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Segregation and preterm birth: The effects of neighborhood racial composition in North Carolina

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Background

Racial residential segregation, the uneven distribution of race groups across a geographic region, is a persistent feature of the United States (U.S.) landscape. In the U.S., blacks are more highly segregated from whites than are Hispanics and Asians (Fong and Shibuya, 2005; Massey and Denton, 1987; Massey and Denton, 1989), with levels of black-white segregation in some cities approaching those of apartheid-era South Africa (Massey, 2004). Therefore, racial residential segregation in the U.S., hereafter segregation, usually refers to the segregation of blacks from the white population.

Segregation is one mechanism by which racial groups are differentially exposed to stressors and resources in this country, resulting in negative economic and social consequences for black communities (Massey, et al., 1987). Previous research has found high levels of segregation to be associated with increased risks of homicide victimization (Peterson and Krivo, 1999), tuberculosis (Acevedo-Garcia, 2001), all-cause mortality (Collins and Williams, 1999; Cooper, et al., 2001), poor self-rated health (Subramanian, et al., 2005), high body-mass index (Chang, 2006), infant mortality (LaVeist, 1989; Polednak, 1991), low birth weight (Bell, et al., 2006; Grady, 2006), and preterm birth (Roberts, 1997) in the black population. However, other research has found better health among black residents living in racially homogeneous neighborhoods, compared with their more integrated counterparts (Fang, et al., 1998; Pickett, et al., 2005; Inagami, et al., 2006; Bell, et al., 2006). The inconsistent findings suggest that segregation effects may be context-dependent. For example, racially homogeneous neighborhoods may provide social support and buffer potentially stressful inter-racial interactions, but protective effects may be overwhelmed in areas of concentrated poverty.

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While suggestive, the segregation literature to date is limited in several ways. First, much of the segregation research has focused on the North (Fang, et al., 1998) and Midwest (Roberts, 1997), leaving large segments of the U.S. unexamined. One neglected region is the southern United States, for which we found only one segregation study (Herrick, 1996). Given the large black population and the unique history of legislated segregation in this region, the lack of attention to the South represents an important omission in the literature.

A second limitation concerns the intersection of segregation and socioeconomic deprivation. The relationship between predominantly black neighborhoods and area-level disadvantage is well-established in the literature (Massey and Eggers, 1990). Some investigators consider segregation the fundamental cause of the economic inequality between blacks and whites (Williams and Collins, 2001) because black individuals residing in black neighborhoods are geographically isolated from the employment networks and opportunities available in white areas (Kain, 1968; Schulz, et al., 2002). Usually, area-level socioeconomic status is treated as a confounder in the literature (Guest, et al., 1998). However, some studies have examined the interaction between segregation and area-level deprivation. For example, Pickett et al. found residence in wealthier neighborhoods to have beneficial effects on preterm birth among black women only if the neighborhoods were predominantly black; the authors suggested that negative aspects of residence in mixed-race neighborhoods (e.g., discrimination) may undermine the protective impact of area-level resources (Pickett, et al., 2005).

A third important limitation of this literature relates to the scale at which segregation effects are explored. Segregation research has typically used census tracts as proxies for neighborhoods. Descriptive analyses using census tracts as neighborhood proxies have found the South to be less segregated than the Northeast and Midwest (Massey and Denton, 1989). Previous research conducted in two counties in the southern U.S., however, found residential patterns characterized by blacks and whites living in highly segregated but geographically adjacent blocks (Laraia, et al., 2006). This type of small-scale segregation will not be captured by census tracts, which are administrative units based on population density (U.S. Census Bureau, 2003) and are physically larger in the less densely populated South. For example, the average census tract in this study area is almost five square miles, compared to less than 0.25 square miles in New York City. Thus, a single tract may include both black and white neighborhoods, thereby underestimating segregation levels in the study region.

In this paper, we seek to explore the association of racial residential segregation with preterm birth. Preterm birth (PTB) is an important health outcome; the excess risk of PTB among black women contributes significantly to the racial disparity in infant mortality rates in the U.S. (Fiscella, 2004). The causes of PTB, defined as birth before the 37th week of gestation, are not well understood, nor are the reasons for the variation in risk across race groups. Researchers have generally found that individual-level variables such as behavior and income do not account for the disparity (Berg, et al., 2001; Wadhwa, et al., 2001), leading to recent investigations into contextual and psychosocial exposures thought to influence birth outcomes through stress-related mechanisms and resource pathways (Culhane and Elo, 2005; Hogue and Bremner, 2005; Wadhwa, et al., 2001). To the extent that segregation organizes ethnic groups into distinct risk environments, it may contribute importantly to PTB.

In light of the aforementioned limitations to the existing literature, this study aims to answer the following three segregation-related questions for a portion of the U.S. South: (1) Is residence in black neighborhoods, measured using neighborhood-level percent black, associated with risk of PTB for black and white women? (2) Does area-level deprivation modify the observed association between neighborhood-level percent black and PTB among these women? (3) Does the geographic unit chosen to approximate the neighborhood influence the observed association between neighborhood-level percent black and PTB?

Methods

Data sources

Three consecutive years of birth records (1999–2001) for Wake and Durham Counties, North Carolina, provided data on birth outcomes and individual-level covariates. Maternal addresses were geocoded with latitude and longitude values using Geographic Data Technology, Inc. (GDT) and assigned to year 2000 U.S. census tracts. Of the 98.6% of birth files with complete addresses sent to GDT for geocoding, 93.2% achieved an exact match using GDT's methods. The North Carolina birth records contain information about each woman's birth outcome, personal characteristics and health behaviors.

Black and white populations at the block, block group, and tract levels were obtained from the 2000 U.S. Census. Although individuals could report more than one race on the 2000 Census, only about 3% did (U.S. Census Bureau, 2001), and for simplicity, only those reporting one race were used for this analysis. Census data were merged with birth records data by block, block group, and tract Federal Information Processing Standards (FIPS) codes.

Outcome definition

Preterm birth (PTB) was the outcome of interest for all three research questions. A birth was defined as preterm if it was a live singleton birth at clinically estimated gestational age of ≥ 20 weeks and < 37 weeks and weighing < 3888 grams (Alexander, et al., 1996). Due to the limited numbers of Hispanic births during the study period (approximately 10% in each county) and for comparability with previous research, only births to non-Hispanic black and white women were used in this analysis.

Covariate definitions

Individual-level covariates—Adjusted models included the following covariates from the birth records that are known or suspected confounders of the neighborhood-level percent black—PTB relationship: maternal age (continuous; a squared term was not found to improve model fit), maternal education (categorized as <12 , 12, and >12 years), gravidity (categorized as 1, 2–5, 6+ pregnancies including the current one – standard categories corresponding to primigravidity, multigravidity, and grand multigravidity), prenatal care adequacy (adequate if prenatal care was initiated in the first trimester, and inadequate if prenatal care was initiated later or not at all), marital status (married vs. unmarried), and smoking during current pregnancy (none vs. any).

Exposure definitions and data analyses

Question 1: what is the neighborhood-level percent black – PTB relationship in the U.S. South?

Exposure definition: In order to be comparable with previous neighborhood-level studies, we approximated segregation using the percent of the neighborhood population who reported their race as black in the 2000 census. While we previously noted the potential limitations of using the tract level of aggregation, we defined neighborhoods as census tracts (“tract-level percent black”) for comparability. *Data analysis.* Race-stratified multilevel logistic models were used to account for the clustering of individuals within geographic units while allowing for the estimation of contextual-level effects. Because the relationship between log odds of PTB and percent black was linear, percent black was included in the models as a continuous variable, scaled such that the odds ratio corresponds to a 20 percentage-point increase in neighborhood-level percent black. To facilitate the interpretation of our findings, an adjusted model was also run with percent black dichotomized at 25%. Adjusted models included the individual-level

covariates. A percent black – county interaction term was also investigated to determine whether the effect differed across counties.

Question 2: does area-level deprivation modify the neighborhood-level percent black–PTB association?

Exposure definition: Percent black at the census tract level was again employed as the exposure for this analysis. *Area-level covariate.* We estimated area-level deprivation using the Neighborhood Deprivation Index (NDI). The NDI, described in detail elsewhere (Messer, et al., 2006), results from eight census variables from five socio-demographic domains (poverty, education, employment, housing and occupation) empirically summarized using principal components analysis. Lower values on the NDI indicate less deprivation, while higher values represent greater deprivation. *Data analysis.* The modeling procedure was identical to that described for Question 1, except adjusted models were stratified by tract-level deprivation, which was divided into below-and above-median categories.

Question 3: does neighborhood scale affect the neighborhood-level percent black–PTB association?

Exposure definition: To assess if the neighborhood-level percent black–PTB relationship was dependent upon the unit of aggregation used for “neighborhood,” we compared block-level percent black and block group-level percent black to the adjusted estimates using tract-level percent black obtained for Question 1. *Data analysis.* The modeling procedure was identical to that described for Question 1

Results

Non-Hispanic women residing in Wake and Durham Counties had 33,220 singleton live births between 1999 and 2001. Of these, we excluded births to women who were non-Hispanic but reported their race as something other than “black” or “white” (n=539), observations with FIPS codes not corresponding to Wake or Durham County (n=2), and observations with missing gestational age data (n=7) or with implausible or improbable birth weight values (n=29). In addition, we excluded 928 births occurring to women residing in census blocks for which the 2000 census reported a population of zero, as neighborhood-level percent black could not be computed for these observations; these births may have occurred to women in the North Carolina Correctional Institution for Women in Raleigh or may reflect geocoding inaccuracies. Thus, the analyses were conducted on 31,715 observations.

Black mothers in the study area were younger, less well educated, less likely to be married, more likely to have smoked during the current pregnancy, less likely to have received adequate prenatal care, and less likely to be primigravid than were white women (Table 1a). Black and white women residing in Durham County were younger, less highly educated, and less likely to be married than their counterparts in Wake County. Rates of PTB were related to maternal characteristics as expected, with black women having 1.5–2 times the rate of PTB as white women; rates of PTB were generally higher among women residing in Durham County. Almost three quarters (73.3%) of Wake County tracts were predominantly white (less than 25% black residents), compared to under a third (32.7%) of Durham County tracts (data not shown), making women in Durham County more likely to live in mixed-race and black tracts (Table 1). PTB rates were positively and approximately linearly related to the tract-level proportion black.

Model 1: what is the neighborhood-level percent black – PTB relationship in the U.S. South?

We sought first to investigate the association between tract-level percent black and odds of PTB among black and white women. Unadjusted odds ratios for PTB for a 20 percentage-point

increase in tract-level percent black were 1.15 (95%CI: 1.08, 1.22) and 1.14 (95%CI: 1.09, 1.19) among white and black women, respectively (Table 2). Adjustment for maternal age, education, gravidity, prenatal care, marital status, tobacco use, and county of residence attenuated these odds ratios to 1.09 (95%CI: 1.01, 1.18) for white women and 1.05 (95%CI: 0.99, 1.11) for black women; county was not found to be a significant modifier of the percent black – PTB relationship at $\alpha = 0.20$. Adjusted models where percent black was dichotomized at $< 25\%$ (95 tracts) and $\geq 25\%$ (63 tracts) found slightly increased odds of PTB associated with residence in predominantly black tracts among both white and black women: OR=1.12 (95%CI: 0.96, 1.29) and OR= 1.18 (95%CI: 1.00, 1.39), respectively. From these model results, we conclude that segregation, approximated by tract-level percent black, is associated with a small increase in odds of PTB for both white and black women living in Durham and Wake Counties, NC.

Model 2: does area-level deprivation modify the neighborhood-level percent black –PTB association?

Because of the possibility that the effects of neighborhood racial composition differ depending on neighborhood socioeconomic disadvantage, models were stratified by neighborhood deprivation dichotomized at the median (Table 3). Similar odds ratios were observed for both low and high levels of deprivation; ORs were 1.10 (95%CI: 0.95, 1.27) and 1.07 (95%CI: 0.95, 1.20) among white women in less and more deprived tracts, respectively, and 1.09 (95%CI: 0.99, 1.34) and 1.05 (95%CI: 0.98, 1.12) among black women in less and more deprived tracts, respectively. Stratified results were similar to unstratified (model 1) results. It appears that, in these Southern counties, area-level deprivation does not modify the neighborhood-level percent black–PTB relationship.

Model 3: does neighborhood scale affect the neighborhood-level percent black–PTB association?

The study population resided in 158 tracts, 390 block groups, and 5,838 blocks. Of these, 63 tracts, 150 block groups, and 1,928 blocks were $\geq 25\%$ black. Previous research in the region suggested that smaller geographic units might better approximate neighborhoods in our study area; however, block- and block group-level percent black results were similar to those obtained using census tract-level percent black. Adjusted odds ratios for PTB associated with a 20 percentage-point increase in block-level percent black were 1.05 (95%CI: 0.99, 1.11) and 1.04 (95%CI: 1.00, 1.08) among white and black women, respectively; ORs associated with a 20 percentage-point increase in block group-level percent black were 1.09 (95%CI: 1.01, 1.17) and 1.03 (95%CI: 0.98, 1.09) among white and black women, respectively. These block- and block group-level ORs compare with the adjusted tract values for white and black women of 1.09 (95%CI: 1.01, 1.18) and 1.05 (95%CI: 0.99, 1.11), respectively. In sum, the choice of administrative unit used to estimate the neighborhood did not affect the magnitude or direction of the neighborhood-level percent black – PTB relationship in our study area.

Discussion

In this study, we found a small effect of racial residential segregation, approximated by tract-level percent black, on odds of PTB among women living in two counties in the Southern U.S. The magnitude of the association observed in this study is consistent with that observed in studies of neighborhood racial composition and health in the Northeast, Midwest and U.S. as a whole. Among investigators looking at birth outcomes, Baker and Hellerstadt compared medium- and low- to high-black concentration census tracts in a Minnesota study area, finding an odds ratio of 0.9 (95%CI: 0.8, 1.1) for low birth weight (Baker and Hellerstedt, 2006). Grady reported an odds ratio of 1.07 (95%CI: 1.05, 1.10) for low birth weight among black women associated with a one-unit increase in the natural log of the local spatial segregation index in

New York City* (Grady, 2006). Similar segregation effects are noted for non-reproductive health endpoints as well. Bond-Huie et al. report a hazard ratio of 1.08 ($p \leq 0.05$) for adult mortality comparing neighborhoods with 14% or higher black concentration to those with 4% or lower black concentration across the U.S. (Bond-Huie, et al., 2002). Similarly, LeClere compared tracts across the U.S. with more than 17% black population to those with less than a half percent black, finding that combined black and white adults in high-black-concentration areas had 1.16 ($p=0.05$) times the risk of death as those in low-black-concentration areas, controlling for individual race (LeClere, et al., 1997). Finally, White et al. report odds ratios of 1.68 (95%CI: 1.05, 2.69) for poor self-rated health among a combined population of blacks, whites, Hispanics and Asians in New York City, comparing the highest to the lowest tertiles for tract-level percent black and controlling for individual race/ethnicity and tract SES (White and Borrell, 2006). The small effect estimates reported in our study may be biased toward the null by the exposure misclassification that is likely inherent in studies using census units as neighborhood proxies. On the other hand, small estimates are also consistent with residual confounding by unmeasured aspects of socioeconomic status that may influence an individual's neighborhood selection.

Finding a similar magnitude of effect for both black and white women was somewhat surprising, based on previous literature on this population (O'Campo, et al., in press). The similar effects observed in black and white women may further indicate that some unmeasured aspect of socioeconomic well-being, common to blacks and whites, is driving the neighborhood-level percent black – PTB association or, alternatively, that the contextual risk factors disproportionately present with an increasing proportion of black residents are equally harmful to black and white pregnancies.

In this study, we did not find evidence that the relationship between neighborhood-level percent black and PTB was substantially modified by neighborhood deprivation. Finding no meaningful effect modification by neighborhood-level deprivation indicates that segregation operates similarly to affect health in both poor and wealthy neighborhoods; thus, the pathway between neighborhood racial composition (segregation) and PTB may be determined by contextual factors other than neighborhood-level resources. Despite the lack of compelling evidence for effect modification, we cannot rule out the possibility that socioeconomic position, not fully captured by our measures of SES, is at least partially responsible for the observed odds ratios in both levels of neighborhood deprivation.

Previous research informed our hypothesis that smaller geographic units would be more valid proxies for neighborhoods in our study area; however, all three units of aggregation (block, block group and tract-level percent black) appeared to have similar effects on PTB odds. The level of aggregation used to estimate racial residential segregation may have been irrelevant for two reasons: (1) people do not stay within their blocks (or even their tracts), preventing these geographic units from accurately representing the salient social space of individuals in our sample – car ownership, and even air travel, make the concepts “neighborhood” and “neighborhood effects” fluid and more permeable than the geographic units usually employed to operationalize them; and (2) it may be that larger scale segregation is more important to both material and mental health than small scale segregation. For instance, someone who encounters an individual of a different race three minutes' drive outside their neighborhood has a very different segregation experience than someone who would have to travel 30 minutes before encountering someone who looks different from them. In other words, segregation undoubtedly

*For purposes of comparison with other studies, note that this odds ratio (1.07) corresponds to a change from 0.30 to 0.82 in the unlogged segregation index, which ranges from 0 to 1. However, because the model assumes a non-linear relationship between the unlogged segregation index and the log odds of low birth weight, an odds ratio of 1.07 will correspond to smaller changes at the bottom of the segregation scale than at the top; for example, a change from 0.01 to 0.03 in the segregation index will also correspond approximately to an odds ratio of 1.07.

happens at multiple scales, and segregation at larger scales may have a more potent impact on health outcomes because it is a more explicit form of social exclusion and/or it translates into greater restriction of access to resources.

The mechanisms through which segregation may influence adverse birth outcomes are largely untested, but thought to include stress and resource pathways. Findings from a number of studies highlight an association between stress, resulting from discrimination, negative life events, or social disorganization and poor birth outcomes (Collins, et al., 2000; Dole, et al., 2004; Messer, et al., 2006; O'Campo, et al., 1997; Rini, et al., 1999; Rosenberg, et al., 2002). Stress is suspected to influence PTB either directly, through hormonal effects, or indirectly through compromised immune function and increased susceptibility to infections (Culhane and Elo, 2005; Culhane, et al., 2002; Hogue and Bremner, 2005). The resource pathway is supported by a growing body of literature documenting an association between neighborhood disadvantage and poor birth outcomes, even after adjustment for individual-level socioeconomic status (Messer, et al., 2006; O'Campo, et al., 1997; Roberts, 1997). The stress and resource pathways are not mutually exclusive and may be synergistic; for example, lack of resources may be a cause of chronic stress. To the extent that segregation organizes ethnic groups into social and geographical risk profiles, it serves as a determinant of PTB. The results of this study provide suggestive evidence that segregation is a risk factor for PTB, though the available data did not allow us to investigate the specific mechanisms involved.

Like most neighborhood-level studies of residential segregation, we chose neighborhood-level percent black as the exposure variable, despite the availability of other indices of segregation. These additional indices measure (1) the degree to which the average black individual is residentially isolated from the white population (isolation), (2) the population density of black residential areas relative to white residential areas (relative concentration), (3) the contiguity of black neighborhoods (clustering), (4) the tendency for the black population to be clustered in the central city (centralization), and (5) the extent to which racially heterogeneous regions are made up of racially homogeneous neighborhoods (evenness) (Massey and Denton, 1988). These measures were designed for use in ecological comparisons of cities, but have also been applied to neighborhood-level analyses (Acevedo-Garcia, 2001; Guest, et al., 1998). When applied to cities, these indices measure the average of some neighborhood characteristic (e.g. distance from city center) for the black and/or white population, which reflects the influence of city-level policies and practices. Applied to within-region analyses, such as our study, the indices measure characteristics of some small geographic unit (e.g. a block group), averaged across a larger geographic unit (e.g. a census tract). We chose not to apply these indices to our within-region analysis because their appropriate application and interpretation requires the problematic assumption that census tracts, like cities, are independent of one another and are meaningful units over which to average individuals' neighborhood experience. For example, had we used the index of isolation in our analysis, we would have obtained the minority-weighted census tract average of the block group racial composition. In other words, the index of isolation would have represented the racial composition (percent black) of the block group in which the average black census tract resident lived. We could think of no reason to favor the neighborhood environment experienced by the *average* rather than an *actual* individual, so we used neighborhood-level percent black as the exposure in our study. Furthermore, exploratory analyses revealed a very high degree of correlation between these measures (correlation coefficient > 0.9), and results of analyses using the index of isolation were equal to those from the tract-level percent black.

As with much of the previous research on segregation and health, our study has important limitations that should be considered when interpreting the results. First, the assumption that the place of residence influences individuals' health may not be equally true for all individuals. For instance, individuals who spend 18 hours a day away from their homes may be less affected

by their residential neighborhood than individuals who spend the bulk of their day in the vicinity of their residence. However, the available data limit the extent to which such heterogeneity may be examined. Second, one of the motivations for this research was the hypothesis that census block groups are better representations of neighborhoods in Wake and Durham Counties than are census tracts; however, no administrative units are likely to exactly correspond to neighborhood boundaries, and we do not have the ability to determine the degree to which the units employed in the study relate to salient aspects of the neighborhood environment. The use of aspatial measures of segregation, which treat each unit as though it were in a vacuum and rely on the validity of the geographic units as proxies for neighborhoods, makes this an issue of particular concern. Though not a solution to the conceptual problem of defining a neighborhood, future studies using spatial measures of segregation, such as those by Grady (Grady, 2006) and Bell et al. (Bell, et al., 2006), may provide results that are more robust to some misspecification of the relevant geographic units. Third, the birth records data do not provide information on when a woman moved into her neighborhood, so it was not possible to categorize women by duration or timing of exposure. Finally, individuals are not randomly assigned to neighborhoods, but select certain neighborhoods because of individual characteristics (such as income) that may have important influences on birth outcomes. Thus, we cannot rule out the possibility that the neighborhood is serving as a sensitive indicator of socioeconomic status, and that the observed relationship between neighborhood racial composition and PTB is driven by residual confounding.

Despite these limitations, our study contributes to the literature by investigating the segregation-health association as well as the potential interaction between neighborhood racial composition and neighborhood deprivation in an understudied area (the U.S. South). Furthermore, we were able to investigate a hypothesis, driven by prior research, regarding the geographic scale most relevant to this association. Future work in this area would benefit from the use of spatial measures of segregation and from longitudinal data that would allow for more precise identification of confounding and intermediate variables.

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TABLE 1
Distribution of maternal characteristics of the sample population^a by county and race, 1999–2001

Variables ^b	Wake County				Durham County			
	White		Black		White		Black	
	N (%)	% preterm	N (%)	% preterm	N (%)	% preterm	N (%)	% preterm
<i>Maternal age</i>								
< 20 years	458 (2.8)	8.7	726 (13.1)	10.9	407 (7.6)	14.0	690 (16.1)	16.7
20–24 years	1700 (10.3)	7.2	1583 (28.5)	11.7	1002 (18.7)	6.0	1308 (30.6)	14.8
25–29 years	4505 (27.3)	7.4	1443 (26.0)	11.4	1535 (28.6)	8.0	1089 (25.5)	14.9
30–34 years	6288 (38.2)	6.0	1125 (20.2)	13.7	1582 (29.5)	6.9	782 (18.3)	12.5
35+ years	3566 (21.6)	6.7	681 (12.3)	15.6	839 (15.6)	8.1	406 (9.5)	17.2
Trend ^c		p=0.02		p=0.002		p=0.07		p=0.44
<i>Maternal education</i>								
> 12 years	13647 (82.8)	6.3	2835 (51.2)	10.4	3170 (59.5)	6.5	1972 (46.3)	12.1
= 12 years	2159 (13.1)	8.6	1738 (31.4)	13.5	818 (15.4)	9.9	1232 (28.9)	15.4
< 12 years	685 (4.2)	8.3	970 (17.5)	15.9	1337 (25.1)	9.3	1054 (24.8)	19.5
Trend ^c		p<0.0001		p<0.0001		p=0.0004		p<0.0001
<i>Marital status</i>								
Married	15072 (91.3)	6.9	2501 (45.0)	12.0	4191 (78.2)	7.5	1593 (37.3)	12.3
Not married	1444 (8.7)	9.8	3057 (55.0)	16.0	1172 (21.9)	11.7	2682 (62.7)	20.9
<i>Tobacco use</i>								
Nonsmoker	15596 (94.5)	6.8	5046 (90.9)	12.9	5119 (96.2)	8.0	3886 (91.3)	16.0
Smoker	908 (5.5)	13.8	508 (9.2)	28.0	205 (3.9)	18.5	369 (8.7)	35.2
<i>Prenatal care</i>								
Adequate	15623 (94.9)	7.0	1359 (75.4)	13.0	4929 (94.5)	7.9	3457 (82.0)	15.7
Not adequate	834 (5.1)	10.3	4154 (24.7)	17.7	286 (5.5)	14.9	760 (18.0)	26.0

Variables ^b	Wake County				Durham County			
	White		Black		White		Black	
	N (%)	% preterm	N (%)	% preterm	N (%)	% preterm	N (%)	% preterm
<i>Gravidity</i>								
First pregnancy	6070 (36.8)	7.4	1566 (28.2)	10.9	2233 (41.7)	8.1	1309 (30.8)	14
2-5 pregnancies	10049 (60.9)	6.1	3589 (64.6)	12	3004 (56.2)	7.4	2736 (64.4)	14.9
6+ pregnancies	389 (2.4)	11.8	399 (7.2)	21.8	113 (2.1)	8.8	206 (4.9)	19.4
Trend ^c		p=0.2		p<0.0001		p=0.5		p=0.1
<i>% black in maternal census tract</i>								
<25	14450 (87.5)	6.6	2521 (45.4)	10.7	1945 (36.3)	6.9	424 (9.9)	11.6
25-49	1731 (10.5)	7.4	1303 (23.4)	14.4	2243 (41.8)	7.9	1385 (32.4)	12.1
50-74	281 (1.7)	9.6	867 (15.6)	12.0	873 (16.3)	8.6	1115 (26.1)	16.0
75+	55 (0.3)	5.5	867 (15.6)	14.6	304 (5.7)	9.9	1351 (31.6)	18.0
Trend ^c		p=0.06		p=0.005		p=0.03		p<0.0001

^a Sample population includes singleton live births to all non-Hispanic black and white women in Wake and Durham counties between 1999 and 2001 (n=33,220), excluding births occurring to women residing in census blocks for which no population was reported in 2000 (n=928) or for which the FIPS codes did not correspond to Wake or Durham county (n=2), those with missing gestational age data (n=7), and those with impossible birth weight data (n=29); sample used in analysis consisted of 31,715 births

^b Missing values ranged from 0.0% (marital status among white women in Wake and Durham) to 2.9% (prenatal care among white women in Durham)

^c Trends were computed using ordinal values for the categories of the x variable

TABLE 2

Crude and adjusted estimates of the association between tract-level percent black and preterm birth among non-Hispanic black and white women in Wake and Durham Counties, NC from 1999 through 2001

Model and Variables	White		Black	
	OR	95% CI	OR	95% CI
<i>Crude</i>				
Tract-level percent black ^a	1.15	1.08,1.22	1.14	1.09,1.19
<i>Adjusted</i>				
Tract-level percent black ^a	1.09	1.01,1.18	1.05	0.99,1.11
Maternal age (continuous)	1.01	0.99,1.02	1.03	1.02,1.04
Educational attainment				
>12 years	1.00	--	1.00	--
=12 years	1.21	1.03,1.42	1.20	1.03,1.40
<12 years	1.10	0.88,1.37	1.47	1.22,1.77
Gravidity				
Multigravid (2–5 pregnancies)	1.00	--	1.00	--
Primigravid (1 pregnancy)	0.81	0.72,0.90	1.00	0.87,1.16
Grand multigravid (6+ pregnancies)	1.29	0.95,1.76	1.36	1.05,1.75
PNC adequacy (1 st visit in 1 st trimester)				
No	1.00	--	1.00	--
Yes	0.79	0.64,0.98	0.83	0.72,0.96
Marital status				
Married	1.00	--	1.00	--
Unmarried	1.14	0.96,1.36	1.40	1.21,1.62
Tobacco use during current pregnancy				
Nonsmoker	1.00	--	1.00	--
Smoker	1.77	1.44,2.16	1.58	1.31,1.91
County				
Wake	1.00	--	1.00	--
Durham	1.02	0.88,1.19	1.18	1.01,1.36
Dichotomized percent black				
< 25% (mean: 0.12; sd: 0.07)	1.00	--	1.00	--
>=25% (mean: 0.56; sd: 0.23)	1.12	0.96, 1.29	1.18	1.00, 1.39

^a Odds ratios correspond to a 20 percentage-point change (e.g., change from 20% to 40%) in tract-level percent black

TABLE 3

Estimates of the association between tract-level percent black and preterm birth among non-Hispanic black and white women in Wake and Durham

Variables	Less deprived tracts (below median) ^b			More deprived tracts (median and above) ^b		
	White		Black	White		Black
	OR	95% CI	OR	95% CI	OR	95% CI
Tract-level percent black ^a	1.10	0.95,1.27	1.09	0.88,1.34	1.07	0.95,1.20
Maternal age (continuous)	1.01	0.99,1.02	1.03	1.01,1.06	1.00	0.98,1.02
Educational attainment						
> 12 years	1.00	--	1.00	--	1.00	--
= 12 years	1.41	1.15,1.72	1.47	1.11,1.94	0.97	0.74,1.26
< 12 years	1.06	0.74,1.5	1.97	1.32,2.93	1.02	0.75,1.40
Gravidity						
Multigravid (2–5 pregnancies)	1.00	--	1.00	--	1.00	--
Primigravid (1 pregnancy)	0.74	0.65,0.85	1.03	0.80,1.33	0.97	0.79,1.19
Grand multigravid (6+ pregnancies)	0.91	0.58,1.42	1.71	1.04,2.82	2.06	1.31,3.23
PNC adequacy (1 st visit in 1 st trimester)						
No	1.00	--	1.00	--	1.00	--
Yes	0.88	0.63,1.23	1.08	0.78,1.48	0.74	0.55,0.99
Marital status						
Married	1.00	--	1.00	--	1.00	--
Unmarried	1.01	0.78,1.31	1.56	1.20,2.02	1.28	1.00,1.63
Tobacco use during current pregnancy						
Nonsmoker	1.00	--	1.00	--	1.00	--
Smoker	1.57	1.18,2.10	1.66	1.07,2.56	1.95	1.46,2.61
County						
Wake	1.00	--	1.00	--	1.00	--
Durham	1.04	0.86,1.26	1.10	0.79,1.52	1.03	0.76,1.39

^a Odds ratios correspond to a 20 percentage-point change (e.g., change from 20% to 40%) in tract-level percent black

^b Neighborhood deprivation based on the principal components summary of eight census items from five SES domains including poverty, education, employment, housing and occupation

Counties, NC from 1999 through 2001, stratified by neighborhood deprivation