

# STRUCTURAL RACIAL INEQUITIES IN SOCIOECONOMIC STATUS, URBAN-RURAL CLASSIFICATION, AND INFANT MORTALITY IN US COUNTIES

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**Objectives:** Despite improvements in infant mortality rates (IMR) in the United States, racial gaps in IMR remain and may be driven by both structural racism and place. This study assesses the relationship between structural racism and race-specific IMR and the role of urban-rural classification on race-specific IMR and Black/White racial gaps in IMR.

**Methods:** We conducted an analysis of variance tests using 2019 County Health Rankings Data to determine differences in structural racism indicators, IMR and other co-variables by urban-rural classification. We used linear regressions to determine the associations between measures of structural racism and county-level health outcomes.

**Results:** Study results suggest that racial inequities in education, work, and homeownership negatively impact Black IMR, especially in large fringe, medium, and small metro counties, and positively impact White IMR. Structural racism is also associated with Black-White gaps in IMR.

**Conclusions:** Factors related to structural racism may not be homogenous or have the same impacts on overall IMR, race-specific IMR, and racial differences in IMR across places. Understanding these differential impacts can help public health professionals and policymakers improve Black infant health and eliminate racial inequities in IMR. *Ethn Dis.* 2020;30(3):389-398; doi:10.18865/ed.30.3.389

**Keywords:** Infant Mortality; Health Inequities; Maternal Health; Infant Health; Structural Racism; Racial Inequalities

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## INTRODUCTION

Infant mortality rates (IMR) in the United States are lower than rates in most of the 20th century, yet recent increases in IMR and persistent racial differences in IMR<sup>1</sup> have garnered new attention among researchers, advocates, and policymakers. IMR is an indicator of not just infant health, but also overall population health and how well a country has progressed over time.<sup>2</sup> IMR in the United States is higher compared with peer countries. For example, in 2016-2017, overall IMR in the United States was 5.8 deaths per 1,000 live births, which is higher than Canada (4.5), the United Kingdom (4.3), and France (3.2), and twice as high as countries like Sweden (2.6), Norway (2.5), and Japan (2.0).<sup>3</sup> Within the United States, Black IMR (11.4) is higher than IMR in countries like Thailand (9.2), Sri Lanka (8.4), and Kuwait (7.0).<sup>3</sup> Black IMR have persistently been among the highest in

the United States and Black infants are twice as likely to die before their first birthday compared with White infants.<sup>4</sup> This racial gap in IMR has been documented over decades and its drivers are multifaceted.

Research on racial inequities in IMR within the US has focused on individual or organizational determinants, such as access to prenatal and maternity care,<sup>5</sup> maternal morbidity, low-birth weight and premature births,<sup>6</sup> and provider bias,<sup>7</sup> or cultural and behavioral factors, such as knowledge and attitudes toward prenatal health.<sup>8</sup> However, these approaches do not necessarily incorporate the roles social determinants play in racial inequities found in IMR.

Structural racism is one social determinant contributing to racial health inequities and may be the most important pathway connecting racism and health.<sup>9</sup> Structural racism is defined as the interconnected institutions that foster and reinforce racial discrimination to advantage one racial group over others.<sup>10</sup> Structural racism is a fundamental cause of health inequities because it is a system designed to disadvantage and socially marginalize populations based on race through multiple pathways, both intentionally and unconsciously. For

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example, structural racism limits access to quality education and health care,<sup>11</sup> safe and affordable housing,<sup>12</sup> opportunities to build wealth,<sup>13</sup> and employment<sup>14</sup> based on race. As a result, Blacks in the United States face disproportionate risk factors that lead to poorer health outcomes due to the effects of structural racism that disadvantages Blacks with regard to these social determinants of health.<sup>15-17</sup>

Previous research has demonstrated relationships between social inequality and racial inequities in IMR. A growing body of research shows that structural racism is posi-

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*This study assesses the relationship between county-level structural racism and race-specific infant mortality rate...*

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tively associated with different health outcomes for Black populations and negatively related to health outcomes among Whites. Siddiqi and colleagues examined how state-level racial income inequality was related to racial inequalities in IMR over time and found that contemporaneous income inequality was negatively associated with White IMR.<sup>18</sup> They also found that two-year lagged income inequality had the most significant impact on Black-White inequities in IMR and was negatively associated with Black IMR. Simi-

larly, Wallace et al examined the relationship between state-level measures of structural racism and infant mortality; their findings show that racial inequities in employment and education are associated with higher Black IMR, but not White IMR.<sup>19</sup>

Findings such as these have led researchers to theorize why structural racism impacts races differently. Discrimination may negatively impact socially marginalized populations (those populations targeted for negative discrimination), and may advantage those who are socially privileged in a system of racism.<sup>20</sup> Intersectionality theory posits that different populations experience different axes of oppression based on their social identities.<sup>21,22</sup> For example, Black women may face unique stressors that increase the risk of infant mortality throughout their lifespans, including power imbalances within the health care system, biases, and racial stereotypes.<sup>23,24</sup> Thus, within an oppressive social system based on race, Black women face unique risks to their health compared with White women, which, in turn, shapes their infants' health.<sup>25</sup> Although Blacks and Whites live within the same system in the United States, those receiving structural privileges within this system based on their race, on average, have better health outcomes compared with those who are discriminated against or oppressed.

Although structural racism plays a role in population health, place also impacts health outcomes. On average, places farthest away from an urban core area have poorer health outcomes, including higher IMR.<sup>26</sup> Research has demonstrated a persis-

tent urban-rural divide in health and that place is related to race-specific health. Within rural health research, access to care and other health-promoting resources have been cited as factors contributing to the urban-rural health divide.<sup>27</sup> Racism has also been suggested as a contributor to poorer health outcomes in rural communities.<sup>27,28</sup> Studies have documented larger racial disparities in health in rural areas, and scholars have suggested the need to examine the role of racism in rural contexts, which may have unique mechanisms on health and racial disparities in IMR.<sup>28-30</sup>

Structural racism may complicate the factors associated with urban-rural health inequities. Little is known about the role of place, including urban-rural classification, in the relationship between structural racism and health outcomes in the United States at the county level. Counties in the United States are subdivisions within states and vary in size. This study assesses the relationship between county-level structural racism and race-specific IMR and the role of urban-rural classification on race-specific IMR and racial gaps in IMR. We focus on counties because local social conditions may have a more proximal effect on health compared with state-level measures of structural racism. There is also county-level variation in the distribution of resources related to health, like education and employment, that may be masked in state-level analyses. We also focus on the county-level due to newly available county-level race-specific IMR data, providing an opportunity to conduct race-specific analyses on IMR, structural racism,

and urban-rural classification across the United States. We hypothesize that county-level race-specific IMR and racial gaps in IMR vary across urban-rural classification. Additionally, corresponding with previous research on structural racism in health, we expect to find that structural racism, measured as county-level racial inequity in socioeconomic status (SES), negatively impacts county-level Black IMR but not White IMR.

## METHODS

County Health Rankings (CHR) is a compilation of health and health-related outcomes in US counties over time. A collaboration between the Robert Wood Johnson Foundation and the University of Wisconsin Population Health Institute, CHR collects data from various sources to develop a ranking of health based on several factors. The source of data for this study was the Centers for Disease Control Wide-ranging Online Data for Epidemiologic Research (CDC WONDER), which is an online database of health data made accessible to public health researchers and policymakers. It includes county-level data for a number of health and mortality outcomes. Data on race-specific infant mortality rates from 2011 to 2017 were included in the 2019 CHR. County-level infant mortality data were linked with county-level sociodemographic data from the American Community Surveys 5-Year estimates (ACS). The ACS is a survey of the US population conducted by the US Census Bureau annually. Five years of data

are compiled to obtain representative data for every US county. This study included data for every county in the United States from the 2014 5-Year ACS estimates in the data analysis.

## Variables

The dependent variable was race-specific infant mortality rate (IMR). IMR was calculated as the number of deaths of children aged <1 year per 1,000 live births. The 2011-2017 IMR in US counties among Blacks and Whites was calculated and included in data from the 2019 CHR. From this, a ratio of Black-to-White IMR was also calculated for each county in the United States.

Independent variables included four indicators of structural racism. The median income, percentage who completed a 4-year college degree, percentage who were unemployed, and percentage who were homeowners for non-Hispanic Blacks and non-Hispanic Whites were obtained for each county. Structural racism was measured as racial inequality in these indicators, operationalized as county-level Black-White ratios. In statistical analyses, these variables were formatted such that a higher value represented greater racial inequality in SES in the county.

Covariates included county population size, percentage of African American residents in the county, Dissimilarity Index score, and overall county-level median income, percentage of residents with a 4-year college degree, percentage of residents who were unemployed and percentage of residents who were homeowners. The Dissimilarity In-

dex score measures the unevenness component of racial residential segregation and demonstrates the spatial distribution of race groups within a geographical area.<sup>30</sup> It describes the percentage of the minority group (here Black populations) that would need to move from their census tract of residence for there to be an even distribution of Blacks and Whites in a given geographical area.<sup>30</sup> The Dissimilarity Index score was calculated with the following equation ( $D = \sum_{i=1}^n [t_i | p_i - (P/2TP(1-P))]$ , Equation 1), where  $t_i$  is the total population in the census tract,  $p_i$  is the Black population in the census tract,  $T$  is the total population in the county, and  $P$  is the total Black population in the county.

Analyses were stratified by county urban-rural classification categories based on the 2013 National Center for Health Statistics Urban-Rural Classification Scheme for Counties.<sup>31</sup> These categories are based on population density and proximity to a metropolitan area. Categories included large central metro, large fringe metro, medium metro, small metro, micropolitan and non-core.

## Statistical Analyses

Analysis of variance tests were used to determine differences in structural racism indicators, IMR and other co-variables by county urban-rural classification. Because the dependent variables were rates (ie, infant deaths per 1,000 live births), linear regressions were used to determine the associations between county-level racial inequities in SES and county-level IMR among Blacks, Whites and the Black-White IMR

## Race, Inequities, Urban-Rural, Infant Mortality - Owens-Young and Bell

ratio. In Model 1, each indicator of racial inequity in SES was regressed on the dependent variable. In Model 2, regression analyses additionally controlled for county population size, racial composition, racial segregation, measures of overall county SES, and urban-rural classification. Multiplicative interaction terms were analyzed in regressions to determine the potential moderating effects of urban-rural classification on the associations between indicators of racial inequity in SES and health. Associations between racial inequity in SES and IMR or Black-White IMR ratio were then assessed within county urban-rural classification.  $P$ s  $\leq .05$  were considered statistically

significant. All statistical procedures were performed using STATA statistical software, Version 14 (Stata-Corp LP, College Station, TX).

## RESULTS

Table 1 displays demographics, structural racism, and infant mortality rates (IMR) by county urban-rural classification. There was variation in median income, percentage of residents who were college graduates, unemployed and homeowners by urban-rural classification, as well as variation in population size, racial composition (as indicated by the percentage of Black residents) and racial

segregation (as indicated by the Dissimilarity Index). The mean Black-White median income ratio was .67 but varied by urban-rural classification. For example, in large central metro counties, the Black-White median income ratio was .55 compared with .71 in large fringe metro counties ( $P < .001$ ). Black-White ratios of college graduates also varied by county urban-rural classification with an overall mean of .61 and ranged from .47 in large central metro counties to .71 in large fringe metro counties ( $P < .001$ ). Unemployment rates among Blacks were about two-and-a-half times higher than Whites. In central fringe metro counties, the Black-White unemployment ratio was

**Table 1: County-level demographics, indicators of racial inequity in socioeconomic status, and infant mortality rates by urban-rural classification**

	Total	Large central metro	Large fringe metro	Medium metro	Small metro	Micropolitan	Non-core	P
	N=3,142	n=68	n=368	n=372	n=358	n=641	n=1,335	
Median income, \$10,000	4.65 ± 1.21	5.60 ± 1.38	6.16 ± 1.61	4.97 ± 1.21	4.73 ± .86	4.41 ± .94	4.20 ± .89	<.001
College graduates, %	13.2	21.3	17.1	15.0	14.0	12.5	11.3	<.001
Unemployed, %	8.6	9.7	8.5	9.0	8.6	9.0	8.2	<.001
Homeowner, %	71.7	54.1	73.7	7.4	69.3	7.1	73.9	<.001
Population, 100,000	.99 ± 3.20	14.10 ± 14.37	2.11 ± 2.94	1.76 ± 1.95	.81 ± .62	.42 ± .26	.14 ± .11	<.001
Non-Hispanic Black residents, %	8.9	2.7	10.4	10.9	9.2	8.0	7.6	<.001
Dissimilarity Index	.43 ± .18	.60 ± .11	.44 ± .15	.47 ± .14	.45 ± .14	.46 ± .15	.38 ± .21	<.001
Black-White ratio								
Median income	.67 ± .31	.55 ± .11	.71 ± .23	.65 ± .27	.66 ± .31	.68 ± .34	.68 ± .35	.004
College graduation rate	.61 ± .75	.47 ± .13	.71 ± .46	.63 ± .47	.66 ± .77	.59 ± .60	.57 ± .95	.012
Unemployment	2.41 ± 4.12	2.41 ± .66	1.82 ± 1.18	2.05 ± 1.78	2.28 ± 2.52	2.36 ± 2.58	2.82 ± 6.09	.001
Homeownership	.63 ± .35	.56 ± .12	.65 ± .24	.64 ± .27	.60 ± .29	.59 ± .34	.66 ± .43	.001
Infant mortality rate, per 1,000 live births								
Black	12.14 ± 3.63	11.21 ± 3.20	10.26 ± 3.02	12.98 ± 3.07	14.60 ± 4.19	13.13 ± 2.64	---	<.001
White	5.02 ± 1.46	4.16 ± 1.03	4.51 ± 1.30	5.24 ± 1.29	5.84 ± 1.45	7.62 ± 1.30	---	<.001
Black-White ratio	2.19 ± 1.21	2.70 ± .84	2.03 ± 1.08	2.15 ± 1.29	2.15 ± 1.45	2.61 ± .82	---	.002

Data are mean ± SD unless noted otherwise.

1.82, but in non-core counties Blacks had 2.82 times the rate of unemployment as Whites ( $P<.001$ ). The Black homeownership rate was about two-thirds that of Whites (Black-White ratio=.63) overall. However, it varied by county urban-rural classification.

The biggest Black-White difference in homeownership was observed in large central metro (.56) and micropolitan counties (.59), and smaller racial differences in observed in large fringe metro (.65) and non-core counties (.66,  $P<.001$ ). The average IMR among Blacks was 12.14 per 1,000 live births compared with a rate of 5.02 per 1,000 per live

births among Whites with a Black-White IMR ratio of 2.19. For both Blacks and Whites, the IMR varied by urban-rural classification with the highest rates in small metro counties. Black IMRs were lower in large fringe counties ( $P<.001$ ); the White IMR was lowest in large central metro counties ( $P<.001$ ). The Black-White IMR ratio was largest in large central metro counties and lowest in large fringe metro counties ( $P=.002$ ). There were insufficient data available on IMR in non-core counties, so this urban-rural classification category was not included in further analyses.

The associations between county-

level racial inequity and urban-rural classification with IMR is shown in Table 2. In Model 1, with every unit increase in median income inequity between Blacks and Whites, there was an increase in Black IMR ( $\beta=6.86$ ,  $se=2.62$ ). Higher racial inequity in homeownership at the county-level was also associated with higher Black IMR ( $\beta=5.18$ ,  $se=1.69$ ). Adjusting for co-variates in Model 2, racial inequity in homeownership was associated with higher Black IMR ( $\beta=10.39$ ,  $s.e.=1.90$ ). In Model 1, racial inequity in median income was associated with higher White IMR ( $\beta=3.20$ ,  $se=.90$ ). However,

**Table 2. Association between county-level racial inequity, urban-rural classification and infant mortality rate (IMR)**

	Black IMR		White IMR		Black-White IMR ratio	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)
Racial inequity						
Median income	6.86 (2.62) <sup>a</sup>	.93 (2.66)	3.20 (.90) <sup>a</sup>	1.28 (.79)	-.33 (.62)	-.24 (.74)
College graduation	.67 (1.62)	1.28 (1.80)	-1.54 (.58) <sup>a</sup>	-1.47 (.55) <sup>a</sup>	1.04 (.38) <sup>a</sup>	1.31 (.49) <sup>a</sup>
Unemployment	.35 (.45)	.60 (.46)	-.29 (.14) <sup>a</sup>	-.19 (.11)	.32 (.11) <sup>a</sup>	.24 (.13)
Homeownership	5.18 (1.69) <sup>a</sup>	10.39 (1.90) <sup>a</sup>	-1.78 (.63) <sup>a</sup>	.70 (.64)	1.83 (.40) <sup>a</sup>	1.71 (.53) <sup>a</sup>
Urbanization						
Large central metro		---		---		---
Large fringe metro		-1.13 (.68)		.24 (.24)		-.34 (.19)
Medium		.06 (.09)		.26 (.22)		-.09 (.16)
Small		1.39 (.71)		.78 (.26) <sup>a</sup>		-.05 (.19)
Micropolitan		-1.30 (1.29)		1.91 (.46) <sup>a</sup>		-.70 (.35) <sup>a</sup>
Population, 100,000		-.03 (.02)		-.01 (.01)		-.01 (.01)
% non-Hispanic Black		3.54 (1.79) <sup>a</sup>		1.88 (.61) <sup>a</sup>		.06 (.50)
Dissimilarity Index		.39 (1.81)		-1.36 (.65) <sup>a</sup>		.59 (.49)
Median income, \$10,000		-.68 (.21) <sup>a</sup>		-.31 (.07) <sup>a</sup>		.04 (.06)
% college graduate		-.04 (.06)		-.09 (.02) <sup>a</sup>		.03 (.02) <sup>a</sup>
% unemployed		.06 (.09)		-.08 (.03) <sup>a</sup>		.05 (.03)
% homeowner		12.05 (2.56) <sup>a</sup>		-.29 (.87)		2.33 (.70) <sup>a</sup>
Constant	6.15 (.80) <sup>a</sup>	1.18 (2.85)	5.76 (.30) <sup>a</sup>	9.60 (.97) <sup>a</sup>	.79 (.19) <sup>a</sup>	-2.02 (.78) <sup>a</sup>
Number of observations	349	264	405	308	348	263
R-squared	.18	.49	.05	.55	.23	.32
Adjusted R-squared	.17	.46	.04	.53	.22	.28
F statistic (P)	18.45 ( $P<.001$ )	15.66 ( $P<.001$ )	4.90 (.001)	23.83 ( $P<.001$ )	25.66 ( $P<.001$ )	7.70 ( $P<.001$ )

a.  $P<.05$   
SE, standard error.



**Table 3. Interactions between county-level racial inequality and urban-rural classification on infant mortality rate (IMR) in US counties**

	Black IMR	White IMR	Black-white IMR ratio
	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)
<b>Racial inequity</b>			
Median income	.81 (6.22)	.64 (2.42)	1.24 (1.72)
College graduation	8.06 (4.86)	-4.04 (1.83) <sup>a</sup>	3.31 (1.35) <sup>a</sup>
Unemployment	.35 (1.20)	.08 (.43)	.11 (.33)
Homeownership	4.94 (3.62)	1.45 (1.41)	.12 (1.00)
<b>Urbanization</b>			
Large central metro	---	---	---
Large fringe metro	1.83 (2.72)	-.62 (1.00)	1.12 (.75)
Medium	-2.50 (2.86)	-.71 (1.04)	.40 (.79)
Small	2.28 (3.09)	.94 (1.03)	.51 (.85)
Micropolitan	9.58 (11.79)	.41 (3.75)	1.70 (3.25)
<b>Racial inequity in median income × Urbanization</b>			
Large central metro	---	---	---
Large fringe metro	-4.41 (7.93)	2.05 (3.08)	-3.45 (2.23)
Medium	3.64 (7.83)	.68 (2.68)	-.76 (2.16)
Small	5.71 (8.97)	1.63 (2.94)	-1.70 (2.48)
Micropolitan	-16.70 (23.16)	-8.68 (7.78)	-2.02 (6.39)
<b>Racial inequity in college graduation × Urbanization</b>			
Large central metro	---	---	---
Large fringe metro	-2.83 (5.54)	2.39 (2.09)	-1.44 (1.53)
Medium	-8.27 (5.65)	2.66 (1.96)	-1.63 (1.56)
Small	-10.54 (6.37)	1.36 (2.19)	-2.24 (1.76)
Micropolitan	-13.80 (15.16)	13.43 (5.90) <sup>a</sup>	-6.54 (4.19)
<b>Racial inequity in unemployment × Urbanization</b>			
Large central metro	---	---	---
Large fringe metro	-.12 (1.48)	-.09 (.52)	-.01 (.41)
Medium	.99 (1.43)	-.28 (.48)	.04 (.39)
Small	-2.33 (1.48)	-.40 (.47)	-.26 (.41)
Micropolitan	.40 (4.84)	.62 (.80)	.07 (1.34)
<b>Racial inequity in homeownership × Urbanization</b>			
Large central metro	---	---	---
Large fringe metro	1.37 (4.86)	-1.88 (1.87)	1.46 (1.36)
Medium	6.57 (4.65)	-.06 (1.72)	1.33 (1.28)
Small	16.22 (5.01) <sup>a</sup>	-1.59 (1.73)	4.45 (1.38) <sup>a</sup>
Micropolitan	3.11 (21.13)	-6.23 (5.63)	3.67 (5.83)
Population, 100,000	-.03 (.02)	-.01 (.01)	-.01 (.01)
% non-Hispanic Black	2.41 (1.82)	2.14 (.64) <sup>a</sup>	-.34 (.51)
Dissimilarity Index	-1.21 (1.89)	-1.05 (.69)	.26 (.52)
Median income, \$10,000	-.74 (.21) <sup>a</sup>	-.35 (.07) <sup>a</sup>	.04 (.06)
% college graduate	-.04 (.06)	-.09 (.02) <sup>a</sup>	.03 (.02)
% unemployed	.04 (.10)	-.11 (.04) <sup>a</sup>	.06 (.03) <sup>a</sup>
% homeowner	12.24 (2.67) <sup>a</sup>	-.47 (.91)	2.39 (.74) <sup>a</sup>
Constant	2.22 (3.45)	10.73 (1.25) <sup>a</sup>	-2.59 (.95) <sup>a</sup>
Number of observations	264	308	263
R-squared	.56	.58	.40
Adjusted R-squared	.50	.54	.32
F statistic (P)	9.43 (P<.001)	12.49 (P<.001)	5.02 (P<.001)

a. P<.05.

county-level racial inequity in college graduation rates ( $\beta=-1.54$ ,  $se=.58$ ), unemployment ( $\beta=-.29$ ,  $se=.14$ ) and homeownership ( $\beta=-1.78$ ,  $se=.63$ ) was associated with lower IMR in US counties among Whites. In Model 2, after adjusting for co-variates, White IMR was negatively associated with college graduation racial inequity only. That is, as racial differences in college graduation rates increase, the White IMR decreases ( $\beta= -1.47$ ,  $se=.55$ ). The White IMR was higher in small metro ( $\beta=.78$ ,  $se=.26$ ) and micropolitan counties ( $\beta=1.91$ ,  $se=.46$ ) compared with central metro counties. Unadjusted analyses in Model 1 show that racial inequity in college graduation ( $\beta=1.04$ ,  $se=.38$ ), unemployment ( $\beta=.32$ ,  $se=.11$ ) and homeownership rates ( $\beta=1.83$ ,  $se=.40$ ) is positively association with Black-White IMR ratio. In Model 2, the Black-White IMR

ratio increased with greater racial inequity in median income ( $\beta=2.03$ ,  $se=.76$ ) and college graduation rates ( $\beta=1.25$ ,  $se=.54$ ), but Black and White IMR were closer in micropolitan counties compared with central metro counties ( $\beta= -1.36$ ,  $se=.44$ ).

The interaction between county racial inequity in SES and urban-rural classification on IMR is displayed in Table 3. The association between racial inequity in homeownership and Black IMR was moderated by urban-rural classification as indicated by a significant interaction between racial inequity in homeownership and small metro county ( $\beta=16.22$ ,  $se=5.01$ ). Urban-rural classification also moderated the association between county-level racial inequity and county-level White IMR. Specifically, the association between racial inequity in college graduation rates and White IMR was moder-

ated by micropolitan county classification ( $\beta=13.43$ ,  $se=5.90$ ). Small metro classification moderated the association between racial inequity in homeownership and Black-White IMR ratio ( $\beta=4.45$ ,  $se=1.38$ ).

Table 4 demonstrates the associations between racial inequity and IMR by county urban-rural classification. In large central metro counties, no indicators of racial inequity were associated with IMR. In large fringe metro counties, racial inequity in college graduation was associated with higher Black IMR ( $\beta=7.92$ ,  $se=3.26$ ). More racial inequity in homeownership was also associated with higher Black IMR in medium ( $\beta=10.84$ ,  $se=4.25$ ) and small metro counties ( $\beta=21.23$ ,  $s.e.=4.99$ ). However, in medium metro counties, racial inequity in college graduation was associated with lower White IMR ( $\beta= -2.38$ ,

**Table 4: Association between racial inequity in SES and infant mortality rate (IMR) by urban-rural classification**

	Large central metro	Large fringe metro	Medium metro	Small metro
	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)	$\beta$ (SE)
<b>Black IMR</b>				
Median income	2.18 (5.07)	-4.71 (4.76)	1.63 (5.13)	4.33 (9.49)
College graduation	5.56 (4.49)	7.92 (3.26) <sup>a</sup>	-1.06 (3.31)	-2.19 (5.33)
Unemployment	.33 (.99)	.08 (.93)	1.21 (.90)	-2.03 (1.25)
Homeownership	5.64 (3.09)	7.34 (3.69)	10.84 (4.25) <sup>a</sup>	21.23 (4.99) <sup>a</sup>
<b>White IMR</b>				
Median income	-.42 (1.77)	2.02 (1.79)	1.65 (1.11)	3.69 (2.58)
College graduation	-2.41 (1.56)	-.78 (1.15)	-2.38 (.75)*	-2.20 (1.69)
Unemployment	-.06 (.33)	-.19 (.29)	-.29 (.21)	-.41 (.25)
Homeownership	1.48 (1.08)	.76 (1.37)	.33 (1.21)	-.65 (1.64)
<b>Black-White IMR ratio</b>				
Median income	2.22 (1.72)	.22 (1.56)	1.32 (1.33)	2.29 (2.17)
College graduation	2.63 (1.52)	1.90 (1.00)	2.32 (.91) <sup>a</sup>	-.23 (1.43)
Unemployment	-.08 (.32)	.11 (.26)	.75 (.25) <sup>a</sup>	-.09 (.21)
Homeownership	.18 (1.05)	2.32 (1.19)	1.81 (1.46)	3.90 (1.39) <sup>a</sup>

Sources: 2019 County Health Rankings, including data from the 2011-2017 CDC WONDER and American Community Survey, 2014 5-Year ACS estimates.  
a.  $P < .05$ . Adjusted for population size, % Black, Dissimilarity Index, median income, college graduation, unemployment and homeownership rates.

se=.75). The Black-White IMR ratio was associated with racial inequity in medium and small metro counties. Racial inequity in college graduation ( $\beta=2.32$ ,  $se=.91$ ) and unemployment ( $\beta=.75$ ,  $se=.25$ ) was associated with wider differences in Black and White IMR in medium metro counties, and racial inequity in homeownership was associated with larger Black-White IMR ratios in small metro counties ( $\beta=3.90$ ,  $se=1.39$ ).

## DISCUSSION

This study sought to determine whether racial inequities in county-level socioeconomic indicators are associated with race-specific IMR and Black-White differences in IMR and to determine if urban-rural classification moderates these associations. Study results suggest that racial inequities in education, work, and homeownership negatively impact Black IMR, particularly in large fringe, medium, and small metro counties. Findings also demonstrate that White infants may benefit from racial inequities in education, especially in medium metro counties. No indicators of racial inequity were associated with IMR in large central metro counties. These findings suggest that urban-rural classification may be an important factor in understanding how structural racism impacts race-specific IMR and Black-White differences in IMR, demonstrating racial-spatial inequalities in infant mortality.

Place matters for health. Previous research has demonstrated different experiences and risk factors to health based on geography and local

demographics. Racial inequalities are etched into US geography. Across the United States, Black communities typically face greater risks to their health due to racism in terms of unjust distributions of power and access to health-promoting resources.<sup>32</sup> However, the magnitude of racial inequities one may experience vary across place. Murray and colleagues examined county-level mortality rates across different places categorized as “eight Americas.” They found

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*Study results suggest that racial inequities in education, work, and homeownership negatively impacts Black infant mortality rate, particularly in large fringe, medium, and small metro counties.*

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that across the eight Americas, there are distinct health and socioeconomic profiles that should be considered when designing health programs and policies. People face different risks depending on where they live and their own demographic identities.<sup>33</sup> Relatedly, different factors may promote health for different populations across geographies. Racial and health inequalities, and structural factors associated with those inequalities, may be traced along spatial lines.

Our study results build upon the findings from Murray et al. and other studies, demonstrating that place influences the relationship between structural racism and IMR. Depending on location, specific types of racial inequities may matter more to health than others. For example, study results suggest that reducing inequities in education and employment in some places may have a greater impact on Black IMR and reducing Black-White IMR gaps compared with addressing inequities in homeownership in other places.

Structural racism is related to health outcomes for both Blacks and Whites across multiple geographies. Cities are often characterized as places with high racial inequities in health, and thus, have received significant research attention and policy and philanthropic support to address health inequities. Because urban areas are home to a significant proportion of the US population, it is logical to focus resources on improving urban health. Though our study was unable to assess these associations in non-core counties, rural areas are also sites of studies in racial differences in health; a growing literature has brought attention to the challenges rural communities face for health promotion and racial inequities within rural communities.<sup>29,34</sup> Infant mortality is a concern in rural areas; on average, IMR is higher for both Black and White infants in rural areas compared with urban communities.<sup>35,36</sup>

However, the places in between urban cores and rural areas should be considered in efforts to reduce and eliminate racial inequities in health. Focusing on these in-be-



tween places could be significant to achieving racial health equity. About a third of the counties in the United States are small metro or micropolitan, yet research on racial inequality in these areas is limited. Because area-level factors influence health beginning at birth, increasing research focused on health and structural racism in small metro areas and micropolitan counties could help public health professionals better understand how the mechanisms of structural racism operate differently in multiple types of places.<sup>33</sup>

Racism generally harms health for Black communities and promotes health for White communities; however, the relationship between structural racism and health outcomes vary across places. It should be noted that, particularly in medium metro counties, the White IMR decreased as racial inequity in college graduation rates increased. It is possible that counties with more racial inequity are characterized by potentially racially unbalanced distribution of resources to the benefit of Whites. This aligns with the understanding that structural racism works to not only disadvantage Blacks, but also to either implicitly or explicitly advantage Whites, likely manifesting in lower rates of IMR among Whites in counties with larger racial inequities in college graduation rates.

Thus, policymakers and public health practitioners should adopt policies and practices that specifically address structural racism and race-specific IMR within their counties. Context matters to the relationship between structural racism and health. This requires understanding their

county-specific measures of structural racism, local history and politics, and the lived experiences of Black communities within their county. Policymakers should also understand that initiatives to improve infant health may impact Black and White IMR differently; thus, policymakers should account for those differences during decision-making processes. A lack of specific adaptation of policies and programs to address local environments and needs may limit the impacts of interventions to improve Black IMR and eliminate racial gaps in IMR.

### Study Limitations

There are a few study strengths and weaknesses to note. One strength is that this study uses a six-level urban-rural classification scheme that captures a spectrum of urbanization beyond just an urban/non-urban measure. Another strength is that this study uses national, race-specific data on structural racism and IMR at the county level. This captures more local economic and social conditions compared with state-level analyses. Relatedly, one weakness is that smaller, non-core counties were excluded from this study due to county-level race-specific IMR data limitations. Merging smaller county-units in future research could address this limitation. Additionally, IMR data include multiple years of data and due to the cross-sectional design of this study, causality cannot be determined. Another limitation is that other measures of structural racism common in the public health literature, specifically incarceration,<sup>19</sup> was not included in this study due to its focus on SES indicators. Lastly, another limi-

tation to note is that this study did not examine inequities among Latinx or Indigenous populations because of the study's focus on Black-White inequities due to related race-specific discrimination that is manifested in racial inequities in SES. Future studies should address this limitation.

## CONCLUSION

There is an established and growing literature on the role of structural racism on racial inequities in IMR. Most counties in the United States are outside of the metropolitan core and have factors related to structural racism that should be considered in research, policy, and practice. As research on the role of structural racism on health outcomes continues to grow, it is important to incorporate the role of place in the relationships between socioeconomic factors and health. Although structural racism exists across the United States, factors related to structural racism may not be homogenous or have the same impacts on overall population health, race-specific health, and racial differences in health across places. Understanding these differential impacts can help public health professionals and policymakers improve Black infant health and reduce and eliminate racial inequities in IMR.

### CONFLICT OF INTEREST

No conflicts of interest to report.

### AUTHOR CONTRIBUTIONS

Research concept and design: Owens-Young, Bell; Data analysis and interpretation: Bell; Manuscript draft: Owens-Young; Statistical expertise: Bell; Administrative: Owens-Young

## Race, Inequities, Urban-Rural, Infant Mortality - Owens-Young and Bell

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