Title: Neighborhood deprivation domains and preterm birth

BACKGROUND

Preterm birth is an important public health concern. Preterm birth, generally defined as birth at less than 37 weeks completed gestation, is the single most important cause of perinatal mortality in North America and Europe (1), is the leading cause of death for black infants (2, 3) and contributes substantially to perinatal and infant morbidity (1, 4). Most cases of preterm birth occur without a known cause (1, 5). Predictors of preterm birth include: prior preterm delivery, multiple gestations (1, 6), low prepregnancy weight (7-9), tobacco use and bacterial vaginosis (6, 10). Markers for preterm birth risk include: black race, single marital status and low socioeconomic status, among others (1, 11-13). Researchers estimate that 25-30% of preterm births in developed countries can be explained by known risk factors (5).

Disparities in all perinatal outcomes, including preterm birth, exist. One of the most highly predictive markers for adverse birth outcomes in this county is black race. In the United States, significant excesses in rates of infant mortality, very low birth weight, and preterm birth exist among African American, compared with white, women. Almost two-thirds of the black-white difference in infant mortality and 84% of the black-white gap in neonatal mortality were due to higher rates of very low birth weight among black infants (14). In 2002, 17.7% of black infants were preterm compared with 11.0% of white infants (15). While this black-white disparity in preterm birth has decreased in recent years, the decrease is largely due to an increase in preterm delivery among white women and a small decrease in the preterm delivery rate in black women (16). Research indicates that protective factors such as college education, good health and access to quality prenatal care do not provide the same level of protection against adverse birth outcomes for African American women as for white women. Black and white women at comparable high levels of education (i.e., college and beyond) have a larger gap in rate of adverse birth outcome than comparable women at lower educational levels (17-19). Similarly, moving out of poverty to increased income does not provide the same reduction in low birth weight for African American women as for white women (20). The disparity in adverse birth outcomes between black and white women cannot be explained by individual socioeconomic factors. The relatively small proportion of explained preterm birth variation has encouraged recent attention to neighborhood level influences (21).

Neighborhood effects, including those associated with neighborhood deprivation, are of increasing interest in public health and perinatal research. Neighborhood socio-

economic disparities in key pregnancy indicators represent the most widely observed neighborhood effect in the perinatal literature (5, 22-24). Lower birth weights have been associated with higher rates of neighborhood poverty (25-27), unemployment (27), lower educational and income levels (25, 27, 28), higher median rent (25), and higher rates of violent crime (29-31). The neighborhood effects literature has demonstrated consistent but fairly small effects of neighborhood environments. Differences in neighborhood level exposures may account for some proportion of the disparity between black and white women's low birth weight rates.

Neighborhood-level deprivation is a multidimensional feature, comprising several sociodemographic domains. Area deprivation comprises multiple domains including poverty, housing, employment, education, residential stability and occupation. Despite its multidimensionality, single variable constructs are commonly used to approximate the deprivation environment (32, 33, 34, among many others). For instance, poverty is the socioeconomic construct employed most frequently in health research and its various forms include proportion of individuals or households below the federal poverty level, percent on public assistance and percent of female-headed households with dependent children. When deprivation indices are used, they usually include several deprivation domains to capture the multidimensional character of community socioeconomic position (35-38). While specific domains are recognized in the literature, limited systematic work has assessed their unique association with a health outcome. This work proposes to create six sociodemographic domains, related to area-level deprivation, and consider their singular contribution to the health outcome of preterm birth.

Recognizing the multidimensional nature of deprivation on health outcomes, this research sought to expand the estimation of neighborhood sociodemographic context through its use of sociodemograhic domains to answer the following questions: 1) Do black and white nonHispanic women differ in their neighborhood environments as defined by multiple deprivation domains? And 2) Are these differences in domain environments associated with preterm birth among these women. Understanding the unique contribution of each deprivation area could provide policy relevant findings to improve the public health and address preterm birth disparities.

METHODS

Data Sources. These data came from the North Carolina Birth Outcomes Partnership Project (NC-BOP), part of a HRSA/MCHB project funded to study contextual level influences on risk of preterm birth in four urban areas in the United States. The birth outcome and individual women's characteristics came from three consecutive years of North Carolina Birth Records (1999-2001) for Wake County NC. The Wake County birth record file contained 30,481 births for the three years. The individual births were geocoded with latitude and longitude values using Geographic Data Technology (GDT) and were assigned to year 2000 US census tracts. Of the 98.6% of birth files with complete addresses sent to GDT for geocoding, 93.2% achieved an exact census tract match using GDT's methods. The North Carolina birth records contain information on each woman including details about her birth outcome (gestational age, birth weight, singleton status), her personal characteristics (race/ethnicity, age, education, marital status) and her health behaviors (smoking, drinking, number of prenatal visits). We used these records to create the outcomes and covariates for this analysis.

Year 2000 Census of Population and Housing Data from the US Census Bureau (39) for Wake County used to develop the deprivation-domain indices. Census tract domain indices were merged with women's birth records.

Neighborhood definition. Neighborhood is a term loosely used to refer to a person's immediate residential environment, which is hypothesized to have both material and social characteristics related to health (40). The reported research considered census tracts to approximate the neighborhood environment. Census tract data were chosen to maximize the precision and stability of area adverse birth outcome rates and still ensure a rough approximation of each woman's immediate physical neighborhood. Previous research has indicated that the largest statistical effect of economic disadvantage on low birth weight, among other outcomes, is observed at the block group and census tract levels, but effects of lesser magnitude at larger levels of aggregation, such as zip codes or counties (33). On average Wake County census tracts are larger than the optimal size and contain 5979 persons (sd=3375). This level of aggregation is large enough to contain women who delivered during the study years, but small enough to approximate the immediate physical neighborhood for our study subjects.

Study Outcome. The study outcome for this paper was preterm birth among the cohort of singleton births. The birth cohort for this analysis was limited to singleton births for two reasons: One, the etiology of preterm birth is different for singletons versus multiple gestations. And two, while increasing in prevalence, the occurrence of natural multiples is still relatively rare; most multiple gestations result from reproductive assistance. It is probable that the reasons driving women to use reproductive technologies to assist them becoming pregnant may be the same factors that put women at higher risk of adverse birth outcomes, thereby confounding the relationship between multiple births and adverse birth outcomes like preterm birth. Preterm birth is defined as gestational age less than 37 weeks (and birth weight less than 3888g) and was constructed using the clinical gestational age variable found in the birth records (41). In the study population represented by this vital records cohort, 26,823 (91.8%) of the singleton births were term and 2389 (8.2%) were preterm.

Neighborhood Exposure. Wake County comprises 105 census tracts. The neighborhood exposure variables include tract-level indices of poverty, employment, education, housing, occupation and residential stability.

Data Reduction Method. Principal components analysis (PCA) and factor analysis (FA) are data reduction techniques frequently used in neighborhood-level research to create sociodemographic scales or indices for inclusion in statistical models. PCA analyzes total variance while FA analyzes shared variance (42, 43)but in both cases, the loading represents the correlation between the variable and the factor or component[1] (44). Researchers interested in a unique theoretical solution uncontaminated by error variability should use FA while those seeking an empirical data summary should use PCA (43, 45). Both FA (38, 46-48) and PCA (37, 49-54) have been successfully used to reduce census data. .

Variable selection. Socioeconomic variables at the neighborhood level represent aspects of community stratification, opportunity structures and social conditions (38, 55-57). Following a review of the literature, the research team identified six sociodemographic domains consistently associated with health. Multiple variables, singly or in an index, were observed as having represented these domains, however. Starting with a list of variables that have conceptual

[1] For FA, a moderate correlation (0.50) also represents the minimum loadings thought to represent one factor. For PCA, no minimum-loading recommendations are established because the amount of variance explained, and subsequent component loading, will differ based on the number of variables included in the PCA and the magnitude of error variance.

association with heath outcomes and have demonstrated an empirical relationship, we assigned each of the variables to our *a priori* identified domains. For instance, variables related to housing value and crowding were included in the housing index whereas those related to public assistance and female-headed household status were placed in the poverty index. While recognizing specific variables influence multiple domains, for instance families with annual income below the federally-established poverty level are more likely to reside in inadequate housing, we restricted each variable's presence to only one domain.

Component extraction and index construction. Although it is possible to form as many independent linear combinations as there are variables, the first principal component is the unique linear combination that accounts for the largest possible proportion of the total variability in the component measures (43). Therefore, we retained the variable loadings for only the first principal component. Item loadings from the first component were used to weight the contribution of each item to the summary score for each of the sociodemographic domains for each Wake County census tract. Each variable in each index was standardized with a mean of 0 and variance of 1. Index medians, means and standard deviations and proportion variance accounted for are found in Table 1. The second component added only 3% to 18% to the explained variance, and so was not utilized. The internal reliability of each index was confirmed with a Chronbach's alpha statistic (Table 1). Quartiles of each index were used for these analyses.

Covariates. Individual covariates in adjusted models include maternal race, maternal age and maternal education. These individual-level variables are established risk factors for preterm birth and possible confounders to the neighborhood environment-preterm birth relationship. Adjustment for confounders was made when the crude risk ratio differed from the adjusted for each confounder by 10% or more (58).

Data Analysis. Analyses were limited to white non-Hispanic (white nH) and black non-Hispanic (black nH) race, only, due to limited numbers of women of other races represented in the birth file. Analyses were race-stratified because of anticipated heterogeneities in the social and neighborhood processes resulting in preterm birth. The limited number of women from other races precluded more detailed racial considerations. Logistic regression analysis produced odds ratios (OR) and 95% confidence intervals (CI) for level one (individual level) models. The relationships between the deprivation domain indices (level two variables) were assessed using Spearman correlations (data not shown in this preliminary manuscript draft). Multilevel analyses

were conducted to explore the contribution of the neighborhood environment (level two variables) over that of the individual level predictors and to account for any clustering of the birth outcomes. We estimated random effects logistic models with a fixed slope value for each predictor variable but with randomly distributed tract-specific intercepts and adjusted the models for maternal age and education. All analyses were conducted in Stata 9.0.

RESULTS

Six sociodemographic indices were created for use in multilevel models with preterm birth in Wake County NC, including poverty, housing, residential stability, occupation, education and employment (Table 1). The poverty index included the percents of households living below the 1999 poverty line, on public assistance, with less than $30,000 annual income, female headed households with dependent children and with no car. These variables explained almost 79% of the total variable variance with high internal consistency (Chronbach's alpha = 0.93). The housing index included six variables: median household value, percents of households with more than one occupant per room, owner cost in excess of 50% of income, renter costs in excess of 50% of income, vacant housing and renter-occupied housing. This index explained almost 57% of the total variance with Chronbach's alpha = 0.83. Residential stability constituted three variables: percents in same house since 1995, residents older than 64 years of age and owner occupied housing, which explained over 61% of the total variance (Chronbach's alpha = 0.67). The occupation index explained almost 82% of the total variance with the percents of males in management and professional occupations (Chronbach's alpha = 0.78). The education and employment index each contained two variables; percents with less than and more than a high school degree (97% of variance explained, 0.97 Chronbach's alpha) and percent unemployed (males and females) and percent males no longer in the labor force (76% of explained variance, alpha = 0.68).

This final version of this paper will discuss the nature of the association between the tract-level sociodemographic indices in detail, and if differentially associated in neighborhoods where predominantly white nH versus black nH women live.

Of the three-year study cohort, 22,657 women delivered term births and 2030 delivered preterm (Table 2). White nH women had the largest absolute number of term and preterm births (16,745 [62.5%] and 1238 [52.2%], respectively), but black nH women had almost twice the rate of preterm births compared with white nH women (784 [12.4% preterm, compared with 6.9% preterm]). Slightly higher proportions of women delivering preterm reported obtaining less

than 12 years of education compared with those delivering term. The distribution of maternal age was similar between women delivering term and preterm, with roughly equal proportions represented in each age category. Tract-level poverty was differentially distributed between term and preterm births. The fewest number of women delivering term resided in tracts with very high levels of poverty (15.8%) but this percent was considerably higher for women delivering preterm (24.3%). Quartiles of tract housing followed a pattern similar to that for poverty; generally, the less desirable the area-level housing, the higher the preterm birth proportion (12% for low quality compared with 6.9% for very high quality housing). No consistent relationship with preterm birth was apparent for neighborhood residential stability, but women delivering preterm appeared more likely to live in tracts with a low proportion of management and professional occupations (30.8%) than women delivering term (20.1). Tract-level education was similarly distributed between women delivering term and preterm, with the percent preterm decreasing with increasing tract-level education (11.5% for low education compared with 6.3% for very high education). Similarly, living in tracts with low unemployment was associated with decreased preterm birth percentages, with the smallest proportion of women delivering term (13.6%) and preterm (9.8%) residing in tracts characterized by very high unemployment.

Table 3 examines race-stratified maternal attributes and provides crude odds ratios (OR) and 95% confidence intervals (95% CI) for the maternal covariates. In general, black nH women were more likely to be unmarried (53.9%) than white nH women (9.2%), but for both groups, being unmarried was associated with increased odds of delivering preterm. Compared with white nH women, a larger proportion of black nH women are represented by the younger age categories, but younger maternal age (< 20 years) may be associated with increased odds of preterm birth among white nH women (OR = 1.3, 95% CI: 1.0, 1.8) whereas only older maternal age (35+ years) is associated with increased odds of PTB for nH black women (OR=1.4, 95%CI: 1.1, 1.8). The majority of both white (82.0%) and black (50.4%) women had more than a high school education. Differences in individual-level attributes do not appear to explain the differing rates of PTB among this population.

Important differences are apparent between the white nH and black nH women's neighborhoods, as defined by their tract-level socio-demographic domain indices. The bulk of white nH women live in block groups in the lowest poverty index quartile, 35.3%, compared with an even larger proportion of black nH women living in block groups in the highest poverty index quartile (44.1%). Increasing amounts of area-level poverty is suggestive of increased odds of preterm birth among white nH women in both unadjusted and adjusted models, but the

estimates are sufficiently imprecise to not exclude the null value. Living in tracts with the highest amounts of poverty is associated with increased odds of preterm birth among nH black women in both unadjusted (OR=1.9, 95% CI: 1.3, 2.6) and adjusted (OR=1.8, 95% CI: 1.2, 2.5) models. Similar patterns of association are observed for women living in tracts with poor quality housing (defined as crowded, larger proportion renter, high vacancy status, etc.). A larger proportion of white nH women live in tracts characterized by higher quality housing (40.2%) compared with nH black women (11.5%). Both the unadjusted and adjusted models suggest that living in tracts with high quality housing is associated with increased odds of preterm birth, but these associations do not achieve statistical significance for either white nH or black nH women.

Black and white nH women are fairly evenly distributed among the quartiles of residential stability, with a slightly smaller proportion of black nH women living in highly stable census tracts (14.2%) compared with nH white women (18.2%). Residential stability appears unassociated with preterm birth odds among both black and white nH women. Women are much more differentially distributed by race across tracts characterized by high proportions of managerial and professional occupations however. Over half of the nH black women giving birth to singletons in Wake County during the study years lived in tracts in the lowest occupation quartile (51.0%) compared with nH white women (12.4%). Living in tracts with the highest quartile of managerial and professional occupations was associated with decreased odds of preterm birth for both nH white (OR=0.8, 95% CI: 0.6, 0.9) and nH black (OR=0.6, 95% CI: 0.4, 0.9) women in adjusted models, suggesting a protective effect of area-level occupation type on preterm birth.

In a pattern similar to occupation, living in tracts with high education is differentially distributed by race. While roughly one-quarter of all nH white women live in tracts characterized by high levels of education (25.8%), a much smaller proportion of nH black women share this neighborhood-level attribute (6.4%). Living in tracts with high and very high levels of education appears protective for nH white women in both unadjusted (OR=0.7, 95% CI: 0.5, 0.8) and adjusted models (OR=0.7, 95% CI: 0.5, 0.8). In unadjusted models, this association is also observed for nH black women, but the relationship is attenuated following adjustment for maternal covariates. Most nH white women live in tracts with low unemployment (40.4%) with a very small proportion living in tracts characterized by very high unemployment rates (7.0%). The distribution of nH black women across quartiles of unemployment is much more equally distributed, however. The smallest proportion of nH black women live in low unemployment tracts (19.6%) and the highest proportion in very high unemployment tracts (35.3%). For nH

white women, tract employment appears unassociated with preterm birth odds. In unadjusted models, very high tract-unemployment was associated with increase odds of preterm birth for nH black women (OR=1.4, 95% CI: 1.1, 1.7) but this relationship is slightly attenuated following adjustment. It appears that black and white women live in very different neighborhood environments as defined by neighborhood deprivation and crime rate, and these differences may influence their different PTB rates.

DISCUSSION

Multilevel analyses were conducted to determine the contribution census-tract level sociodemographic indices made to the preterm birth differentials between black and white non-Hispanic women. The analyses suggested white nH and black nH women live in different neighborhood environments, as demonstrated by their relative proportions across quartiles of the six sociodemographic domains. These neighborhood differences may suggest differential exposure to neighborhood stressors or adverse events, which in turn may predispose certain women to increased risk of preterm birth.

The effects of the neighborhood-level sociodemographic domains were differential by race. The poverty index was clearly associated with increased odds of preterm birth in adjusted models, and the housing and employment indices offered suggestive associations for increase odds. Among white nH women, none of the area-level indices were clearly associated with increased preterm birth odds. For women of both races, living in tracts with high proportions of managerial and professional workers was clearly protective against odds of preterm birth. Living in a tract with high education was also protective for white NH women in adjusted models.

Area-level deprivation is a multidimensional concept with characteristics that cluster geographically. One finds areas of high poverty where there is also low area-level educational attainment, high area-level unemployment and a dearth of professional or managerial occupations represented. It makes questionable conceptual or empirical sense to try to separate out specific effects of one domain in the absence of considerations of the other variables contributing to generalized deprivation. However, when one endeavors to produce policy-relevant research findings, domain specific results become much more relevant. No one heads the office of neighborhood deprivation but there are local leaders and offices devoted to public housing, education and employment. Getting these individuals and offices to the table to consider “their role” in producing poor health or health disparities requires targeted research. Therefore, developing domain specific findings for these audiences, with the caveat that any

one domain is part of the larger deprivation picture, can be more influential for public policy and advocacy than discussing the ills of area deprivation.

The neighborhoods in which women live, work and gestate are a probable source of both support and stress. These neighborhood influences, which arise from political, economic and racial structures (such as racism), may reasonably affect birth outcomes. Work in this area is relatively new and underdeveloped and while the results of this study are not as pronounced as one might expect, they represent an important step forward in understanding the role the neighborhood environment may play in adverse birth outcomes, such as preterm birth.

Ties to existing research, study strengths and limitations, and implications for policy and future research will be discussed in the final version of this paper.

TABLE 1. Wake County distribution of census tract attributes and scale properties.

INDEX VARIABLES (range)	Median	Mean	Std dev.	% variance explained	Chronbach Alpha
Poverty Index (less poverty better for health)				78.5%	0.93
% hh < 1999 poverty line	6.6	9.8	9.6		
% hh on public assistance	0.9	1.9	2.6		
% hh < $30,000 income	22.6	26.2	15.0		
% female-headed households	8.5	11.0	8.6		
% no car	1.7	2.6	4.4		
Housing Index (better housing quality better for health)				56.8%	0.83
Median household value	150,000	167,399	65,721		
% > 1 occupant per room	2.6	3.6	3.4		
% owner cost >50% income	9.5	10.3	5.1		
% renter cost >50% income	9.0	10.1	4.5		
% vacant housing	5.9	6.4	3.1		
% renter occupied housing	33.4	37.9	23.6		
Residential Stability Index (more stable areas better for health)				61.4%	0.67
% in same house since 1995	42.9	42.3	12.8		
% residents > 65 years of age	6.9	8.1	5.0		
% owner occupied housing	66.6	62.1	23.6		
Occupation Index (more professional work better for health)				81.6%	0.78
% males management	18.3	18.6	8.9		
% males professional work	27.0	26.0	10.5		

TABLE 1, continued.

INDEX VARIABLES	Median	Mean	Std Dev.	% variance explained	Chronbach Alpha
Education (higher education better for health)				97.0%	0.97
% with no high school degree	9.6	12.0	9.8		
% with more than high school	73.3	70.2	16.6		
Employment (high employment, low unemployment better)				75.9%	0.68
% unemployed males, females	2.9	4.5	5.4		
% males no longer labor force	17.8	19.4	10.4		

TABLE 2. Distribution of individual and neighborhood attributes by birth outcome status among Wake County singleton cohort, 1999-2001.

	TERM	PRETERM	PERCENT
(column percent)	N (%)	N (%)	PRETERM
Maternal Race	22,2657 (100)	2030 (100)	8.4
Non-Hispanic White	16,745 (62.5)	1238 (52.2)	6.9
Non-Hispanic Black	5520 (20.6)	784 (33.0)	12.4
Hispanic	3128 (11.7)	239 (10.1)	7.1
Other	1414 (5.3)	112 (4.7)	7.3
Marital Status			
Married	17,693 (79.5)	1388 (68.6)	7.3
Not Married	4570 (20.5)	634 (31.4)	12.2
Maternal Education			
> 12 years	16,548 (74.5)	1278 (63.5)	7.2
12 years	3977 (17.9)	486 (24.1)	10.9
< 12 years	1700 (7.7)	250 (12.4)	12.8
Maternal Age			
<20 years	1234 (5.5)	143 (7.1)	10.4
20-24 years	3389 (15.2)	353 (17.5)	9.4
25-29 years	6006 (27.0)	560 (27.7)	8.5
30-34 years	7419 (33.3)	583 (28.8)	7.3
35+ years	4217 (18.9)	383 (18.9)	8.3

TABLE 2, continued.

	TERM	PRETERM	PERCENT
(column percent)	N (%)	N (%)	PRETERM
Poverty Index (low suggests low levels of tract poverty indicators)			
Low ([-2.0] – [-1.21])	6123 (28.4)	416 (21.5)	6.4
Medium ([-1.2] – [-0.47])	6214 (28.9)	520 (26.9)	7.7
High ([-0.5] – 0.39)	5780 (26.9)	531 (27.4)	8.4
Very High (0.41 – 12.5)	3410 (15.8)	470 (24.3)	12.1
Housing Index (very high means more renter, vacant, crowding; less house value)			
Low ([-3.0]–[-1.4])	7120 (33.1)	525 (27.1)	6.9
Medium ([-1.3] – [-0.32])	6212 (28.9)	558 (28.8)	8.2
High ([-0.3] – 0.85)	5149 (23.9)	438 (22.6)	7.8
Very High (0.9–5.2)	3046 (14.2)	416 (21.5)	12.0
Residential Stability Index (low means unstable neighborhoods)			
Low ([-3.2] – [-0.8])	4336 (20.1)	396 (20.4)	8.4
Medium ([-0.7] – 0.06])	6480 (30.1)	552 (28.5)	7.9
High (0.07 – 0.89)	6994 (32.5)	653 (33.1)	8.5
Very High (0.91 – 3.5)	3717 (17.3)	336 (17.4)	8.3
Occupation Index (low indicates small proportion management and professionals)			
Low ([-2.8] – [-0.89])	4621 (21.5)	596 (30.8)	11.4
Medium ([-0.88] – 0.07])	6148 (28.6)	575 (29.7)	8.6
High (0.14 – 1.01)	5780 (26.9)	445 (23.0)	7.2
Very High (1.02 – 2.2)	4978 (23.1)	321 (16.6)	6.1

TABLE 2, continued.

	TERM	**PRETERM**	**PERCENT**
(column percent)	**N (%)**	**N (%)**	**PRETERM**
Education Index (low means lower tract-level education)			
Low ([-4.5] – [-0.7])	4477 (20.8)	579 (29.9)	11.5
Medium ([-0.67] – 0.3)	6572 (30.5)	621 (32.1)	8.6
High (0.4 – 1.18)	5925 (27.5)	433 (22.4)	6.8
Very High (1.2 – 1.9)	4553 (21.2)	304 (15.7)	6.3
Employment Index (very high suggests high levels of tract unemployment)			
Low ([-1.1] – [-0.7])	7604 (35.3)	579 (29.9)	7.1
Medium ([-0.69] – [-0.33])	6490 (30.2)	533 (27.5)	7.6
High ([-0.31] – 0.1)	4496 (20.9)	442 (22.8)	9.0
Very High (0.11 – 6.7)	2937 (13.6)	383 (19.8)	11.5

TABLE 3. Race stratified distribution of maternal attributes and associated Odds Ratios [OR] (95% Confidence Intervals [95% CI]) for preterm birth among Wake County singleton cohort, 1999-2001.

	NON-HISPANIC WHITE		NON-HISPANIC BLACK	
(column percent)	**N (%)**	**OR (95% CI)**	**N (%)**	**OR (95% CI)**
Maternal Marital Status				
Married	17,118 (90.9)	Referent	2889 (44.1)	Referent
Not Married	1724 (9.2)	1.4 [1.2, 1.7]	3655 (53.9)	1.3 [1.1, 1.5]
Maternal Age				
<20 years	554 (2.9)	1.3 [1.0, 1.8]	844 (12.9)	0.9 [0.7, 1.2]
20-24 years	1976 (10.5)	Referent	1889 (28.9)	Referent
25-29 years	5144 (27.3)	1.0 [0.8, 1.2]	1705 (26.1)	1.0 [0.8, 1.3]
30-34 years	7103 (37.7)	0.8 [0.7, 1.0]	1299 (19.9)	1.2 [1.0,1.5]
35+ years	4068 (21.6)	0.9 [0.7, 1.1]	799 (12.2)	1.4 [1.1, 1.8]
Maternal Education				
> 12 years	15,431 (82.0)	Referent	3286 (50.4)	Referent
12 years	2535 (13.5)	1.4 [1.2, 1.7]	2080 (31.9)	1.3 [1.1, 1.5]
< 12 years	845 (4.5)	1.5 [1.2, 1.9]	1151 (17.7)	1.5 [1.3, 1.9]

TABLE 4. Race-stratified distribution of neighborhood attributes; unadjusted and adjusted[2] Odds Ratios [OR] (95% Confidence Intervals [CI] for preterm birth by neighborhood indices among Wake County cohort, 1999-2001.

	NON-HISPANIC WHITE			NON-HISPANIC BLACK		
POVERTY INDEX	**NUMBER (PERCENT)**	**UNADJUSTED OR (95%CI)**	**ADJUSTED OR (95%CI)**	**NUMBER (PERCENT)**	**UNADJUSTED OR (95%CI)**	**ADJUSTED OR (95%CI)**
Low tract poverty	6457 (35.3)	Referent	Referent	462 (7.4)	Referent	Referent
Medium	5698 (31.3)	1.1 [0.9, 1.3]	1.0 [0.9, 1.2]	1330 (21.4)	1.6 [1.1, 2.3]	1.5 [1.0, 2.2]
High	4862 (26.6)	1.2 [1.0, 1.4]	1.1[1.0, 1.3]	1686 (27.1)	1.4 [1.0, 2.1]	1.4 [1.0, 2.1]
Very high tract poverty	1284 (7.0)	1.3 [1.0, 1.7]	1.2 [0.9, 1.5]	2745 (44.1)	1.9 [1.3, 2.6]	1.8 [1.2, 2.5]
HOUSING INDEX (very high means more renter, vacant, crowding; less median house value)						
Low rental, crowding	7357 (40.2)	Referent	Referent	715 (11.5)	Referent	Referent
Medium	5324 (29.1)	1.1 [1.0, 1.3]	1.1 [0.9, 1.3]	1720 (27.6)	1.0 [0.8, 1.3]	1.0 [0.7, 1.4]
High	4456 (24.4)	1.0 [0.9, 1.2]	1.0 [0.8, 1.1]	1368 (22.0)	1.1 [0.8, 1.5]	1.2 [0.9, 1.7]
Very high home value	1164 (6.4)	1.3 [1.0, 1.6]	1.2 [0.9, 1.5]	2420 (38.9)	1.3 [1.0, 1.7]	1.3 [1.0, 1.8]

[2] Each index is modeled separately, adjusted for categorical maternal age and education.

TABLE 4, continued.

	NON-HISPANIC WHITE			NON-HISPANIC BLACK		
	NUMBER (PERCENT)	**UNADJUSTED OR (95%CI)**	**ADJUSTED OR (95%CI)**	**NUMBER (PERCENT)**	**UNADJUSTED OR (95%CI)**	**ADJUSTED OR (95%CI)**
RESIDENTIAL STABILITY (low means unstable neighborhoods)						
Low	3295 (18.0)	Referent	Referent	1636 (26.3)	Referent	Referent
Medium	5751 (31.4)	1.0 [0.9, 1.2]	1.0 [0.9, 1.2]	1572 (25.3)	1.0 [0.8, 1.2]	1.0 [0.7, 1.3]
High	5928 (33.3)	1.1 [1.0, 1.4]	1.1 [0.9, 1.3]	2130 (34.2)	1.0 [0.8, 1.2]	1.0 [0.8, 1.2]
Very High	3327 (18.2)	1.1 [0.9, 1.3]	1.1 [0.9, 1.3]	885 (14.2)	1.1 [0.8, 1.4]	1.0 [0.8, 1.4]
OCCUPATION INDEX (low indicates small proportion management and professionals)						
Low	2264 (12.4)	Referent	Referent	3171 (51.0)	Referent	Referent
Medium	5210 (28.5)	0.9 [0.7, 1.0]	0.9 [0.8, 1.1]	1744 (28.0)	0.8 [0.7, 1.0]	0.8 [0.7, 1.0]
High	5606 (30.6)	0.8 [0.6, 0.9]	0.8, 0.7, 1.0]	942 (15.1)	0.8 [0.6, 1.0]	0.8 [0.7, 1.1]
Very High	5221 (28.5)	0.7 [0.6, 0.8]	0.8 [0.6, 0.9]	366 (5.9)	0.6 [0.4, 0.9]	0.6 [0.4, 0.9]

TABLE 4, continued. [3]

	NON-HISPANIC WHITE			NON-HISPANIC BLACK		
	NUMBER (PERCENT)	**UNADJUSTED OR (95%CI)**	**ADJUSTED OR (95%CI)**	**NUMBER (PERCENT)**	**UNADJUSTED OR (95%CI)**	**ADJUSTED OR (95%CI)**
EDUCATION INDEX (low means lower tract-level education)						
Low	2385 (13.0)	Referent	Referent	2875 (46.2)	Referent	Referent
Medium	5569 (30.4)	0.8 [0.7, 1.0]	0.8 [0.7, 1.0]	1875 (30.1)	0.9 [0.8, 1.1]	1.0 [0.8, 1.2]
High	5624 (30.7)	0.7 [0.6, 0.8]	0.7 [0.6, 0.9]	1076 (17.3)	0.7 [0.6, 0.9]	0.8 [0.6, 1.1]
Very High	4273 (25.8)	0.7 [0.5, 0.8]	0.7 [0.6, 0.9]	397 (6.4)	0.7 [0.5, 1.0]	0.7 [0.5, 1.1]
EMPLOYMENT INDEX (very high suggests high levels of tract unemployment)						
Low	7400 (40.4)	Referent	Referent	1222 (19.6)	Referent	Referent
Medium	5694 (32.6)	1.1 [0.9, 1.2]	1.0 [0.9, 1.2]	1331 (21.4)	1.0 [0.8, 1.3]	1.0 [0.8, 1.3]
High	3665 (20.0)	1.2 [1.0, 1.4]	1.1 [1.0, 1.3]	1476 (23.7)	1.1 [0.9, 1.4]	1.1 [0.8, 1.4]
Very High	1272 (7.0)	1.0 [0.8, 1.3]	1.0 [0.8, 1.3]	2194 (35.3)	1.4 [1.1, 1.7]	1.3 [1.0, 1.6]

[3] The minimum, mean and maximum number of NH white women per tract were 7, 166.3 and 947 respectively. NH white women resided in 105 of the County's tracts. NH black women lived in 103 block groups. Their minimum, mean and maximum number per block group were 1, 58.3 and 192, respectively. The intra-class correlation coefficient, an indicator of PTB clustering by census tract, ranged between 0 and 0.01 for both NH white and NH black women.

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