Rates of Preterm Delivery among Black Women and White Women in the United States over Two Decades: An Age-Period-Cohort Analysis

Cande V. Ananth PhD, MPH

Dawn P. Misra MHS, PhD

John Smulian MD, MPH
Lehigh Valley Health Network, john.smulian@lvhn.org

William E. Scorza MD
Lehigh Valley Health Network, William_E.Scorza@lvhn.org

Robert A. Knuppel MD, MPH

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Rates of Preterm Delivery among Black Women and White Women in the United States over Two Decades: An Age-Period-Cohort Analysis

Cande V. Ananth,[1] Dawn P. Misra,[2] Kitaw Demissie,[3] and John C. Smulian[4]

The authors assessed the influence of age, period, and cohort effects on rates of preterm delivery in the United States. Rates of preterm delivery for singleton births (<37 weeks) in seven age groups (15–19, 20–24, …, 45–49 years), five periods (1975, 1980, 1985, 1990, 1995), and 11 maternal birth cohorts (1926–1930, 1931–1935, …, 1976–1980) were examined. Over the 20-year study interval, preterm delivery increased by 3.6% among Blacks (from 15.5% in 1975 to 16.0% in 1995) and by 22.3% among Whites (from 6.9% to 8.4%). Among Black primigravid women, rates of preterm delivery increased from 1975 to 1990 and began to decline thereafter; among Whites, the rates increased between 1975 and 1995. In Blacks, women aged 25–29 years had the lowest rates for the first and second births, and women aged 30–34 years had the lowest rate for subsequent births. In Whites, the age groups with the lowest preterm delivery rates were 20–24 years for first births and 25–29 years for subsequent births. Cohort-specific rates of preterm delivery remained fairly constant across age strata and periods for Whites, but a small trend was apparent for Blacks aged 30–44 years. The consistency of the observed age effects across periods and cohorts suggests that the age effect is partly due to biologic factors. The presence of period effects might be linked to the increased survival of premature infants or to increased viability among births occurring at lower lengths of gestation. *Am J Epidemiol* 2001; 154:657–65.

age factors; blacks; cohort effect; infant, premature; time factors; whites

In a classic age-period-cohort analysis, the goal is to examine these three closely related time factors simultaneously in order to determine the independent effects of any one of the factors. Two of these factors, age and period, are frequently the object of study, but they are seldom examined together, nor is maternal birth cohort usually considered. For example, a number of studies have examined the relation between maternal age and preterm delivery (1–4), but such studies have rarely included more than a few years of data, and most do not compare the effect of age across time periods. Examination of age effects on preterm delivery across maternal birth cohorts has also been neglected in studies of maternal age, since the data frequently are not conducive to such analyses. Studies of time periods report on trends in preterm delivery but do not consider how those trends may differ by maternal age or birth cohort. Finally, since age and gravidity are closely linked, the aging effect of the uterine environment (repeated pregnancies) adds another dimension to the age-period-cohort analysis.

These issues, in the context of preterm delivery, remain largely unexplored; yet examining these factors may reveal interesting patterns for further investigation. For example, if the effect of maternal age had changed across maternal birth cohorts, this would suggest an interaction between the mother's early childhood factors and her age at delivery, which might be important in the etiology of preterm delivery. If the effect of age changed across time periods, this might suggest that secular trends in other factors influenced the relation between maternal age and outcome. A similar conclusion would be reached if period effects were seen across age and birth cohorts. Therefore, we assessed whether rates of preterm delivery among Black women and White women in the United States over the past two decades (1975–1995) were influenced by effects of age, period, maternal birth cohort, or gravidity.

MATERIALS AND METHODS

We utilized data from the US national natality files assembled by the National Center for Health Statistics. These data comprise all births that occur in the 50 states and

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[1] Section of Epidemiology and Biostatistics, Department of Obstetrics, Gynecology and Reproductive Sciences, Robert Wood Johnson Medical School, University of Medicine and Dentistry of New Jersey (UMDNJ), New Brunswick, NJ.

[2] Department of Population and Family Health Sciences, School of Hygiene and Public Health, Johns Hopkins University, Baltimore, MD.

[3] Division of Epidemiology, School of Public Health, UMDNJ, New Brunswick, NJ.

[4] Division of Maternal-Fetal Medicine, Department of Obstetrics, Gynecology and Reproductive Sciences, Robert Wood Johnson Medical School/Saint Peter's University Hospital, UMDNJ, New Brunswick, NJ.

Correspondence to Dr. Cande V. Ananth, Robert Wood Johnson Medical School–UMDNJ, 125 Paterson Street, New Brunswick, NJ 08901-1977 (e-mail: ananthcv@epi.umdnj.edu).

the District of Columbia, which are sent to the National Center for Health Statistics for compilation under the Vital Statistics Cooperative Program (5). The natality files, produced annually, include statistical data from birth certificates. The data conform to uniform coding specifications and have passed statistical quality checks. They have been edited and reviewed, and they form the basis for official US birth statistics.

Data on pregnancies that resulted in singleton livebirths were abstracted for the years 1975, 1980, 1985, 1990, and 1995; this information formed the "period" data. Since the number of multiple births has been increasing in the United States over the past decade (6), we restricted the analysis to singleton pregnancies. Maternal age was grouped into 5-year intervals as 15–19, 20–24, 25–29, …, 45–49 years. There were few pregnancies among women aged <15 years, so we excluded these pregnancies in order to avoid instability in the analysis. Finally, mother's year of birth (the "cohort" set) was derived from the period of birth and the mother's age (cohort = period – age); this information was also grouped into 5-year categories (1926–1930, 1931–1935, …, 1976–1980). A unique feature of age-period-cohort analysis is that any two of these effects are sufficient to derive the third; this phenomenon has been discussed in the statistical literature in the context of the "identifiability" problem (7). For instance, women aged 25 years who gave birth in 1995 would chiefly belong to 1966–1970 maternal birth cohort.

Preterm delivery was defined as a pregnancy that ended before 37 completed weeks of gestation. For 95 percent of births, assignment of gestational age in these data was derived from the date of the last menstrual period, and in the remainder of births, it was either imputed or based on a clinical estimate of gestation (8). The clinical estimate was used if the date of the last menstrual period was inconsistent with birth weight; this was done for normal birth weight of apparently short gestation or full-term delivery with very low birth weight. The clinical estimate of gestation was based on the birth attendant's estimate, which is usually based on either the Dubowitz or Ballard assessment of gestational age. When reported birth weight was inconsistent with both the clinical estimate of gestation and the estimate based on the last menstrual period, the gestational age based on the last menstrual period was used if it was within 5 weeks of the clinical estimate, and birth weight was reclassified as "not stated." If the discrepancy was greater than 5 weeks, both gestational age and birth weight were reclassified as "not stated." The imputations and the replacement by clinical estimate were both performed by the National Center for Health Statistics (5, 8).

Data on gestational age for 1975, 1980, and 1985 differ from those for 1990 and 1995 in at least two respects. First, imputation of gestational age was performed for the latter two data sets (11.7 percent in 1990 and 9.0 percent in 1995) but not for the 1975, 1980, and 1985 periods. Second, replacement of inconsistent gestational age based on the last menstrual period by a clinical estimate of gestational age was also performed for the latter years (3.9 percent in 1990 and 5.1 percent in 1995) but not for the earlier periods. Since these differences are likely to have influenced rates of preterm delivery, we performed two sets of analysis. We first examined age, period, and cohort effects on preterm delivery using the data as they were, and in the second analysis we excluded the imputed and clinically estimated gestational ages from the 1990 and 1995 periods to examine the sensitivity of imputation and replacement of inconsistent gestational ages in the latter data. The results of both analyses were fairly similar, so in this paper we present the results from the first analysis.

For the years 1975, 1980, 1985, 1990, and 1995, there were 16,988,848 singleton livebirths in the United States. We sequentially excluded infants who weighed less than 500 g (n = 23,671) and those who were delivered prior to 20 completed weeks' gestation (n = 4,474) and births with missing data on gestational age (n = 1,671,931). The proportion of births with missing gestational age data declined with increasing period, and the proportion was greater among Blacks than among Whites for each period. In addition, there were 42,152 pregnancies to women aged <15 years; these were also excluded. The final data comprised 15,246,620 pregnancies that resulted in singleton livebirths.

RESULTS

Rates of preterm delivery increased 3.6 percent among Black women in the United States between 1975 (15.5 percent) and 1995 (16.0 percent). There was a corresponding 22.3 percent relative increase (from 6.9 percent to 8.4 percent) among White women during the same period. For Blacks, within each period, preterm delivery rates decreased as age increased (see table 1, reading from the lower left to the upper right, as indicated by the arrows), until they reached a nadir at age 25–29 years, and began to rise thereafter (figure 1). With the exception of teenagers, preterm delivery rates within each age stratum increased by period. The overall patterns of preterm delivery rates among Whites were similar to those of Black women (figure 2).

We also examined patterns in preterm delivery rates by birth cohort within strata of age. Rates of preterm delivery among Blacks were fairly constant for women under age 35 years, but a small increase in rates for women aged 35–44 years was apparent (figure 3). However, among Whites, there were virtually no cohort influences on preterm delivery (figure 4). Furthermore, for any combination of maternal age, period, and/or birth cohort, Blacks had approximately a twofold increased risk for preterm delivery compared with White women.

To further evaluate the independent contributions of age and gravidity, we examined effects of age and gravidity on rates of preterm delivery. Among Black primigravid women, with the exception of births to women aged 35 years or more, preterm delivery rates increased from 1975 to 1990 and then declined through 1995 (table 2). Among White primigravid women, preterm delivery rates consistently increased by period for all age groups, but no striking cohort effects were evident.

Among women of gravida 2 (i.e., in their second pregnancy), rates of preterm delivery showed similar overall pat-

TABLE 1. Distribution of livebirths by maternal age, maternal birth cohort, and year of delivery among Black and White women, United States, 1975–1995

Year of delivery (period)	Maternal age (years)							Maternal birth cohort
	15–19	20–24	25–29	30–34	35–39	40–44	45–49	
				Blacks				
							141	1926–1930
						1,972	114	1931–1935
					7,299	2,393	165	1936–1940
				18,242	12,014	3,375	196	1941–1945
			42,468	39,495	22,705	5,257	246	1946–1950
		72,845	82,636	67,916	33,296	7,318		1951–1955
	63,961	125,979	133,394	93,426	39,870			1956–1960
1975	87,424	184,301	158,654	90,304				1961–1965
1980	120,689	207,014	126,091					1966–1970
1985	145,663	174,893						1971–1975
1990	128,777							1976–1980
1995								
				Whites				
							480	1926–1930
						8,787	610	1931–1935
					40,600	12,279	723	1935–1940
				142,342	80,592	21,150	1,106	1941–1945
			370,021	333,761	164,663	37,515	1,839	1946–1950
		406,147	686,762	550,934	249,119	51,024		1951–1955
	176,175	706,521	950,881	706,803	298,046			1956–1960
1975	263,724	852,292	1,011,720	717,886				1961–1965
1980	302,647	809,138	837,664					1966–1970
1985	343,516	716,514						1971–1975
1990	337,902							1976–1980
1995								

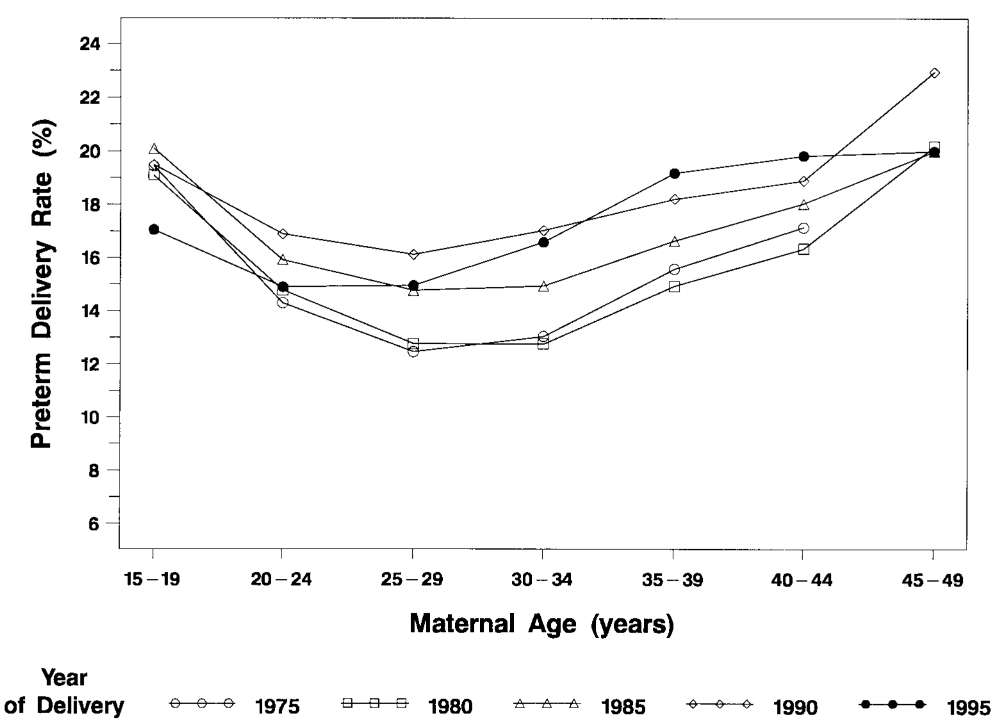

FIGURE 1. Rates of preterm delivery by maternal age and year of delivery (period) among Black women, United States, 1975–1995.

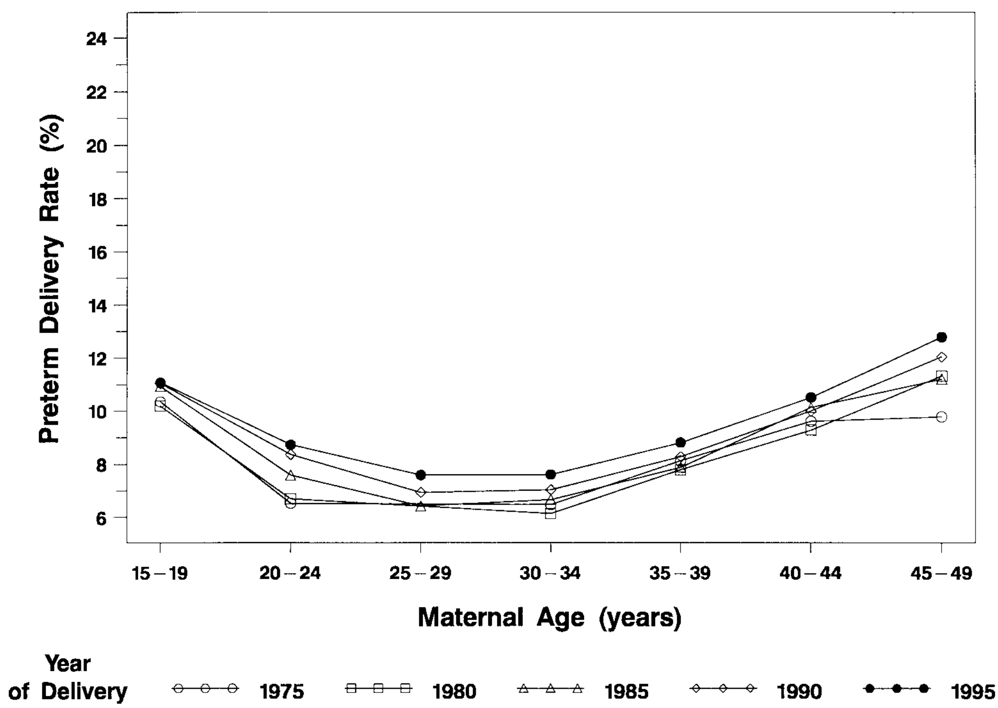

FIGURE 2. Rates of preterm delivery by maternal age and year of delivery (period) among White women, United States, 1975–1995.

terns in comparison with primigravid women (table 3). However, with the exception of teenage women, preterm delivery rates were lower for women of gravida 2 than for primigravid women. Within each age category, preterm delivery rates among Blacks increased until 1990 and fell in 1995, whereas among Whites, the rates continued to

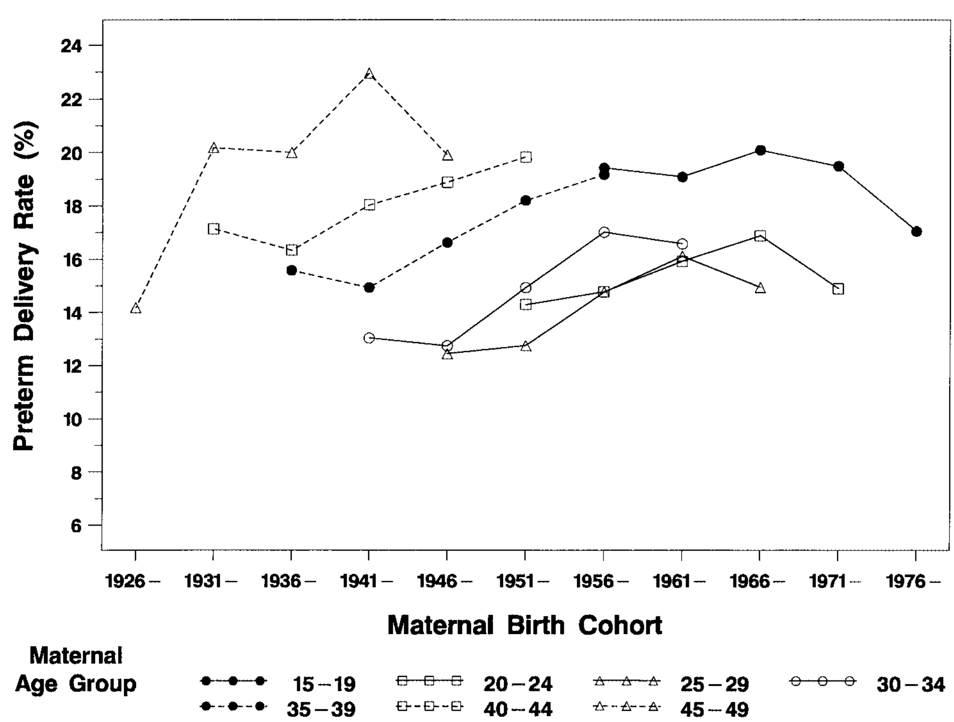

FIGURE 3. Rates of preterm delivery by maternal birth cohort and maternal age (years) among Black women, United States, 1975–1995.

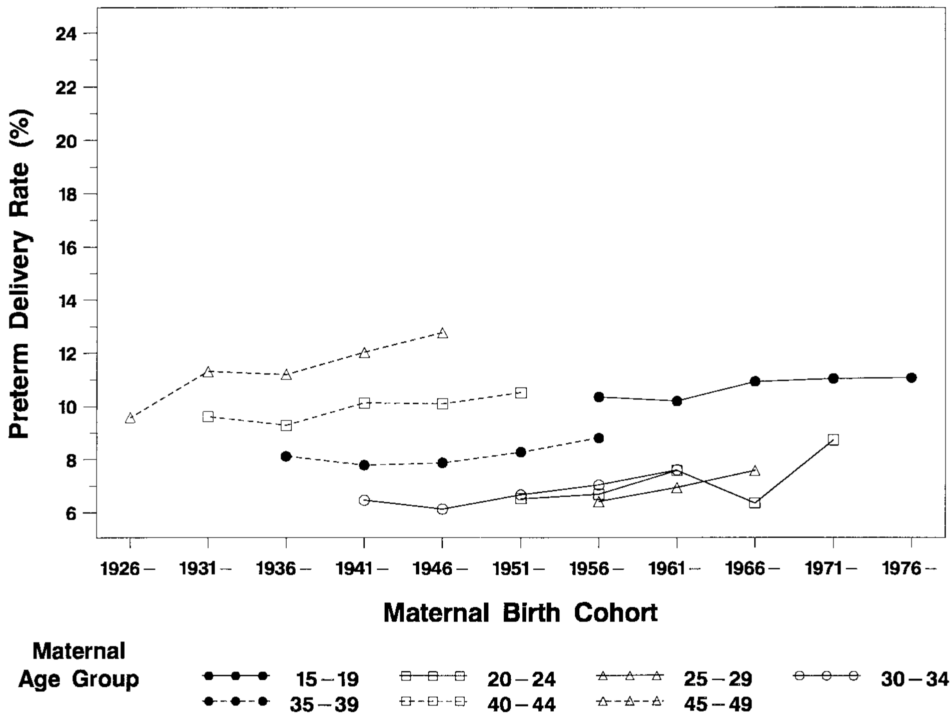

FIGURE 4. Rates of preterm delivery by maternal birth cohort and maternal age (years) among White women, United States, 1975–1995.

increase in all periods. The data did not reveal any patterns by birth cohort for either Blacks or Whites.

Rates of preterm delivery demonstrated a strong age and period effect among multigravid (gravida ≥3) women (table 4). In particular, within each period, the rates were "U"-shaped for both Blacks and Whites, with the lowest rates appearing in women aged 30–34 years. Once again, no appreciable cohort effects were evident.

DISCUSSION

Preterm delivery remains one of the leading causes of perinatal mortality. Despite impressive reductions in mortality over the past decade, preterm delivery has been increasing steadily in the United States among Whites; among Blacks, the rates increased up to 1992 but have been declining since (9). Conclusive explanations for these trends are still lacking. Examination of age, period, and cohort effects on preterm delivery may serve as a valuable epidemiologic tool for understanding the factors contributing to these trends. Noteworthy findings from our study include 1) strong age and period effects, 2) virtually no cohort effect among Whites but a slight trend among older Blacks, and 3) a substantial variation in preterm delivery rates between Black women and White women.

Extremes of maternal age are generally implicated as high-risk categories for preterm delivery. The effects of age are not purely biologic but rather encompass a social dimension as well. This is most evident with regard to teenage pregnancy. When social factors (such as poverty) that frequently accompany teenage pregnancy are controlled for in analyses, no substantial increase in the risk of adverse outcomes is observed (10). Older maternal age probably also represents both biologic and social factors. While there may be biologic differences between older mothers and those in their twenties related to reproductive aging, there are also sociodemographic disparities. Currently, older mothers in the United States have higher incomes and are more likely to be married (11). However, this was not always the case. The sociodemographic characteristics of older mothers have changed over time. In earlier decades, pregnancy after the age of 35 was extremely uncommon (12). In addition, such births rarely occurred to primiparous women but rather tended to occur as the last birth in a large family to a woman who perhaps began childbearing in her teens or twenties.

Changes in the characteristics of older mothers over time suggest that an analysis of age effects should include an examination of period of delivery. The persistence and consistency of age effects across periods and cohorts noted in our study suggests that the effect of maternal age is perhaps rooted more in biology than in social components of the age construct. The similarity of age effects across birth cohorts also suggests that external influences in a woman's early life do not have a measurable effect on the influence of maternal age. Finally, the development of chronic diseases might help explain the age effects on preterm delivery (13).

The age and gravidity effects observed in our data could also be used to test Geronimus' "weathering" hypothesis (14). Geronimus proposed that Blacks experience early

TABLE 2. Rates of preterm delivery (%) among Black and White primigravid women, by maternal age, maternal birth cohort, and year of delivery, United States, 1975–1995

Year of delivery (period)	Maternal age (years)							Maternal birth cohort
	15–19	20–24	25–29	30–34	35–39	40–44	45–49	
				Blacks				
							—*	1926–1930
						—	—	1931–1935
					14.4	—	—	1936–1940
				12.5	16.5	17.7	—	1941–1946
			10.6	13.0	18.8	20.3	—	1946–1950
		12.4	11.2	14.3	17.7	21.1		1951–1955
1975	18.3	12.6	13.1	15.2	18.2			1956–1960
1980	17.9	13.9	13.4	14.9				1961–1965
1985	19.1	13.9	13.0					1966–1970
1990	18.1	12.8						1971–1975
1995	16.2							1976–1980
				Whites				
							—	1926–1930
						9.5	—	1931–1935
					8.7	10.1	—	1936–1940
				6.7	9.2	12.2	—	1941–1945
			5.5	6.9	9.2	10.9	—	1946–1950
		6.1	6.1	7.7	9.8	12.0		1951–1955
1975	10.1	6.2	6.5	7.8	10.3			1956–1960
1980	9.9	7.1	6.9	8.4				1961–1965
1985	10.6	7.8	7.6					1966–1970
1990	10.7	8.3						1971–1975
1995	10.7							1976–1980

* Inadequate number of observations.

health deterioration ("weathering") as a consequence of social inequality (15). This weathering was hypothesized to explain 1) the increased risk of adverse outcomes with increasing age seen for Black women but not for White women, and 2) a widening of the racial disparity in pregnancy outcomes with increasing maternal age. To see how an age-period-cohort analysis can be used to test these hypotheses, we can consider the data for primigravid women. For each 5 years of period data, trends in preterm delivery by maternal age and race were examined. For all years, rates of preterm delivery among Blacks were higher at the extremes of maternal age, with the lowest risk being seen in the group aged 25–29 years (figure 1). The same pattern was also seen for White women (figure 2), which is inconsistent with the weathering hypothesis. Furthermore, the relative risk for preterm delivery in Blacks versus Whites also remained constant across age, period, and birth cohorts (data not shown).

Detection of period effects in rates of preterm delivery suggests that temporal changes might be examined for possible explanations for the trend. First, improvements in general socioeconomic conditions, nutrition, and obstetric practices are possible candidates. The strong period effects suggest that the etiology of preterm delivery is indeed related, at least partly, to factors that have varied over the past two decades. Second, a decrease in the rate of stillbirths in the United States may be another factor. Third, women who themselves were born preterm or with low birth weight are more likely to deliver offspring who are preterm or low birth weight, respectively (16, 17). These intergenerational effects may be the result of childhood deprivation or could also be the result of a genetic predisposition. For instance, mothers aged 15 years who delivered during the 1990 or 1995 period would have been born in 1975 or 1980, respectively. If these women were delivered preterm, they would have been more likely to deliver premature babies; that might account for part of the period effect noted here. This effect would probably become more pronounced over time as more preterm infants survived to reproduce. Unfortunately, the natality files do not contain enough information to allow examination of intergenerational effects.

Over four decades ago, Baird (18) proposed that several factors in a woman's early life—both in utero and postnatal—may affect her reproductive performance later in life. Within that context, several studies have attempted to examine the role of cohort effects on adverse pregnancy outcomes. Recently, Wilcox et al. (19) examined age, period,

TABLE 3. Rates of preterm delivery (%) among Black and White women of gravida 2 (second pregnancy), by maternal age, maternal birth cohort, and year of delivery, United States, 1975–1995

Year of delivery (period)	Maternal age (years)							Maternal birth cohort
	15–19	20–24	25–29	30–34	35–39	40–44	45–49	
				Blacks				
							—*	1926–1930
						—	—	1931–1935
					12.9	18.6	—	1936–1940
				10.8	13.7	16.9	—	1941–1945
			11.0	11.5	15.8	17.8	—	1946–1950
		13.9	11.5	13.7	17.4	18.8		1951–1955
	21.6	14.3	13.3	14.7	17.2			1956–1960
1975	20.7	15.3	13.6	13.8				1961–1965
1980	21.5	16.0	12.7					1966–1970
1985	20.8	14.0						1971–1975
1990	18.1							1976–1980
1995								
				Whites				
							—	1926–1930
						9.5	—	1931–1935
					7.4	8.6	—	1936–1940
				5.6	7.6	10.0	—	1941–1945
			5.0	5.6	7.6	10.3	—	1946–1950
		6.2	5.2	6.1	7.8	9.7		1951–1955
	11.0	6.5	5.7	6.4	8.2			1956–1960
1975	10.9	7.2	6.2	6.8				1961–1965
1980	11.6	7.9	6.8					1966–1970
1985	11.6	8.2						1971–1975
1990	11.8							1976–1980
1995								

* Inadequate number of observations.

and cohort effects on perinatal mortality in the Norwegian population. They hypothesized that unfavorable social conditions resulting from the occupation of Norway by Nazi Germany in the 1940s would be associated with poor perinatal survival, yet they found no evidence to support their hypothesis. The absence of cohort effects on preterm delivery rates among Whites in our study are in general agreement with those results (19). However, a small cohort effect among older Blacks (ages 30–44 years) was observed, the causes of which remain unknown and warrant careful examination.

Four important factors may have affected our results: increased registration of births near the borderline of viability, increased use of ultrasonography for gestational dating, antenatal referral patterns, and the influence of confounding effects of socioeconomic and behavioral factors on preterm delivery. With the rapid improvement in medical care facilities, physicians are more aware that babies delivered at 22–24 weeks and those weighing less than 500 g now have a good chance of survival, which thereby increases the proportion of infants delivered preterm. However, a recent study concluded that the increase in preterm delivery attributable to this phenomenon had a very small impact on preterm delivery (20). Since we excluded babies who weighed less than 500 g, it is unlikely that this could have affected our findings. As more women elect to undergo early ultrasonography, the dating of such pregnancies is becoming relatively more accurate in comparison with the 1970s. Effects of increasing use of ultrasonography for gestational dating (21) and inaccuracies in the estimation of gestational age (22) on vital statistics may have also influenced our findings to some extent.

In conclusion, the results of this study indicate 1) the presence of strong age and period effects on rates of preterm delivery in the United States; 2) virtually no cohort effect among Whites but a small trend among older Blacks; and 3) substantial variation in preterm delivery rates between Blacks and Whites. Among Blacks, women aged 25–29 years had the lowest rates of preterm delivery for first and second births, and women aged 30–34 years had the lowest rate for subsequent births. Among Whites, the age group with the lowest rate of preterm delivery at first birth was 20–24 years, and the age group with the lowest rates for second and subsequent pregnancies was 25–29 years. Further research should carefully examine the effects on preterm delivery of age, gravidity, and other factors that have changed over time.

TABLE 4. Rates of preterm delivery (%) among Black and White women of gravida ≥3 (third or later pregnancy), by maternal age, maternal birth cohort, and year of delivery, United States, 1975–1995

Year of delivery (period)	Maternal age (years)							Maternal birth cohort
	15–19	20–24	25–29	30–34	35–39	40–44	45–49	
				Blacks				
							—*	1926–1930
						16.9	—	1931–1935
					16.0	16.2	20.1	1936–1940
				13.7	15.0	18.2	22.9	1941–1945
			13.7	13.1	16.6	19.0	19.7	1946–1950
		16.7	14.0	15.5	18.5	19.9		1951–1955
	23.4	17.3	16.2	18.2	19.9			1956–1960
1975	23.0	18.3	18.3	18.1				1961–1965
1980	22.8	19.5	16.7					1966–1970
1985	22.8	17.0						1971–1975
1990	19.6							1976–1980
1995								
				Whites				
							9.6	1926–1930
						9.6	11.7	1931–1935
					8.2	9.3	11.2	1936–1940
				6.8	7.6	9.9	11.8	1941–1945
			6.4	6.2	7.7	9.8	11.9	1946–1950
		8.6	6.3	6.7	8.1	10.5		1951–1955
	13.1	8.3	7.0	7.1	8.7			1956–1960
1975	12.7	9.2	7.7	7.8				1961–1965
1980	13.0	9.9	8.3					1966–1970
1985	13.0	10.2						1971–1975
1990	12.9							1976–1980
1995								

* Inadequate number of observations.

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REFERENCES

1. Kessler I, Lancet M, Borenstein R, et al. The problem of the older primipara. Obstet Gynecol 1980;56:165–9.
2. Forman MR, Meirik O, Berendes HW. Delayed childbearing in Sweden. JAMA 1984;252:3135–9.
3. Barkan SE, Bracken MB. Delayed childbearing: no evidence for increased risk of low birth weight and preterm delivery. Am J Epidemiol 1987;125:101–9.
4. Berkowitz GS, Skovron ML, Lapinski RH, et al. Delayed childbearing and the outcome of pregnancy. N Engl J Med 1990;322:659–64.
5. MacDorman MF, Atkinson JO. Infant mortality statistics from the linked birth/infant death data set—1995 period data. (Monthly vital statistics reports, vol 46, no. 6 (suppl 2)). Hyattsville, MD: National Center for Health Statistics, 1998.
6. Jewell SE, Yip R. Increasing trends in plural births in the United States. Obstet Gynecol 1995;85:229–32.
7. Kupper LL, Janis JM, Karmous A, et al. Statistical age-period-cohort analysis: a review and critique. J Chronic Dis 1985;38:811–30.
8. Taffel S, Johnson D, Heuser R. A method of imputing length of gestation on birth certificates. (Vital and health statistics, series 2, no. 93). Hyattsville, MD: National Center for Health Statistics, 1982.
9. Ventura SJ, Martin JA, Curtin SC, et al. Births: final data for 1997. (National vital statistics reports, vol 47, no. 18). Hyattsville, MD: National Center for Health Statistics, 1999.
10. Strobino DM, Ensumiger ME, Kim YJ, et al. Mechanisms of maternal age differences in birth weight. Am J Epidemiol 1995;142:504–14.
11. Berkowitz TS, Papiernik E. Epidemiology of preterm births. Epidemiol Rev 1993;15:414–43.
12. Ventura SJ. Trends and variations in first births to older women, United States, 1970–86. (Vital and health statistics, series 21, no. 47). Hyattsville, MD: National Center for Health Statistics, 1989.
13. Misra DP, Grason HG, Weisman C. An intersection of women's and perinatal health: the role of chronic conditions. Womens Health Issues 2000;10:256–67.
14. Geronimus AT. The weathering hypothesis and the health of African-American women and infants: evidence and speculations. Ethn Dis 1992;2:207–21.
15. Geronimus AT. Black/white differences in the relationship of maternal age to birthweight: a population-based test of the weathering hypothesis. Soc Sci Med 1996;42:589–97.

16. Alberman E, Emmanuel I, Filakti H, et al. The contrasting effects of parental birthweight and gestational age on the birthweight of offspring. Paediatr Perinat Epidemiol 1992;6:134–44.
17. Skjaerven R, Wilcox AJ, Oyen N, et al. Mothers' birth weight and survival of their offspring: population based study. BMJ 1997;314:1376–80.
18. Baird D. Social class and foetal mortality. Lancet 1947;2:531–5.
19. Wilcox AJ, Skjaerven R, Irgens LM. Harsh social conditions and perinatal survival: an age-period-cohort analysis of the World War II occupation of Norway. Am J Public Health 1994;84:1463–7.
20. Kramer MS, Platt R, Yang H, et al. Secular trends in preterm birth: a hospital-based cohort study. JAMA 1998;280:1849–54.
21. Kramer MS, McLean FH, Boyd ME, et al. The validity of gestational age estimation by menstrual dating in term, preterm and postterm gestations. JAMA 1988;260:3306–8.
22. Gjessing HK, Skjaerven R, Wilcox AJ. Errors in gestational age: evidence of bleeding early in pregnancy. Am J Public Health 1999;89:213–18.