

**HEALTHY START LOCAL EVALUATION REPORT:  
The Relative Contribution of Race & SES, at the Individual and  
Community Levels, to Birth Weight**

**PROJECT NAME:** Kalamazoo County Healthy Babies-Healthy Start

**TITLE OF REPORT:** The Relative Contribution of Race & SES, at the Individual and Community Levels, to Birth Weight

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**Section I: INTRODUCTION**

**Local Evaluation Component**

Health inequities are a pervasive public health issue across communities and across nations (Bleich et al., 2012). Significant inequities have been tied to race and socioeconomic status (SES), foundational causes of health (Smedley et al., 2003; Link and Phelan, 1995; Krieger et al., 2008). Beyond these individual-level factors, critical space theory posits that individuals and resources are spatially distributed in ways that reflect socio-political power and inequities (Soja, 1980; Soja, 2010; MacIntyre and Ellaway, 2003). The goals of this study are two-fold: To examine the interaction of maternal race and SES upon infant birthweight, and to examine whether birthweight has a spatial structure that remains after individual-level race and SES have been accounted for.

**Key Questions / Hypotheses**

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**Section II: PROCESS**

The study was a cross-sectional design utilizing two secondary Kalamazoo County Michigan datasets that were joined using geographic information systems (GIS): (1) Y2010 birth certificate records and (2) Y2010 census tract characteristics. Permission and access to the birth records data was provided by the Michigan Department of Community Health Vital Records and Health Statistics Section. Institutional Review Board approval was provided by Western Michigan University Human Subjects Institutional Review Board.

*Setting*

Kalamazoo County, Michigan has a population of 252,074 within a mix of rural and urban communities ([http://www.kalcounty.com/hsd/pdf\\_files/Sect1\\_1SurveillanceBook.pdf](http://www.kalcounty.com/hsd/pdf_files/Sect1_1SurveillanceBook.pdf)). More importantly for the purposes of this study, Kalamazoo County 's maternal population is comparable to the nation's on race and income (18.4% Black compared to 15.9% national Black, and 47.8% Medicaid-paid births compared to 41.0% national Medicaid-paid births), but with a high Black infant mortality rate (18.7 IMR per 1,000 live births among Black women, 2006-2010 period) and high racial disparity (Black to White IMR disparity

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ratio of 3.5, 2006-2010 five-year moving average) (MDCH, 2012; NVSR, 2012). The racial disparity in this community is substantially higher than in the State of Michigan (Black-White disparity ratio of 2.7) and the Nation (Black-White disparity ratio of 2.2) (NVSR, 2012).

*Multi-level, Nested Samples*

The study utilized nested populations, with individuals residing within census tracts. The individual-level study sample was drawn from the population of 3,119 women who were residents of Kalamazoo County, Michigan when they gave birth in 2010. Exclusion criteria included multiple gestation birth, and maternal race other than Black or White. After exclusion, the final individual-level population was 2,861. Census tracts commonly serve as proxies for neighborhood community units (Diez-Roux, 2003; Krieger, 2003; Ross, 2001). Within this study, the community population sample was the 57 census tracts within Kalamazoo County in 2010. Individual-level birth records were geo-coded using maternal address, and then linked to census tract (downloaded from the Michigan Geographic Data Library) through an ArcGIS10.0 spatial join.

*Data Collection & Measures*

Individual-level birth record data was obtained from the Michigan Department of Community Health Vital Records Division. The following variables were abstracted from the 2010 birth records dataset for study use: Maternal address, infant birth weight, maternal race and whether delivery was Medicaid-paid or not.

Outcome variable:

Birth weight was measured in grams. To reduce the influence of extreme outliers at the low end of the distribution and to capture the policy- and clinically-relevant low birth weight (LBW) category threshold, birth weight was further operationalized into two distinct outcomes: (1) a dichotomous measure of LBW or not ( $\pm 2,500$  grams) and (2) for all births within the not-LBW category, the actual continuous measure of birth weight, in grams.

Predictor variables:

Four predictor variables were used: race and SES at the individual-level, and race and SES at the community-level. At the individual-level, predictors were dichotomized into Black or White (maternal race) and low-income or not (derived from the Medicaid-paid birth variable, a proxy for maternal SES). Medicaid-paid birth was considered “low income.” At the community-level, predictors were abstracted from census tract data downloaded from the American Community Survey (<http://www.census.gov/acs>) for a five-year estimate (2006-2010) of race and SES. Community-level predictors were dichotomized into Black-concentration or not (race) and poverty-concentration or not (SES). The original downloaded measures were continuous (percent Black residents and percent of residents living below the Federal Poverty level). A cut-off of 20% or above was used for dichotomization of both variables; a threshold that has been validated for the poverty measure (Krieger, 2003), and was extended to the race measure for operational consistency. Given the study focus upon the cumulative effects of race and SES, and the likelihood that traditional covariates (such as prenatal care, maternal disease and infection, maternal age, smoking) lay upon the causal pathway to birth weight (Bell, 2006), such control variables were not included in this analysis.

*Statistical Analysis*

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The relationships of maternal race and SES, and community race and SES upon birth weight was examined using multiple approaches. First, contingency tables was generated for the frequency distribution of low-income across the two race groups at the individual level and at the community level; significance testing was conducted using Pearson Chi Square with two-sided significance set at the 95% confidence level. Next, a two-part Bayesian model was used. The first part models the risk of LBW using probit regression and the second part used a log-normal regression to model non-low birth weights.

**Section III: FINDINGS / DISCUSSION**

**Results**

*Birth Weight*

Figure 1 illustrates the negative skew of the birth weight distribution. As described in the methods, two outcome variables were created from the distribution: A dichotomous LBW (low birth weight) variable and a left-censored continuous variable (in gram units). Among the study population, 190 births (6.6%) fell under the LBW threshold of 2,500 grams.

Figure 1. Histogram of Individual-Level Birth Weight

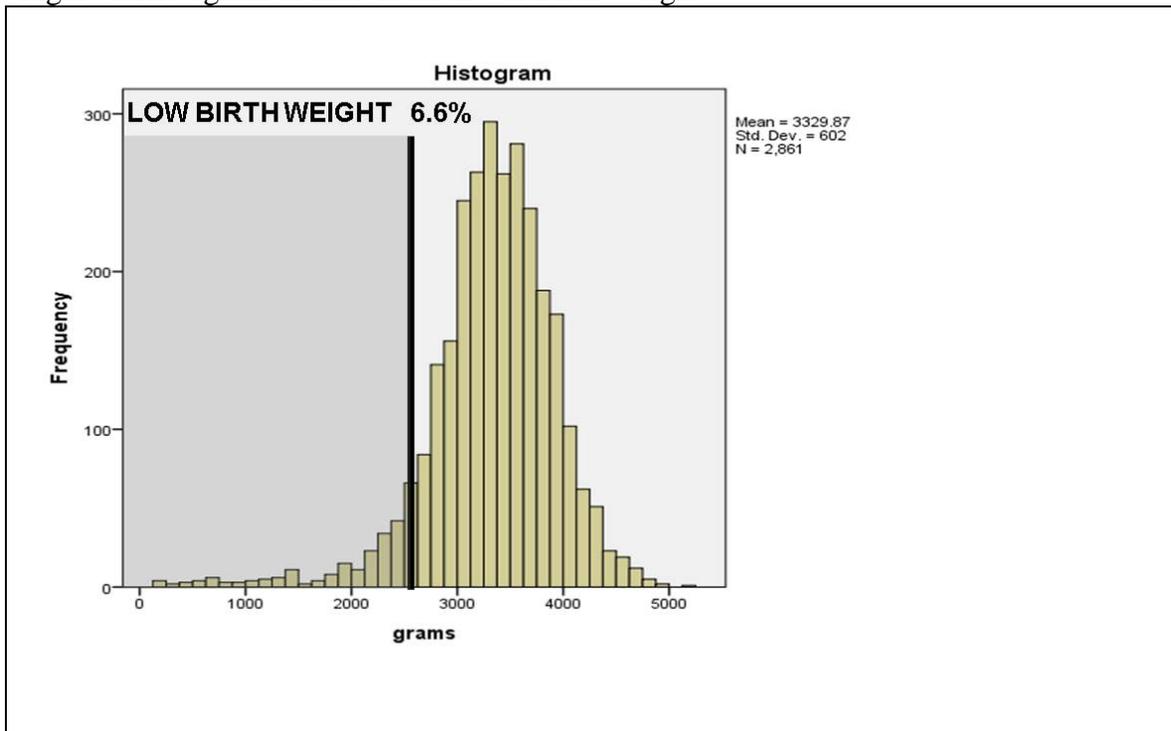
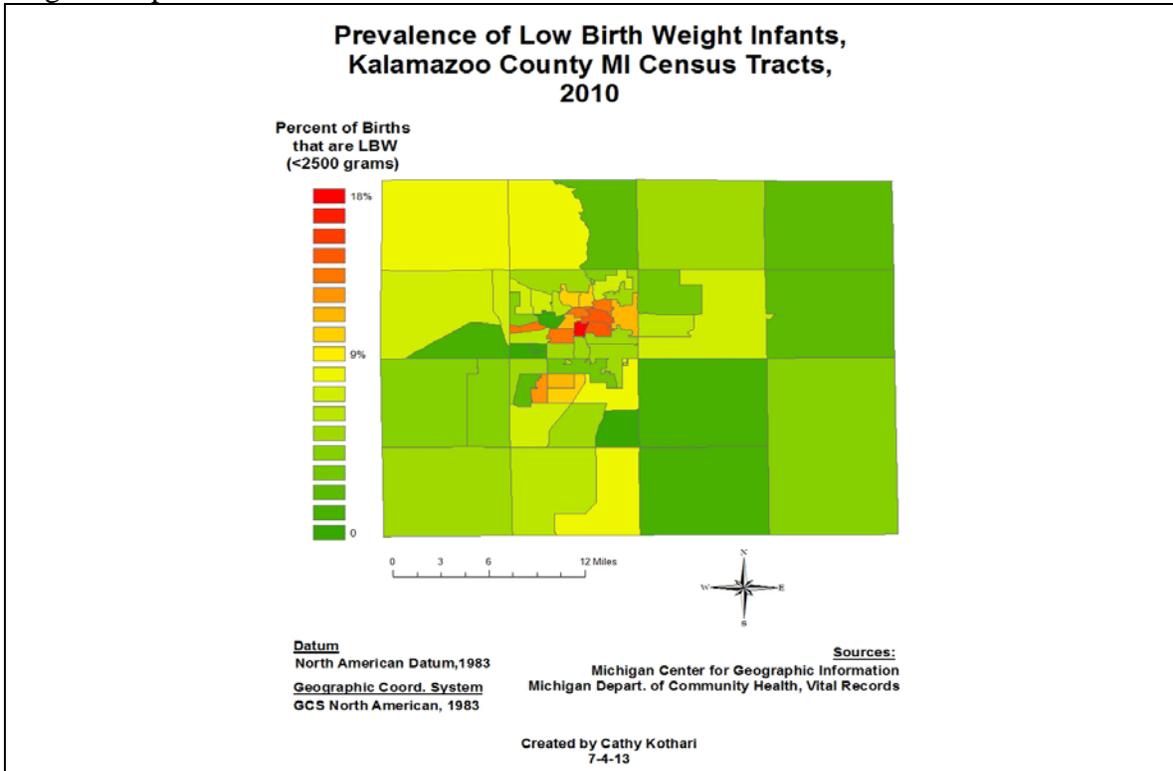


Figure 2 maps out the distribution of LBW-prevalence throughout the county. There was substantial variation, ranging from 0% to 18% of births, with clear patterns of higher prevalence within the denser census tracts (because census tracts are defined by population size, smaller-size tract indicate greater residential density). Two LBW

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clusters emerged; one in the urban core and one in a suburban community located south of that.

Figure2. Spatial Distribution of LBW Births across Communities



*Race and Socioeconomic Status (SES)*

One in five study participants (19.2%, n=550) self-reported being Black race. Nearly half (47.7%, n=1363) had a Medicaid-paid birth, meeting study criteria for being low income. Race and SES were statistically significantly associated with each other; Black women were 9.3 times as likely as White women to be low income ( $\chi^2(1) = 387.919, p < .001$ ).

The same association between race and SES was seen at the community-level. One in five census tracts (19.3%, 11 of 57) had higher-density Black residents (20% or more residents were of Black race) and 33.3% (19 of 57 census tracts) had higher-density low-income residents (20% or more residents living at or below the federal poverty level). All eleven of the high-density Black census tracts were in high poverty areas, compared to eight of the thirty-eight low-density Black areas ( $\chi^2(1) = 27.261, p < .001$ ).

*Modelling Individual-Level Race and SES upon Birth Weight*

As seen from the unadjusted beta coefficients in Table 1, race and low-income were each significant predictors of birth weight (being LBW, as well as the actual birth weight in grams for those who were above the LBW-threshold). Being Black race and being low-income is associated with lower birth weight, e.g., low enough to be in the LBW category or decreased grams for those in the not-LBW group. There was no evidence of an interaction effect either for predicting LBW or for predicting birth weight

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grams among the not-LBW group; in other words, race has the same predictive effect for low-income women as for high-income women. The race X income interaction variable, then, was not included in the adjusted regression model.

**Table 1. Regression Modelling of Individual-Level Race and SES upon Birth Weight**  
Add crude Race model (probit & regression) and crude Income model (probit & regression). Add raceXincome interaction (probit & regression) to crude model. Decide whether to add raceX ses to adjusted model or not.

|                          | Individual-Level | (exp) B (CI)       | B (CI)                  |
|--------------------------|------------------|--------------------|-------------------------|
| Probit Model– LBW or not | Black Race       | 1.7 OR* (1.2, 2.3) | -----                   |
|                          | Low-income       | 2.0 OR* (1.2, 3.0) | -----                   |
| Regression- # grams      | Black Race       | -----              | -78 grams* (-95, -52)   |
|                          | Low-income       | -----              | -128 grams* (-156, -84) |

\*statistically significant predictor,  $p=.95$

The adjusted regression coefficients in Table 1 illustrate that the effects of race and SES upon birth weight are additive; when they are both included in the model they each continue to function as independent and significant predictors of birth weight. The consistency of their predictive effect, in the adjusted as well as unadjusted models, suggests they do not mediate each other in their relationship with infant birth weight (Baron & Kenny, 1986). At the individual level, being Black race and being low-income predict delivery of infants with lower birth weight.

***Adding Community-Level Race and SES to Model***

The figures in Table 2 demonstrate that adding community-level race and income to the regression model had little impact; these community-level factors did not add predictive value to the model, nor did they change the relationship between individual-level predictors and birth weight. In other words, living in neighborhoods with different concentrations of Black residents or of poor residents did not affect the relationship between being Black or being poor yourself and the birth weight of your infant. Further, the interaction between individual-level race and community-level race was not significant. Living in neighborhoods with higher concentrations of Black residents made no difference in the birth weights of infants to Black or White women.

**Table 2. Multi-level Regression of Race and SES upon Birth Weight**

| Individual-level |            | Odds Ratio (CI) | Exp( $\beta$ ) (CI) |
|------------------|------------|-----------------|---------------------|
| Risk of LBW      | Black Race | 1.7 (1.2, 2.3)  | -----               |
|                  | Low-income | 2.0 (1.2, 3.0)  | -----               |

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|                        |                              |                |                        |
|------------------------|------------------------------|----------------|------------------------|
| Birth Weight in Grams  | Black Race                   | -----          | -78 grams (-95, -52)   |
|                        | Low-income                   | -----          | -128 grams (-156, -84) |
| <b>Community-level</b> |                              |                |                        |
| Risk of LBW            | Concentration–Blacks 20% +   | 0.7 (0.4, 1.2) | -----                  |
|                        | Concentration–Low-inc. 20% + | 1.7 (0.9, 2.9) | -----                  |
|                        | Indiv Race X Commun Race     | 0.6 (0.2, 1.4) |                        |
| Birth Weight in Grams  | Concentration–Blacks 20% +   | -----          | 1142 grms (-404, 5351) |
|                        | Concentration–Low-inc. 20% + | -----          | 198 grms (-719, 2724)  |
|                        | Indiv Race X Commun Race     | -----          | 52 grms (-35, 182)     |

**Discussion**

Discussion

In this Midwestern population, with its high Black infant mortality and racial disparity, individual-level race and socioeconomic status far outweigh community-level; each carrying independent, additive risk. Low-income women were 2.0 times as likely to deliver a low birth weight infant as higher-income women. Black women, regardless of their socioeconomic status, were 1.7 times as likely as White women to deliver a low birth weight infant. Women who were both low-income and Black women fared the worst, with 3.7 higher risk than their higher-income, White counterparts. This relationship was consistent across the two birth weight measures, LBW or not and weight in grams among the above-LBW threshold. Regardless of operationalization (education, household income, poverty level, wealth), SES has been consistently shown to have a strong graded relationship with multiple health outcomes (chronic disease, mortality, physical and mental health functioning) across varied populations (infant, child, adolescent, middle aged adults, elderly) (Nicklett, '11; Pollack, '13; Eudy, '09; Hayward, '00; Fuller-Thompson, '09; Louie, '11; McLeod, '00; LaVeist, '05; Harding, '03). However, the relationship of SES to health appears to vary both quantitatively and qualitatively by race. Compared to Whites, the distribution of SES across Blacks peaks nearer the low end, with only a few outliers at the high end; this means that if there is an SES threshold for increased health gain, as suggested by some of the literature, then many fewer Blacks are reaching this threshold (Nicklett, '11; Pollack, '13; Eudy, '09; LaVeist, '05; Neponmyaschy, '09; Harding, '03). Furthermore, there is evidence that the process by which improved SES is translated into health gain may be different for Blacks than Whites, with Blacks doing relatively better at low SES levels (with fewer losses accruing from early delinquency behavior) and relatively worse at higher levels (with fewer gains from the traditional mechanisms of SES security through education and marriage) (McLeod, '00; Corcoran '95 in McLeod ; LaVeist, '05).

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In conclusion, maternal race and SES equally and independently predict birthweight, regardless of neighborhood factors regarding concentrated black residents or concentrated poverty.

**Limitations of Findings**

These findings should be viewed in light of the following study limitations. Study variables were restricted to those contained within the Michigan Department of Community Health's birth records dataset: As a result, there were no direct measures of internal conditions of stress, perceived racism or personal empowerment, key constructs moderating the effect of race upon health. Additionally, several covariates known to be important predictors of birth outcomes, including mental health, family violence, drug abuse and homelessness, were also missing from the analysis, although this is somewhat mitigated by the inclusion of several variables (smoking, sexually transmitted infections, education level, insurance level) known to correlate highly with the unmeasured factors.<sup>36,70</sup> A direct measure of income was also missing from the analysis, however insurance status was included as a proxy measure of income. A final limitation in this study is that by focusing upon individuals, we have not accounted for the impact of the institutional structures and cultural climates that may perpetuate discrimination and racism.<sup>15</sup>

**Section VI: PUBLICATIONS**

Study results were presented to the social service, public health and medical community at Kalamazoo Infant Mortality Community Action Initiative Kickoff. They were presented nationally at the 2014 Annual American Public Health Association conference and at the XVth International Symposium in Medical/Health Geography, July 2013.

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