Differential Effect of Ecologic Risk Factors on the Low Birthweight Components of African-American, Mexican-American, and Non-Latino White Infants in Chicago

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This study explored the relationship between ecologic risk factors and infant birthweight. A stratified analysis was performed on all African-American, Mexican-American, and white infants born in Chicago in 1990. One half of African-American mothers (n=26,799) resided in communities with multiple ecologic risk factors, yet their very low birthweight rates were unaffected by the number of these factors. By contrast, only 5% of Mexican-American mothers (n=9913) and 5% of white mothers (n=13,596) lived in communities with multiple ecologic risk factors. Their very low birthweights were twice that of infants born to mothers who resided in communities with no ecologic risk factors. These results indicate that ecologic risk factors affect the very low birthweight rates of Mexican Americans and whites but not African Americans. (*J Natl Med Assoc.* 1998;90:223-229.)

Key words: very low birthweight ◆ low birthweight ◆ ecologic ◆ African Americans ◆ Mexican Americans

For more than 40 years, the infant mortality rate of African Americans has been twice that of whites.[1] The racial differential in low birthweight (<2500 g) components underlies this public health problem.[1,2] African Americans have a threefold greater very low birthweight (<1500 g) rate and a twofold greater moderately low birthweight (1501 to 2499 g) rate than whites.[2] Published studies show that individual-level risk factors do not explain the racial disparity in low birthweight components,[2-5] nor do they explain the relatively favorable birth outcomes of Mexican Americans,[6,7] in whom low birthweight rate is one half that of African Americans despite comparable sociodemographic profiles and utilization rates of prenatal care.[7,8]

The extent to which a mother's residential environment, as distinct from her individual attributes, contribute to racial and ethnic differences in low birthweight rates is poorly understood.[9,10] African-American mothers are much more likely than Mexican-American and white mothers to reside in impoverished neighborhoods.[7-11] This may contribute to racial and ethnic group differences in low birthweight rates. The effect of community-level risk factors on infant birthweight might be particularly pronounced in cities with the largest contiguous con-

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Table 1. Low Birthweight Components by Maternal Race and Ethnicity, Chicago, Illinois, 1990

	No.	≤1500 g*	1501 to 2499 g*
African-American	26,799	2.9	10.7
Mexican-American	9913	0.8	3.6
White	13,596	1.0	4.0
African American:Mexican American			
Relative risk		3.6	3.0
95% confidence interval		2.8-4.6	2.7-3.3
African American:white			
Relative risk		2.9	2.7
95% confidence interval		2.4-3.5	2.4-2.9

*Per 100 live births.

centrations of African Americans, the so-called hypersegregated cities as Chicago, Detroit, and Boston.[9-11]

This study examined the effect of ecologic risk factors on the low birthweight rates of urban African-American, Mexican-American, and non-Latino white infants in Chicago.

MATERIALS AND METHODS

The Illinois vital records of all African-American, Mexican-American, and non-Latino white singleton infants born to Chicago residents in 1990 were obtained. Based on maternal place of residence listed on the birth certificate, 1990 US census information and 1990 Chicago Department of Public Health data were appended to each birth record.

In Chicago, there are 77 community areas; each is a meaningful ecologic unit.[7] Four community area variables were dichotomized to measure the absence or presence of risk: median family income (<$15,000/year), unemployment rate (>19%), homicide rate (>1.3/1,000), and lead poisoning rate (>2.8/1,000). Three categories were defined: 1) no risk factors, 2) one risk factor, and 3) two or more risk factors. Maternal age, maternal education, and trimester of prenatal care initiation were evaluated as individual-level variables. To reduce the confounding effect of multiple gestations and advanced maternal age, the study population was restricted to singleton births with mothers ≤35 years.

The very low and moderately low birthweight rates of African-American, Mexican-American, and non-Latino white infants were calculated. As an initial step in exploring the association between maternal race and ethnicity and low birthweight components, the distribution of ecologic risk factors was examined in each racial/ethnic group. Next, racial/ethnic group-specific very low and moderately low birthweight rates were calculated according to the number of ecologic risk factors. Lastly, within each ecologic risk factor stratum, racial/ethnic group-specific very low and moderately low birthweight rates were determined according to individual-level risk factors. For each 2×2 analysis, the relative risk (RR) was calculated[12] and the 95% confidence interval (CI) was estimated using the Taylor series method.[13]

RESULTS

Table 1 shows the low birthweight components for African Americans (n=26,799), Mexican Americans (n=9913), and whites (n=13,596). As expected, African Americans had approximately threefold greater very low and moderately low birthweight rates than the other two ethnic groups.

Table 2 shows the distribution of ecologic risk factors according to maternal race and ethnicity. Nearly 84% of Mexican-American and 88% of white mothers resided in communities with no ecologic risk factors. In stark contrast, only 20% of African-American mothers resided in communities with no ecologic risk factors. Almost 25% of African-American mothers were exposed to four ecologic risk factors.

The low birthweight components of African-American, Mexican-American, and white infants as a function of the number of maternal ecologic risk factors are shown in Table 3. Among the Mexican-American and white infants, those with mothers who resided in communities with two or more ecologic risk factors had very low birthweight rates

Table 2. Distribution of Maternal Ecologic Risk Factors by Race and Ethnicity, Chicago, Illinois, 1990

Ecologic Risk Factor	% African American* (n=26,799)	% Mexican American* (n=9913)	% White* (n=13,596)
0	20.2	83.6	88.3
1	30.3	10.9	6.9
2	8.8	1.0	1.0
3	15.6	2.3	2.1
4	24.8	2.4	1.8

*Per 100 live births.

twice that of those with mothers who resided in communities with no ecologic risk factors. There was a modest association between maternal exposure to ecologic risk factors and the moderately low birthweight rate of African-American infants; mothers who resided in communities with two or more ecologic risk factors had a 30% greater risk of delivering a moderately low birthweight infant than mothers who resided in communities with no ecologic risk factors (RR=1.3; range: 1.1 to 1.4).

Among Mexican-American and white infants, those with mothers who resided in communities with two or more ecologic risk factors still had twice the very low birthweight rate as those with mothers who lived in communities with no ecologic risk factors, independent of maternal individual-level risk factors (Table 4). Conversely, the very low birthweight rates of African-American infants were not affected by ecologic risk factors regardless of maternal age, education, and prenatal care initiation.

The modest association between the number of ecologic risk factors and moderately low birthweight rates for African-American infants was minimally altered by the inclusion of maternal individual-level variables (Table 5). With the exception of Mexican-American mothers with <12 years of education, there was no association between the moderately low birthweight rate of Mexican-American and white infants, and the number of ecologic risk factors across each maternal age, maternal education, and prenatal care category. In the "2+" ecologic risk factors stratum, the RR of moderately low birthweight for teenaged African-American and white mothers were 0.8 (range: 0.7 to 0.9) and 2.1 (range: 0.9 to 4.7), respectively. There were too few teenaged Mexican-American mothers in the "2+" ecologic risk factors stratum to calculate meaningful moderately low birthweight rates.

DISCUSSION

Most investigations into the birthweight disparities among African-American, Mexican-American, and non-Latino infants have focused solely on individual-level risk factors, not causal pathways at the community level. Selected ecologic risk factors not only differed in quantity among African-American, Mexican-American, and white mothers but also exerted qualitatively different effects on their respective birth outcomes, regardless of individual-level risk factors.

The very low birthweight rate of African-American infants was unrelated to the number of ecologic risk factors; it was still approximately 3% in areas with no ecologic risk factors. In contrast, Mexican-American and white mothers who resided in communities with two or more ecologic risk factors were twice as likely to deliver very low birthweight infants as their counterparts who lived in communities with no ecologic risk factors. More research into the mother's residential environment during both her childhood and adulthood is needed to better understand these findings.

Our data emphasize that African-American mothers frequently reside in communities with multiple ecologic risk factors while Mexican-American and white mothers usually live in areas with no ecologic risk factors. The relatively few Mexican-American and whites who lived in communities with multiple ecologic risk factors had a very low birthweight rate twice that of their peers who resided in communities with no ecologic risk factors. We hypothesize that their residence in communities with multiple ecologic risk factors is a chronic stressor.[14] A multidisciplinary approach is needed to determine whether the sources of the stress, the stress itself, or the psychological price of coping with stress, underlies the association of ecologic risk fac-

Table 3. Low Birthweight Components by Ecologic Risk Factors and Maternal Race and Ethnicity, Chicago, Illinois, 1990*

Ecologic Risk Factor/Maternal Race	No.	≤1500 g†	1501 to 2499 g†
Zero Risk Factors			
African American	5474	2.9	9.6
Mexican American	8290	0.8	3.7
White	11,998	0.9	3.9
One Risk Factor			
African American	8128	2.8	9.7
Mexican American	1077	1.0	3.2
White	935	1.5	4.9
Two+ Risk Factors‡			
African American	13,197	3.0	11.8
Mexican American	546	1.6	2.6
White	662	2.0	4.1

*For African Americans, the relative risk (95% confidence interval [CI]) of very low and moderately low birthweight for women exposed to two+ (compared with zero) ecologic risk factors were 1.0 (0.9-1.2) and 1.3 (1.1-1.4), respectively. For Mexican Americans, the relative risk (95% CI) of very low and moderately low birthweight for women exposed to two+ (compared with zero) ecologic risk factors was 2.2 (1.1-4.3) and 0.7 (0.4-1.2), respectively. For non-Latino whites, the relative risk (95% CI) of very low and moderately low birthweight for women exposed to two+ (compared with zero) ecologic risk factors was 2.3 (1.2-4.2) and 1.2 (0.8-2.5), respectively.

†Per 100 live births.

‡Two, three, or four ecologic risk factors.

tors and very low birthweight rates.

In stark contrast, all African-American mothers, even those who resided in communities with no ecologic risk factors, still had a very low birthweight rate that was three times that of the other two groups. We speculate that the majority of these African-American mothers grew up in impoverished communities.[11,15] As such, their increased risk of delivering very low birthweight infants may reflect injuries to their procreative potential that dates from a detrimental residential environment when they were younger.

The concept that maternal health during childhood is important for later pregnancy outcome was largely developed by Baird[16] and more recently expanded by Emanuel.[17] After the Industrial Revolution in Britain, an improvement in perinatal outcome did not occur among infants born to mothers who were themselves born to impoverished mothers.[16] In addition, marital mobility studies support the theory that childhood environmental conditions influence adult pregnancy outcome.[17] Further research is warranted to determine whether transgenerational factors contribute to the persistently high very low birthweight rate among African-American infants.

In communities with multiple ecologic risk factors, mature African-Americans had a greater moderately low birthweight rate than teenaged African-Americans whereas mature whites had a lower moderately low birthweight rate than teenaged whites. This observation is consistent with a weathering phenomenon among African Americans. Geronimus[18] noted that aging is a weathering process reflective of life circumstances that affect women's health and reproductive outcome. For example, African-American women are more likely to reside in communities with high lead levels, and high-dose exposure is a risk factor for low birthweight.[19,20] Since the racial disparity in lead levels is greatest among older women, the magnitude of the gap is likely to reflect the cumulative effect of differential environmental exposure to lead.[19]

Limitations of the present study relate to the use of secondary data. First, the community-level variables in the data set were predetermined and might not be optimal for examining the impact of residential environment on women's health and consequent

Table 4. Ethnic Group-Specific Very Low Birthweight Rates by Ecologic Risk Factors and Selected Individual Level Variables, Chicago, Illinois, 1990

	Birthweight Rate (per 100 Live Births)			
	ERF 0	ERF 1	ERF 2+	RR (95% CI)*
African American				
No. women	5474	8290	11,998	
Maternal education (years)				
<12	3.4	3.5	2.9	0.8 (0.6-1.1)
12	2.5	2.4	2.6	1.1 (0.7-1.5)
>12	2.8	2.6	3.4	1.2 (0.8-1.7)
Prenatal care†				
Inadequate	3.5	3.2	3.0	0.9 (0.6-1.2)
Adequate	2.6	2.6	2.9	1.1 (0.9-1.4)
Maternal age (years)				
<20	3.3	3.1	2.9	0.9 (0.6-1.3)
20 to 35	3.0	3.0	3.4	1.0 (0.8-1.3)
Mexican American				
No. women	8128	1077	935	
Maternal education (years)				
<12	0.8	0.9	1.2	1.7 (0.7-4.2)
12	0.9	‡	‡	—
>12	0.7	‡	‡	—
Prenatal care				
Inadequate	0.8	‡	2.3	2.8 (1.0-8.1)
Adequate	0.7	1.1	1.0	1.5 (0.5-4.1)
Maternal age (years)				
<20	0.9	‡	‡	—
20 to 35	0.7	1.0	1.8	2.4 (1.2-5.1)
White				
No. women	13,197	546	662	
Maternal education (years)				
<12	1.2	1.3	3.1	2.5 (1.0-6.4)
12	0.9	2.0	‡	—
>12	0.8	1.2	1.2	1.6 (0.6-4.4)
Prenatal care				
Inadequate	1.0	‡	‡	—
Adequate	0.9	1.5	1.5	1.7 (0.8-3.5)
Maternal age (years)				
<20	1.1	‡	‡	—
20 to 35	0.9	1.2	1.5	1.4 (0.6-2.9)

Abbreviations: ERF=ecologic risk factors, RR=relative risk, and CI=confidence interval.
*Compares 2+ with 0 ERF.
†Inadequate=care initiated after first trimester and adequate=care initiated in first trimester.
‡Undefined, <4 infants.

reproductive outcome. Previous studies, however, confirm the rationale of investigating selected community-level variables.[7,20-22]

Second, although we attempted to control for racial and ethnic group differences in residential environments by measuring the number of ecologic

Table 5. Racial Ethnic Group-Specific Moderately Low Birthweight Rates by Maternal Ecologic Risk Factors and Selected Individual Level Variables, Chicago, Illinois, 1990

	Birthweight Rate (per 100 Live Births)			
	ERF 0	ERF 1	ERF 2+	RR (95% CI)*
African American				
No. women	5474	8290	11,998	
Maternal education (years)				
<12	11.9	11.1	13.0	1.1 (1.0 to 1.3)
12	9.4	9.8	11.2	1.2 (1.0 to 1.4)
>12	7.9	10.2	10.2	1.4 (1.1 to 1.8)
Prenatal care†				
Inadequate	11.0	11.2	12.9	1.2 (1.0 to 8.1)
Adequate	8.8	8.7	11.0	1.2 (1.1 to 1.4)
Maternal age (years)				
<20	10.2	9.5	10.6	1.0 (0.6 to 1.3)
20 to 35	9.4	9.7	12.4	1.3 (1.2 to 1.5)
Mexican American				
No. women	8128	1077	935	
Maternal education (years)				
<12	3.8	2.5	8.2	2.2 (1.1 to 4.3)
12	3.8	3.9	3.5	1.0 (0.4 to 2.6)
>12	2.9	5.7	‡	— 3.0
Prenatal care				
Inadequate	4.1	2.3	5.8	—
Adequate	3.4	3.6	2.4	0.7 (0.4 to 1.4)
Maternal age (years)				
<20	4.1	‡	‡	—
20 to 35	3.6	3.4	2.6	0.7 (0.4 to 1.3)
White				
No. women	13,197	546	662	
Maternal education (years)				
<12	5.5	6.2	6.2	1.2 (0.6 to 2.1)
12	3.9	4.2	3.4	0.6 (0.3 to 1.3)
>12	3.0	1.8	4.2	1.5 (0.9-2.5)
Prenatal care				
Inadequate	5.1	6.1	2.8	0.5 (0.2 to 1.5
Adequate	3.5	4.4	4.9	1.1 (0.7 to 1.7)
Maternal age (years)				
<20	5.4	4.9	8.2	1.5 (0.7-3.2)
20 to 35	3.7	4.9	3.9	1.1 (0.7 to 1.6)

Abbreviations: ERF=ecologic risk factors, RR=relative risk, and CI=confidence interval.
*Compares 2+ with 0 ERF.
†Inadequate=care initiated after first trimester and adequate=care initiated in first trimester.
‡Undefined, <4 infants.

risk factors, African Americans rarely reside in the same communities as Mexican Americans and whites. Moreover, African-American communities with no ecologic risk factors are more likely to be contiguous with communities with multiple ecologic risk factors than are white communities (Grossman R, White B. *Chicago Tribune.* Feb 1, 1997).[7] This may contribute to the high very low birthweight rate of

African Americans in communities with no ecologic risk factors. Our results cannot be generalized to communities in which African Americans, Mexican Americans, and whites live side by side.

Third, we did not have information on maternal nativity and duration of residence. This is particularly important for US-born African-American mothers who reside in communities with no ecologic risk factors and foreign-born Mexican-American mothers who live in areas with multiple ecologic risk factors. Such information may prove especially useful in explaining why immigrant women have a lower risk for low birthweight than native-born women.[7,23] Finally, although the overall study population was large, we could not fully address the relation of ecologic risk factors to infant birthweight among certain subgroups.

CONCLUSION

Further investigation is needed on the impact of community-level variables on infant birthweight. We speculate that the persistently elevated very low birthweight rate of African Americans who reside in communities with no ecologic risk factors represents the lingering effects of childhood impoverishment that are passed on to the next generation.

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