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INTRODUCTION

Black patients are less represented in medical textbooks [1]. This underrepresentation may make it more difficult for physicians to recognize the dermatologic manifestations of certain diseases in black patients [2]. For Lyme disease, this may lead to a delay in diagnosis, which may result in black patients presenting more often with disseminated disease when initially diagnosed. Black patients also may present to physicians later than white patients do. Prior research using 1990s single-state data found that black patients with Lyme disease were more likely to present with disseminated disease [3]. More recent national estimates of racial differences in the distribution of clinical manifestations of Lyme disease are unknown.

METHODS

Analyses were performed using 2015–2016 claims data for a random nationwide 20% sample of Traditional Medicare beneficiaries. In ICD-10, Lyme disease is divided into "Lyme disease, unspecified" (A69.20), "Meningitis due to Lyme disease" (A69.21), "Other neurologic disorders in Lyme disease (cranial neuritis, meningoencephalitis, polyneuropathy)" (A69.22), "Arthritis due to Lyme disease" (A69.23), and "Other conditions associated with Lyme disease (myopericarditis)" (A69.29) [4]. A new diagnosis of Lyme disease in 2016 was defined as having a medical claim with a Lyme disease diagnosis code in 2016 with no claim for Lyme disease in 2015. Month of diagnosis was defined as month of the first claim for Lyme disease. Meningitis and other neurologic disorders were combined into one category. Erythema migrans was assumed to be coded as A69.20 ("Lyme disease, unspecified"). The distributions of clinical manifestations and of month of diagnosis between black and white patients were compared using chi-square tests. Two binary variables were then created—disseminated disease (those with ICD-10 codes A69.21-A69.29 versus those with A69.20) and out-of-season diagnosis (those diagnosed outside of May–August [the 4 months when incidence is highest] [5] versus those diagnosed during these months). Separate linear regressions were performed for each of these outcomes with black versus white race as the main independent variable, controlling also for age, sex, and state of residence, with standard errors clustered at the state level. We included state fixed effects to compare black and white patients living in the same state. Analyses were conducted using Stata 16.1. The IRB of the National Bureau of Economic Research, where the data were housed and analyzed, approved the study.

RESULTS

The sample included 6171 white Medicare patients and 167 black Medicare patients newly diagnosed with

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Lyme disease in 2016. White patients were older and less likely to be female (Table 1). About 9% of white patients and 34% of black patients had neurologic manifestations of Lyme disease on initial diagnosis (Figure 1, panel A). The chi-square statistic for the black-white difference in distribution of clinical manifestations was 128.5 ($p<0.001$). In a multivariable linear regression, the black-white difference in having disseminated disease was 20.7 percentage points (95%CI 12.2–29.2). The chi-square statistic for difference in distribution of month of first diagnosis was 25 ($p=0.008$) (Figure 1, panel B). In a multivariable linear regression, the black–white difference in being initially diagnosed outside of May–August was 12.5 percentage points (95%CI 8.3–16.7). Results were substantively unchanged when using logistic regression models. Results were unchanged when limiting to those with two or more claims for Lyme disease (results not shown). Approximately 89% of white patients and 88% of black patients with newly diagnosed Lyme disease had a clinician visit in 2016 prior to Lyme disease diagnosis (results not shown).

DISCUSSION

Among Medicare patients, black patients with Lyme disease appear to be diagnosed more often with disseminated disease on initial diagnosis compared to white patients, and they appear to be diagnosed more often outside of the months Lyme disease is most frequently diagnosed. These differences may reflect differential recognition of dermatologic

Table 1 Sample characteristics

	White, non-Hispanic (n=6,171)	Black (n=167)	p-value for the difference
Mean age	72.4	66.1	<0.001
Female (%)	53.6	65.3	0.003
Census Division 1: New England (%)	23.3	9.0	<0.001
Census Division 2: Middle Atlantic (%)	38.7	31.1	
Census Division 3: East North Central (%)	7.1	3.6	
Census Division 4: West North Central (%)	2.7	1.2	
Census Division 5: South Atlantic (%)	18.1	38.9	
Census Division 6: East South Central (%)	2.8	7.2	
Census Division 7: West South Central (%)	2.6	7.2	
Census Division 8: Mountain (%)	1.6	0	
Census Division 9: Pacific (%)	3.1	1.8	
Disseminated Lyme disease (%)	16.2	41.3	<0.001
Lyme disease initially diagnosed outside of May–August (%)	48.3	62.3	<0.001

Note: Author's calculation using Medicare data from 2015 to 2016. Beneficiaries who were continuously enrolled in Parts A and B in 2015 and 2016 were included. Race is self-reported and listed as unknown for 2% of the sample. Census Division 1 includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. Census Division 2 includes New Jersey, New York, and Pennsylvania. Census Division 3 includes Indiana, Illinois, Michigan, Ohio, and Wisconsin. Census Division 4 includes Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota. Census Division 5 includes Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia. Census Division 6 includes Alabama, Kentucky, Mississippi, and Tennessee. Census Division 7 includes Arkansas, Louisiana, Oklahoma, and Texas. Census Division 8 includes Arizona, Colorado, Idaho, New Mexico, Montana, Utah, Nevada, and Wyoming. Census Division 9 includes Alaska, California, Hawaii, Oregon, and Washington. Disseminated disease was defined as those with ICD-10 codes A69.21–A69.29 versus those with A69.20. p-values were calculated using t-tests for means and chi-square tests for categories

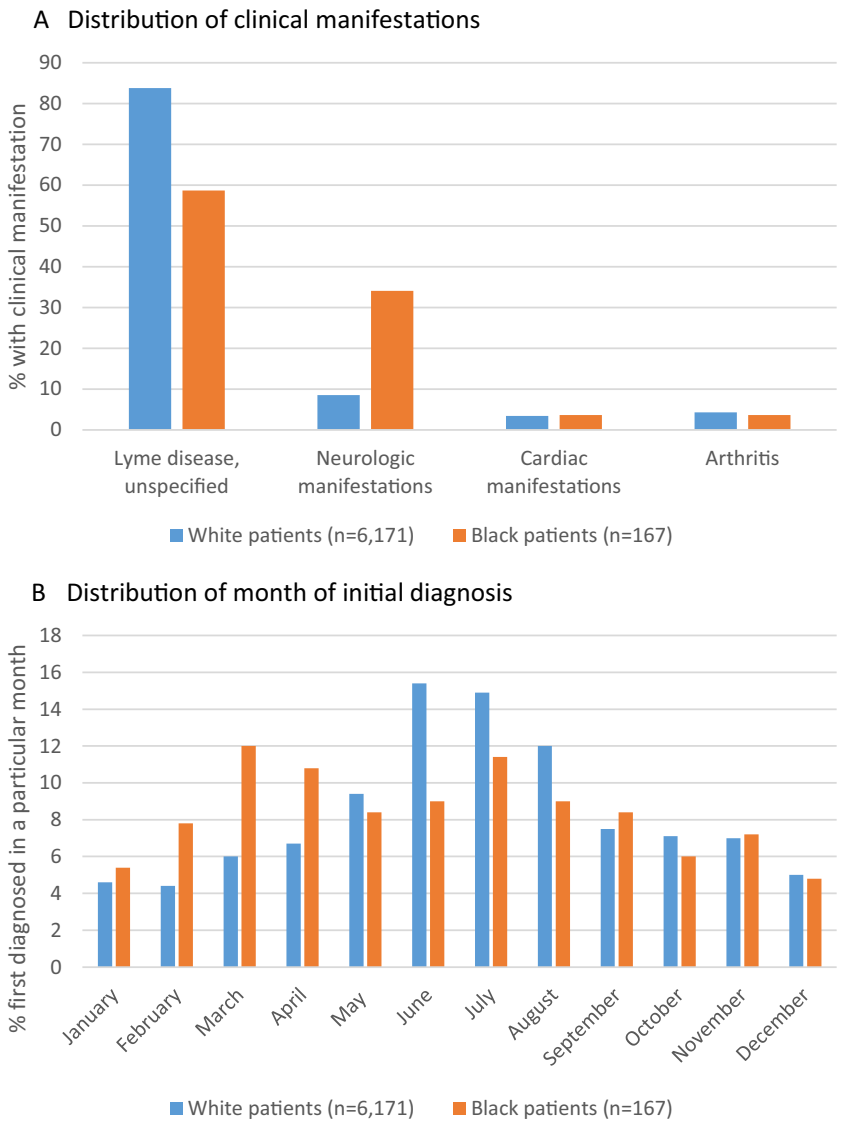

Figure 1 Black–white differences in the distribution of clinical manifestations of Lyme disease when initially diagnosed and in the distribution of month of initial diagnosis, 2016. Author's calculation using Medicare data from 2015 to 2016. Beneficiaries who were continuously enrolled in Parts A and B in 2015 and 2016 were included. Race is self-reported and listed as unknown for 2% of the sample. Patients with multiple clinical manifestations were assigned to the latest stage; the stages were assumed to be in the following order: Lyme disease (unspecified), neurologic manifestations, cardiac manifestations, arthritis. Panel A: Distribution of clinical manifestations. Panel B: Distribution of month of initial diagnosis

manifestations of Lyme disease by physicians or by patients themselves, although other reasons are possible. Study limitations include the assumption that early localized Lyme disease was coded as "Lyme disease, unspecified." The use of diagnosis codes in claims data, which could not be confirmed by chart review, may lead to misclassification of outcome; non-differential misclassification will generally bias towards null, but differential misclassification by race is possible. Low rates of cardiac manifestations and arthritis were observed, which may be due to a well-insured population being diagnosed before such manifestations occur.

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