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Geographic Hotspots for Low Birthweight: An Analysis of Counties With Persistently High Rates

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Abstract

This study evaluated persistency in county-level rates of low birthweight outcomes to identify "hotspot counties" and their associated area-level characteristics. Administrative data from the National Center for Health Statistics Birth Data Files, years 2011 to 2016 were used to calculate annual county-level rates of low birthweight. Counties ranking in the worst quintile (Q5) for ≥3 years with a neighboring county in the worst quintile were identified as hotspot counties. Multivariate logistic regression was used to associate county-level characteristics with hotspot designation. Adverse birth outcomes were persistent in poor performing counties, with 52% of counties in Q5 for low birthweight in 2011 remaining in Q5 in 2016. The rate of low birthweight among low birthweight hotspot counties (n = 495) was 1.6 times the rate of low birthweight among non-hotspot counties (9.3% vs 5.8%). The rate of very low birthweight among very low birthweight hotspot counties (n = 387) was twice as high compared to non-hotspot counties (1.8% vs 0.9%). A one standard deviation (6.5%) increase in the percentage of adults with at least a high school degree decreased the probability of low birthweight hotspot designation by 1.7 percentage points (P = .006). A one standard deviation (20%) increase in the percentage of the population that was of minority race/ethnicity increased hotspot designation for low birthweight by 5.7 percentage points (P < .001). Given the association between low birthweight and chronic conditions, hotspot counties should be a focus for policy makers in order to improve health equity across the life course.

Keywords
birth outcomes, prematurity, low birthweight

What do we already know about this topic?
High rates of adverse birth outcomes have been identified in the southeastern United States, with Black infants having much higher risk than White infants.

How does your research contribute to the field?
This analysis identifies hotspot counties for adverse birth outcomes that can be targeted for interventions and highlights the need to address the large racial disparities at the county-level.

What are your research's implications toward theory, practice, or policy?
Public health and health policy makers can identify clusters of counties for targeted interventions that may improve health equity across the life course given the relationship between adverse birth outcomes and chronic conditions.

Introduction

Approximately 35% of infant death in the United States can be attributed to complications associated with low birthweight and preterm birth.[1] Previous studies have indicated areas in the United States, such as in the southeastern region, where infants are at particular risk for prematurity and low birthweight outcomes.[2,3] In 2017, Mississippi had the highest state-level rates of preterm births (13.6%) and low birthweight (11.6), with rates twice as high as states with the lowest rates.[4] For comparison, 7.5% of births in Vermont were preterm and 5.6% of births in Rhode Island were low birthweight. Notably, rates for both of these adverse birth outcomes were higher among states with high concentrations of non-Hispanic Black populations.

Healthy People 2020 set a goal to eliminate disparities and to achieve health equity, including disparities among geographic regions.[5] Consistent with these goals, identifying regions with high rates of low birthweight can inform policy making related to resource allocation needed to improve access to and coverage for appropriate healthcare and educational programs, especially for at-risk populations. For example, after the southeastern area of the United States was identified as a high-risk area for infant mortality in the early 1980s, the Southern Regional Task Force on Infant Mortality was established to develop initiatives targeting the high rate of infant mortality in this region of the country.[6]

Previous studies that evaluate geographic variation in rates of adverse infant outcomes indicate large variation among counties, with between a 2- and 5-fold variation in rates of preterm birth and a greater than 5-fold variation among infant mortality rates when considering white infants only.[7-9] Such variation in infant outcomes suggest large health inequities across regions. Identifying regions with high rates of adverse birth outcomes has the potential to reduce disparities in infant mortality and chronic comorbidities across the life course.[10-15] Furthermore, small-area evaluation may be important for identifying mechanisms that may be leading to relatively low rates of adverse birth outcomes in some areas.[16] While a number of individual-level characteristics (eg, maternal age) are associated with adverse birth outcomes, other social determinants at the county-level, such as the number of primary care providers and neighborhood deprivation, additionally impact birth outcomes.[17,18]

Despite analyses that evaluate persistency in adverse birth outcomes among larger counties or at the state-level,[16,19] studies that evaluate persistency in county-level rates among individual counties across the United States to identify low birthweight hotspot counties are limited. The use of data at the county-level has been suggested as the geographic level that provides the smallest stable unit in which policies related to social or healthcare services may be created.[18] As such, the primary goal of this study was to evaluate *persistency* in *county-level* rates of adverse birth outcomes and the association of county-level characteristics with hotspot designation under the hypothesis that hotspot counties could be identified to reduce rates of adverse birth outcomes.

Methods

Primary Outcomes

Data from the National Center for Health Statistics (NCHS) Vital Statistics Birth Data Files (hereafter "Birth Data Files"), years 2011 to 2016, were used to calculate county-level rates of low birthweight (<2,500 grams) and very low birthweight (<1,500 grams). The Birth Data Files contain data abstracted from birth certificates for 100% of the registered births in all 50 states and the District of Columbia, and it is estimated that 99% of live births in the United States are registered.[20]

County-level rates were limited to counties in the contiguous United States with at least 30 births in at least 3 years, which included 2,946 counties based on the outcomes of 21,800,484 births. Birth outcomes were analyzed based on the mother's county and state of residence. A limit of 30 births was used as the threshold, as this is a generally accepted minimum to obtain a sample with an approximately normal distribution, regardless of the distribution among the population data.[21]

Following a similar approach to a study that identified health priority areas for older adults, a county was designated as a hotspot county if that county ranked in Q5 for 3 or more years and if a neighboring county also ranked in Q5 for 3 or more years.[22] Contiguous counties were identified using county adjacency information from the United States Census Bureau.[23]

Analyses

Hotspot and persistency analyses. Counties were ranked into quintiles for each birth outcome in each year separately. To describe the persistence in county ranking, the data were analyzed through 2 approaches. First, we assessed the relationship between county-level quintile ranking in 2011 with county-level quintile ranking in 2016 for each adverse birth outcome separately. Counties were required to have at least 30 births in year 2011 and in 2016 for this analysis (n=2,912 counties). Next, we assessed whether counties in the quintile with the highest (Q5) and lowest (Q1) rates of adverse birth outcomes in 2011 consistently remained among the higher and lower quintiles throughout the 6 years of data. For this analysis, counties were required to have at least 30 births in each of the 6 years (n=2,885 counties).

Multivariate logistic regression was used to evaluate the association between area-level factors and hotspot designation. To obtain area-level information, county-level rates were linked to the Area Health Resource File (AHRF) from the Center for Disease Control and Prevention and data from Behavioral Risk Factor Surveillance System (BRFSS) obtained from the Robert Wood Johnson County Health Rankings & Roadmaps data.[24] A full description of the

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Table 1. Persistency in County-Level Rates of Low Birthweight and Very Low Birthweight, National Center for Health Statistics Vital Statistics Birth Data Files, Years 2011 Through 2016 (n = 2,912[a]).

	2016 ranking % (N)				
2011 ranking	Low birthweight[b]				
	Q1	Q2	Q3	Q4	Q5
Q1	44.5 (258)	23.6 (137)	12.4 (72)	11.9 (69)	7.6 (44)
Q2	23.6 (137)	35.7 (207)	21.2 (123)	11.7 (68)	8.6 (50)
Q3	15.0 (87)	20.5 (119)	33.6 (195)	21.7 (126)	10.2 (59)
Q4	9.1 (53)	13.6 (79)	22.6 (131)	33.4 (194)	21.7 (126)
Q5	7.1 (41)	7.6 (44)	10.5 (61)	22.4 (130)	52.1 (302)
	Very low birthweight[b]				
2011 ranking	Q1	Q2	Q3	Q4	Q5
Q1	39.3 (227)	15.1 (87)	11.6 (67)	14.4 (83)	19.6 (113)
Q2	12.8 (74)	34.3 (198)	26.7 (154)	17.7 (102)	10.4 (60)
Q3	10.4 (60)	29.3 (169)	28.9 (167)	20.6 (119)	12.0 (69)
Q4	11.8 (68)	14.4 (83)	21.8 (126)	31.0 (179)	22.4 (129)
Q5	23.4 (135)	9.2 (53)	13.3 (77)	18.0 (104)	36.2 (209)

[a]Counties were required to have an eligible rate (n ≥ 30 births) in years 2011 and 2016. Thus, the sample size for this table is smaller than for the study overall (n = 2,946).
[b]Low birthweight = birthweight <2,500 grams; Very low birthweight = birthweight <1,500 grams.

covariates along with the acquisition of the study sample is provided in Supplemental Appendix 1.

To improve interpretability of the findings, marginal effects were calculated at the means to indicate percentage point changes in the probability of being a hotspot-designated county. Area-level factors were standardized using z-scores so that the coefficients would represent the percentage point change in the probability of hotspot designation for a one standard deviation increase in the area-level factor.

Individual counties with the highest and lowest rates. Non-Hispanic Black infants have approximately twice the rate of low birthweight (13.7% vs 7.0%) and 1.5 times the rate of prematurity (13.8% vs 9.0%) compared to non-Hispanic White infants.[4] To identify the counties with the highest and lowest rates with highly stable estimates, we limited this component of our study to large counties with at least 5,000 births across the study period (2011-2016) for births of all races/ethnicities (n = 707 counties), non-Hispanic White births (n = 556 counties), and non-Hispanic Black births (n = 134 counties).[25]

Data preparation and descriptive statistics were conducted in SAS, version 9.4. Regressions and marginal effects were completed in Stata, version 12. Visualizations were created using Tableau Software, version 2019.2. Statistical significance was assumed at $P < .05$. This study was determined to be non-human subjects research by the University of Arkansas for Medical Sciences Institutional Review Board (IRB #: 207384).

Findings from the analyses regarding low birthweight and very low birthweight are discussed as the primary outcomes in the text; however, all analyses are available for preterm births (<37 weeks gestation) and very preterm births (<32 weeks gestation) in the Supplemental Appendices.

Results

Hotspot and Persistency Analyses

Table 1 displays the county-level ranking in year 2011 relative to the ranking in 2016 for low birthweight and very low birthweight. Percentages add to 100% across each row to represent the percentage of counties that rank in a given quintile in 2016 from a given quintile in 2011. Among counties with the lowest rates (Q1) in 2011, 44.5% (n = 258) ranked in Q1 in 2016. Over half (52.1%; n = 302) of counties that ranked worse for low birthweight (Q5) remained in the worse ranking quintile in 2016.

To further evaluate persistency, we evaluated the persistency in quintile rankings throughout the 6 years for those counties that had an adequate number of births (≥30) across all years (results not shown; n = 2,885 counties). Of the 577 counties that ranked in the quintile with the highest rates (Q5) of low birthweight in 2011 and that had an eligible county-level rate for all 6 years, 42% (244 counties) remained in either Q4 or Q5 in at least 5 of the 6 years. Only 28% (160/568) of counties in Q1 (in 2011) for low birthweight remained in either Q1 or Q2 for at least 5 of the 6 years.

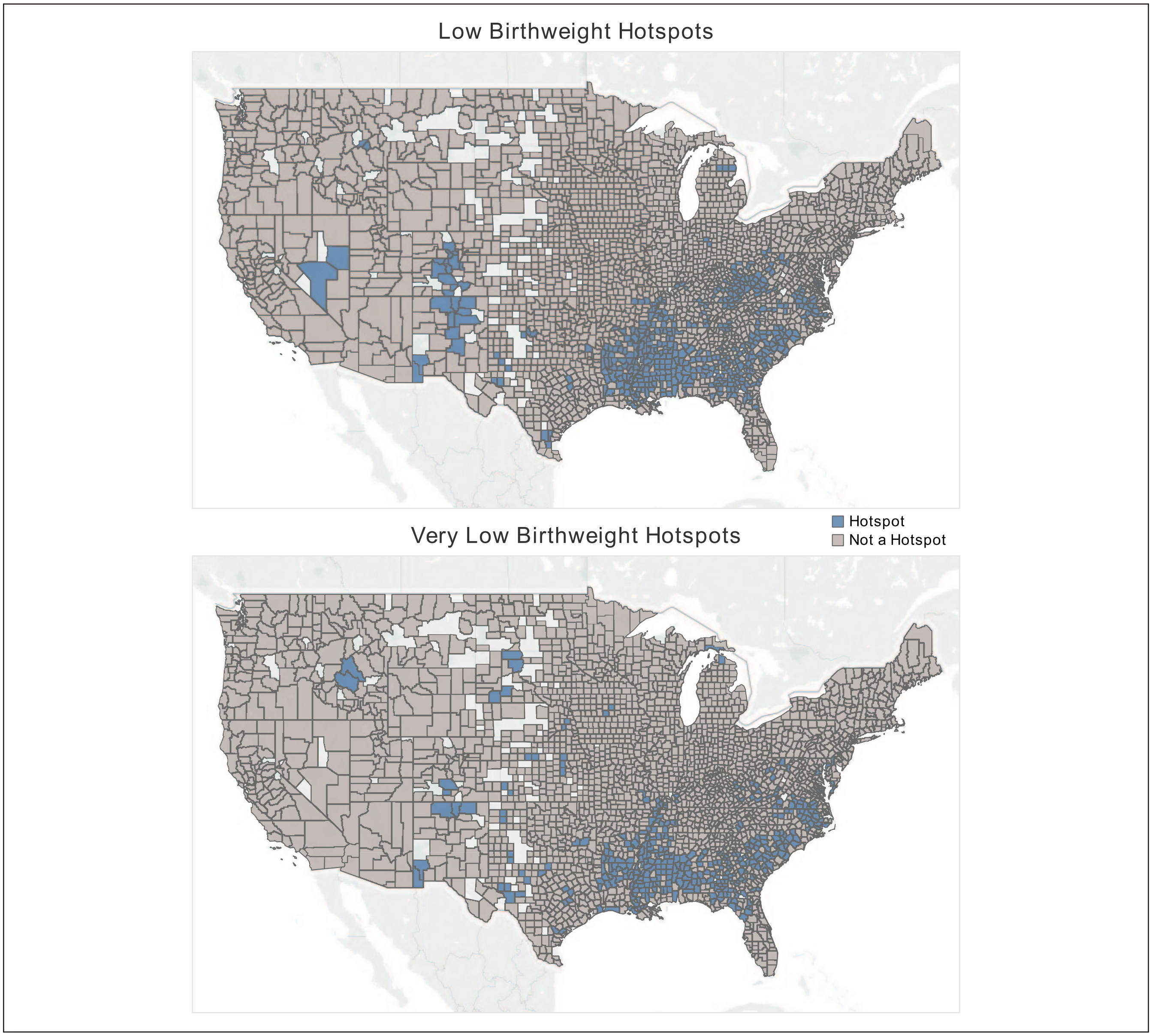

Figure 1. County-level low birthweight and very low birthweight hotspots designation, National Center for Health Statistics Vital Statistics Birth Data Files years 2011 to 2016 (n = 2,946).

Note. The figure displays the 495 counties identified as low birthweight hotspots and the 387 counties identified as very low birthweight. A county was designated as a hotspot county if that county ranked in quintile 5 for 3 or more years and if a neighboring county also ranked in quintile 5 for at least 3 years. Hotspot counties are colored blue and non-hotspot counties are colored gray. Counties that were excluded from the analysis are not colored in the map.

Low birthweight = birthweight <2,500 grams; Very low birthweight = birthweight <1,500 grams.

We identified 495 (16.8%) low birthweight hotspots and 387 (13.1%) very low birthweight hotspots (Figure 1). Hotspot areas clustered in the southeastern region of the country; however, there were additional areas in the north central, western, and Appalachian regions that were designated as hotspots. Refer to the Supplementary Material for lists of the Federal Information Processing Standards codes for hotspot counties for all 4.

Table 2 describes the characteristics of birth and area-level factors among counties designated as hotspot and non-hotspot counties for low birthweight or very low birthweight. As expected, hotspot counties had characteristics associated with poorer socioeconomic status and increased concentration of minority residents, indicated by 95% confidence intervals that do not contain zero. For example, low birthweight hotspot counties had an average population of minority race/ethnicity of 37.1% while non-hotspot counties had an average of 20.0% (difference: −17.1%; 95% CI: −18.9%, −15.3%). Non-hotspot areas for low birthweight had a higher percentage of adults with at least a high school degree (difference: 6.8%; 95% CI:

Table 2. Average County-Level Characteristics by Low Birthweight and Very Low Birthweight Hotspot Designation, National Center for Health Statistics Vital Statistics Birth Data Files Years 2011 to 2016 (n = 2,946).[a]

	Low birthweight[b]			Very low birthweight[b]		
	Non-hotspot (n = 2,451)	Hotspot (n = 495)	Difference (95% CI)	Non-hotspot (n = 2,559)	Hotspot (n = 387)	Difference (95% CI)
Low birthweight rate	5.8	9.3	−3.6 (−3.7, −3.4)	5.9	9.1	−3.2 (−3.3, −3.0)
Very low birthweight rate	0.9	1.6	−0.7 (−0.7, −0.6)	0.9	1.8	−0.9 (−0.9, −0.9)
% minority race/ethnicity[c,d]	20.0	37.1	−17.1 (−18.9, −15.3)	19.8	43.3	−23.5 (−25.5, −21.5)
% urban population[d]	45.5	33.2	12.4 (9.4, 15.3)	44.7	35.5	9.1 (5.8, 12.4)
Average household size[d]	2.5	2.5	0.0 (0.0, 0.0)	2.5	2.5	0.0 (0.0, 0.0)
% with ≥ high school degree[d]	86.8	80.0	6.8 (6.2, 7.4)	86.5	80.4	6.1 (5.5, 6.8)
% unemployed[d]	5.0	6.7	−1.7 (−1.9, −1.5)	5.1	6.5	−1.4 (−1.6, −1.2)
Median household income[d]	$51,754	$38,457	$13,298 ($12,139, $14,457)	$51,034	$39,509	$11,526 ($10,201, $12,850)
Daily fine particulate matter (PM2.5)[d]	11.8	12.4	−0.6 (−0.7, −0.5)	11.8	12.2	−0.4 (−0.6, −0.3)
% under 138% FPL w/o health insurance[d]	17.4	18.1	−0.7 (−1.3, 0.0)	17.2	19.5	−2.3 (−3.0, −1.5)
# of PCPs per 10,000[d]	55.1	42.6	12.5 (9.3, 15.7)	54.5	43.2	11.3 (7.8, 14.9)
# of hospitals with ultrasounds per 10,000[d]	3.3	2.4	0.8 (0.3, 1.3)	3.2	2.8	0.3 (−0.2,0.9)
% poor or fair health[e]	16.6	22.7	−6.2 (−6.6, −5.8)	16.9	22.4	−5.5 (−6.0, −5.1)
% of adults who are obese[e]	31.6	35.3	−3.7 (−4.1, −3.3)	31.7	35.5	−3.7 (−4.2, −3.3)
% of adults with diabetes[e]	11.2	14.3	−3.1 (−3.3, −2.9)	11.3	14.2	−2.9 (−3.1, −2.6)

Note. CI = confidence interval; FPL = federal poverty level; PCP = primary care provider.
[a]A county was designated as a hotspot county if that county ranked in quintile 5 for 3 or more years and if a neighboring county also ranked in quintile 5 for at least 3 years. Counties were required to have ≥3 years with ≥30 births.
[b]Low birthweight = birthweight <2,500 grams; Very low birthweight = birthweight <1,500 grams.
[c]Percentage of the female population that is not of non-Hispanic white race.
[d]Data from the Center for Disease Control and Prevention Area Health Resource File (AHRF).
[e]Data from Behavioral Risk Factor Surveillance System (BRFSS) obtained from the Robert Wood Johnson County Health Rankings & Roadmaps program.

6.2%, 7.4%), a higher average number of primary care physicians per 10,000 (difference: 12.5; 95% CI: 9.3, 15.7), and lower daily fine particulate matter concentration compared to hotspot areas (difference: −0.6; 95% CI: −0.7, −0.5). Non-hotspot counties for low birthweight additionally had a lower percentage of adults with poor or fair heath (difference: −6.2%; 95% CI: −6.6%, −5.8%), obesity (difference: −3.7%; 95% CI: −4.1%, −3.3%), or diabetes (difference: −3.1%; 95% CI: −3.3%, −2.9%).

Table 3 provides the marginal effects from the logistic regression between *z*-scores of area-level characteristics and hotspot designation. The marginal estimates provide the percentage point change in a county's probability of hotspot designation for an increase in a given area-level characteristic by one standard deviation (leftmost data column). For example, a one standard deviation (6.5%) increase in the percentage of adults with at least a high school degree decreased the probability that a county was designated as a low birthweight hotspot by 1.7 percentage points ($P = .006$) or as a very low birthweight hotspot by 1.3 percentage points ($P = .017$). A one standard deviation (20%) increase in the percentage of the population that was of minority race/ethnicity increased the probability of hotspot designation for low birthweight by 5.7 percentage points ($P < .001$) and very low birthweight by 6.8 percentage points ($P < .001$).

Of the access to healthcare service characteristics, the number of primary care providers per 10,000 and the number of hospitals with ultrasound services per 10,000 were not statistically associated with differences in hotspot designation. Hotspot designations for low birthweight and very low birthweight were associated with county-level rates of obesity and diabetes, and hotspot designation for low birthweight was additionally associated with county-level rates of overall health.

Individual Counties With the Highest and Lowest Rates

In order to better understand disparities among geographic regions, we further analyzed outcomes stratified by race. Supplemental Appendix 7 provides the 10 individual large counties (n ≥ 5,000) with the highest and lowest rates for low birthweight, stratified by race, for outcomes across the study period (2011-2016). Among non-Hispanic Black births, the county with the highest rate of low birthweight had a rate that was 2.1 times greater than the county with the lowest rate (15.4% vs 7.4%). Among non-Hispanic White

Table 3. Marginal Effects From Adjusted Logistic Regressions for Changes in z-Scores of County-Level Variables and Likelihood of Low Birthweight or Very Low Birthweight Hotspot Designation, National Center for Health Statistics Vital Statistics Birth Data Files Years 2011 to 2016 (n = 2,946).[a]

		Low birthweight[b]		Very low birthweight[b]	
	SD	ME[c]	*P* value	ME[c]	*P* value
% minority race/ethnicity[c,d]	20.0	5.7	<.001	6.8	<.001
% urban population[d]	30.7	−1.3	.012	−1.1	.018
Average household size[d]	0.2	−4.7	<.001	−3.1	<.001
% with ≥ high school degree[d]	6.5	−1.7	.006	−1.3	.017
% unemployed[d]	1.1	1.1	.006	0.3	.482
Median household income[d]	$12,981	−2.4	.012	−2.0	.015
Daily fine particulate matter (PM2.5)[d]	1.4	4.6	<.001	2.9	<.001
% under 138% FPL w/o health insurance[d]	7.0	0.5	.256	1.3	.003
# of PCPs per 10,000[d]	33.4	0.4	.445	0.2	.616
# of hospitals with ultrasounds per 10,000[d]	5.0	−0.6	.153	0.2	.642
% poor or fair health[e]	4.7	1.8	.029	−1.5	.059
% of adults who are obese[e]	4.6	1.2	.023	1.8	<.001
% of adults with diabetes[e]	2.6	2.7	<.001	2.7	<.001

Note. ME = marginal effect; PCP = primary care provider; SD = standard deviation.
[a]Z-scores were calculated for each county as (county value − average among all counties/standard deviation among all counties). Marginal effects were calculated at the means. And were multiplied by 100 to provide percentage-point changes. A county was designated as a hotspot county if that county ranked in quintile 5 for 3 or more years and if a neighboring county also ranked in quintile 5 for at least 3 years. Counties were required to have ≥3 years with ≥30 births.
[b]Low birthweight = birthweight <2,500 grams; Very low birthweight = birthweight <1,500 grams.
[c]Percentage of the female population that is not of non-Hispanic white race.
[d]Data from the Center for Disease Control and Prevention Area Health Resource File (AHRF).
[e]Data from Behavioral Risk Factor Surveillance System (BRFSS) obtained from the Robert Wood Johnson County Health Rankings & Roadmaps program.

births, the county with the highest rate of low birthweight had a rate 2.7 (8.3% vs 3.1%) times greater than the county with the lowest rate.

Discussion

This study provides unique insight regarding persistency in county-level rankings of adverse birth outcomes by identifying hotspot counties as those counties with persistently high rates of low birthweight births. Given the association between low birthweight and complex medical comorbidities throughout childhood and into adulthood, targeted efforts to reduce rates of adverse birth outcomes among high-risk regions have the potential to reduce geographic disparities in infant mortality and chronic conditions that exist across the life course.[10-15]

Hotspot areas were identified as counties with persistently higher rates of low birthweight outcomes relative to other counties in the country. Our findings have the ability to inform clinical and public health authorities at the national level, but also at the state-level, given the potential for areas within a given state to display localized patterns of relatively high or relatively low rates of low birthweight births. Within the areas with high concentrations of counties designated as hotspots for any given birth outcome, there are counties that are not designated hotspot areas; similarly, there are clusters of hotspot counties in areas with relatively few hotspots. For example, there are clusters of counties in the northeastern corner of Mississippi and in the northern half of Alabama that are not hotspot areas for any of the outcomes, despite a large portion of those states being classified as hotspots.

We found persistency in county-level rankings of adverse birth outcomes among counties that were in quintiles with the highest (Q5) and lowest (Q1) rates in the first year of the study period. Counties in Q5 were more likely to remain a lower performing county (Q4 or Q5) for at least 5 of the 6 years than the likelihood that a county in Q1 was to stay in a high performing quintile (Q1 or Q2). This suggests that movement among counties within quintiles over time may be less common among those counties with the highest rates. To our knowledge, evaluation of persistency in rates of adverse birth outcomes is lacking. The use of county-level estimates and multiple years of data provides an opportunity for a granular analysis that provides relevant information at the county level. As many decentralized public health systems operate at the county level, hotspot designation at the county-level may be important for policymaking and resource allocation.[26] For example, the average rate of low birthweight (8.9%) in the state of Arkansas may not reflect the risks of populations at the county level, which vary significantly across counties (min: 4.9%, max: 11.7%).

Hotspot counties differed significantly from non-hotspot counties on nearly all of the area-level factors, indicating potential characteristics to address with community or county-level programs. While some characteristics are mutable (eg, number of primary care providers in a county) other characteristics are not (eg, rural/urban status). In our study, the largest area-level difference associated with hotspot designation was the percent of residents that were of minority race/ethnicity. In fact, hotspot counties had nearly twice the percentage of non-White residents. The disparities in adverse outcomes among areas with high concentrations of minority populations is not a novel finding,[4] but the finding from our analysis regarding the persistency in adverse birth outcomes among these areas is important for continuing efforts in addressing such long-standing disparities.

Efforts to reduce high rates of adverse birth outcomes among hotspot counties will like take multifaceted efforts, given that women may be at risk of having a low birthweight birth from a combination of multiple different clinical factors and psychosocial stressors. Specifically, initiatives are likely needed at multiple levels, such as home visits during the prenatal time period for women who are at higher risk of adverse birth outcomes, as well as initiatives at the healthcare system level, such as addressing provider cultural competency, strengthening the minority provider workforce, and improving access to care, which may address implicit biases and other structural issues of quality of healthcare delivery for racial minorities.[27] For example, recent work highlighted the potential for Medicaid expansion to reduce adverse birth outcomes for vulnerable populations, which could be related to improvements in continuity of insurance coverage.[28] Additional efforts are needed to assess mechanisms associated with non-hotspot status and to identify and highlight the success of specific programs that may reduce rates of low birthweight in these areas.

Our study highlights the pervasive association between area-level rates of adverse birth outcomes among counties with high concentrations of racial/ethnic minorities. These findings suggest that it will be difficult to improve rates of adverse birth outcomes among hotspot areas without an increased understanding of racial disparities in birth outcomes. Further work is needed to assess the association between persistency in rates of adverse birth outcomes at the county-level with other factors that could not be included in this study, such as maternal stress, discrimination, lack of racial concordance of providers with their patients, and other structural determinants.[29]

In our primary analysis, we identified low birthweight hotspots among county-level rates of births of all races/ethnicities, despite the greater rates of adverse birth outcomes among racial/ethnic minorities, particularly non-Hispanic black infants. Stratifying analyses to identify hotspot counties among non-Hispanic Black births would leave only 37% of the counties for analysis (1,077 out of the 2,946 included in the study). Because of the requirement of neighboring counties in our hotspot identification definition, we were unable to complete a hotspot analysis using non-Hispanic Black births alone. However, our analysis of rates among Black births in large counties found that rates among the counties with the highest rates were over twice as high as rates for the counties with the lowest rates for all 4 of the birth outcomes. Future studies should attempt to evaluate hotspot areas among black births, independently, using other hotspot approaches that may be less limited by the requirements in this analysis.

Limitations

The primary data source came from birth certificates and were not specifically gathered for research purposes. Studies evaluating the validity and reliability of birth certificate data have generally found gestational age to be less reliable than birthweight.[30-34] Our analyses regarding preterm birth (findings provided in the Supplemental Appendices) use the obstetric/clinical estimate of gestational age, which the NCHS uses as the standard for estimating gestational age.[4] To mitigate potential concerns with gestational age estimates, our primary analysis focused on low birthweight, and we additionally provide findings from analyses of very preterm birth, which may be less sensitive to estimations of gestational age than preterm birth.[18]

We evaluated outcomes at the county-level, which is the smallest geographical unit of analysis that could be matched between the data sources. Furthermore, counties provide the smallest stable geographic unit in which policies related to social or healthcare services are created; however, other geographic units, such as neonatal intensive care regions, newborn service areas, metropolitan statistical areas, or states may provide different findings.[2,3,18,35]

Conclusion

We found persistent differences in county-level rates of low birthweight and very low birthweight births as well as area-level characteristics that are predictive of hotspot designation. Identification of the hotspot counties with persistently high rates is a first step toward improving health equity across regions. Information from this analysis can inform policy-makers as to which geographic areas should be of primary focus for future efforts to reduce the rates of low birthweight and prematurity. Hotspot counties identified in this analysis had up to twice the rates of adverse birth outcomes relative to the rates among non-hotspot counties. Given the association of low birthweight with infant mortality, chronic conditions, and economic burden across the life course, a focused effort on the hotspot counties identified in this analysis could potentially reduce the established geographic disparities in childhood and adult comorbidities. The analysis also suggests that any attempt to reduce rates of adverse birth outcomes among the hotspot counties needs to begin with a better understanding of the large disparities among Black infants relative to White and Hispanic infants.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: HCF and JMT report copyright income from Trestle Tree Inc. JEM serves as the executive director of the Institute for Medicaid Innovation. CCB serves as a research fellow for the Institute for Medicaid Innovation.

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Data Availability Statement

The data that support the findings of this study are available upon request from the National Center for Health Statistics of the Centers for Disease Control and Prevention. Restrictions apply to the availability of these data, which were used for this study. Data are available at https://www.cdc.gov/nchs/nvss/nvss-restricted-data.htm with the permission of the National Center for Health Statistics. The authors cannot provide access to these data.

Supplemental Material

Supplemental material for this article is available online.

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