Explaining Race and Ethnic Disparities in Birthweight in Chicago Neighborhoods†

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Abstract

This paper examines the contribution of neighborhood and maternal characteristics to

1. Introduction

Group differences in health reflect unequal life chances. Studying these differences can reveal important etiological mechanisms in the pathway to disease and is also valuable for identifying the groups most in need of—and most likely to benefit from—societal investments in health (Preston and Taubman, 1994). For these reasons, explaining the large and persistent race and ethnic disparities in birth outcomes and infant health in the U.S. is a priority. Despite dramatic improvements over the past century in the health of all infants, significant differences persist. Today, black infants are about 2.5 times more likely to die than white infants (Hoyert et al. 2001), compared to 1.5 times in 1900 (Preston and Haines, 1991). The public health impact of this disparity is enormous but under appreciated. If black newborns faced the same mortality risk as white newborns, over 60 percent of black infant deaths—a total of about 5,000—would be averted each year.[1]

Birthweight is a key indicator of the health of infants at birth, as well as of the mother's reproductive health. It is likely to play a key role in the production of race and ethnic group differences in infant survival because it is one of the strongest predictors of infant mortality risk the mid-1990s, the mean birthweight for singleton black infants in the U.S. was 3,132 grams, about 277 grams less than the mean birthweight of 3,409 grams for whites (Martin, MacDorman, and Mathews, 1997). Compared to whites, the variation in black birthweights is also larger and skewed to the left. The net result is that black infants are more than twice as likely as white infants to be born at birthweights below 2,500 grams (Martin et al., 2002), where the risk of infant death is 24 times greater than for birthweights above 2,500 grams, and three times more likely than whites to be born at birthweights below 1,500 grams, where the risk of infant death is 100 times greater (Mathews, MacDorman, and Menacker, 2002).

The impact of birthweight appears to extend well beyond infancy. According to the fetal origins hypothesis (Barker, 1998), fetal undernutrition, for which low birthweight is a marker, may permanently program the body—for example, by reducing the numbers of cells in specific organs, changing the distribution of cell types, or influencing metabolic processes. These programmed changes are associated with a variety of chronic disease outcomes during adulthood and old age, such as diabetes (Barker et al., 1993), hypertension (Law et al., 1993), and cardiovascular disease (Rich-Edwards et al., 1997). In addition, birthweight may affect physiological and developmental outcomes extending from infancy through childhood and into adulthood. Studies have found a significant association between birthweight and school age disabilities (Avchen, Scott, and Mason 2001), behavioral problems (Sommerfelt, Ellertsen, and Markestad, 1993), school-age reading and math scores (Boardman et al., 2002; Jefferis, Power, and Hertzman, 2002), cognitive function during young adulthood (Sorensen et al., 1997; Richards et al., 2001), and adult educational attainment (Conley and Bennett, 2000), as well as reproductive outcomes such as low birthweight (Sanderson, Emanuel, and Holt, 1995; Wang et al., 1995), preterm birth (Porter et al., 1997), and gestational diabetes (Innes et al., 2002). It is unclear, however, the extent to which birthweight has a causal effect on these outcomes (reflecting intrauterine malnutrition, for exam than non-Hispanic whites and Mexican-origin Hispanics. Birth outcomes were qualitatively very similar for non-Hispanic whites and Mexican-origin remainder of the gaps in birthweight by race and ethnicity.

The paper is organized as follows. We begin, in the next section, with a description of our conceptual framework and modeling approach. In Section 3, we outline our statistical methods. In Section 4, we provide a detailed overview of the data and the covariates that we considered. We present the model results in Section 5. We discuss policy issues in the final section.

2. Conceptual Framework and Modeling Approach

are unmeasured but potentially measurable. Finally, the shaded boxes represent unobserved factors that cannot be measured easily.

Child sex is our only child-specific background factor. It is well documented that males have higher birthweights than females. Unmeasured child-level factors include various dimensions of the health of the specific pregnancy. Below we explain why and how unmeasured factors may affect our analysis.

Relevant measured background characteristics of the mother and family include the mother's age, race and ethnicity, education, nativity, and marital status. As discussed below, a key variable that is unavailable from vital statistics is household economic status. Finally, many aspects of the mother's inherent healthiness are not measured and cannot be measured satisfactorily. This includes, for example, her genetic endowment that either predisposes or protects her—and her child—from adverse health outcomes.

There is a potentially large group of neighborhood- or community-level factors that might affect birthweight.[4] The existing literature on this topic, although growing, is at present relatively small primarily because few data sets with information on birth outcomes also include, or can be linked with, data at the neighborhood level. We included no neighborhood level factors in our models. This is because their inclusion would distract from the main goal of this paper, which is to examine race and ethnic disparities in birthweight. Nevertheless, we believe

[4] Previous research has examined the effects of various demographic, social and economic characteristics of neighborhoods on birth outcomes (Collins and David, 1997; O'Campo et al., 1997; Roberts, 1997; Pearl, Braveman, and Abrams, 2001; Rauh, Andrews and Garfinkel, 2001). Neighborhood demographic factors have

that neighborhood factors *are* likely to be important. To reconcile these two perspectives, we included, separately for each tract, a single dummy variable. This variable captures the effects of all measured—and unmeasured—factors operating at the tract level and hence allowed us to control for the complete set of neighborhood variables, although it does not permit us to identify the specific aspects of neighborhoods that are important.[5]

Intermediate child- or pregnancy-specific risk factors include gestation length, interpregnancy interval, parity, and medical risk factors. Birthweight is closely tied to gestation length and it is essential to control for this because there are systematic differences in gestation length according to race and ethnicity. A pregnancy that occurs only a short duration after the previous one ended can tax the mother physically and nutritionally and lead to a baby with a lower birthweight. Parity may represent a similar cumulative process, but there may be benefits (such as experience) as well as costs to reaching higher parities. A variety of medical risk factors may directly affect birthweight.

Smoking and alcohol use are intermediate factors that represent longer-term health behavior choices of mothers. There is considerable evidence that smoking and alcohol use lead to lower birthweight and worsen other birth outcomes (Lundsberg, Bracken, and Saftlas 1997; Sprauve et al. 1999). Finally, use of health services represents mother-specific behavior that is also influenced by neighborhood level factors such as the availability of health care. We consider three specific dimensions of health service use: prenatal care, birth attendance, and place of delivery. Prenatal care has been hypothesized to be a key intermediate factor affecting

[5] We used census tracts to represent neighborhoods. Census tracts are of moderate size and closely approximate social definitions of neighborhoods. There is no consequence to this choice if neighborhoods are in reality comprised of multiple tracts. However, it will matter if true neighborhoods have boundaries that bisect tracts or are smaller than tracts.

birth outcomes and, in particular, to be one that

Collins, Schulte, and Drolet, 1998; Roberts, 1997; Pearl, Braveman, and Abrams, 2001; O'Campo et al., 1997) have only partly adjusted for neighborhood characteristics through the incorporation of measured community-level variables. This is necessarily true because the array of community level variables available through the decennial census or most other data sources is limited. Controlling for omitted neighborhood variables though the use of fixed effects also provides a way to account for the correlation among birthweights in the same tract that would otherwise result in standard errors for parameter estimates being understated. Fixed effects models represent a specific alternative to the multilevel modeling approach that is growing in popularity among studies in public health, sociology, and other disciplines (Goldstein, 1995). In particular, multilevel models are based on the incorporation of random effects (at one or more levels) that absorb level-specific errors. However, an important assumption behind standard multilevel models is that the random effects are independent of the measured covariates that appear in the model. This assumption may be violated quite commonly. However, few researchers test this assumption, although a straightforward statistical test, developed by Hausman (1978), is available. In contrast, fixed effects models provide a simple means to control for the possible correlation between these unmeasured effects and the covariates that appear in the model by including a separate dummy variable for each tract represented in the data. To the extent that this correlation is present and important, it means that random effects models, in contrast to fixed effects models, lead to biased and inconsistent parameter estimates.[10] The fixed effects approach was a better choice for our analysis because a series of formal Hausman tests comparing this approach to the random effects approach consistently rejected the assumption on which the random effects model is based (namely, that the regressors and the

[10] Random effects models provide more efficient estimates, and hence are preferred, when correlation between the unobserved effects and measured covariates is unimportant.

Bureau, 2001d).

There were 60,242 live births to Chicago-resident mothers in 1990. For our analysis, we used information on 49,104 singleton births with complete information that were born to mothers who were non-Hispanic white (12,918 births), non-Hispanic black (26,005), or Mexican-origin Hispanic (10,181). We excluded all 1,530 multiple bi mother (see National Center for Health Statistics, 1999). Pregnancy-related information includes live-birth order and parity, preceding birth interval, gestation length, prenatal care, tobacco and alcohol use during pregnancy, weight gained, medical risk factors, and obstetric procedures. Birth information includes birthweight, place of delivery, method of delivery, and delivery attendant, Apgar score, complications of labor and delivery, abnormal conditions of the newborn, and congenital anomalies. Finally, information on the mother includes her race and ethnicity, national origin, age, educational attainment, and marital status. There is no information from the birth certificate on the economic status of the mother or her household. The certificate asks about the father's characteristics, such as his age, race/ethnicity, place of birth, and education, but missing data is a major problem. Information contained in birth certificates is largely

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modest, they translated into substantial differences in low birthweight rates. For example, 13.4 percent of births to non-Hispanic blacks were of low birthweight (< 2,500 grams) which was almost three times higher than the rate among non-Hispanic whites of 4.8 percent.

The covariates of birthweight that we examined were suggested by the conceptual framework outlined above and circumscribed by information contained in vital statistics for births. Although the specific covariates were similar to those used in previous studies, a number were coded differently and we highlight these differences in the brief overview of model covariates that we provide here. We also discuss similarities and differences in summary statistics for covariates across the three race and ethnic groups.

The list of covariates we examined appears in Table 2, along with the means for the three race and ethnic groups and the analysis sample as a whole. Background child and mother characteristics included child sex and mother’s age, marital status, nativity, education, and race. For mother’s education, Table 2 shows summary statistics for the number of years of schooling. In our models, however, we examined the effects of years of schooling beyond the eleventh grade. Our preliminary models suggested that it was reasonable to pool all mothers who had not completed high school as a single, homogenous group and then consider the linear effects of an additional year of education. This provided a good compromise between simplicity and obtaining a good fit to the data. In particular, it was much better than treating education as linear through its entire range or having a dummy variable comparing high school-graduates with non-high school graduates. The other background variables followed standard coding practices.

There were large differences between race and ethnic groups in mother’s education, nativity, marital status, and age. Mexican-origin Hispanics had substantially lower levels of education and were vastly more likely to have been foreign born. Mean years of education for Mexican-origin Hispanic mothers was 8.9 years, three years below that for non-Hispanic blacks and almost four and a half years below non-Hispanic whites. Over 80 percent of Mexican-origin Hispanics were foreign born, in contrast to 18 percent of non-Hispanic whites and fewer than two percent of non-Hispanic blacks. Non-Hispanic blacks stand out in terms of the percent of births to unmarried mothers, which at 82 percent were two-and-a-half times higher than the proportion for Mexican-origin Hispanics and over four times higher than for non-Hispanic whites. Non-Hispanic blacks had births at much younger ages than women in the other two groups.

Intermediate covariates included first birth status, interpregnancy interval, gestation length, adequacy of prenatal care, medical risk factors, tobacco and alcohol use, place of delivery, and birth attendant. The interpregnancy interval was modeled as a three-part linear spline[13] that provided an excellent fit to the data—substantially better than treating this covariate as a categorical variable (for example, as in Rawlings, Rawlings, and Read, 1995 or Zhu et al., 1999). Our coding of this variable was based on a preliminary analysis that showed birthweight to have a very strong positive relationship with interpregnancy intervals when there was less than number of prenatal care visits and the month during the pregnancy that prenatal care began were recoded into Kotelchuck's (1994a and 1994b) Adequacy of Prenatal Care Utilization Index that included two parts. The first part provides an assessment of the timing of prenatal care initiation and the second part describes the frequency of visits received after initiation. In addition, we examined the effects of the number of prenatal care visits which was also modeled as a two-part spline with a knot at the mean of 14 visits. Information on 16 different medical risk factors during pregnancy was collected on birth certificates beginning in 1989. In our models we

We present our first set of findings in Table 3, which shows results for four different models of birthweight estimated using data pooled across all three race and ethnic groups. We begin by focusing on race and ethnic differences in birthweight across the four models. In Model I, which includes only a control for race and ethnicity, we recover the means from Table 1 and highlight the differences in birthweight between the baseline group (non-Hispanic blacks) and the other two groups (non-Hispanic whites and Mexican-origin Hispanics). The parameters in this model can be interpreted as the average difference in birthweight between non-Hispanic blacks and, say, non-Hispanic whites if we picked one non-Hispanic black birth and one non-Hispanic white birth from anywhere in Chicago. On average, we would find that non-Hispanic whites had birthweights 332 grams higher than non-Hispanic blacks. Birthweights for Mexican-origin Hispanics were only slightly lower than the average for non-Hispanic whites, but were substantially above those for non-Hispanic blacks.

The introduction of fixed effects for each census tract in Model II changes the nature of the comparison of birthweights across race and ethnic groups. In particular, by controlling for *all* measurable and unmeasurable neighborhood-level variables through the use of a tract-specific dummy variable, we are essentially examining birthweight disparities by race and ethnic group among births that occurred *in the same neighborhood*. We find that neighborhood factors accounted for 30 percent of the average birthweight disparity between non-Hispanic whites and non-Hispanic blacks; the difference in birthweight between these two groups is 231 grams in Model II, down from 332 grams in Model I. The birthweight disparity between non-Hispanic blacks and Mexican-origin Hispanics dropped 14 pe no insights into what specific neighborhood factors might be important. In addition, neighborhood effects in the model will pick up any observed or unobserved individual characteristics that were shared by all births in the same tract. Nevertheless, these results suggest that neighborhood factors played a significant role in explaining race and ethnic differences in birthweight.

Models III and IV introduce additional controls for background and intermediate characteristics. We interpret the coefficients for race and ethnicity in these models to be the average difference in birthweight among births in the same neighborhood after controlling for differences in mother's education, nativity, marital status, age, and child sex (Model III) and, in addition, birth order, interpregnancy intervals, gestation length, prenatal care, medical risk factors, smoking and alcohol use, place of delivery, and delivery assistance (Model IV).

We find from Model III that background factors accounted for 17 percent of the total birthweight differential between non-Hispanic blacks and non-Hispanic whites, while adding intermediate factors accounted for a further 17 percent of the differential. For the comparison between Mexican-origin Hispanics and non-Hispanic blacks, background factors explained 14 percent of the differential while intermediate factors explained an additional 30 percent. Model IV, which includes the full set of covariates, explained 64 percent of the birthweight differential between non-Hispanic blacks and non-Hispanic whites and 57 percent of the differential between Mexican-origin Hispanics and non-Hispanic blacks. Note, however, that the remaining unexplained birthweight differential is statistically significant at the .01 level for both comparisons (although the difference between non-Hispanic whites and Mexican-origin Hispanics is not statistically significant). Our results indicate that observed differences in a comprehensive set of covariates describing the mother's demographic and social characteristics, as well as behaviors leading up to and during her pregnancy, accounted for a considerable part of the differences across race and ethnic groups—however, they did not explain it all. Roughly 36-43 percent of the differential between non-Hispanic blacks and the two comparison groups remains unexplained by the variables in our model.

Two sets of factors account for the unexplained portion of the differential. First, several potentially important covariates were not included in the model, because they were either not measured or had a large fraction of missing values. These include measures of the economic into marital status having varying effects on birthweight.[14] This issue is important not only from a modeling point of view, but also with regard to policy implications of the findings. In particular, the pooled model implies that, from a policy perspective, efforts to reduce the birthweight gap across race and ethnic groups should focus on improving the *characteristics* of disadvantaged groups. However, allowing different covariate effects across the groups will tell us the extent to which *relationships* may be different, which may suggest an alternative set of interventions. We investigate this issue in more detail in the next subsection. In the remainder of this subsection we describe the results for the other covariates in our models.

There were positive effects on birthweight of infant sex, mother's education, and mother's marital status. Each year of education beyond eleventh grade was associated with a 20 gram increase in birthweight. Especially large effects were present for infant sex and mother's marital status. Females had birthweights 114 grams lower than males and children born to married mothers have birthweights that were 121 grams higher, on average, than those born to unmarried mothers. Mother's nativity was not associated with birthweight and the effects of mother's age, although negative and significant in Model III, switched signs in Model IV.

The background variables included in the models presented in Table 3 represent a range from purely biological (infant sex) to largely social (marital status). A comparison of the estimated effects of these background variables between Models III and IV show that a

[14] To make this illustration more concrete, consider that non-Hispanic blacks may have lower birthweights than non-Hispanic whites not only because they have lower marriage rates (and knowing that, after controlling for other factors, children born to married parents have higher birthweights), but also perhaps because the beneficial effects of having a birth within a marriage are smaller for non-Hispanic blacks. This may occur, for example, because lower marriage rates mean that marriage is a weaker institution and hence fewer resources, less care, and limited information is provided to the mother by the husband.

non-Hispanic whites, non-Hispanic blacks, and Mexican-origin Hispanics. The results for the models including only background variables are presented in Table 4 while the results for the models that add intermediate variables are presented in Table 5. We focus our discussion on giving birth at the youngest ages (mean of 24 years), followed by Mexican-origin Hispanics at 26 years, and non-Hispanic whites at 28 years. However, the lower average ages translate into far higher teenage pregnancy rates among non-Hispanic blacks, which at 28 percent were roughly twice as high compared to Mexican-origin Hispanics (15 percent) and almost four times higher than non-Hispanic whites (7 percent). Mother's age was unrelated to birthweight for non-Hispanic whites. For non-Hispanic blacks, the age effect was negative and statistically significant: a one-year increase in age was associated with a 7-gram decrease in birthweight. Finally, for Mexican-origin Hispanics, age was positive and significant, with a one-year increment in age associated with a 10-gram increase in birthweight. Although these differences were not enough to account for much of the total birthweight disparity between non-Hispanic blacks and the other two groups, they certainly contributed towards it. The deleterious effects of age on maternal and child health for African Americans has been characterized as a form of rapid "weathering" that arises from their more difficult life circumstances (Geronimus, 1992).

Differences in the effects of mother's education were large across race and ethnic groups. Education had a statistically significant relationship with birthweight only for non-Hispanic whites and non-Hispanic blacks; for Mexican-origin Hispanics, education for women had challenging environment to navigate in order to achieve a healthy pregnancy and birth, due to disadvantage and discrimination, and education provides women with the knowledge and ability to navigate these environments more successfully.

There was no difference in birthweight between native born and foreign-born Mexican-origin Hispanics after adjusting for background characteristics, in contrast to previous studies that were unable to account entirely for higher birthweights among foreign-born Mexican-origin Hispanics (e.g., Landale, Oropesa, and Gorman, 1999). However, non-Hispanic black immigrants had substantially higher birthweights than non-immigrants. This is likely to be related to the selectivity of these two groups, compared to their native-born co-ethnics. Under 2 percent of non-Hispanic blacks were foreign born, in contrast to 81 percent of Mexican-origin Hispanics. The small immigrant stream of non-Hispanic blacks was likely to have been more select, in terms of both observed and unobserved characteristics, than the huge stream of Mexican-origin Hispanics. For non-Hispanic whites, foreign-born mothers had slightly lower birthweights.

We turn next to Table 5, which presents results for models that include intermediate factors. We focus on two sets of findings. First, we discuss changes in the effects of the background variables (comparing these results to those in Table 4). Second, we discuss the effects of the intermediate factors, highlighting again similarities and differences across the three ethnic groups.

As expected, the effects of the background variables were again attenuated in almost every instance once we incorporated intermediate factors into the models. There were, however, essentially no statistically significant effects rendered insignificant, although some of the effects changed substantially. In particular, by including the intermediate factors, we accounted for a large portion of the effect of education (for non-Hispanic whites and blacks), of mother's nativity (for non-Hispanic blacks), marital status (for all three groups), and mother's age (especially for non-Hispanic blacks). The largest and most consistent changes occurred for marital status. The intermediate factors in our models accounted for roughly two-thirds of the birthweight advantage experienced by children of married mothers. This suggests that married women generally practiced health-related behaviors during their pregnancy that were beneficial for their babies, such as not smoking nor consuming alcohol. The other notable change is that the effect of mother's age for non-Hispanic blacks was attenuated substantially and is only significant at the .10 level after controlling for the intermediate factors. This suggests that older non-Hispanic black mothers had less favorable pregnancy-related behaviors than younger mothers; once these behaviors were taken into account, mother's age had a minor effect on birthweight (as was the case for non-Hispanic whites).

Intermediate variable effects that were similar across the three race and ethnic groups included first birth, interpregnancy interval, gestation length, and smoking. Substantial differences were observed for medical risk factors, alcohol use, and place of delivery. A number of the intermediate variables did not have significant effects. For example, few of the indicators regarding prenatal care were statistically significant.

For the three intermediate variables for which there were substantial differences in effects across the groups, the only statistically significant effects were for non-Hispanic blacks. For this group, the deleterious effects of having a medical risk factor, using alcohol during pregnancy, or having a non-hospital delivery were large, even though in all three cases there were minor differences in levels compared to non-Hispanic whites. This suggests a source of disadvantage for non-Hispanic blacks that may reflect either more serious medical risk factors, more damaging patterns of alcohol use, poorer delivery assistance, or worse treatment for medical risk factors. The absence of clear effects for prenatal care may have been caused by adverse selection (i.e., women who anticipated problems with a pregnancy may have initiated earlier prenatal care) or other factors. However, there is some evidence that adequacy of prenatal care visits was associated with higher birthweight.

The final task is to summarize the differences in birthweight across the three race and ethnic groups and, in particular, to identify the extent to which the measured background and intermediate covariates accounted for observed differences. In Table 6 we present a decomposition of birthweight differences among the three groups. The entries along the diagonal show observed values. The off-diagonal elements describe the counterfactual associated with a model (identified by the column) and a set of characteristics (identified by the row). For example, the top right entry in the table shows the predicted mean birthweight for non-Hispanic whites if the effects of their (background and intermediate) characteristics on birthweight were the same as for Mexican-origin Hispanics. The difference between this value (3,417.4) and the actual value for non-Hispanic whites (3,418.5) reflects overall differences in relationships—which are minor. The difference compared to the actual value for Mexican-origin Hispanics (3,383.8) reflects differences in characteristics—which in this case accounts for essentially the entire differential in birthweight between these two groups. Thus, the results indicate that the background and intermediate factors in the models account for all the birthweight difference between non-Hispanic whites and Mexican-origin Hispanics. The result is symmetric, in that we reach the same conclusion when examining predicted mean birthweight for Mexican-origin Hispanics using estimated relationships for non-Hispanic whites.

Measured characteristics account for just over half of the birthweight gap between non-Hispanic blacks and whites. Of the 331.7 gram difference in birthweight between non-Hispanic blacks and whites, 51 percent is accounted for by measured characteristics based on the model for non-Hispanic whites and 55 percent based on the model for non-Hispanic blacks. That leaves 44-49 percent that is accounted for by differences in the ways that the measured characteristics affect birthweight, as well as omitted variables.

Comparing non-Hispanic blacks and Mexican-origin Hispanics, we find that the results differ based on which model is selected as the standard (note, however, that the standard errors of the counterfactual estimates are large). Of the 297.0 gram difference in birthweight between these two groups, 66 percent is accounted for by differences in characteristics when using the non-Hispanic black model while 44 percent is accounted for when the Mexican-origin Hispanic model is used. The higher percentage explained by the non-Hispanic black model is due to this model's substantially better fit. In particular, the non-Hispanic black model has an adjusted R^2 of .48—indicating that this model explained roughly half the variation in birthweight for non-Hispanic blacks. In contrast, the model for Mexican-origin Hispanics has an adjusted R^2 of .30. The implication, however, is that there is a fairly large confidence interval in attributing this race/ethnic gap in birthweight between characteristics and relationships. Nevertheless, it is clear that differences in characteristics do not explain the entire differential between non-Hispanic blacks and Mexican-origin Hispanics.

Overall these results suggest that the disadvantage in birthweights for infants born to non-Hispanic black mothers—compared to non-Hispanic white and Mexican-origin Hispanic mothers—was not simply the result of non-Hispanic blacks being more disadvantaged according to their (measured) social characteristics and reproductive behaviors. Rather, there were significant differences in birth outcomes between non-Hispanic blacks and the other two groups when the characteristics of the mother and the pregnancy were set at exactly the same values, with non-Hispanic blacks faring substantially worse. This may be the result of the omission of important covariates—such as household income or measures of maternal stress or health status. However, it also suggests that, for non-Hispanic blacks, not only were the effects of demographic, social, and reproductive factors overall less beneficial for the positive factors and more deleterious for the negative factors (as we showed above), but that the consequences for birthweight of these differences were large.

6. Conclusions

The goal of this study was to examine differences in birthweight across race and ethnic groups in Chicago, Illinois in 1990. Specifically, our analyses addressed three questions. First, what proportion of racial and ethnic birthweight disparities is explained by differences in maternal characteristics and health and reproductive behaviors? Second, what proportion of these disparities is explained by differences in the *effects* of these characteristics or behaviors on birthweight? Third, what proportion of racial and ethnic birthweight disparities are accounted by neighborhood factors?

We found that measured characteristics accounted for about half of the birthweight gap between non-Hispanic whites and blacks (of 332 grams) and between non-Hispanic blacks and Mexican-origin Hispanics (of 297 grams). In both cases, the remainder was accounted for by differences in variable effects or unmeasured variables. This result has important implications for policies and programs to improve birthweight and to eliminate race and ethnic disparities in infant health. In particular, it suggests that it is not enough simply to provide non-Hispanic black women with more advantageous characteristics, such as better education and access to medical care. Although this might eliminate roughly half of the current disparity in birthweight, it would not, however, be sufficient to erase it entirely. Rather, more significant structural changes are required—changes that would alter the way in which mothers' characteristics and behaviors affect birth outcomes.

The principal differences in characteristics that led to low birthweight among non-Hispanic black mothers were their lower levels of education, higher rates of non-marital births, less adequate prenatal care, higher rates of smoking and, especially, shorter gestation lengths. A number of factors had distinct effects for non-Hispanic blacks compared to the other two groups, including mother's age, mother's education, medical risk factors, and alcohol use. Policy interventions to improve birthweight among non-Hispanic blacks need to focus on both sets of factors in order to eliminate race and ethnic disparities. Policies designed to alter mothers' characteristics are fairly easy to design and implement, but ones aimed at changing relationships are more difficult to conceptualize, let alone implement.

One reason that relationships may differ—for example, that the effects of medical risk factors have a strong negative effect on birthweight only for non-Hispanic blacks—is that the underlying factor is actually different across the race/ethnic groups. For example, given the same risk factor, non-Hispanic blacks may suffer from worse forms of the disease or condition. Better measurement of these factors may be the solution to this problem. However, another reason that relationships may vary is that processes may differ fundamentally across the race/ethnic groups. For instance, non-Hispanic blacks may, due to a variety of reasons, may receive poorer health care for their risk factors, although the actual type and severity of the disease or condition is no different than that for either of the other two groups. Both of these issues should be investigated in order to develop a better understanding of race and ethnic

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Table 1. Summary birthweight statistics by race/ethnicity for Chicago, 1990

	Race			
	Non-Hispanic Whites	**Non-Hispanic Blacks**	**Mexican-origin Hispanics**	**Total**
Birthweight (grams)				
Mean	3,418.5	3,086.8	3,383.7	3,235.7
Standard deviation	568.7	628.9	546.4	617.7
Low birthweight (< 2,500 g)	4.8%	13.4%	4.4%	9.1%
Very low birthweight (< 1,500 g)	0.9%	2.7%	0.8%	1.7%
Number of observations	12,918	26,005	10,181	49,104

Source: Authors' calculations from Chicago birth certificate data.

Table 2. Means (and standard deviations) or percent by category for independent variables by race for Chicago, 1990

	Race			
Variable	Non-Hispanic whites	Non-Hispanic blacks	Mexican-origin Hispanics	**Total**
Infant sex				
Male	51.1%	50.5%	51.6%	50.9%
Female	48.9	49.5	48.4	49.1

Table 2. *Continued*

Variable	Race: Non-Hispanic whites	Non-Hispanic blacks	Mexican-origin Hispanics	Total
Birth attendant				
Medical person	94.2%	92.6%	91.7%	92.8%
Midwife	2.8	1.3	2.3	1.9
Other	3.1	6.1	6.0	5.3
Number of observations	12,918	26,005	10,181	49,104

Source: Authors' calculations using 1990 Chicago vital statistics data.

Notes: a. Among women with a prior live birth.

b. Cigarettes per day among women who smoked during pregnancy.

c. Alcoholic drinks per week among women who used alcohol during pregnancy.

Table 3. Regression models showing the effects of neighborhood and individual characteristics on racial/ethnic differentials in birthweight

Variable	Model I	Model II	Model III	Model IV
Infant sex				
Male[a]				

Table 3. *Continued*

Variable	Model I		Model II		Model III		Model IV	
Smoked during pregnancy								
No[a]	.	.	.	.	.	.	.	.
Yes	.	.	.	.	.	.	-162.5***	(9.1)
Cigarettes per day[c]								

Table 4. Fixed effects regression of birthweight on exogenous characteristics by race/ethnicity

Variable	Race: Non-Hispanic whites		Non-Hispanic blacks		Mexican-origin Hispanics	
Infant sex						
Male[a]	.	.	.	.	.	.
Female	-119.3***	(10.0)	-114.9***	(7.8)	-102.8***	(10.9)
Mother's education (years)	15.6***	(3.0)	33.7***	(3.3)	-1.3	(5.2)
Mother's nativity						
U.S. born[a]	.	.	.	.	.	.
Foreign born	-35.6*	(14.0)	89.6**	(31.4)	-5.8	(15.4)
Mother's marital status						
Not married[a]	.	.	.	.	.	.
Married	155.0***	(14.9)	131.5***	(11.4)	76.3***	(12.2)
Mother's age (years)	-0.8	(1.0)	-6.6***	(0.8)	9.5***	(1.0)
Constant	3,322.2***	(13.9)	3,070.0***	(7.1)	3,383.4***	(15.9)
Model F-test (df)	66.2***	(5)	106.9***	(5)	50.6***	(5)
Tract fixed effect	Yes		Yes		Yes	
Adjusted R-squared	0.03		0.02		0.02	
Number of observations	12,918		26,005		10,181	

**p*<.05; ***p*<.01; ****p*<.001; standard errors in parentheses.

Source: Authors' calculations using 1990 Chicago vital statistics data.

Note: a. Reference category.

Table 5. Fixed effects regression of birthweight on endogenous and exogenous characteristics by race/ethnicity

Variable	Race					
	Non-Hispanic whites		**Non-Hispanic blacks**		**Mexican-origin Hispanics**	
Infant sex						
Male[a]	.	.	.	.	.	.
Female	-128.6***	(8.0)	-113.1***	(5.7)	-113.3***	(9.3)
Mother's education (years)	9.0***	(2.6)	13.9***	(2.5)	0.3	(4.5)
Mother's nativity						
U.S. born[a]	.	.	.	.	.	.
Foreign born	-36.4***	(11.5)	68.0**	(23.0)	-32.4*	(13.3)
Mother's marital status						
Not married[a]	.	.	.	.	.	.
Married	53.9***	(12.4)	55.4***	(8.5)	27 -1.14	d2-85.1(.)16i[.n25

Table 5. *Continued*

Variable	Race					
	Non-Hispanic whites		**Non-Hispanic blacks**		**Mexican-origin Hispanics**	
Cigarettes per day[b]	-2.1*	(0.9)	0.1	(0.5)	-0.2	(2.1)
Alcohol use during pregnancy						
Some[a]	.	.	.	.	.	.
None	-25.8	(46.8)	-105.1***	(26.8)	-30.0	(245.9)
Alcoholic drinks per week[c]	1.4	(12.3)	4.4	(3.9)	-66.2	(71.3)
Place of delivery						
Hospital[a]	.	.	.	.	.	.
Other	54.9	(42.0)	-109.0***	(27.9)	-85.4	(99.2)
Birth attendant						
Medical person[a]	.	.	.	.	.	.
Midwife	-0.2	(25.5)	42.3	(25.2)	61.9*	(31.2)
Other	-56.0*	(23.9)	5.3	(12.2)	-16.7	(19.8)
Constant	3,536.1***	(84.7)	3,498.9***	(46.7)	3,713.5***	(82.6)
Model F-test (df)	242.0***	(31)	738.0***	(31)	133.3***	(31)
Tract fixed effects	Yes		Yes		Yes	
Adjusted R-Squared	0.39		0.48		0.30	
Number of observations	12,918		26,005		10,181	

**p*<.05; ***p*<.01; ****p*<.001; standard errors in parentheses.

Source: Authors' calculations using 1990 Chicago vital statistics data.

Notes: a. Reference category.

b. Cigarettes per day among women who smoked during pregnancy.

c. Alcoholic drinks per week among women who used alcohol during pregnancy.

Table 6. Decomposition of race/ethnic differences in birthweight based on fixed effects regression models with endogenous and exogenous characteristics

Group	Model: Non-Hispanic whites		Non-Hispanic blacks		Mexican-origin Hispanics	
Non-Hispanic whites	3,418.5[a]	(3.9)	3,269.4	(7.0)	3,417.4	(13.0)
Non-Hispanic blacks	3,249.3	(8.7)	3,086.8[a]	(2.8)	3,253.9	(12.3)
Mexican-origin Hispanics	3,385.6	(9.4)	3,292.4	(18.9)	3,383.8[a]	(4.5)

Source: Authors' calculations using 1990 Chicago vital statistics data.
Notes: a. Actual observed value; standard errors in parentheses.

Figure 1. Conceptual Framework for Analysis of Birthweight

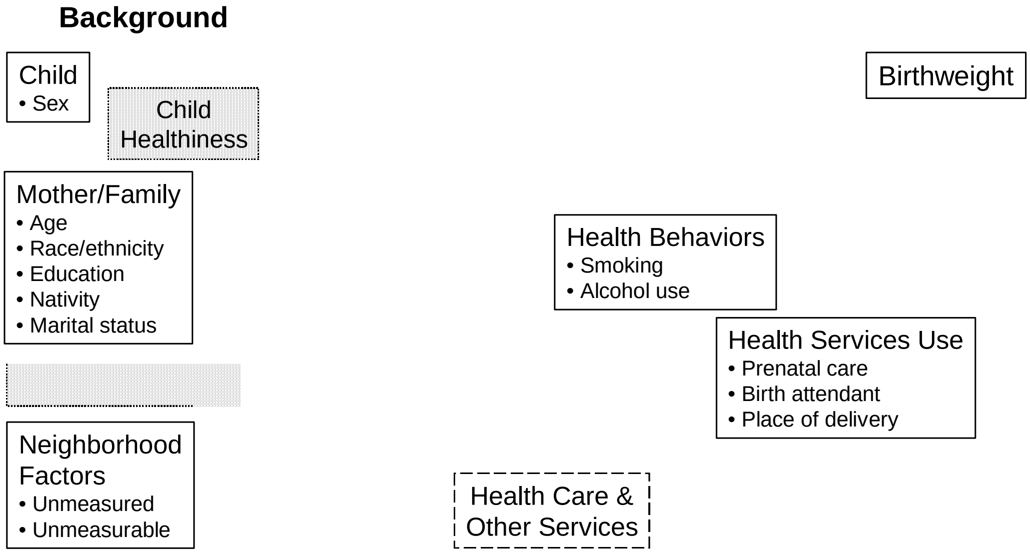

Figure 2. The Relationship Between Birthweight a