

Linking Social Vulnerability and Adverse Birth Outcomes in the Southeast United States

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Abstract

Background

This study aims to explore the relationship between social vulnerability (SoVI) indicators (race/ethnicity, population structure, socioeconomic status, housing structure, and access/functional needs) with low birth weight (LBW) and preterm delivery (PTD) rates across the Southeastern United States.

Methods

Annual low birth weight and premature birth rates for all counties were collected between 2000 and 2015. LBW and PTD were recoded into two categories below (0) and above (1) the annual national average for each year. Multinomial logistic regression (MLR) was employed to conduct regression analysis to investigate the relationship.

Results

Twenty-six and twenty-four different social vulnerability indicators were influential in predicting low birth weight rates and preterm delivery across the SE United States from 2005–2015, respectively. Racial and ethnic variables were among the most frequent influential social vulnerability indicators of low birth weights. Like race and ethnicity, counties with low and medium house values have a higher likelihood of low LBW compared to counties with higher house values. Unlike LBW, race and ethnic characteristics influence PTD rates across the study area in different ways. Whereas LBW rates are driven up in counties with low/medium Hispanic populations compared to high percentage counties, PTD is more strongly associated with Black communities. Further, population structure and socioeconomic status indicators provide the most robust indication of counties more likely to have higher PTD than the national average.

Conclusion

Influential variables point toward a dire need to comprehensively understand the links between social vulnerability and LBW and PTD. Moving toward a comprehensive view of social vulnerability borne out of the hazards literature provides a more robust understanding of the drivers of adverse birth outcomes that has rarely been addressed in the literature.

Background

Adverse Birth Outcomes and Links with Social Vulnerability

Social and biomedical research have both identified low birth weight and preterm delivery as critical risk factors for lifelong consequences, including poor health, cognitive deficits, and behavioral problems. Pregnancy length and birth weight were commonly used to evaluate a newborn's health quality [1]. A premature baby, defined as a live birth before completion of 37 weeks, is an essential marker of developmental complications throughout life [2]. Low birth weight (less than 5 pounds, 8 ounces, or 2500 grams) is strongly associated with a higher risk of infant mortality and morbidity [3]. The South Eastern United States provides a poignant example of continued elevation of PTD and LBW compared to the national average. Above (national) average LBW and PTD across many Southeastern US counties make this an appropriate study area for undertaking explanatory statistical analysis linking adverse birth outcomes to underlying socio-economic and demographic characteristics.

To date, most studies of this kind have only linked adverse birth outcomes to individual socio-demographic indicators such as poverty and access, which affect birth outcomes through underutilization of maternal health services, lower socioeconomic status, and limited health education [4]. Interactive effects between social indicators and birth outcomes have mainly focused on racial and ethnic disparities, concentrated poverty at the individual or community level, fragmented social support, and risky behaviors such as substance abuse, self-harm, unprotected sex, and having sex with multiple sexual partners. [5–10]. More recent health research on pregnancy outcomes investigates a broader definition of social vulnerability links with adverse birth outcomes, especially LBW and PTD. Concentrated research attention on a more developed conceptualization of those socioeconomic drivers linked to adverse birth outcomes stands to provide a more nuanced approach toward building interventions (programs, policies, strategies) for promoting healthy full-term births [9]. This research is guided by one overarching research question: How are underlying social vulnerability indicators linked to adverse birth outcomes at the county level? Contrary to many previous studies that analyze influences on LBW and PTD together [5–10], this research measures social drivers' impact on each individually to build a more robust description of factors influencing these adverse birth outcomes across the Southeast United States.

Social vulnerability index (SoVI®) variables [11] measure pre-existing community susceptibility to harm from external stressors such as natural or human-caused disasters or disease outbreaks that drastically affect lives and livelihoods [12]. The social vulnerability concept attempts to explain socioeconomic and demographic variations in a community's ability to prepare for, respond to, and rebound from environmental shocks and stressors [13]. Social vulnerability theory is built upon the understanding that human characteristics intervene between natural processes and the built environment to redistribute the social burden of disaster impacts, indicating that these social characteristics are independent of hazard type and magnitude [12–13]. Social vulnerability shares close conceptual and empirical ties with the concepts of health disparities and the social determinants of health [14]. Numerous researchers characterize the determinants of adverse health outcomes using variables similar to those used in social vulnerability literature [15]. At the community level, health literature repeatedly examines healthcare access and vulnerability. Here, access is defined not only in terms of scarcity of services such as the lack of emergency services in rural areas [16], but also through insurance status [17–18], proximity to health providers [19], or family characteristics such as father's occupation, mother's height, maternal educational attainment, and the birth interval between pregnancies [20]. While many studies agree on the theoretical links between

social determinants and health outcomes, few move beyond unidimensional analysis and toward building an understanding of the multidimensional nature of health (health needs and status and access) [21]. Though the frameworks for measuring health often separate concrete indicators of medical need and health access from social vulnerability indicators, some analyses simply tend to substitute them [22 and 23]. The study on the interaction between social vulnerability and natural systems measured ecological shocks' (social effects) or stressors on people and places [24]. However, no systematic effort has yet been identified to evaluate the possible impact of the full suite of social vulnerability indicators on adverse birth outcomes.

Inequalities in social vulnerability and associated outcomes may negatively affect the nutrition system, food security, education, healthcare utilization, and health status, often manifesting in higher risk/impacts on disadvantaged communities [5–11, 25]. This paper seeks to explore how a broad suite of social vulnerability indicators, previously applied to environmental and disaster-related adverse outcomes, can independently predict preterm delivery and low birth weights. Here, exploring how community social vulnerability characteristics can explain adverse birth outcomes between 2000 to 2015 provides a broader example of social indication of health disparities. This study's more nuanced analysis of inequalities in adverse birth outcomes across the US Southeast generates a new perspective supporting effective health intervention and policy creation.

Methods

Study area

The current study analyzed 12 states in the Southeast United States, including 928-935 counties between 2000-2015. Southeastern states, characterized by widespread poverty, unemployment, lower educational attainment, and various other social vulnerability indicators, also have high preterm delivery and low birth weight rates. According to the United States Census, all states included in this study except Virginia had lower per capita income than the national average and a higher percent of people living in poverty during 2014-2018 [26]. Table 1 provides some basic socio-economic data comparing the study area states to national averages for several social vulnerability indicators. Lower incomes and home values, and higher percentages of age dependent populations (under-five over 65 years), disabled, and those without health insurance under the age of 65 all indicate that disparities across the Southeast are significant in comparison to the US as a whole. Further, figure 1 illustrates annual average low birth weights and pre-term birth rates in the Southeast United States (2000-2015). Low birth weight rates (Figure 1A), displayed here using CDC's National Center for Health Statistics classification scheme show medium high (>9.6%) and high (>10.8%) low-birth weight rates across 38.8% of Southeastern Counties [27]. Pre-Term Birth Rates (Figure 1B), displayed here using the March of Dimes Report Card classification scheme show that a majority of counties (74.1%) have either a "D" or "F" rating [28]. In combination, 34.5% counties have both medium-high or higher low birth rate AND a "D" or "F" according to March of Dimes birth report card. These facts make the southeast US ideal for investigations into relationships between these adverse outcomes and underlying social conditions. Identifying more nuanced relationships between adverse birth outcomes and underlying social vulnerabilities can only help policymakers, and program developers build better interventions into the future.

Data

Birth outcome data

Dependent variables in this analysis are annual low birth weight and premature birth rates for each county, calculated as the number of live singleton low birth weight and premature births) divided by the total number of live singleton births year. The analysis unit is county because birth outcome data for this large geographic area is only available at the county level. Part of the data on low birth weight and premature birth comes from publicly available data released by each states' department of health (table 2). However, much of the data was not publicly available and required written request to several state health departments. County LBW and PTD were recoded into two categories - below (0) and above (1) the annual national rates (Table 3) for each birth outcome - in preparation for statistical analysis. Table 3 indicates the data on the national average and the range of LBW and PTD.

Social Vulnerability Predictor Data

Model-independent (predictor) data, gathered from UCF's Vulnerability Mapping and Analysis Platform [29] characterizes county populations based on a suite of socioeconomic indicators identified in disaster case study literature as useful for understanding lack of capacity to prepare for, respond to, or rebound from shocks and stresses [11]. (Table 4) Together, these variables provide a snapshot of social vulnerability to a broad range of environmental hazards and disasters [11-13]. Table 4 provides the variable name, description, and numerical range of each binned social vulnerability variable for each year's model. Variables were standardized and then recoded into three categories using standard deviations (<-.5 = Low -.5 = Medium, and > .5 = High). Social vulnerability (predictor) variables were coded into either low, medium, or high categories based on their values in reference to the binned values in table 4. For example, County X, with 27.5% renters in 2005, was classified as "High" compared to other counties based on the standard deviation classification of all renters across the study area for that model. Conversely, the same county was classified as "Medium" with 27.5% renter populations in the 2010 model. Note that classification breaks are not continuous because county level raw social vulnerability data are not continuous variables when collected by the US Census.

Analytic Strategy

Application of multinomial logistic regression (MLR) enabled consideration of a two-category dependent variable. The MLR model is an extension of binary logistic regression, producing two sets of coefficients expressed as odds ratios. MLR can be applied when underlying variable assumptions cannot be met for Ordinary Least Squares (OLS) regressions. Whereas ratio or interval scales provide a sound basis for a more robust OLS model, these assumptions tend to disintegrate in a regression model with categorical outcome data. Moreover, MLR has alternative assumptions like the non-perfect separation across groups of the outcome variables, which prevents unrealistic coefficients and exaggerated effect sizes [30].

A multinomial logistic regression model identified influential relationships between social vulnerability variables and adverse birth outcomes. Coefficients depicted the association between the social vulnerability variables and the odds of a county having lower low birth weight and premature birth rates than the

odds of that same county having higher rates of low birth weight and premature birth. Further, while OLS R^2 indicates the variability in the dependent variable explained by the model, Psuedo R^2 (resulting from MLR) is neither directly comparable to the R-squared for OLS models nor can it be interpreted same fashion as R^2 . Rather, pseudo-R-squared is a relative measure of how well the model explains the data. The following value classifications for our pseudo R^2 values were utilized: < 0.3 (no or very weak model explanation), .3 - .5 (weak model explanation), .5 - .7 (moderate model explanation), and >.7 (strong model explanation), adapted from Moore and Kirkland [31]. The MRL model identifies individual variable influence on adverse birth outcome categories (low and high). The results of the beta coefficient cardinality, odds, ratios, and significance level enable a straightforward way of understanding how social variables directly influence outcomes in a controlled manner.

Results

Understanding links between social vulnerability and adverse birth outcomes for each year (2000-2015) required 15 MLR models for each outcome measure (LBW and PTD). While trends in variable interactions across all years would clearly indicate key drivers, this analysis primary aim is a more holistic understanding of all interactions. Annual MLR model runs controlling for all other social vulnerability variables enables identification of individual variable interactions year-to-year. Although some threads of similar socioeconomic influence are seen across each annual model run, there are many instances where adverse birth outcome drivers vary year to year. Furthermore, social variables are grouped according to their theoretical link to vulnerability, known here as vulnerability "Pillars." These pillars categorize the indicators into concepts, each pillar showing the underlying dimensions of the SoVI index [32].

Across all models, the pseudo-R-square values range from .104 to .304, indicating low to moderate overall model fit across the years and outcomes. The data has a slightly higher fit for LBW in 2009 (Nagelkerke Psuedo R^2 of .304) than other years; however, generally, lower pseudo-R-squared values suggest that there are many additional variables besides social vulnerability driving adverse birth outcomes. However, because the intent of this analysis is to build an understanding of social vulnerability characteristic influence on adverse birth outcomes rather than developing a complete model for predicting birth outcomes, such Nagelkerke Psuedo R^2 value are expected. In this way, individual variable odds ratios and associated significance produced by MLR suggest that several social variables each year have a substantial influence on adverse birth outcomes. Tables 5 and 6 show MLS model information, including number of inputs, Chi-Square significance, Nagelkerke Psuedo R^2 for each year/model, and those social vulnerability variables with a significant influence on adverse birth outcomes.

Low Birth Weight Models

Many social vulnerability indicators provide a significant and robust influence on low-birth-weight rates across the study area (Table 5). Twenty-six different social vulnerability indicators were influential in predicting low birth weight Rates across the SE United States from 2005-2015. While some of these social indicators were only significant in a limited number of model runs, several characteristic groupings (low, medium, high percentages) were predictive in most models (ie. Low Hispanic Populations was a significant and robust indicator in 75% of models, Mobile homes (50% of models), educational attainment (56% of models), female-headed households (50% of models), and renters (50% of models) (Table 5A).

Racial and ethnic variables were among the most frequent influential social vulnerability indicators of low birth weights in the Southeast United States between 2000-2015. Counties have an increased likelihood (+42% - +66% likelihood) of higher low-birth-weight rates when they also have low and medium percentages of Hispanic populations and (+25 - +77%) when a county had at least medium percentages of Native American populations compared to higher percentages. Similarly, between 2000 - 2005, counties with low and medium-low percentages are age-dependent populations (under 5 or over 65 years) had increased likelihood (+44% - +66%) of higher LBW rates than counties with higher percentages of age-dependent populations. These results indicate a protective effect associated with higher populations of these racial and ethnic populations. Further, although a suite of socioeconomic indicators shows the influence on LBW rates in some years, per-capita income (a routinely used indicator) was a less robust indicator of LBW rates across the study area in comparison to housing value. Here, house value provides the most consistent wealth indicator of LBW across many years. Like race and ethnicity, counties with low and medium house values have a higher likelihood of low LBW compared to counties with higher house values.

Conversely, several social vulnerability indicators show a substantial and significant positive influence on LBW. Namely, counties with low and medium percent Black populations, females, female-headed households, educational attainment, unemployment, extractive and service employment, renters, limited English proficiency, and social security beneficiaries tended to have lower LBW rates in comparison to counties with high percentages of these characteristics (Table 5B). Unfortunately, some of these findings point to inequities requiring immediate attention and solutions. Each of these "positive influences" points out that counties with the highest percentages across these social vulnerability indicators are more likely to have higher LBW rates. This sad fact requires swift intervention.

Preterm Delivery Models

Twenty-four (24) social vulnerability variables were influential in one or more PTD models for the SE United States (Table 6). Like LWB models, several variables were only significantly influential in one or few models, included the Percentage of People Living in Poverty, which was only a significant predictor in the 2000 and 2004 models. However, several groupings of variables, including low/medium percentage black populations (81% of models), low/medium gross rent (43% of models), and low/medium nursing home residents per capita (37% of models), had a significant relationship with PTD rates.

Unlike LBW, race and ethnic characteristics influence PTD rates across the study area in different ways. Whereas LBW rates are driven up in counties with low/medium Hispanic populations compared to high percentage counties, PTD is more strongly associated with higher percentages of Black populations. Further, population structure and socioeconomic status indicators provide the most robust indication of counties more likely to have higher PTD than the

national average. Although no consistent indicator of PTD was discovered across all models (years), higher rates were more heavily influenced by low and medium gross rent across many years (models).

Many more indicators were influential in decreasing the likelihood of PTD across the study area (Figure 1B). Here, like in the LWB analysis, counties with low and moderate Black populations are significantly less likely to have PTD than counties with high Black populations. As expected, counties with low percent females, female-headed households, female labor force participation had a decreased likelihood of high PTD rates in comparison to counties with high percentages of these populations. However, the influence was not standard across all years. Finally, random positive (decreasing) influence on several years of PTD was found for counties with low and medium extractive industry employment, per capita income, renters, nursing home residents, and English language proficiency compared to counties with high percentages indicators. Here, access and functional needs indicators were more influential in the earlier years (2000 – 2005) than in later years, indicating the presence of possible PTD related interventions for these groups in later years.

Discussion

Findings indicate several critical pathways forward. First, the fact that twenty-six (26) and twenty-four (24) individual variables were influential in one or more models of LBW and PTD rates, respectively, points toward a dire need to more comprehensively understand the links between social vulnerability and adverse birth outcomes. The present study identifies a suite of socio-demographic indicators predicting LBW and PTD rates. It is imperative to move away from standard and simplified use of socio-economic indicators, including poverty [8–9] as the sole means to understand adverse birth outcomes. Rather, the field should utilize a more comprehensive view of social vulnerability - borne out of the hazard's literature - which provides a more robust understanding of the drivers of adverse birth outcomes than has been addressed in the literature [21]. Second, knowledge of these more nuanced relationships between adverse birth outcomes and social vulnerabilities can be easily transformed into practical and impactful interventions. For example, findings here indicate that decreasing the unemployment rate positively affects adverse birth outcomes. As such, programs and policies targeting unemployment may become more appealing because an intervention focused on this more socioeconomic issue could have a dual impact on PTD and LBW.

Because birth outcome data is protected, we are required to undertake this summary level analysis in a way that creates at least one significant limitation. Namely, assessing individual-level birth outcomes with county-level data requires creating a necessary Ecological Fallacy in which summary level socio-demographic indicators effectively represent every observation. Identifying the root connections between social characteristics and outcomes will only be possible by examining individual level characteristics. Unfortunately, detailed social vulnerability information is not currently collected systematically and comprehensively. Future investigations should attempt to match socio-demographic with outcomes on a case-by-case basis. Such detailed data would likely provide noteworthy analytic results. Collection of more highly refined socio-demographic data will prove useful in such future analysis.

Conclusions

Findings point to the utility of a broader set of social indicators when assessing adverse birth outcomes. While the social construct is not adequate alone to describe all adverse birth outcomes, individual variables play an essential role in low birth weights and preterm delivery. Although these findings indicate that adverse birth outcomes are linked with a more extensive set of underlying social vulnerabilities, one must recognize that social vulnerability manifests itself dynamically based on the multi-faceted and specific characteristics of populations. Therefore, it is crucial to continue this line of research by assessing social vulnerability variable interactions. Such analysis promises to provide additional nuance to the detailed univariate analysis provided here. None-the-less, this analysis has offered fruitful data to inform the creation of specific interventions aimed at these social inequities in adverse outcomes.

What is already known on this subject

Research related to adverse birth outcomes often measured the relationship between individual indicators and low birth weight or preterm delivery. In the current study, the Social Vulnerability Index is a comprehensive view of social vulnerability to identify drivers of adverse birth outcomes that have rarely been addressed in the literature.

What this study adds

The Social Vulnerability Index is partially describing the disparity in low birth weight and low birth weight across states in the Southeastern. Several individual variables were influential in decreasing or increasing adverse birth outcomes in different years. However, some socioeconomic variables like unemployment tend to impact both low birth weight and preterm delivery across the years.

Declarations

- Ethics approval and consent to participate – Not Applicable
- Consent for publication - Not applicable
- Availability of data and materials - The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.
- Competing interests - The authors declare that they have no competing interests
- Funding – Funding for this research provided by the UCF Boardman Endowed Professorship in Environmental Science and Public Administration
- Authors' contributions – HF conceptualized the problem, developed the background and rationale, completed the statistical analysis, and was a major contributor in writing the manuscript. CE provided all social vulnerability data, set the analytic procedures, mentored HF in research, developed results, discussion, and conclusion section of the manuscript.
- Acknowledgments – Not Applicable

- Authors' information (optional)

Availability of data and materials

Part of the data used during the current study are publicly available and some are not. The source of data for Social Vulnerability data is Source: US Census AS (2014-2018). The source/contact resource for low birth weight and preterm delivery at the county level and the national average are included in table 2 and 3.

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Tables

Table 1: Selected social vulnerability characteristics for Southeastern states in comparison to US Averages. Source: US Census AS (2014-2018). Bolded values indicated states that are have more vulnerable populations than the US average for any given indicator.

	Persons under 5 years	Persons 65 years and over	Black or African American	With a disability	Persons without health insurance	Persons in poverty	Median household income	Per capita income in past 12 months
United States	6.10%	16.00%	13.40%	8.60%	10.00%	11.80%	\$60,293	\$32,621
Georgia	6.20%	13.90%	32.40%	8.70%	15.70%	14.30%	\$55,679	\$29,523
Florida	5.40%	20.50%	16.90%	8.60%	16.00%	13.60%	\$53,267	\$30,197
Arkansas	6.30%	17.00%	15.70%	12.50%	9.80%	17.20%	\$45,726	\$25,635
Alabama	6.00%	16.90%	26.80%	11.60%	12.00%	16.80%	\$48,486	\$26,846
West Virginia	5.30%	19.90%	3.60%	14.10%	7.90%	17.80%	\$44,921	\$25,479
Virginia	6.00%	15.40%	19.90%	8.00%	10.20%	10.70%	\$71,564	\$37,763
South Carolina	5.80%	17.70%	27.10%	10.40%	12.70%	15.30%	\$51,015	\$27,986
North Carolina	5.90%	16.30%	22.20%	9.50%	12.70%	14.00%	\$52,413	\$29,456
Mississippi	6.20%	15.90%	37.80%	11.80%	14.40%	19.70%	\$43,567	\$23,434
Louisiana	6.60%	15.40%	32.70%	11.00%	9.30%	18.60%	\$47,942	\$27,027
Tennessee	6.00%	16.40%	17.10%	11.10%	12.00%	15.30%	\$50,972	\$28,511
Kentucky	6.20%	16.40%	8.40%	13.10%	6.70%	16.90%	\$48,392	\$26,948

Table 2: State birth outcome data sources.

State	Resource	Source
Alabama	Alabama Department of Public Health	http://www.alabamapublichealth.gov/healthstats
Arkansas	Arkansas Department of Health	Direct Data Request
Florida	Florida Department of Health	http://www.flhealthcharts.com/charts/SearchResult.aspx
Georgia	Kids Count Data Center	https://datacenter.kidscount.org/data#GA/2/0/char/0
Kentucky	Foundation for a Healthy Kentucky	http://www.kentuckyhealthfacts.org , www.healthy-ky.org
Louisiana	Louisiana Office of Public Health, Bureau of Family Health	Direct Data Request
Mississippi	Kids Count Data Center	https://datacenter.kidscount.org/
North Carolina	North Carolina Department of Health and Human Services	https://schs.dph.ncdhhs.gov/data/databook/CD7B%20Preterm%20births.html
South Carolina	South Carolina Department of Health and Environmental Control	http://scangis.dhec.sc.gov/scan/bdp/tables/birthtable.aspx
Tennessee	Tennessee Department of Health	https://www.tn.gov/health/health-program-areas.html
Virginia	Virginia Department of Human Resource Management	Direct Data Request
West Virginia	West Virginia Department of Health	Direct Data Request

Table 3: National Average and Ranges of Low Birth Weights and Pre-Term Births, 2000 - 2015

Year	National Average		Low Birth Weights Ranges		Pre-Term Birth Ranges		Source
	Low Birth Weight	Pre-Term Birth	Low	High	Low	High	
2000	7.6	11.6	0-7.58	7.60-24.17	0-11.59	11.60-34.40	https://www.cdc.gov/nchs/data/nvsr/nvsr50/nvsr50_05.pdf
2001	7.7	11.9	0-7.67	7.70-20.30	0.11.80	11.90-33.50	https://www.cdc.gov/nchs/data/nvsr/nvsr51/nvsr51_02.pdf
2002	7.8	12.1	0-7.78	7.80-20.40	0.12.09	12.10-29.20	https://www.cdc.gov/nchs/data/nvsr/nvsr52/nvsr52_10.pdf
2003	7.9	12.3	0-7.78	7.80-20.40	0.12.26	12.30-29.09	https://wonder.cdc.gov/wonder/sci_data/natal/detail/type_txt/natal03/births03.pdf
2004	8.1	12.5	0-8.09	8.10-28.60	0-12.69	12.70-27.80	https://www.cdc.gov/nchs/data/hestat/prelimbirths04/prelimbirths04health.htm#figg
2005	8.2	12.7	0-8.18	8.20-24	0-12.69	12.70-27.80	https://www.cdc.gov/nchs/pressroom/sosmap/lbw_births/lbw.htm , https://www.cdc.gov/nchs/pressroom/sosmap/preterm_births/preterm.htm
2006	8.3	12.8	0-8.26	8.3-24.6	0-12.79	12.8-29.5	https://www.cdc.gov/nchs/data/nvsr/nvsr56/nvsr56_07.pdf
2007	8.2	12.7	0-8.19	8.2-28.4	0-12.68	12.7-37.1	https://data.unicef.org/resources/data_explorer/unicef_f/?ag=UNICEF&df=GLOBAL_DATAFLOW&ver=1.0&dq=.NT_BW_LBW.&startPeriod=2005&endPi
2008	8.1	12.3	0-8.08	8.1-30.8	0-12.29	12.3-30.8	https://data.unicef.org/resources/data_explorer/unicef_f/?ag=UNICEF&df=GLOBAL_DATAFLOW&ver=1.0&dq=.NT_BW_LBW.&startPeriod=2005&endPi
2009	8.1	12.1	0-8.09	8.1-30.7	0-12.08	12.1-26.2	https://www.cdc.gov/nchs/pressroom/sosmap/lbw_births/lbw.htm , https://www.cdc.gov/nchs/pressroom/sosmap/preterm_births/preterm.htm
2010	8.1	11.9	0-8.03	8.1-35	0-11.88	11.9-26.39	https://www.cdc.gov/nchs/pressroom/sosmap/lbw_births/lbw.htm , https://www.cdc.gov/nchs/pressroom/sosmap/preterm_births/preterm.htm
2011	8.1	11.7	0-8	8.1-30	0-11.67	11.7-35.7	https://www.cdc.gov/nchs/pressroom/sosmap/lbw_births/lbw.htm , https://www.cdc.gov/nchs/pressroom/sosmap/preterm_births/preterm.htm
2012	7.9	11.7	0-7.8	7.9-28.6	0-11.48	11.5-30.6	https://www.cdc.gov/nchs/pressroom/sosmap/lbw_births/lbw.htm , https://www.cdc.gov/nchs/pressroom/sosmap/preterm_births/preterm.htm
2013	8	11.3	0-7.9	8-30.8	0-11.27	11.3-26.9	https://www.cdc.gov/nchs/pressroom/sosmap/lbw_births/lbw.htm , https://www.cdc.gov/nchs/pressroom/sosmap/preterm_births/preterm.htm
2014	8	9.5	0-7.9	7.9-21.1	0-9.49	9.5-24.6	https://www.cdc.gov/nchs/pressroom/sosmap/lbw_births/lbw.htm , https://www.cdc.gov/nchs/pressroom/sosmap/preterm_births/preterm.htm
2015	8	9.6	0-8	8.1-22	0-9.56	9.6-26.2	https://www.cdc.gov/nchs/pressroom/sosmap/lbw_births/lbw.htm , https://www.cdc.gov/nchs/pressroom/sosmap/preterm_births/preterm.htm

Due to technical limitations, table 4, 5, 6 is only available as a download in the Supplemental Files section.

Figures

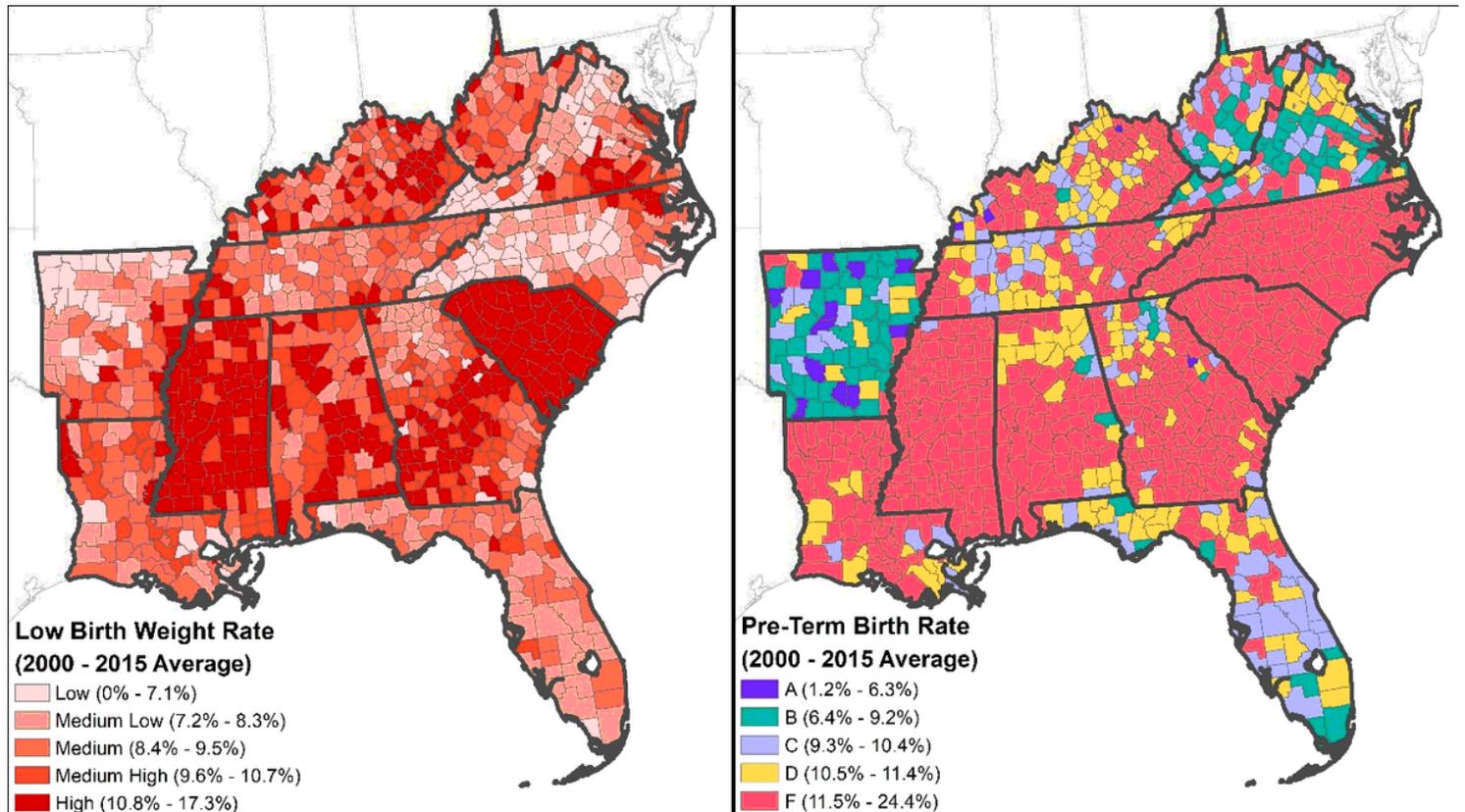


Figure 1

County level A. Low Birth Weight Rates, and B. Pre-Term Birth Rates in the 12-state Southeastern US study area.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Table4.png](#)
- [Table5.png](#)
- [Table6.png](#)