

# The impact of prenatal care in the United States on preterm births in the presence and absence of antenatal high-risk conditions

Anthony M. Vintzileos, MD,<sup>a</sup> Cande V. Ananth, PhD, MPH,<sup>b</sup> John C. Smulian, MD, MPH,<sup>a</sup>  
William E. Scorza, MD,<sup>a</sup> and Robert A. Knuppel, MD, MPH<sup>a</sup>

New Brunswick, NJ

**OBJECTIVE:** This study was undertaken to determine the association between prenatal care in the United States and preterm birth rate in the presence, as well as absence, of high-risk pregnancy conditions for African American and white women.

**STUDY DESIGN:** Data were derived from the natality data set for the years 1995 to 1998 provided by the National Center for Health Statistics. Analyses were restricted to singleton live births that occurred at  $\geq 20$  weeks' gestation. Multiple births, fetal deaths, congenital malformations, chromosomal abnormalities, missing data on gestational age, and birth weight less than 500 g were excluded. Multivariable logistic regression analyses were used to adjust for the presence or absence of various antenatal high-risk conditions, maternal age, gravidity, marital status, smoking, alcohol, and education. Prenatal care was considered present if there was one or more prenatal visits. Preterm delivery was defined as delivery at less than 37 completed weeks of gestation.

**RESULTS:** For 14,071,757 births analyzed, 1,348,643 (9.6%) resulted in preterm birth. Preterm birth rates were higher for African American women than white women in the presence (15.1% vs 8.3%) and absence (34.9% vs 21.9%) of prenatal care. The absence of prenatal care increased the relative risk for preterm birth 2.8-fold in both African American and white women. There was an inverse dose-response relationship between the number of prenatal visits and the gestational age at delivery both among African American and white women. Lack of prenatal care was associated with increased preterm birth rates to a similar degree in the presence of pregnancy complications for both African American and white women, ranging from 1.6-fold to 5.5-fold for the various antenatal high-risk conditions.

**CONCLUSION:** In the United States, prenatal care is associated with fewer preterm births in the presence, as well as absence of high-risk conditions for both African American and white women. Strategies to increase prenatal care participation may decrease preterm birth rates. (*Am J Obstet Gynecol* 2002;187:1254-7.)

**Key words:** Prenatal care, preterm birth, vital statistics, high-risk conditions

Preterm birth is the most frequent cause of perinatal morbidity and mortality in the United States, accounting for more than 70% of perinatal mortality in fetuses without anomalies.<sup>1</sup> High-risk factors predisposing to preterm births include lack of prenatal care and race, with African American women more likely than white women to be delivered preterm.<sup>2-4</sup> However, the extent of the black-white disparity in preterm birth rates that is directly the result of lack of prenatal care, per se, or due to the

high frequency of antenatal medical and obstetric high-risk conditions seen among those with no prenatal care remains unknown.

The purpose of this large population-based cohort study was to determine the association between prenatal care and preterm birth rates in the United States in the presence and absence of antenatal high-risk conditions. We also explored the association, if any, between prenatal care and black-white disparity in preterm birth rates.

## Material and methods

The study was approved by the institutional review board. Data for this study were derived from the natality data sets for the years 1995 to 1998, assembled and provided by the National Center for Health Statistics.<sup>5</sup> These data are coded according to uniform coding specifications, have passed rigorous statistical quality checks, have been reviewed and carefully edited by the National Center for Health Statistics, and form the basis for official US

*From the Division of Maternal-Fetal Medicine,<sup>a</sup> Section of Epidemiology and Biostatistics,<sup>b</sup> Department of Obstetrics, Gynecology and Reproductive Sciences, University of Medicine and Dentistry of New Jersey—Robert Wood Johnson Medical School/St Peter's University Hospital.*

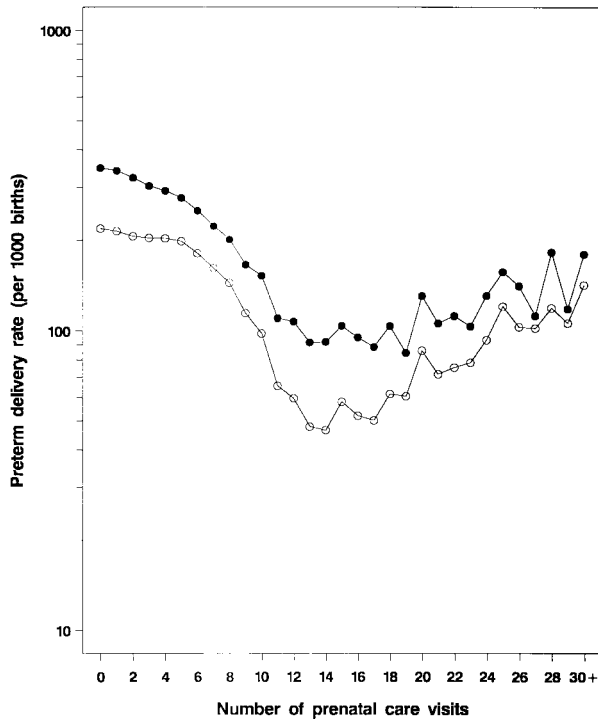
*Presented at the Twenty-second Annual Meeting of the Society of Maternal-Fetal Medicine, New Orleans, La, January 14-19, 2002.*

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0002-9378/2002 \$35.00 + 0 6/6/127140

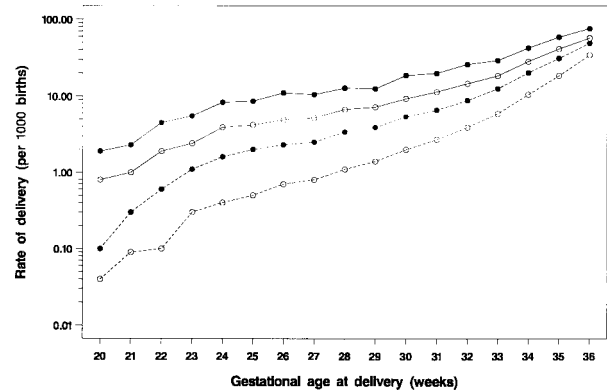
doi:10.1067/mob.2002.127140



**Fig 1.** Relationship between the number of prenatal care visits and preterm birth rate. *Solid circles*, African American women; *open circles*, white women.

birth statistics. Analysis was restricted to singleton live births that occurred after 20 completed weeks of gestation. Gestational age (in completed weeks) was calculated as the interval between the date of the delivery and the date of last menstrual period (LMP). Records with missing date of LMP, but with valid month and year of the LMP, had gestational age imputed.<sup>6</sup> When the LMP date was missing or when the LMP-based gestational age was inconsistent with birth weight, a clinical estimate of gestational age was used instead (in about 5% of records). These imputations and replacements of gestational age by clinical estimates were performed by the National Center for Health Statistics. All antenatal medical and obstetrical high-risk conditions are recorded by using a check-box format on birth certificates indicating the presence or absence of the condition.<sup>7</sup> Multiple births, fetal deaths, congenital or chromosomal abnormalities, missing data on gestational age, birth weight below 500 g, and those with missing data regarding the presence or absence of prenatal care were excluded.

Prenatal care was considered present if there was at least one prenatal visit during the course of pregnancy. Preterm birth was defined as delivery at <37 weeks' gestation. The analyzed high-risk conditions included maternal anemia, intrapartum fever, hydramnios, diabetes, chronic hypertension, pregnancy-induced hypertension, renal disease, abruptio placentae, placenta previa, bleed-



**Fig 2.** Relationship between gestational age-specific rates of delivery and preterm births by race and prenatal care status. *Solid circles—continuous line*, African American women with no prenatal care; *open circles—continuous line*, white women with no prenatal care; *solid circles—dashed line*, African American women with prenatal care; *open circles—dashed line*, white women with prenatal care.

ing (unknown cause), fetal growth restriction (birth weight <10th percentile for gestational age), and history of prior preterm or small-for-gestational-age infant. Race was determined on the basis of maternal self-report and was restricted to African American and white women.

Rates of preterm birth were compared for women with and without prenatal care, and adjusted relative risks (RRs) with 95% CIs derived as measures of effect. Adjusted odds ratios derived from multivariable logistic regression models were transformed to adjusted relative risks.<sup>8</sup> Covariates considered for adjustment in the regression models included obstetric and medical high-risk conditions, as well as maternal age, gravidity, maternal education ( $\leq 12$ , 13 or more years of schooling), marital status (unmarried or married), smoking, and alcohol use in pregnancy. Weight gain was not considered as a confounder because it was not recorded in almost half the cases. Furthermore, because the relationship among maternal age, birth weight, gestational age, and the risk of preterm birth were nonlinear, we modeled these three covariates by including second-degree polynomial terms. Confounders that changed adjusted relative risks by at least 10% were retained in the regression models for adjustment. The data were analyzed with the SAS System, version 8 (SAS Institute, Cary, NC).

## Results

During the years 1995 to 1998, there were 15,627,407 live births in the United States. Of these, the following were sequentially excluded: multiple births ( $n = 437,870$ ), congenital or chromosomal abnormalities ( $n = 668,540$ ), missing data on gestational age or birth weight below 500 g ( $n = 153,301$ ), and missing data on the presence or absence of prenatal care ( $n = 295,939$ ). After these exclu-

**Table I.** Preterm delivery rates and risks by prenatal care status

	<i>Prenatal care present</i>			<i>Prenatal care absent</i>			<i>Adjusted relative risk (95% CI)</i>
	<i>Total births (No.)</i>	<i>Preterm delivery</i>		<i>Total births (No.)</i>	<i>Preterm delivery</i>		
		<i>No.</i>	<i>%</i>		<i>No.</i>	<i>%</i>	
Overall (all races)	13,913,219	1,306,532	9.2	158,538	42,111	25.6	2.9 (2.8-3.0)
White women	11,146,955	929,413	8.3	95,164	20,816	21.9	2.8 (2.7-2.9)
African American women	2,059,540	311,573	15.1	56,954	19,847	34.9	2.8 (2.7-2.29)

**Table II.** Rates and relative risks for preterm delivery in the presence of high-risk conditions

<i>High-risk condition</i>	<i>Preterm delivery</i>		<i>Adjusted relative risk (95% CI)*</i>
	<i>Prenatal care present (No. [%])</i>	<i>Prenatal care absent (No. [%])</i>	
Maternal anemia	30,849 (11.3)	1,171 (32.1)	5.5 (5.1-5.9)
Intrapartum fever	20,118 (9.2)	682 (35.9)	4.4 (3.9-4.9)
Bleeding (unknown cause)	18,125 (14.6)	617 (42.2)	3.5 (3.1-3.9)
Prior preterm/small for gestational age infant	43,017 (27.1)	1,728 (58.8)	3.0 (2.8-3.3)
Renal disease	5,316 (14.0)	110 (37.3)	3.0 (2.3-3.8)
Placenta previa	17,429 (40.0)	454 (68.7)	2.8 (2.3-3.3)
Hydramnios	30,031 (18.4)	866 (40.1)	2.4 (2.2-2.7)
Abruptio placentae	30,272 (43.7)	1,582 (69.7)	2.2 (2.0-2.4)
Pregnancy-induced hypertension	99,923 (19.4)	1,872 (40.2)	2.1 (2.0-2.3)
Diabetes	47,426 (13.3)	396 (26.6)	2.0 (1.7-2.2)
Chronic hypertension	18,276 (20.2)	407 (39.2)	1.9 (1.7-2.2)
Small for gestational age	118,803 (9.2)	4,277 (15.2)	1.6 (1.5-1.7)
None of the above	484,618 (11.5)	15,597 (25.9)	2.6 (2.5-2.8)

\*Relative risks were adjusted for each high-risk condition, maternal age, gravidity, marital status, and maternal education.

sions, a total of 14,071,757 births (including all races) remained for analysis. Among all races, there were 1,348,643 preterm births (preterm birth rate 9.6%) and 158,538 (1.1%) women with no prenatal care. Subsequently, 713,144 nonwhite and non-African American patients were excluded, so the remaining analysis was confined to African American and white women only. African American women were 3.2-fold more likely to have no prenatal care compared with white women (2.7% vs 0.8%).

Table I compares the preterm birth rates of the entire cohort (all races), as well as for African American and white women both in the presence and absence of prenatal care. Preterm birth rates were higher for African American women compared with white women in the presence (15.1% vs 8.3%) and absence (34.9% vs 21.9%) of prenatal care. The absence of prenatal care increased the RR for preterm birth 2.8-fold in both African American and white women. There was an inverse dose-response relationship between the number of prenatal visits and preterm birth rate, both among African American and white women (Fig 1) The inverse dose-response relationship was confined up to 14 visits for both African American and white women; thereafter, the preterm birth rate increased (presumably because of the pregnancy being high risk). Fig 2 shows the gestational

age-specific rates of preterm birth according to race and prenatal care status. Throughout gestation, African American women with no prenatal care had the highest preterm birth rate, followed by white women with no prenatal care, African American women with prenatal care, and white women with prenatal care. The differences among the four groups in gestational age-specific preterm delivery rates were the most pronounced during the early gestations.

At least one high-risk pregnancy condition was present in 37% of African American women and 29% of white women. Lack of prenatal care was associated with increased preterm birth rates to a similar degree for the individual high-risk pregnancy conditions for both African American and white women. Therefore, the data were combined for the whole population in Table II that shows the adjusted RRs for preterm birth rates in the presence of antenatal high-risk conditions. Lack of prenatal care was associated with increased risk for preterm birth in the presence of each high-risk condition examined.

### Comment

The current study found that lack of prenatal care was associated with an overall increased preterm birth rate 2.8-fold in both African American and white women. Al-

though the protective effect of prenatal care in reducing preterm birth rate was similar among African American and white women, the black-white disparity in preterm birth rates persisted even in the presence of prenatal care (15.1% vs 8.3%, respectively). The excess preterm births between African American and white women among those who had prenatal care was 6.8%, whereas among those without prenatal care was 13% (Table I). Thus, prenatal care reduced the disparity in preterm birth rate among African American women by 48% compared with white women. Because African American women were 3.2-fold more likely to have no prenatal care than white women, increased prenatal care participation, especially among African American women, may be expected to decrease the number of preterm births.

The association between prenatal care and preterm births was the greatest in cases of extreme prematurity, as shown in Fig 2. Possible reasons for the decreased preterm birth rate in the presence of placenta previa or unexplained vaginal bleeding among women with prenatal care include patient education for bed rest and early symptom recognition. The beneficial effects of prenatal care in chronic hypertension, pregnancy-induced hypertension, and placental abruption may be related to better control of blood pressure, early recognition, and timely intervention in cases of worsening maternal disease. The beneficial effects of prenatal care with respect to maternal anemia and diabetes may be due to appropriate diet with iron supplementation and blood sugar control, respectively. The beneficial effects of prenatal care in cases with a history of prior preterm or small-for-gestational-age birth, small-for-gestational-age fetus in the present pregnancy, or renal disease may be related to patient education with respect to adequate bed rest, appropriate diet, and maternal-fetal monitoring. Finally, another possible explanation for higher preterm birth rates among African American women may be lack of utilization or access to medical care and therefore lack of control of various preexisting diseases before pregnancy.

Previous studies have examined the timing and number of prenatal care visits to define adequacy of prenatal care.<sup>9</sup> In the current study, prenatal care was considered as a categorical variable (present vs absent). The rationale for using this definition is that patients with preterm birth have shorter gestations and therefore are expected to have fewer prenatal visits. Thus, the fewer prenatal visits may be the result rather than the cause for a short gestation. In addition, although we found a strong inverse dose-response relationship between the number of visits and preterm birth rate, we also found that there was a beneficial effect of only one visit. Errors in gestational age may have been more likely to occur in the no prenatal

care group. However, this may have resulted in overestimation of gestational age in the no prenatal care group, given the fact that anovulation and long cycles are the most frequent causes for erroneous estimation of gestational age. This possible overestimation of gestational age in the no prenatal care group would have actually strengthened our conclusions.

It should be emphasized that one of the strengths of the current study is the large number of included patients based on national data. Possible weaknesses is the underreporting of certain risk factors and complications, as well as the unavailability of certain known risk factors in the vital statistics data. Risk factors such as maternal stress, poor weight gain, long work hours, or drug abuse are factors known to be associated with increased preterm birth rates. However, such factors were unavailable in the vital statistics data set. Therefore, it is possible that our results may be biased due to residual confounding, and lack of prenatal care may simply serve as a marker for these high-risk behaviors, lifestyles, and conditions.

Notwithstanding these limitations, we conclude that in the United States prenatal care appears to be associated with fewer preterm births in the presence, as well as absence, of high-risk conditions for both African American and white women. Strategies to increase prenatal care participation, especially among African American women, are necessary to decrease the number of preterm births. Clearly, future studies are needed to identify the reasons for the persistence of the black-white disparity in the preterm birth rate.

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