State Economic Status and Racial Disparities in Infant Mortality in the U.S., 1999-2007

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Abstract

Background

This paper statistically examined which state policies and characteristics are associated with improvement in the Black-White infant mortality rate ratio.

Methods

The dependent variables are state-specific infant, neonatal, and postneonatal mortality rate by race, 1999-2007. Independent variables, including state-level population, economics, geography, government, education, health, crime and welfare, came from the "Congressional Quarterly (CQ) State Fact Finder" and CDC's BRFSS. We used state and year fixed-effects regression models and Chow test.

Results

Economic status as measured by per capita gross state product (GSP) is significantly associated with lower infant mortality for both whites and blacks; however, it offers significantly more benefit to black infant survival than whites: A 1% rise in GSP is associated with lowered infant mortality rate by 0.39% for whites ($p<0.01$) and 0.48% for blacks ($p<0.01$).

Conclusions

Our findings suggest that the current economic recession would have a bigger impact on black infants than white infants.

Background

U.S. infant mortality rates fell steadily throughout the 20th century due to improvements first in public health and sanitation and later in medical technology [1, 2]. The causes of infant death have shifted from primarily infectious to primarily prematurity related causes [3]. However, the irony, as observed by many health researchers, is that enhancing overall population health sometimes does not automatically reduce disparities [4]. The gap in infant mortality between whites and blacks persists. Between 2003 and 2005 among States that have enough black population, Oregon has the lowest Black-White infant mortality rate ratio (BWIMRR) (1.6) and Hawaii has the highest BWIMRR of 3.9 [6]. Nevertheless, several states have achieved consistent reductions in their race-related infant survival disparities and in race-related rates of low birth weight. Connecticut, Massachusetts, Nebraska, New Mexico and Rhode Island have each reduced their BWIMRR by 17% or more between 1985 and 1997 [7].

Using infant mortality data from 2005 [8], Figure 1 shows the range of and variation in BWIMRR across states and Washington DC. There seems no apparent trend of the distribution of BWIMRR by geography or state wealth. Interestingly, according to U.S. Census, Maryland, New Jersey and Connecticut were the top three states with the highest median household income in 2005 [9], yet their BWIMRR are quite high: 2.62 in Maryland, 3.21 in New Jersey and 3.27 in Connecticut, as a result of their relatively low white infant mortality rate but high black infant mortality rate. This observation suggests that state's wealth may not necessarily help its subpopulations in the same fashion. Oregon, on the other hand, has the lowest BWIMRR (1.56) with low infant mortality rates of both white and black infants, 5.50 and 8.58, respectively. While, Oregon's median household income ranked only 31, well below the U.S. average level [10].

(Figure 1 is about here.)

What state characteristics explain racial gaps in infant mortality? Racial and ethnic gaps in infant mortality have been studied extensively at the individual level. However, there has been little research in recent years comparing the influence of state-level health policies and economic performance on black infant mortality versus white infant mortality. This precludes state policy-makers from identifying the effects of their economic policies on racial disparities in infant mortality. Grossman and Jacobowitz (1981) [11] used data from the Area Resource File and fitted separate models of county level 1970-72 neonatal mortality rates for blacks in 359 counties and whites in 679 counties. The authors found the interaction of Medicaid availability and percent in poverty was associated with lower neonatal mortality for blacks but not for whites. A similar ecological study [12] looked at race-specific data on county level neonatal mortality and birth weight from the National Centre for Health Statistics Natality Tape for 1976 to 1978, and reported that abortion rates were associated with lower rates of neonatal mortality and low birth weight with effects of similar magnitude for both blacks and whites. This study also showed that prenatal care availability in a county was associated with better infant survival for whites but not for blacks.

Socio-political culture has been shown to have differential effects on infant mortality by race. LaVeist reported that black political representation was associated with lower infant, neonatal, and postneonatal differentials [13, 14]. A later study used data on infant mortality at the state level and found that the index of dissimilarity (a measure of residential segregation) increased infant mortality rates for blacks but not for whites [15]. Bird and Bauman (1995) [16] found that socio-political variables such as state racial makeup, state educational attainments and measures of racial segregation accounted for more of the variance in infant mortality than measures of health services availability such as the number of physicians per capita, abortion rates, and the number of uninsured people.

A conceptual model. Figure 2 depicts our conceptual model of the health dynamics of population to illustrate how state-level characteristics, including state's policy/legislature, socioeconomics (SES) and demographics may affect infant mortality through several mechanisms. This model is modified from Mosley and Chen's [17]. It demonstrates that state-level determinants including policy/legislature/budget, socioeconomics, demographics, and health status and health care characteristics can affect outcome of infant mortality through influencing individual-level factors such as maternal factors, environment /neighbourhood. The two arrows in different colours on the right side illustrate that the pathways of between determinants and infant mortality may vary from white infants to black infants. We used this conceptual model to guide our study design, data collection and analysis.

(Figure 2 is about here.)

Purpose of this study. In this study, we seek to answer the question of what state-level variables contribute to explain black and white infant mortality gaps, while controlling for state demographics. Based on previous research both at individual- and state-level, we hypothesize that 1) state political, economic and policy indicators explain a portion of the within-state variation in gaps in black-white IMR in each state, after controlling for state demographic composition, and 2) these indicators are likely to have different effects on IMR from whites to blacks.

By identifying a set of policies and socioeconomics that have shown an association with reduced infant health disparities and recognizing that these policies may have been adopted for historical, political reasons, this can help policymakers determine the impact of state policies on racial disparities in infant health.

Methods

Data

The dependent variables are state-level measures of infant mortality rates, neonatal mortality rates, and postneonatal mortality rate, obtained from Centre for Disease Control (CDC)'s National Centre for Health Statistics (NCHS) website. We used the data from 1999 to 2007. The final analytical sample includes nine years of data from 51 states and Washington DC.

Independent variables of state policies and characteristics come from two sources: the "Congressional Quarterly (CQ) State Fact Finder", which is available for 1999-2007 (Centres for Disease Control and Prevention, 2002) and CDC's Behavioural Risk Factor Surveillance System (BRFSS) website. We selected 48 state policy-related variables guided by the conceptual model that are hypothesized to relate to infant mortality. These variables reflect many dimensions of states' characteristics, including: state-level policy/legislature/budget, demographics, socioeconomic status, and health status and health care characteristics.

Statistical Analysis

We first examined the bivariate relationship between each of the 48 independent state-level variables and each of the three infant mortality measures (state-level infant mortality rates, neonatal mortality rates, and postneonatal mortality rate). We used a series of bivariate fixed-effects models that controlled for the correlation between state measures within each state over time. Fixed effects models filter out the confounding effects of unobservable features of states that were constant. If the relationship between an outcome measure and an independent variable achieved a significance level of .05 or better, then this variable was selected into the final multivariate fixed effects models. Within the fixed effects models, each state supplied 1 observation of white infant mortality rate (IMR) and 1 observation of African American IMR each year.

We then used state and year fixed-effect model to examine the associations between selected independent variables and outcomes within each state over the period of 1999-2007. To account for the fact that several states have very few black births and deaths, we applied weight to each state in our model. The weight is calculated by dividing each state's number of black births by the national total number of black births.

Results

A few state-level variables passed bivariate models but were eventually dropped from the final fixed-effect multilevel models because they did not have sufficient variation over time. Five state-level variables qualified for entry into the final models: log of per capita gross state product (GSP), proportion of black residents, administrative costs per Aid to Families with Dependent Children (AFDC)/Temporary Assistance for Needy Families (TANF) case, per capita Medicaid spending, and per capita alcohol consumption; along with the time trend. Table 2 summarizes the results of the fixed-effect multivariate models.

(Table 2 is about here.)

Economic status as measured by per capita GSP is significantly associated with lower infant mortality for both whites and blacks; however, it offers significantly more benefit to black infant survival than whites: A 1% rise in GSP is associated with lowered infant mortality rate by 0.39% for whites ($p<0.01$) and 0.48% for blacks ($p<0.01$). The difference for whites and blacks is significant at .10 level. Similarly, for neonatal mortality, 1% increase in GSP is related to 0.17% decrease for whites ($P<0.01$) and 0.38% for blacks ($P<0.01$), and this racial difference in coefficients is significant at 0.01 level. On the other hand, GSP benefits white postneonatal survival more than blacks: 1% rise in GSP is associated with 0.94% reduction in postneonatal mortality rate for whites ($P<0.01$) and 0.76% for blacks ($P<0.01$), and the racial difference in coefficients is significant at 0.05 level.

Limitation

The analysis is also constrained by the number of states. However, we were able to construct a study design with 51 states clustered in 9 time spots, which allows us to examine changes in infant mortality rates within each state over 9 years while controlling for time and state characteristics. Although there is a potential threat to the fixed effects specification which would be time-varying unobservables at the level of the state that are simultaneously correlated to IMR and to the state policy variables. Secondly, state variables were not collected in a systematic fashion. In fact, they came from 2 different data sources, CQ State Fact Finder and BRFSS, which would not bias the coefficients, but it would create additional noise and a higher chance of type 2 error. However, each state variable (e.g. education spending per capita) is reported in a rather systematic way, and our interest is in the variation in each variable across states, therefore, the different data sources should not notably influence our general findings.

Conclusions

Policy-makers often must decide how to prioritize efforts given multiple public health goals and budget constraints. This report offers a first step towards identifying effects of state-social policies on infant health disparities.

Our findings suggest that the current economic recession would have a bigger impact on black infants than white infants.

Competing interests

No competing interests to declare.

Authors' contributions

Sai Ma conducted the data analysis, contributed to the interpretation of the data, and drafted the paper.
Qingfeng Li contributed to the data collection, analysis and participated in drafting the paper.
David M Bishai contributed to the conception and design of the study, supervised data collection, and contributed to the data analysis and interpretation.

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Figures

Figure 1. Non-Hispanic Black/White Infant Mortality Rate Ratios, by State, 2005

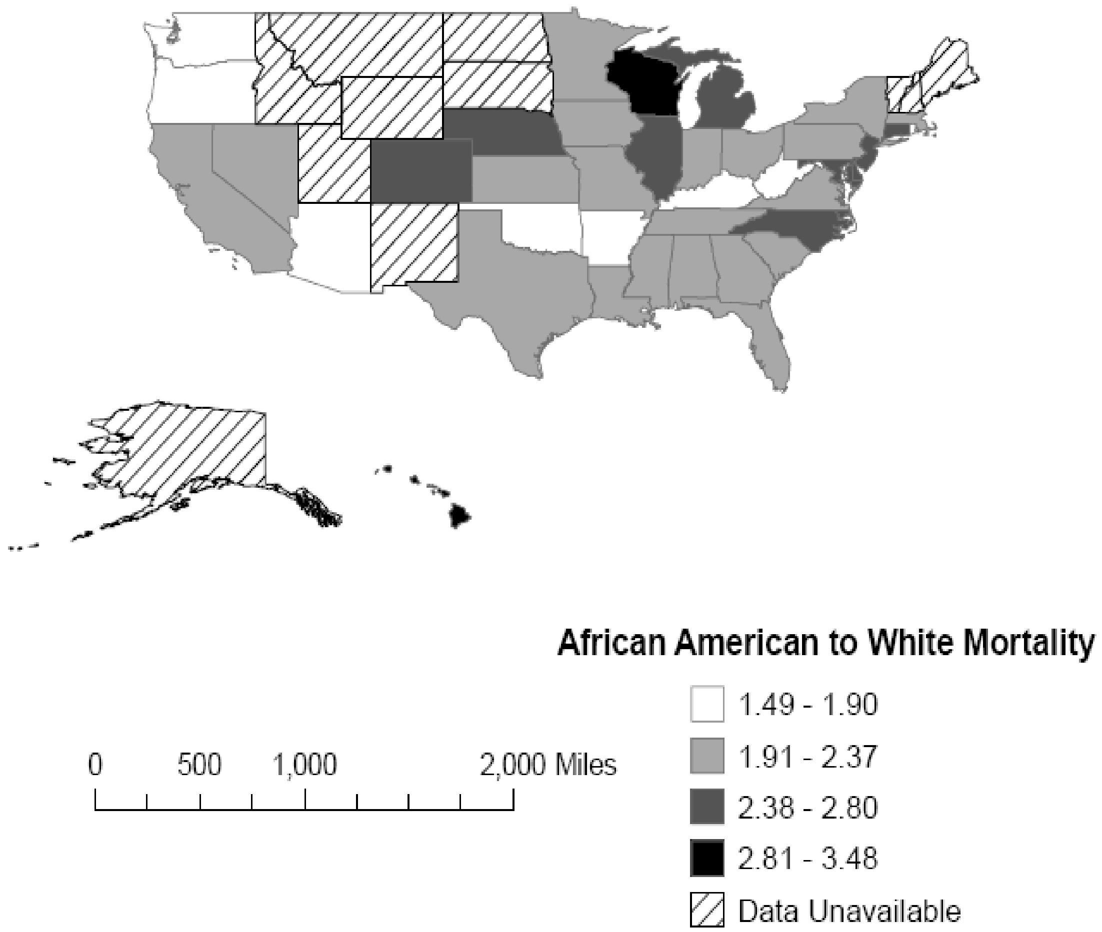
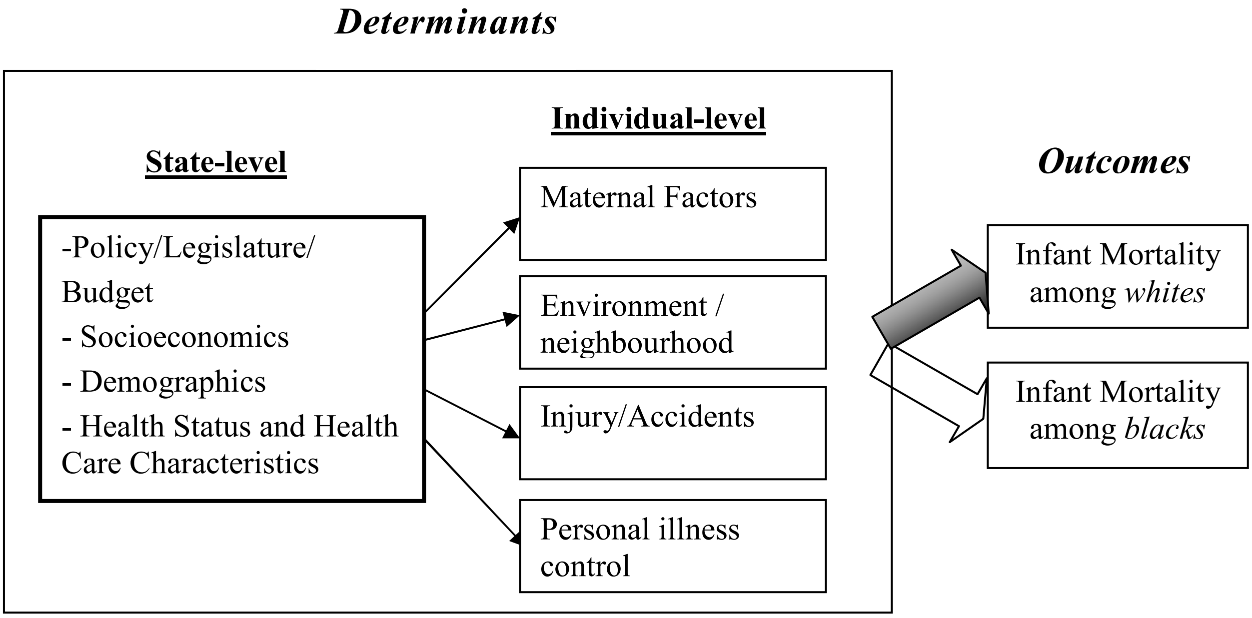


Figure 2. A conceptual model



Note: This conceptual model is modified from Mosley & Chen (1984) and indicates how state level determinants serve as distal factors to the proximal determinants of child health.

Tables

Table 1. Results of Fixed-effect Multivariable Models

VARIABLES	Black Children All Infants	Black Children Neonates	Black Children Post Neonates	White Children All Infants	White Children Neonates	White Children Post Neonates
Log(Gross State Product)	-0.479***	-0.381***	-0.775***	-0.388***	-0.167***	-0.936***
	[-8.115]	[-5.402]	[-9.843]	[-10.202]	[-3.904]	[-13.697]
Proportion of African American	-0.001	0.000	-0.005***	0.001*	-0.000	0.002
	[-0.754]	[0.234]	[-2.905]	[1.871]	[-0.094]	[1.613]
TANF spending per capita	0.046***	0.056***	0.004	0.024***	0.025**	0.001
	[3.485]	[3.525]	[0.236]	[2.781]	[2.583]	[0.088]
Medicaid spending per capita	-0.010***	-0.013***	-0.004	0.001	-0.003	0.009***
	[-3.878]	[-4.105]	[-1.109]	[0.624]	[-1.488]	[2.900]
Alcohol Consumption per Person	-0.000***	-0.000***	-0.000	-0.000***	-0.000***	-0.000**
	[-6.045]	[-6.325]	[-1.318]	[-6.974]	[-6.695]	[-2.331]
Time Trend	0.019***	0.015**	0.025***	0.021***	0.007*	0.048***
	[3.688]	[2.538]	[3.774]	[6.183]	[1.813]	[8.111]
Constant	7.743***	6.344***	9.695***	5.724***	3.139***	10.131***
	[12.744]	[8.701]	[11.931]	[14.614]	[7.120]	[14.352]
Observations	313	296	296	313	296	296
R-squared	0.318	0.278	0.296	0.458	0.232	0.542

t-statistics in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note: * significant at 10%; ** significant at 5%; *** significant at 1%

The number reported inside of parenthesis is standard error.