, logging and construction personnel) had higher Lyme disease attack rates than did personnel with indoor occupations.

In the four-township area surrounding the military facility, cases also occur at a rate which exceeds the rate for the rest of the county and the state. In 1981, cases occurred primarily in Colt's Neck and Howell Townships, which contain the military

TABLE 6
Lyme Disease Incidence Rates, by Location of Workplace Naval Weapons Station Earle, Monmouth County, New Jersey, 1981 and 1982

Location of Workplace	Ill	Well	Total	Attack Rate (per 1,000)	Relative Risk (95% CI)
Outdoor	14	352	366	38.3	4.9* (2.1-11.5)
Indoor	6	760	766	7.8	1.0 (reference)

* $\chi^2 = 13.2, p = .0003$

facility. No cases occurred in Wall or Freehold Townships, which are located immediately to the east and west, respectively, of the other two townships. However, in 1982, five cases occurred in each of these townships. Only time will tell whether this represents the expansion of an endemic focus or not. In 1982 we also recognized a second small focus in a thirty-square-mile area in the vicinity of Medford in north-western Burlington County. Nine cases occurred in this area from 1981-1982.

DISCUSSION

We do not know the precise reasons for the existence of foci of elevated rates of transmission in New Jersey. At the military facility, we feel it is a combination of excellent (virtually 100 percent) case ascertainment because everyone on the base sees only one physician; a high proportion of people have regular outdoor activities; and a favorable setting with high tick and mammal populations (including deer) as a result of their protected status inside a restricted access area. Elsewhere in the four-township area, some of the same factors are at work. Monmouth County physicians are, as a result of increased exposure to cases and publicity about Lyme disease, probably more likely to report each case of Lyme disease than are physicians statewide. In addition, Monmouth County population levels have increased during the last decade, as have the population of many other southern New Jersey counties. Part of the housing for the increased population has been located in wooded areas whose understory serves as the prime habitat for *I. dammini* and small mammals in New Jersey [Schulze TL: unpublished data]. Increased human exposure to ticks in these settings is inevitable.

Other factors which may explain the existence of foci of increased rates for Lyme disease transmission include increased *I. dammini* density in these foci, an increased *I. dammini* infection rate, and presence or absence of *Amblyomma americanum* which also has been shown to be a vector of Lyme disease in New Jersey [8]. We carried out a survey of ticks on deer in 1981 which documents significantly elevated *I. dammini* density in four of 36 deer management zones (DMZ) in New Jersey [9]. Two of our foci for elevated rates of Lyme disease transmission occur in these DMZs, and three human cases occurred together in Ocean County within a third DMZ with elevated tick density. A study is currently planned to evaluate the infection rate of *I. dammini* collected at multiple sites in southern and central New Jersey. We do know that the infection rate of adult *I. dammini* at our study area at the military base is approximately 70 percent, which exceeds that reported by Burgdorfer et al. in their initial study of ticks collected at Fire Island, New York [10].

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