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Risk and Protective Factors for Preterm Birth among Black Women in Oakland, California

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Code availability (software application or custom code)

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Abstract

This project examines risk and protective factors for preterm birth (PTB) among Black women in Oakland, California. Women with singleton births in 2011-2017 (n=6,199) were included. Risk and protective factors for PTB and independent risk groups were identified using logistic regression and recursive partitioning. Having less than 3 prenatal care visits was associated with highest PTB risk. Hypertension (preexisting, gestational), previous PTB, and unknown Women, Infant, Children (WIC) program participation were associated with a two-fold increased risk for PTB. Maternal birth outside of the US and participation in WIC were protective. Broad differences in rates, risks, and protective factors for PTB were observed.

Keywords

Preterm Birth; Risk Factors; Protective Factors; Black Women; Oakland

Introduction

Preterm birth (PTB; birth < 37 weeks gestation) is the second leading cause of infant mortality in the United States (US) [1] and is associated with health problems in infancy, childhood, and adulthood (e.g. respiratory distress, cerebral palsy, developmental disabilities, depression) [2-4]. The rate of PTB is persistently highest among non-Hispanic, Black women (hereafter referred to as Black women) compared to women of all other race/ethnicities. In 2018, the rate of PTB among Black women in the US was 14.1% compared to 9.7% in Hispanic women, 9.1% in White women and 8.6% in Asian women [5]. While differences in rates of PTB by race/ethnicity often vary by geographic area, Black women are consistently found to be at highest risk for PTB across the US. For instance, in 2018, the rate of PTB among Black women in California was 12.3% compared to 9.1% in Hispanic women and 7.7% in white women [5].

Studies find that race/ethnicity differences in PTB rates persist even when accounting for known individual-level risk factors such as socioeconomic status, education level, age, marital status, nativity, smoking, diabetes, hypertension, and health insurance coverage [6-8]. Although studies have cited the importance of considering multiple risk factors when examining patterns of PTB risk, few investigations have looked at the cumulative impact of these risk factors among Black women, across influential socioeconomic factors such as insurance coverage, and/or within specific geographies [9-11]. Studies that focus on the PTB risk factors for Black women in a single city are important because they can identify patterns particular to populations in that area, enabling more rapid pragmatic translation of findings within that place [12-14]. Assessing patterns within groupings and geographies represents a key next step for developing and implementing targeted interventions aimed at reducing rates of PTB in Black women. Oakland, California is a unique geography that could greatly benefit from studies examining the risk factors for PTB. No population-based studies to date have examined risk factors for preterm birth among Black women in Oakland, California. This is concerning because Black women experienced the highest percent of PTBs among all racial/ethnic groups in Oakland between 2016 and 2018 (11.7%), which is 1.8 times the preterm births experienced by white women (6.5%).

Oakland, California, is one of three cities that we selected as part of a place-based initiative [15] to determine the conditions necessary to improve health outcomes specific to birthing people. Place-based initiatives such as the Harlem Children's Zone, the Best Babies Zone, and Promise Neighborhoods have been shown to be effective in addressing and resolving health disparities [16]. Preterm birth has been consistently shown to be a complex social and clinical condition that requires a coordinated, systematic, and life-course approach to resolve.

In addition to the importance of looking at patterns of population rates of PTB in Black women within groups and geographies, an important methodological next step in understanding risk for and protection against PTB among Black women includes assessing factors in combination instead of independently in adjusted modeling. While characterizing individual-specific risk (or protection) for PTB is challenging due to the complex nature of the condition [17-18], considering the co-occurrence of risk and protective factors and their potential interaction offers the opportunity for characterizing patterns of risk and resiliency across groups of Black women. Additionally, this approach provides a foundation for developing strategies to manage risk factors and amplify protective factors in partnership with women in community.

Here we examine patterns of PTB among Black women living in Oakland, California, between 2011 and 2017, when their PTB rate was 11.2% versus 8.1%, 8.2% and 6.7% respectively among Asian, Hispanic, and White women [18]. The existing data set we are used identified birthing people as women and we use this language when referring to the data set. We use Black birthing people elsewhere in the manuscript to accurately describe the range of people with capacity for pregnancy. For this study, we examined risk and protective factors for PTB among Black women residing in Oakland, California and further identified independent levels of risk groupings by type of health insurance coverage as a crude proxy for socioeconomic status.

Materials and Methods

The sample for this retrospective cohort study was drawn from all California live births, January 1, 2011 through December 31, 2017 (n=3,448,707). The sample was restricted to Black women (n=166,979) with singleton births between 20 and 44 weeks' gestation based on best obstetric estimate (n=166,631). The sample was further restricted to women who had an available linked birth certificate and mother and child hospital discharge records (n=151,252) and no chromosomal abnormalities or major birth defects (n=146,911). We included data from women who had a residential address upon giving birth that corresponded to the city of Oakland, California (n=6,199). This cohort was derived from a combined database that included linked birth certificate records from 2011 – 2017 [19] and data from the California Office of Statewide Health Planning and Development (OSHPD) Patient Discharge Database (PDD). Diagnostic and procedure codes were used to identify medical diagnoses which relied on International Classification of Diseases, 9th Revision (ICD-9) codes for 2011 through mid-2015 and ICD-10 codes for mid-2015 through 2017. The sample was further divided into three strata of insurance coverage as a crude proxy for socioeconomic status: Medi-Cal coverage (n=3,432), California's Medicaid program that provides public insurance for low-income persons, employer sponsored insurance coverage (n=1,701), and other coverage (n=1,066; which included self-pay, other government payment, other payer, no payment method, and unknown payment method).

PTB was defined as any birth at <37 weeks of gestation based on best obstetric estimate. The following potential risk and protective factors were considered: parity (multiparous versus nulliparous), maternal age (<18 years, >34 years versus 18-34 years), maternal education (<12 years, >12 years versus 12 years), maternal nativity (foreign-born versus U.S.-born), infant sex (male versus female), number of prenatal care visits (< 3 visits versus ≥ 3 visits), trimester of prenatal care initiation (second, third versus first), participation in the Women, Infants, and Children Program (WIC) (yes versus no), maternal history of smoking during pregnancy (any versus none), maternal body mass index (BMI) as calculated from pre-pregnancy height and weight (underweight BMI <18.5, overweight BMI 25 to 29.9, or obese BMI ≥ 30.0 versus normal BMI 18.5 to 24.9), pre-existing diabetes (yes versus no diabetes), gestational diabetes (yes versus no diabetes), pre-existing hypertension (HTN) (yes versus no hypertension), gestational hypertension (yes versus no hypertension), any infection complicating pregnancy (yes versus no), sickle cell disease (SCD) (yes versus no), anemia complicating pregnancy (yes versus no), any drug or alcohol use (yes versus no), and mental illness complicating pregnancy (yes versus no). Among multiparous women, additional risk factors included any previous PTB, any previous cesarean section, and interpregnancy interval (IPI) (<6, 6-23, > 59 versus 24-59 months). Missing observations were identified for each variable as a separate group entitled “unknown”. Women who had hypertension but were missing an identification for whether the hypertension was gestational or preexisting were categorized as “unknown HTN”.

Descriptive statistics were generated for all characteristics and clinical factors including χ^2 comparisons by insurance coverage group. Crude and adjusted logistic regression models were run, generating odds ratios (ORs) and 95% confidence intervals (CIs) for independent significant risk and protective factors. Only statistically significant risk and protective factors, due to low incidence, ORs were retained in the final multivariable model and were interpreted as indications of risk. Recursive partitioning is a non-parametric approach in which the importance of a variable is determined by its ability to effectively explain the likelihood of experiencing the outcome [20]. Recursive partitioning was used to generate conditional inference trees for all Black women and by insurance coverage group, with all factors entered as candidates for tree construction. In preparation for recursive partitioning, risk factors with missing values (Medi-Cal, parity, previous cesarean section, interpregnancy interval, maternal education, number of prenatal care visits, WIC participation, BMI category, and type of hypertension) were recoded as categorical variables to include “unknown” categories.

Recursive partitioning runs permutation tests on every possible dichotomous split among all candidate variables, dividing the population into sub-populations based on the variable which has the greatest explanatory power for the outcome (minimizing the Bonferonni-adjusted p-values from hypothesis testing).[20] The algorithm proceeds to consider additional splits generating tree branches which represent the characteristics that most effectively identify those with and without the outcome. The earlier a variable splits the data, the more informative that variable may be considered in terms of discerning the likelihood of experiencing preterm birth. In this study, a p-value of < 0.05 was used as the threshold for a split, and tree branches were limited (pruned) to no more than five splits per branch. The terminal nodes from pruned trees were used to create independent risk groups ranked from lowest to highest rate of PTB. Risk of PTB was compared across groups using logistic regression.

All analyses, other than recursive partitioning, were performed using Statistical Analysis Software version 9.4 (Cary, NC). Recursive partitioning was performed using the 'party' package within RStudio. Methods and protocols for the study were approved by the Committee for the Protection of Human Subjects within the Health and Human Services Agency of the State of California. Data used for the study were received by the University by November 2019.

Results

PTB occurred in 8.7% of the sample (Table 1). Most women in the population were between the ages of 18 and 34 (81.5%), were born in the United States (85.1%) and participated in WIC (66.3%). Demographic characteristics differed across the three insurance coverage groups. Women in the "other" coverage grouping had the highest incidence of PTB (9.6%) followed by women with Medi-Cal coverage (8.6%) and by women with private insurance (8.4%). A number of characteristics and clinical factors were associated with PTB in the overall sample and by insurance grouping (Supplemental Table 1). Fewer than three prenatal care visits was associated with the greatest crude odds of PTB in the full sample (OR = 4.7, 95% CI 3.2, 6.9), in the Medi-Cal grouping (OR = 4.1, 95% CI 2.6, 6.5) and in the "other" insurance grouping (OR = 6.5, 95% CI 2.6, 6.1). Gestational hypertension was associated with the highest crude odds of PTB in women with private insurance (OR=4.1, 95% CI 2.7, 6.1).

Risk factors remaining in the final multivariable model for the full sample included fewer than three prenatal care visits, unknown number of prenatal care visits, unknown WIC participation, preexisting hypertension, gestational hypertension, mental illness, and previous PTB, while maternal birth outside of the US and WIC participation were associated with reduced risk of PTB (Table 2). While preexisting and gestational hypertension were associated with increased risks for PTB across all insurance groupings, some factors were only found to be associated with increased risk of PTB for specific insurance groupings. For example, multiparity, unknown maternal education level, drug/alcohol use, and unknown interpregnancy interval were only found to be associated with increased risk in the Medi-Cal grouping (adjusted ORs (aORs) = 1.69 to 2.30). Having fewer than three prenatal care visits was associated with the highest risk of PTB across all women (aOR=4.2, 95% CI 2.82, 6.40). Preexisting hypertension was associated with the highest risk for PTB in the Medi-Cal (aOR = 3.44, 95% CI 2.33, 5.09) and employer sponsored insurance groupings (aOR = 3.08, 95% CI 2.30, 4.14), and unknown WIC participation was associated with the highest risk of PTB among women with "other" health insurance (aOR=5.4, 95% CI 2.0, 14.4).

Recursive partitioning generated eight independent risk groups with differing incidences of PTB in the full sample (Figure 1). In the full sample, the rate and risk of PTB was the highest among women with a reported mental illness who had an unknown number of prenatal care visits (rate = 35.0%, OR=9.0, 95% CI=4.6, 17.4) (Table 3). Five independent risk groups were generated for the Medi-Cal coverage grouping (Supplemental Figure 1) wherein women with reported drug use who were either less than the age of 18 or over the age of 34 had the highest rate and risk of preterm birth (rate = 43.2%, OR =11.9, 95% CI=6.4, 22.1) (Table 3). Three independent risk groups were identified in the employer sponsored insurance grouping with the highest rate and risk observed for women with fewer than three or an unknown number of prenatal care visits (rate = 22.5%, OR = 4.3, 95% CI=2.0, 9.2). Four independent risk groups were identified for women in the “other” insurance grouping with the highest risk group being women with a reported mental illness and an unknown number of prenatal care visits (rate = 62.5%, OR 20.9, 95% CI=4.9, 89.4).

Discussion

In multivariable models, having fewer than three prenatal visits was associated with the highest level of increased independent risk for PTB for the entire study population of Black women. Unknown WIC participation was also a potent risk factor across these groupings associated with a two- to five-fold increased odds of PTB. While factors like preexisting and gestational hypertension conferred a two-fold or higher risk for PTB overall and across sub-groups, some factors, like drug and alcohol use, mental illness, and previous PTB, appeared to confer differing types and levels of risk by insurance grouping. Similarly, while factors like maternal birth outside of the US and participation in WIC conferred some protection against PTB in the overall study population, protection was only observed for maternal birth outside of the US in the Medi-Cal subgroup.

Particularly telling in the present study was how risk and protective factors combined within insurance groupings to identify groups of Black women with low and high rates of PTB in Oakland. Within the Medi-Cal grouping, for example, the rate of PTB among Black women who had fewer risk factors (determined by recursive partitioning as no drug use and no preexisting or gestational hypertension) was 6.0% as compared to the highest rate of 43.2% in women with more risk factors (drug use and age <18 or >34). Despite a much lower rate of PTB, this low-risk group still comprised 52.7% of preterm deliveries to Black women on Medi-Cal in Oakland during this period, while the high-risk group contained only 6.5% of preterm deliveries. These data show that particular variables may have differential importance within subgroups of women, while simultaneously identifying groups that, though relatively low risk, contain the majority of Black women experiencing PTB. This separation allows for examination and exploration of other factors contributing to PTB and is essential for addressing risk and for fostering resiliency against PTB. Additionally, the granularity achieved using these analytic methods can identify potential areas of intervention that can be tailored to the geographic resources that are currently available.

While some studies have examined the relationship between risk and protective factors (separately) and PTB in Black women stratified by insurance coverage type, no studies identified by this group to date have applied recursive partitioning to identify different level of risk groups for PTB overall or by insurance type. Our findings are supported by other studies that have shown that Black women are less likely to experience or receive adequate prenatal care [21-22]. Other studies have also demonstrated the link between gestational and preexisting hypertension and PTB in Black women [23-24] and the increased risk of PTB when drug use is reported [25]. Also important is the agreement between our study and others that have shown participation in WIC [26] and maternal birth outside of the US [27] to be protective against PTB.

Our findings support the importance of exploring in detail local barriers to prenatal care so that interventions targeting these barriers can be mobilized to decrease risk for and rates of PTB. Well-known barriers to accessing prenatal care include lack of transportation, competing needs of existing children, depression, decreased belief in need of prenatal care, fear of medical procedures, accessibility of prenatal providers, clinic locations, cost of services, staff attitudes, and provider bias [28-29]. For Black women, the history of and the potential for experiencing racial discrimination in clinical settings is also a strong deterrent to accessing available care [30]. Black women are also more likely to live in neighborhoods with high rates of poverty and fewer proximal or quality resources, [31-33] adding disproportionate barriers for prenatal care access. We speculate that in this study, number of prenatal care visits may in fact be serving as a proxy for issues of racial discrimination, housing insecurity, or stress [34-35]. These factors must be directly explored in future studies and the findings translated into actionable interventions.

This study had several strengths. The population-based sample of Black women in Oakland, aggregated over seven years, was sufficiently large to allow for in-depth exploration of risk and protective factors within this specific population. This also enabled the examination of factors among insurance coverage subpopulations, a level of specificity that would not be feasible in a smaller study. The dataset itself was unique in its inclusion of data from both birth certificates and hospital discharge records, which allowed for the consideration of medical diagnoses, not otherwise available in databases limited to birth certificates. In addition, the use of recursive partitioning to identify risk groups is less common in research on birth outcomes. Applying recursive partitioning to population-level data also addressed a limitation of tree-building models – that the trees are highly sensitive to the distribution of the data and random variability between samples. As our study utilized all births fitting our inclusion criteria, the distribution of data represented the actual distribution of the population during the study time period. Conditional inference trees are also straightforward to interpret due the hierarchical flow-chart generated by the splitting process. This lends itself to potential research, policy, and clinical benefits in order to consider the level of risk for women who fall into one of the specified risk groups. In this study, we were able to compare results from more traditional multivariable regression modeling with those from the recursive partitioning process.

While use of the dataset allowed for an unprecedented examination of patterns of PTB in the Oakland community, this study also had several limitations. As a large administrative data set, concerns about the accuracy of characteristics are worth considering, as data were not captured for the express purpose of a research investigation. Diagnostic ICD-9 and ICD-10 codes in hospital discharge records and birth certificates were not validated through follow-up consultation with diagnosing physicians. Further investigations may also consider alternative methods for grappling with unknown values. We included these groups as separate categories in the present analyses for transparency purposes, but it remains unclear what these groups represent given that in some instances these categories were associated with increased risk (as with unknown WIC status and unknown number of prenatal care visits). The elevated risk in these groups makes it clear that the variables were not missing at random. Additionally, many potentially important risk factors were not included in this analysis such as neighborhood-level factors (such as neighborhood poverty, neighborhood unemployment, racial residential segregation, or neighborhood levels of violence), paternal race or ethnicity, levels of stress, experiences of racism, and anatomical risk factors for preterm birth such as cervical length. It will be critical that future studies expand to include these factors as well as other potential sources of protection and resiliency [36]. Further exploration will also require extensive qualitative investigation in partnership with community in order to uncover latent risk and protective factors and to more fully characterize constellations of risk and resiliency that can be addressed. Finally, it should be noted that this analysis was intentionally focused on the specific geography of Oakland, California, and the specific population of Black women within that city. As such, our results may not be generalizable to other populations of Black women. The findings suggest that it is critical that additional place-based investigations are done in order to better uncover and address patterns of risk, protection and resiliency for PTB that are place-specific and focused among specific populations of Black women.

Conclusions

This study demonstrates how understanding patterns of risk and resiliency within a specific location may inform local efforts aimed at reducing rates of PTB. Clinicians and researchers interested in identifying Black women at higher risk of PTB in Oakland may utilize the trees generated by recursive partitioning to consider how multiple risk factors interact to identify a particular risk group. By focusing on one city, this study provides evidence to support local intervention development and policy advocacy efforts in Oakland to increase awareness of and resources for addressing PTB in Black women. In addition, the use of recursive partitioning to identify clear yet complex patterns of PTB risk and protective factors could aid clinicians in incorporating these findings into clinical practice, a benefit which could be brought to bear on the field of PTB research more broadly. Building on the findings of this study, future research could delve into the specific patterns identified among Black women in Oakland through both quantitative and qualitative methods to further elucidate patterns in this population. Other localities could apply the methods used in this study to better understand patterns related to PTB within their own specific populations, ultimately allowing for more targeted efforts to reduce PTB risk and rate differences by race/ethnicity nationwide.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1:

Independent Risk Groupings for Preterm Birth among Black Women in Oakland, California as Identified by Recursive Partitioning.

Table 1:

Sample Characteristics.

	All Women (n=6,199) n(%)	Medi-Cal (n=3,432) n(%)	Private (n=1,701) n(%)	Other (n=1,066) n(%)	χ^2 p-value[a]
Birth outcome					
Preterm (<37 weeks)	538 (8.7)	294 (8.6)	142 (8.4)	102 (9.6)	0.5081
Term (≥ 37 weeks)	5,661 (91.3)	3,138 (91.4)	1,559 (91.7)	964 (90.4)	
Parity					
Nulliparous	2,605 (42.0)	1,415 (31.2)	781 (45.9)	409 (38.4)	< 0.0001
Multiparous	3,573 (57.6)	2,009 (58.5)	919 (54.0)	645 (60.5)	
Unknown	21 (0.3)	8 (0.2)	1(0.1)	12(1.1)	
Maternal age					
<18 years	149 (2.4)	104 (3.0)	15 (0.9)	30(2.8)	< 0.0001
18-34 years	5,054 (81.5)	2,938 (85.6)	1,219 (71.7)	897 (84.2)	
>34 years	995 (16.1)	390(11.4)	467 (27.5)	138 (13.0)	
Maternal education					
<12 years	968 (15.6)	703 (20.5)	69 (4.1)	196(18.4)	< 0.0001
12 years	1,920 (31.0)	1,211 (35.3)	317 (18.6)	392 (36.8)	
>12 years	3,055 (49.3)	1,366 (39.8)	1,231 (72.4)	458 (43.0)	
Unknown	256 (4.1)	152 (4.4)	84 (4.9)	20(1.9)	
Maternal nativity					
US-born	5,273 (85.1)	2,872 (83.7)	1,458 (85.7)	943 (88.5)	0.0005
Foreign-bom	926(14.9)	560(16.3)	243 (14.3)	123 (11.5)	
WIC participation					
Yes	4,110(66.3)	2,725 (79.4)	540 (31.8)	845 (79.3)	< 0.0001
No	1,990 (32.1)	635 (18.5)	1,154 (67.8)	201 (18.9)	
Unknown	99(1.6)	72 (2.1)	7 (0.4)	20(1.9)	

– Not applicable

[a]Comparing insurance groupings

Table 2:

Multivariate Models for Preterm Birth Overall and by Insurance Coverage Type by Characteristics and Clinical Factors.[a]

Variable	All Women	Medi-Cal	Private	Other
Multiparous	--	2.3 (1.6, 3.3)	--	--
Unknown education level	--	1.7 (1.0, 2.8)	--	--
Mother born outside US	0.7 (0.5, 0.9)	0.6 (0.4, 0.9)	--	--
Fewer than 3 prenatal care visits	4.2 (2.8 6.4)	3.1 (1.9, 5.1)	--	5.0 (1.9, 13.2)
Unknown number of prenatal care visits	1.6 (1.2, 2.3)	--	--	--
WIC participation	0.8 (0.6, 0.9)	--	--	--
Unknown WIC participation	2.2 (1.3, 3.7)	2.3 (1.2, 4.5)	--	5.4(2.0, 14.4)
Drug/alcohol use	--	2.1 (1.5, 3.0)	--	--
Preexisting hypertension	3.0 (2.22 4.0)	3.4 (2.3, 5.1)	3.1 (2.3, 4.1)	2.5 (1.2, 5.3)
Gestational hypertension	2.6 (2.1, 3.3)	2.4 (1.8, 3.3)	2.5 (2.0, 3.2)	2.2 (1.3, 3.8)
Mental illness	1.8 (1.4, 2.2)	--	2.0(1.6 2.4)	2.2 (1.3, 3.5)
Previous preterm birth	3.1 (1.8, 5.2)	--	--	4.9 (2.1, 11.4)
Unknown IPI	--	2.0 (1.4, 2.8)	--	--

[a]All significant at $p < .05$.

Table 3:

Preterm Versus Term Birth Among Black Women in Oakland, California by Insurance Coverage Type and Independent Risk Group Identified by Recursive Partitioning.

	Risk Group[e]	% of Group Births Preterm[e]	Preterm: n (%)	Term n (%)	OR (95% CI)
All Women (A)[a]	All	8.7	538 (100.0)	5661 (100.0)	
	A-1	5.7	246 (45.7)	4102 (72.5)	Referent
	A-2	10.3	58 (10.8)	506 (8.9)	1.91(1.4,2.6)
	A-3	10.7	55 (10.2)	460 (8.1)	2.0 (1.5, 2.7)
	A-4	18.7	61 (11.3)	266 (4.7)	3.8 (2.8, 5.2)
	A-5	23.4	53 (9.9)	174 (3.1)	5.1 (3.6, 7.1)
	A-6	28.3	13 (2.4)	33 (0.6)	6.6 (3.4, 12.7)
	A-7	28.8	38 (7.1)	94 (1.7)	6.7 (4.5, 10.0)
	A-8	35.0	14 (2.6)	26 (0.5)	9.0 (4.6, 17.4)
Medi-Cal Coverage (M)[b]	All	8.6	294(100.0)	3138 (100.0)	
	M-1	6.0	155 (52.7)	2431 (77.5)	Referent
	M-2	13.5	58 (19.7)	372 (11.6)	2.5 (1.8, 3.4)
	M-3	15.2	32(10.9)	178 (5.7)	2.8 (1.9, 4.3)
	M-4	18.5	30(10.2)	132 (4.2)	3.6 (2.3, 5.5)
	M-5	43.2	19 (6.5)	25 (0.8)	11.9 (6.42 22.1)
Private Coverage(P)[c]	All	8.4	142(100.0)	1559 (100.0)	
	P-1	6.4	94 (66.2)	1380 (88.5)	Referent
	P-2	20.9	39(27.5)	148 (9.5)	3.9 (2.6, 5.8)
	P-3	22.5	9(6.3)	31 (2.0)	4.3(2.0, 9.2)
Other Coverage(O)[d]	All	9.6	102(100.0)	964(100.0)	
	O-1	7.4	65 (63.7)	815 (84.5)	Referent
	O-2	15.3	24 (23.5)	133 (13.8)	2.3 (1.4, 3.7)
	O-3	38.1	8 (7.8)	13 (1.4)	7.7 (3.1, 19.3)
	O-4	62.5	5 (4.9)	3 (0.3)	20.9 (4.9, 89.4)

[a]Risk/protective factors considered across groupings: Number of prenatal care visits, preexisting and gestational hypertension, mental illness, WIC participation, and previous caesarean section (see Figure 1 for specific risk group designations).

[b]Risk/protective factors considered across groupings: Drug abuse, preexisting and gestation hypertension, and maternal age (see Supplemental Figure 1 for specific risk group designations).

[c]Risk/protective factors considered across groupings: Gestational hypertension and number of prenatal care visits (see Supplemental Figure 1 for specific risk group designations).

[d]Risk/protective factors considered across groupings: Number of prenatal care visits and mental illness (see Supplemental Figure 1 for specific risk group designations).

[e]Risk group ranking based on percent of births in each group that are preterm: 1=group with lowest percent of preterm births among members.