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Short Report: Race and Rickettsiae: A United States Perspective

F. Scott Dahlgren,* Ramal Moonesinghe, and Jennifer H. McQuiston

Rickettsial Zoonoses Branch, Division of Vectorborne Infectious Diseases, National Center for Emerging and Zoonotic Infectious Disease, Centers for Disease Control and Prevention, Atlanta, Georgia; Office of Minority Health and Health Disparities, Office of the Director, Centers for Disease Control and Prevention, Atlanta, Georgia

Abstract. US surveillance programs for Rocky Mountain spotted fever (RMSF), ehrlichiosis, and anaplasmosis collect demographic data on patients, including race and ethnicity. Reporting of these diseases among race groups is not uniform across the United States. Because a laboratory confirmation is required to meet the national surveillance case definition, reporting may be influenced by a patient's access to healthcare. Determining the association between race and ethnicity with incidence of rickettsial infections requires targeted, active surveillance.

Health disparities are an important issue in US public health programs. Racial minorities are at higher risk for a variety of infectious and chronic disease conditions, and the gap between socioeconomic status and access to healthcare varies widely by minority group.[1] To better monitor civil rights, the US Office of Management and Budget (OMB) publishes guidelines for the standardized collection of race and ethnicity for government-sponsored data collection.[2]

The tick-borne rickettsial diseases Rocky Mountain spotted fever (RMSF), ehrlichiosis, and anaplasmosis are notifiable conditions in the United States.[3,4] Demographic data, including race and ethnicity, are collected in these case reports, and these data have historically been assessed as part of national surveillance summaries. As defined by the Council of State and Territorial Epidemiologists (CSTE), surveillance case definitions for RMSF, ehrlichiosis, and anaplasmosis require accompanying laboratory evidence to classify a case as confirmed or probable.[3,4] This requirement potentially biases reporting to patients with adequate healthcare coverage. Because race and ethnicity are associated with health insurance coverage, interpreting associations between reported incidence of rickettsial infections with race and ethnicity may be confounded by access to care.[5]

A recent review of national surveillance data for RMSF reported to the National Notifiable Disease System for Surveillance (NNDSS) from 2000 to 2007 included reported incidence by race and ethnicity.[6] Race-specific reported incidence of RMSF was highest among American Indians (16.8 cases/1 million population) followed by white (4.4), black (2.6), and Asian/Pacific Islander (0.5).[6] However, 17% of cases reported through NNDSS were missing race, and 28% of cases were missing ethnicity.[6] A recent review of NNDSS data for ehrlichiosis and anaplasmosis from 2000 to 2007 did not include reported incidence by race, because 38% of cases were missing race and 50% were missing ethnicity.[7] Other demographic variables, including age and gender, were more complete and included in analyses.[7]

Using cases reported to NNDSS and bridged race population estimates, we calculated the crude rate ratio (RR) of rickettsial diseases, with whites as the referent group (Table 1).[8] Bridged race population estimates allow calculations of reported incidence rates where each case is reported under a single race group, whereas an individual may report multiple race groups to the census.[8] However, crude estimates ignore the uneven geographic distribution of race, ethnicity, and incidence rates of rickettsial disease across the United States. To correct for possible confounding by county of residence, we calculated the Mantel–Haenszel (MH) estimator of the RR stratified on county of residence (Table 1).[9,10] An assumption of the MH estimator is that the RR is equal across all counties; however, this assumption was violated, because RRs were not homogeneous (P value < 0.0001).

To better characterize the association between race and ethnicity with reported incidence of these rickettsial diseases, we regressed reported incidence on race and ethnicity using univariate zero-inflated Poisson (ZIP) models.[11] These ZIP models yield two sets of estimates: the odds of cases being reported with complete race or ethnicity and the rate among each race or ethnicity. The estimated RRs from the ZIP regression indicated an increased rate of rickettsial disease among American Indians relative to whites (Table 1). Cases among whites and non-Hispanics were more likely to be reported than other race and ethnic groups. An exception was anaplamosis, where cases among Hispanics were more likely to be reported relative to non-Hispanics (Table 2). From the ZIP regression, we speculate that a large burden of disease caused by RMSF, ehrlichiosis, and anaplasmosis during this time period was not reported, and this burden fell disproportionately on American Indians (Table 1).

These analyses highlight the difficulty in characterizing the burden of rickettsial diseases in the United States among race and ethnic groups: the estimated association between race and ethnicity with reported incidence of rickettsial disease is sensitive to analytical method. Other reviews of national surveillance data have found disparities between racial groups for a variety of infectious diseases.[12,13] With reported rickettsial disease case counts in the thousands during this time period, analysis of reported incidence rates will frequently return statistically significant associations with race or ethnicity; however, assessing confounding and bias should take priority when analyzing data from national surveillance. We believe these data to be truncated; not all cases meeting the surveillance definitions are reported. Furthermore, the extent of truncation is associated with race, ethnicity, and county of residence (Table 2). Because of this truncation, accurate estimation of the association of race and ethnicity with reported incidence of rickettsial infections is difficult, if not impossible, with these data. Possibly, the large number of case reports with missing race and ethnicity represents this differential underreporting

Passive national surveillance systems rely on physicians and state health authorities to report cases. These surveillance systems are useful to monitor for general trends in incidence

*Address correspondence to F. Scott Dahlgren, 1600 Clifton Rd. NE, MS G-44, Atlanta, GA 30333. E-mail: iot0@cdc.gov

TABLE 1

Rate ratio (RR) of rickettsial disease incidence among race and ethnic groups by three methods: crude estimate, the Mantel–Haenszel (MH) estimate, and the zero-inflated Poisson (ZIP) estimate

	Race RR				Ethnicity RR	
	American Indian	Asian	Black	White	Hispanic	Non-Hispanic
RMSF						
Crude	4.0 (3.6, 4.4)	0.12 (0.09, 0.16)	0.52 (0.49, 0.57)	Reference	0.27 (0.24, 0.30)	Reference
MH	2.0 (1.8, 2.2)	0.33 (0.26, 0.44)	0.39 (0.36, 0.42)	Reference	0.65 (0.58, 0.73)	Reference
ZIP	11 (10, 12)	1.2 (0.83, 1.6)	0.89 (0.82, 0.96)	Reference	0.48 (0.43, 0.55)	Reference
Ehrlichiosis						
Crude	2.4 (1.9, 3.1)	0.05 (0.02, 0.10)	0.21 (0.16, 0.26)	Reference	0.22 (0.18, 0.28)	Reference
MH	0.97 (0.74, 1.2)	0.12 (0.05, 0.26)	0.23 (0.18, 0.30)	Reference	0.59 (0.46, 0.76)	Reference
ZIP	8.5 (6.4, 11)	0.95 (0.22, 4.2)	0.56 (0.40, 0.79)	Reference	0.51 (0.38, 0.68)	Reference
Anaplasmosis						
Crude	0.95 (0.65, 1.4)	0.13 (0.08, 0.22)	0.07 (0.05, 0.11)	Reference	0.23 (0.18, 0.30)	Reference
MH	0.74 (0.50, 1.1)	0.29 (0.18, 0.47)	0.17 (0.12, 0.25)	Reference	0.65 (0.50, 0.84)	Reference
ZIP	3.7 (2.0, 6.7)	0.72 (0.35, 1.5)	0.20 (0.11, 0.36)	Reference	0.21 (0.15, 0.28)	Reference

The 95% confidence interval for each estimate is enclosed in parentheses.

TABLE 2

Odds ratio (OR) of reporting cases of rickettsial disease among race and ethnic groups from the zero-inflated Poisson model

	Race OR				Ethnicity OR	
	American Indian	Asian	Black	White	Hispanic	Non-Hispanic
RMSF	0.13 (0.10, 0.17)	0.13 (0.08, 0.20)	0.49 (0.39, 0.60)	Reference	0.84 (0.64, 1.1)	Reference
Ehrlichiosis	0.14 (0.09, 0.22)	0.07 (0.02, 0.27)	0.44 (0.29, 0.67)	Reference	0.64 (0.41, 0.98)	Reference
Anaplasmosis	0.44 (0.23, 0.86)	0.54 (0.25, 1.13)	0.69 (0.34, 1.4)	Reference	1.8 (1.0, 3.1)	Reference

The 95% confidence interval for each odds ratio is enclosed in parentheses.

but are subject to reporting bias. Surveillance case definitions of RMSF, ehrlichiosis, and anaplasmosis require laboratory data to support a diagnosis before reporting.[3,13] To meet these case definitions, patients must have adequate healthcare insurance or be able to pay for testing out of pocket. Creating targeted, active surveillance programs with free or low-cost testing would provide better evidence to assess race and ethnicity as risk factors for rickettsial infections and develop appropriate public health interventions.

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Authors' address: F. Scott Dahlgren, Ramal Moonesinghe, and Jennifer H. McQuiston, Rickettsial Zoonoses Branch, Division of Vectorborne Infectious Diseases, National Center for Emerging and Zoonotic Infectious Disease, Centers for Disease Control and Prevention, Atlanta, GA; and Office of Minority Health and Health Disparities, Office of the Director, Centers for Disease Control and Prevention, Atlanta, GA, E-mails: iot0@cdc.gov, zor7@cdc.gov, and fzh7@cdc.gov.

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