



ORIGINAL CONTRIBUTIONS

Neighborhood Support and the Birth Weight of Urban Infants

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Differences in maternal characteristics only partially explain the lower birth weights of infants of African-American women. It is hypothesized that economic and social features of urban neighborhoods may further account for these differences. The authors conducted a household survey of 8,782 adults residing in 343 Chicago, Illinois, neighborhoods to assess mean levels of perceived social support and used US Census data to estimate neighborhood economic disadvantage. Data on birth weight and maternal risk factors were gathered from 95,711 birth certificates (1994–1996). Before statistical adjustment of the data, infants born to African-American mothers were found to be, on average, 297 g lighter than those born to White mothers. After adjustment for individual-level risk factors, this difference was reduced to 154 g. For African-American mothers only, mean birth weight decreased significantly as the neighborhood level of economic disadvantage increased. For White mothers only, a significant positive association was found between perceived levels of neighborhood social support and infant birth weight. Adding these neighborhood-level predictors to the model reduced the adjusted White versus African-American difference in birth weight to 124 g. Results support the hypothesis that neighborhood-level factors are significantly associated with infant birth weight.

birth weight; poverty; risk factors; social environment; socioeconomic factors

Abbreviation: PHDCN, Project on Human Development in Chicago Neighborhoods.

In the United States, infants born to African-American women are, on average, almost 300 g lighter and more than twice as likely to be low birth weight than are infants of White women (1). Approximately half of this increased risk

can be explained by maternal risk factors including age, marital status, and cigarette smoking (2). Pronounced residential segregation in many cities has led researchers to speculate that contextual or ecologic factors may also

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contribute to the higher risk of low birth weights among African-American women (1–4).

Investigators have begun to examine variation of birth outcomes by administrative region or census tract in US cities (5–11). Lower birth weights have been reported to be associated with contextual-level factors including higher rates of poverty (5, 10, 11) and unemployment (11), lower neighborhood educational and income levels (5, 6, 11), higher median rent (5), and higher rates of violent crime (3). However, to our knowledge, all such multilevel epidemiologic investigations to date have relied on census and administrative data (crime rates, per capita health expenditures). It has also been hypothesized that social processes not fully reflected in such administrative data also vary between neighborhoods and may contribute to the racial gap in birth outcomes (5). Supporting this hypothesis are findings that cohesive social networks, trust, and reciprocal exchanges among residents are associated with lower rates of mortality (12) and morbidity (13). Finally, epidemiologic evidence indicates that, during pregnancy, social support from a partner, family member, and others appears to improve fetal growth (14, 15); neighborhood factors may contribute to such support.

We hypothesized that economic and social features of urban neighborhoods, in particular material disadvantage and residents' perceptions of the level of cohesion and support in their neighborhood, are related to the birth weight of infants from those neighborhoods. We reasoned that there may be several processes through which such neighborhood-level factors translate into improved birth outcomes for pregnant women, including access to medical care, proper nutrition, promotion of desirable health behaviors, and stress reduction.

MATERIALS AND METHODS

Neighborhood measures

Neighborhood-level data for the city of Chicago, Illinois, were gathered in 1995 as part of the Project on Human Development in Chicago Neighborhoods (PHDCN) (16). PHDCN was a large-scale interdisciplinary study designed to provide new information about the role of neighborhood-, family-, and individual-level factors in the development of social functioning, mental health, and physical health status (16). PHDCN combined a neighborhood-level study of the entire city of Chicago and intensive investigation of 80 randomly selected neighborhoods, along with a longitudinal cohort study of approximately 6,000 families. The considerable socioeconomic, racial, and ethnic diversity of the population was a major reason that Chicago was selected as the study site. By applying a spatial definition of "neighborhood"—a collection of people and institutions occupying a subsection of a larger community—we combined all 847 census tracts in Chicago to create 343 ecologically meaningful and homogeneous "neighborhood clusters" by using geographic boundaries and knowledge of traditional Chicago neighborhoods. Following a cluster analysis in which the census tract was the unit of analysis, we used either single, large tracts or combined contiguous census

tracts that were comparable in terms of racial/ethnic composition, household income, educational levels, and housing density to identify neighborhood clusters that each included approximately 8,000 residents. These neighborhood clusters were generated, in part, to provide adequate sample sizes for the cohort-study component of PHDCN, which is not the focus of this paper. Here, we refer to neighborhood clusters as "neighborhoods," keeping in mind that other operational definitions might also have been used; neighborhood clusters are comparable to large census tracts.

We conducted a multistage probability household survey of all neighborhood clusters. For 263 of the clusters, nine census blocks were selected with a probability proportional to population size; three dwelling units were selected at random within each block, and an adult respondent (aged 18 years or older) was randomly selected within each of approximately 20 households. The remaining 80 neighborhood clusters were oversampled (approximately 50 respondents per neighborhood cluster) for more intensive study by using a simple random sample of census blocks and dwelling units within blocks. The overall survey response rate was 75 percent.

Consistent with prior work with these data (17), we derived a neighborhood-level measure of "neighborhood support" (17, 18). Respondents were asked how strongly they agreed (on a five-point scale) with 10 statements such as, "This is a close-knit neighborhood" and "People do favors for each other" (details provided in table 1). Residents' responses within neighborhood cluster were averaged to construct the neighborhood cluster-level measure. This scale has high internal consistency (Cronbach's alpha, 0.82). Because neighborhood-level poverty and other indicators of economic disadvantage have been associated with both lower levels of social cohesion (17–19) and birth outcomes (5, 6), we sought a neighborhood cluster-level index of economic disadvantage as a potential confounder in the relation between neighborhood support and birth weight. Using data from the 1990 US Census, we derived an aggregate measure of neighborhood economic disadvantage, calculated for each neighborhood cluster as the first principal component of the proportion of residents 1) living below the poverty line, 2) on public assistance, and 3) unemployed. Both neighborhood cluster-level scales (neighborhood support and economic disadvantage) were standardized (mean, 0; standard deviation, 1). Racial/ethnic composition (i.e., proportion African American) was determined by the proportion of births to African-American women in each neighborhood cluster.

Birth outcomes

Data on birth outcomes came from 1994–1996 birth certificate files supplied by the Chicago Department of Public Health. Multiple births and those for which data were missing on birth weight or maternal risk factors were excluded from the analysis, as were births from the one neighborhood cluster for which we did not have census data. Furthermore, our analyses included only those births to mothers whose race was recorded as being either White (not Hispanic) or African American.

TABLE 1. Items included in the Neighborhood Support Scale,* Chicago, Illinois, 1994–1996

Social cohesion and trust
People around here are willing to help their neighbors.
This is a close-knit neighborhood.
People in this neighborhood can be trusted.
People in this neighborhood generally don't get along with each other.†
People in this neighborhood do not share the same values.†
Reciprocated exchange
About how often do you and people in your neighborhood ...
Do favors for each other?
Ask each other advice about personal things such as child rearing or job openings?
Have parties or other get-togethers where other people in the neighborhood are invited?
Visit in each other's homes or on the street?
Watch over each other's property?

* Prior to answering these interview questions, respondents were instructed, "Our questions ask about what it's like to live in your neighborhood. By neighborhood, we mean the area around where you live and around your house. It *may* include places you shop, religious or public institutions, or a local business district. It is the general area around your house where you might perform routine tasks, such as shopping, going to the park, or visiting with neighbors."

† Reverse coded.

Analytic approach

We estimated a set of four hierarchical linear regression models (20, 21). Unmeasured neighborhood influences on birth outcomes were represented by a pair of random effects, one for White mothers and one for African-American mothers (22–25). This approach 1) avoids the assumption that the processes affecting birth outcomes are the same for White and African-American mothers, 2) permits estimation of how much variation in birth outcomes lies between and within neighborhoods for White and African-American mothers, and 3) adjusts standard errors to take into account the clustered nature of the sample.

We estimated models that controlled for individual-level characteristics and behaviors (infant's gender, prenatal care, maternal age, mother's marital status, maternal smoking, maternal education, and parity) before testing for associations between neighborhood characteristics and birth weight. Exploratory analysis demonstrated that maternal age was curvilinearly related to birth weight and could be modeled as a quadratic function of age (thus, our models included terms for maternal age and the square of age) and that the number of cigarettes smoked per day during pregnancy and the number of years of maternal education were linearly associated with birth weight. Both parity and prenatal care were modeled as dichotomous variables, indicating primiparity (first birth) and receipt of any prenatal care, respectively.

Model 1 included only the estimated White and African-American neighborhood-mean birth weights, which provided estimates of the variance in birth weight observed between and within neighborhood clusters and the correlation between African-American and White neighborhood-mean birth weights across neighborhoods. Model 2 added all individual maternal risk factors and infant gender. To this

model, we added the racial/ethnic composition (proportion African American) of the neighborhood and economic disadvantage (model 3). Finally, we added neighborhood support to the model (model 4). We also conducted several general linear hypothesis tests (20) to assess whether the joint effect of a group of predictors could be differentiated from zero and whether White versus African-American birth weights differed.

All hierarchical models presented were estimated by restricted maximum likelihood using Hierarchical Linear and Nonlinear Modeling (HLM) software (26). All other statistics presented in this paper were estimated by using SYSTAT (27) and Statistical Analysis System (SAS) (28) software.

RESULTS

Of the 101,723 singleton births recorded to either African-American or White mothers, 2,731 (2.6 percent) could not be mapped to one of the 343 neighborhoods; for 1,753 (1.7 percent), no valid birth weight was available. For the 97,239 remaining birth certificates, 334 (0.3 percent) of the births occurred in the excluded neighborhood and 1,194 (1.2 percent) certificates did not list maternal education and were excluded from analysis. Of the remaining 95,711 births, 29,788 were to White mothers and 65,923 were to African-American mothers.

Infants born to African-American mothers were 297 g smaller, on average, than White infants and were 2.6 times more likely to be of low birth weight (table 2). Compared with White mothers, African-American mothers were younger and more likely to be in their teens, have no high

TABLE 2. Individual-level maternal and infant characteristics by race: singleton livebirths to African-American and non-Hispanic White mothers, Chicago, Illinois, 1994–1996

	Non-Hispanic White	African-American
Total births (no.)	29,788	65,923
Birth weight (g) (mean (SD*))	3,389 (525)	3,092 (583)
Birth weight <2,500 g† (%)	5.2	13.3
Mother's age <20 years (%)	6.1	27.3
Mother's age >35 years (%)	18.2	7.4
Mother's age (years) (mean (SD))	29.2 (5.8)	24.2 (6.2)
Mother: no high school degree (%)	13.7	37.8
Maternal education (no. of years completed) (mean (SD))	13.8 (2.7)	12.0 (1.9)
Mother unmarried (%)	20.2	83.7
Mother primiparous (%)	39.4	26.1
Late (3rd trimester) or no prenatal care (%)	5.7	12.8
Smoking during pregnancy (%)	11.4	15.9
Cigarettes smoked per day (no.) (mean (SD))	1.32 (4.51)	1.36 (4.16)

* SD, standard deviation.

† Low birth weight.

school degree, be unmarried, to have smoked during their pregnancy, and to have received late or no prenatal care.

We divided the 343 neighborhoods into those in which the large majority of births are to African-American women (>90 percent; $n = 135$), those in which the large majority of births are to White women (<10 percent of births to African-American women; $n = 98$), and the remaining more heterogeneous group of 110 neighborhoods. The vast differences in the social circumstances in which African-American and White pregnant women live and the great degree of racial segregation were evident (table 3). More than 85 percent of births to African-American women occurred in only 135 (39 percent) of Chicago's 343 neighborhoods. Mean birth weights decreased and low birth weight proportions increased in neighborhoods in which more African-American births occurred. For neighborhoods in which most (>90 percent) births were to African-American women, the average proportion of adults living below the federal poverty level was 31.2 percent, five times greater than for the majority White birth (>90 percent) neighborhoods (6.2 percent). This situation was further reflected in the values of the composite index of economic disadvantage; there was little overlap in the economic levels of majority African-American and majority White birth neighborhoods.

Residents' perceptions of neighborhood support also varied considerably across neighborhoods. Residents in neighborhoods in which mostly White births occurred reported a mean value of neighborhood support of 0.63, indicating above-average cohesion, trust, and supportive interactions among neighbors. The mean values for the majority African-American birth neighborhoods were one standard deviation lower than those for the White birth neighborhoods. Unlike economic status, levels of neighborhood support reported in majority African-American neighbor-

hoods overlapped considerably with the levels in majority White neighborhoods.

Model 1 (table 4) represented birth outcomes as a function of means for African-American and White mothers plus a pair of random effects for each neighborhood. The estimated neighborhood-mean birth weight for infants born to White mothers (3,376 g) was greater than the neighborhood-mean birth weight for infants of African-American mothers (3,103 g), a difference of 273 g ($p < 0.0005$). Variability in mean birth weights between neighborhoods was statistically significant for both African-American and White mothers ($p < 0.0005$ for both), although the proportion of variance between neighborhoods was small (0.57 percent for African-American mothers and 0.93 percent for White mothers). There was an association between African-American and White birth weights such that neighborhoods manifesting greater birth weights for White mothers also tended to show greater birth weights for African-American mothers ($r = 0.423$).

Model 2 included individual-level maternal characteristics and infant gender only. Educational level, receipt of prenatal care, being married, and giving birth to a male baby were positively associated with birth weight, while primiparity (first birth) and smoking predicted lower birth weight. The direction of these effects was similar for White and African-American mothers, although, in all instances except for the gender of the baby, African-American and White coefficients were significantly different from one another. Maternal age is the one case in which we found a significant (negative) effect for African-American mothers and no significant effect for White mothers. When we held constant all explanatory variables at their grand means, the expected birth weight for White mothers (3,497 g) remained greater than for African-American mothers (3,343 g); the difference was 154 g ($p < 0.0005$).

TABLE 3. Characteristics of the neighborhoods in which mothers live, by proportion of births to African-American women, Chicago, Illinois, 1994–1996

	<10% of births to African-American women (no. of neighborhoods = 98)		10–90% of births to African-American women (no. of neighborhoods = 110)		>90% of births to African-American women (no. of neighborhoods = 135)	
	African-American	White	African-American	White	African-American	White
Total births (no.)	585	19,807	8,897	9,416	56,441	565
Birth weight (g) (mean (SD*))	3,176 (597)	3,399 (521)	3,136 (579)	3,373 (526)	3,084 (583)	3,280 (586)
Birth weight <2,500 g (%)	11.3	4.9	11.6	5.5	13.6	9.0
Residents in poverty (%)						
Mean (SD)	6.2 (4.9)		19.7 (12.2)		31.2 (19.0)	
Range	0.2 to 21.4		1.7 to 60.9		5.5 to 88.2	
Economic disadvantage index						
Mean (SD)	−0.88 (0.26)		−0.27 (0.58)		0.85 (0.94)	
Range	−1.38 to −0.01		−1.33 to 1.88		−0.54 to 3.9	
Neighborhood support						
Mean (SD)	0.63 (0.94)		−0.14 (1.00)		−0.33 (0.81)	
Range	−1.64 to 2.96		−2.19 to 3.57		−2.00 to 1.83	

* SD, standard deviation.

Model 3 added neighborhood racial/ethnic composition and economic disadvantage as explanatory variables. For African-American mothers, mean birth weight decreased 13.1 g for each standard deviation increase in neighborhood economic disadvantage ($p < 0.05$). A similar, yet nonsignifi-

cant effect size was estimated for White mothers. The fact that the effect was significant for African-American but not White mothers, despite the similarity in the coefficients, might be explained by the fact that neighborhood economic disadvantage was more highly variable for African-

TABLE 4. Results of hierarchical regression models predicting mean birth weight (g) in relation to neighborhood and individual-level variables, Chicago, Illinois, 1994–1996

Coefficient in birth weight (g)	Model 1		Model 2		Model 3		Model 4	
	African-American mothers	White mothers	African-American mothers	White mothers	African-American mothers	White mothers	African-American mothers	White mothers
Intercept	3,102.6**	3,376.3**	3,342.8**	3,497.4**	3,344.6**	3,466.0**	3,338.7**	3,471.9**
Proportion of neighborhood African American					−5.0	−11.4	−4.9	2.1
Neighborhood economic disadvantage (1 SD† increase)					−13.1**	−16.8	−14.7**	−6.0
Neighborhood social support (1 SD increase)							−4.7	17.5**
Male infant			108.0**	112.2	107.9**	112.0	108.0**	111.9**
Maternal age			−8.1**	0.4	−8.2**	0.3	−8.2**	0.3
Maternal age ²			−0.3**	−0.2**	−0.3**	−0.2**	−0.3**	−0.2*
Mother married			100.7**	91.3**	96.7**	87.7**	96.8**	86.8**
Mother: highest grade of education			20.9**	12.6**	19.8**	12.3**	19.9**	12.0**
Prenatal care			181.4**	134.9**	181.1**	134.3**	181.2**	132.1**
Parity (first birth)			−36.2**	−78.7**	−38.3**	−79.7**	−38.2**	−78.6**
No. of cigarettes smoked per day			−19.5**	−14.6**	−19.4**	−14.6**	−19.4**	−14.6**

* $p < 0.05$; ** $p < 0.0005$.

† SD, standard deviation.

American than for White mothers. Again holding constant all explanatory variables at their grand means, we found that the expected birth weight for White mothers (3,466 g) remained greater than for African-American mothers (3,345 g), a difference of 121 g ($p < 0.0005$) compared with the difference of 154 g based on model 2. Controlling for economic disadvantage alone accounted for most of the between-neighborhood variance in birth weight estimated in model 2. Specifically, economic disadvantage accounted for 80.8 percent of the between-neighborhood variance for African-American mothers and 76.3 percent for White mothers.

Model 4 added neighborhood social support as an explanatory variable. The estimated association was significantly positive for White but not for African-American mothers. For Whites, an increase of one standard deviation in neighborhood social support was associated with a 17.5-g higher mean birth weight. For African-American mothers, the corresponding coefficient (-4.7) was nonsignificant. These two coefficients were statistically significantly different from each other ($p < 0.0005$). For Whites, controlling for neighborhood social support in addition to neighborhood economic disadvantage explained 90.9 percent of the between-neighborhood variance estimated in model 2. Analyses conducted for infants born to White mothers only indicated that infants in neighborhoods in the top tertile of support had statistically elevated birth weights compared with those in low- or medium-support neighborhoods. In contrast, infants born in those neighborhoods reported as least supportive had mean birth weights similar to those in medium-support neighborhoods.

DISCUSSION

For White mothers only, results indicate a positive association between levels of neighborhood support and the birth weights of infants born in these neighborhoods. This association was independent of the level of economic disadvantage of the neighborhood, racial/ethnic composition, and several established individual-level risk factors. The reports of neighborhood support did not come from the pregnant women themselves. We did not seek to test the hypothesis that level of perceived support reported by individual pregnant women is associated with higher birth weight of their infants. The current results support a more distal mechanism, namely, that the level of support reported by a representative sample of residents enhances birth weight throughout the neighborhood. Neighborhood support may serve as a health-promoting factor, with positive effects accruing when some threshold is surpassed. In our data, this threshold was not arbitrary; the turning point corresponded with a value on the scale of neighborhood support (top tertile) for which residents were more likely than not to state that they trusted and interacted with their neighbors.

For predominantly African-American neighborhoods, we found no association between levels of neighborhood support and infant birth weight. Because social cohesion and interactions among neighbors are not perceived equally by all residents of a neighborhood, we calculated estimates of neighborhood support based on reports from African-

American respondents only. Again, no association was found between perceived neighborhood support and the birth weight of African-American infants. However, we found a significant effect of level of economic disadvantage on the birth weight of African-American infants only. As unemployment, poverty, and public assistance levels increased, the mean birth weight of African-American infants decreased.

The lack of association between neighborhood support and birth weight for African-American infants may, in part, be attributable to the level of residential segregation and the social climate in Chicago and other US cities. Although many births to African-American women occur in neighborhoods that, overall, are reported to be highly supportive, few neighborhoods are perceived as such by their African-American residents. Our data did not permit an adequate test of whether African-American mothers would accrue the same benefit in birth weight associated with higher levels of neighborhood support that was demonstrated for White mothers because there were few African-American mothers living in neighborhoods perceived as supportive by their African-American neighbors. In settings of economic disadvantage, opportunities to generate or sustain social support at the neighborhood level may be constrained. In more advantaged neighborhoods, African-American mothers may experience real or perceived discrimination that serves to distance them from the generally favorable social climate experienced by Whites.

While the total proportion of the variation in infant birth weight at the neighborhood level was small compared with the variation between individual infants, the role of neighborhood characteristics is still of public health significance. The six established individual risk factors included in these analyses (such as maternal age, education, smoking during pregnancy, and receipt of prenatal care) accounted for only 5.3 percent of the variance in individual birth weights. In contrast, the three neighborhood variables (racial/ethnic composition, economic disadvantage, and neighborhood support) accounted for more than 80 percent of the variance in birth weight between neighborhoods. The proportion of variance in birth weights between neighborhoods was small (0.57 percent for African-American mothers and 0.93 percent for White mothers) but statistically significant, and we could account for this variation. Second, these neighborhood-level factors impact the mean birth weight of hundreds of pregnant women per neighborhood. Small neighborhood effects such as those noted may have large population impacts.

Several of the individual-level maternal risk factors we controlled for, such as maternal smoking and lack of prenatal care, may be consequences of lower neighborhood support. For instance, neighborhoods with higher levels of cohesion and interpersonal interaction may encourage mothers to seek prenatal care or to stop smoking during pregnancy. If so, then our decision to include these as individual-level factors would underestimate the amount of variation in birth weight that could be attributed to neighborhood factors. A limitation of the current investigation was the lack of individual-level data on mothers' perceived social support and detailed information on socioeconomic status (beyond marital status and

educational level). White mothers in higher support neighborhoods may perceive and receive greater social support themselves, accounting for the noted association between neighborhood support and birth weight. Similarly, the lower socioeconomic opportunities of African-American women, rather than the level of economic disadvantage of their neighborhoods, might account for this association among the African-American sample. Ideally, future investigations of neighborhood influences on birth weight will address this limitation.

The current analysis draws on and contributes to previous literature demonstrating an association between neighborhood-level social processes and health outcomes. Our measure of "neighborhood support" is conceptually related to constructs of social capital (12, 29), cohesion (30), and collective efficacy (17). These constructs all reflect social processes that may operate within a neighborhood or other collective context to the benefit of residents. While prior investigations have examined sociodemographic, compositional, and other structural features of neighborhoods, this is the first known to examine such perceived social processes at the neighborhood level in relation to birth outcomes. We did not attempt to differentiate between the impact of specific forms of neighborhood support (for example, instrumental vs. emotional support, perceived vs. received support) that have been identified in individual-level studies (15); such work may warrant future investigation.

Neighborhood support, as broadly conceived, could operate through several mechanisms to improve infant birth weight. First, it may foster a local climate of encouragement, information, and tangible aid that contributes to maternal health and fetal growth (31, 32). For example, social support has been consistently associated with reduced cigarette smoking and substance abuse during pregnancy (14, 33, 34). Second, social network researchers have argued that community ties may provide positive reference groups and exert pressures to conform to health-promoting normative standards (35–37). Neighborhood support could thus result in improved utilization of and compliance with medical care as well as positive health-care behaviors during pregnancy. Finally, partial but inconsistent evidence exists that high-quality social support may also directly affect intrauterine growth by dampening adverse hormonal and immunologic reactions to stressors (33, 38).

These results add to the growing evidence that community-wide social processes have positive effects on the health and well-being of residents. Taken together, the growing evidence of the health benefits of neighborhood cohesion, support, and engagement suggests this as an area of potential impact for public health policy and practice.

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