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Changes in Prenatal Care Timing and Low Birth Weight by Race and Socioeconomic Status: Implications for the Medicaid Expansions for Pregnant Women

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Objective. To conduct the first national study that assesses whether the Medicaid expansions for pregnant women, legislated by Congress over a decade ago, met the policy objectives of improved access to care and birth outcomes for poor and near-poor women.

Data Sources/Study Setting. Data on 8.1 million births using the 1980, 1986, and 1993 National Natality Files. We use births from all areas of the United States except California, Texas, Washington, and upstate New York.

Methods. We conduct a before and after analysis that compares obstetrical outcomes by race and socioeconomic status for the periods 1980–86 and 1986–93. We examine whether women of low socioeconomic status showed greater improvements in outcomes during the 1986–93 period compared to the 1980–86 period. We analyze two obstetrical outcomes: the rate of late initiation of prenatal care and the rate of low birth weight.

Data Collection. Natality data were aggregated to race, socioeconomic status, age, and parity groups.

Results. During the 1986–93 period, rates of late initiation of prenatal care decreased by 6.0 to 7.8 percentage points beyond changes estimated for the 1980–86 period for both white and African American women of low socioeconomic status. For some white women of low socioeconomic status, the rate of low birth weight was reduced by 0.26 to 0.37 percentage points between 1986 and 1993 relative to the earlier period. Other white women of low socioeconomic status and all African American women of low socioeconomic status showed no relative improvement in the rate of low birth weight during the 1986–93 period.

Conclusions. The expansions in Medicaid lead to significant improvements in prenatal care utilization among women of low socioeconomic status. The emerging lesson from the Medicaid expansions, however, is that increased access to primary care is

not adequate if the goal is to narrow the gap in newborn health between poor and nonpoor populations.

Key Words. Medicaid, pregnant women, access, outcomes

Significant differences in the incidence of adverse birth outcomes by race and socioeconomic status have long characterized infant health in the United States (Kleinman and Kessel 1987; Schoendorf et al. 1992). These differences have been attributed, in part, to inadequate access to prenatal care services (IOM 1985). Spurred by these disparities and by the United States' low international ranking in infant mortality, Congress extended Medicaid coverage to poor and near-poor pregnant women and infants through a series of legislative reforms between 1986 and 1990. Despite subsequent increases in Medicaid participation rates and declines in the numbers of deliveries to uninsured women, evaluations of the expansions have reported inconsistent evidence regarding whether prenatal care use increased and have found virtually no improvement in birth outcomes (Piper, Ray, and Griffin 1990; Haas et al. 1993; Piper, Mitchel, and Ray 1994a; Currie and Gruber 1996; Ray, Mitchel, and Piper 1997).

Published evaluations of the effects of Medicaid expansions, however, have limitations. In the only national study published to date, researchers tested whether state low birth weight and infant mortality rates were correlated with the proportion of women eligible for Medicaid in that state but did not control for potential confounding from time-varying factors that affect birth outcomes of poor and nonpoor women differently (Currie and Gruber 1996). All other evaluations have been conducted in individual states in an effort to exploit linkages between birth certificates and Medicaid administrative files or discharge abstracts that are not available at the national level. Some

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of these more narrowly focused evaluations may have had limited power to detect statistically significant effects because they examined small incremental changes in Medicaid or included relatively few women affected by the expansions (Piper, Ray, and Griffin 1990; Haas et al. 1993; Piper, Mitchel, and Ray 1994a). Other evaluations did not address temporal confounding (Ray, Mitchel, and Piper 1997; Long and Marquis 1998).

A national evaluation of the Medicaid expansions for pregnant women and infants based on well-defined treatment and control groups has been difficult to accomplish for two reasons: first, there are no nationally representative data with information on family income, insurance status, and birth outcomes necessary for defining treatment and control groups; second, even assuming the requisite data existed, an appropriate comparison group would be difficult to define. The Medicaid expansions were not limited to increases in income eligibility thresholds. Improvements in the eligibility determination process, increased fees, and reimbursement for enhanced prenatal care services affected women already covered by Medicaid as well as women eligible but not covered. Thus, one potential control group—women on Medicaid prior to the expansions—was likely affected by the reforms.

To evaluate whether the Medicaid expansions achieved the policy objective of increased access to care and improved birth outcomes among poor and near-poor women, we conducted a before and after analysis using national natality files to compare rates of delayed initiation of prenatal care and rates of low birth weight by race and socioeconomic status for the periods 1980–86 and 1986–93. If the extensive changes in Medicaid that took place between 1986 and 1993 were effective, we would expect to find improvements in obstetrical outcomes among women of low socioeconomic status between 1986 and 1993 that exceeded changes observed in this group between 1980 and 1986, a period of no major programmatic changes in Medicaid. As an alternative comparison, we contrasted changes in obstetrical outcomes between 1986 and 1993 for women of low and high socioeconomic status, since the latter were unaffected by changes in the Medicaid program.

METHODS

Data

Data for this study come from birth certificates in the United States for the years 1980, 1986, and 1993 compiled by the National Center for Health Statistics (Detail Natality Files). We include all singleton births to white and

African American mothers residing in the United States. We eliminate births to mothers of "other races" that account for approximately 5 percent of all births nationally and thus represented too few cases to analyze separately. We include all singleton births from all areas of the United States except California, Texas, Washington, and upstate New York. Birth certificates in the first three states lack information on maternal schooling, and birth certificates from upstate New York lack information on marital status. Births in the three states excluded accounted for 22.5 percent of all births in 1993. The pattern of birth outcomes in the omitted states is similar to those of the country as a whole (Kleinman and Kessel 1987).

Obstetrical Outcomes

We analyze two outcomes: the percentage of women who initiate prenatal care after the first trimester (this measure includes women who receive no care) and the percentage of low birth weight births. We examine birth weight instead of gestational age because relatively few births have missing information on birth weight and because the reporting of birth weight over the study period is consistent. Gestational age is missing for a substantial proportion of births in 1980. In addition, increased utilization of sonography may have altered gestational age assessments over time, which may introduce spurious change to our trend analysis. Furthermore, U. S. birth certificates began reporting the clinician's estimate of gestation in 1989. Use of the clinical estimate of gestation to edit the natality data after 1989 may introduce an additional source of bias (National Center for Health Statistics 1995). Similarly, we use the timing of the first prenatal care visit and not a more comprehensive index of prenatal care utilization because of the relatively large and changing proportion of cases with missing data over the study period (details available from the authors) (Kotelchuck 1994). Finally, we do not analyze infant mortality because of the potential confounding from the dramatic changes in perinatal medicine, in particular the introduction of surfactant, that have had a major impact on newborn survival during the period of the Medicaid expansions (Schwartz et al. 1994).

Measuring Socioeconomic Status

We classify mothers by socioeconomic status based on marital status and years of completed schooling. We use this approach because marital status and education are primary determinants of socioeconomic status and because income and insurance coverage are unavailable in our data. We create six

socioeconomic categories of mothers: married with less than 12 years of completed schooling; unmarried with less than 12 years of completed schooling; married with between 12 and 15 years of completed schooling; unmarried with between 12 and 15 years of completed schooling; married with at least 16 years of completed schooling; and unmarried with at least 16 years of completed schooling.

We use data from the 1987 and 1994 Current Population Survey (CPS) on women with infants to assess whether our six categories of women are a valid proxy for socioeconomic status and Medicaid participation. The CPS is a national probability sample of approximately 60,000 U. S. households conducted monthly by the U. S. Bureau of Labor Statistics. The March interview collects information on both income and health insurance coverage in the past year. We examine the subsample of women with infants at the time of the March survey because they were pregnant during the proceeding year. We find that our categorization does effectively sort women by socioeconomic status and that it can be used to identify groups of women likely to be affected by the Medicaid expansions.

Table 1 presents information on the percentage of women with incomes below 133 percent of the federal poverty line (FPL) and 185 percent of the FPL by group. We chose to present the distribution based on these two cutoffs because the expansions mandated coverage of women with incomes up to 133 percent of the FPL and many states took advantage of the federal option to cover women with incomes up to 185 percent of the FPL. Thus, together these categories constitute a good proxy for Medicaid eligibility. As can be seen in Table 1, eligibility for Medicaid varied across the six groups. (Unmarried women with 16 or more years of education are excluded from this analysis

Table 1: Income Distribution of Pregnant Women, 1993

	Percentage with Incomes Below 133 Percent FPL	*Percentage with Incomes Below 185 Percent FPL*
Unmarried, <12 years education	100	100
Married, <12 years education	72	86
Unmarried, 12–15 years education	85	92
Married, 12–15 years education	21	37
Married, 16+ years education	4	8

Source: Authors' tabulations of March 1987 and 1994 CPS. Pregnant women are defined as women with an infant at the time of the March Survey. Unmarried women with 16 or more years of education are excluded from this analysis because their sample size on the CPS does not support reliable estimates.

because their sample size on the CPS does not support reliable estimates.) Virtually all unmarried women with less than a high school education would have been eligible for Medicaid in 1993. In contrast, only 4–8 percent of married women with 16 or more years of schooling would have been eligible.

Changes in Medicaid enrollment also varied across the six groups over the expansion period, as can be seen in Table 2. For instance, between 1986 and 1993, the years pertaining to the 1987 and 1994 CPS surveys, respectively, participation in Medicaid increased by 22 percentage points among unmarried women with less than a high school degree (from 55 to 78 percent), by 29 percentage points among married women with less than a high school degree (from 19 to 48 percent), and by 28 percentage points among unmarried women with 12 to 15 years of completed schooling (from 43 to 71 percent). Participation among married women with 12 to 15 years of completed schooling also increased by 11 percentage points (from 6 to 17 percent). In contrast, women with 16 or more years of education increased their participation in Medicaid by less than two percentage points (from 1 to 3 percent) (authors' tabulations based on the March 1994 CPS).

Based on the analysis of the CPS data, we expect to observe improvements in prenatal care use and birth outcomes as a result of the expansions principally among women of low socioeconomic status: married women with less than 12 years of schooling; unmarried women with less than 12 years of schooling; and unmarried women with 12 to 15 years of schooling. Women in these groups had relatively large increases in Medicaid participation over the expansion period and relatively high levels of participation in 1986. While

Table 2: Changes in Medicaid Coverage of Pregnant Women, 1986–93

	Percentage of Women with Medicaid Coverage 1986	*Percentage of Women with Medicaid Coverage 1993*	*Percentage Point Change*
Unmarried, <12 years education	55	78	22
Married, <12 years education	19	48	29
Unmarried, 12–15 years education	43	71	28
Married, 12–15 years education	6	17	11
Married, 16+ years education	1	3	2

Source: Authors' tabulations of March 1987 and 1994 CPS. Pregnant women are defined as women with an infant at the time of the March Survey. Unmarried women with 16 or more years of education are excluded from this analysis because their sample size on the CPS does not support reliable estimates.

participation in Medicaid also increased among married women with 12 to 15 years of schooling, effects for this group will be smaller and more difficult to detect because proportionately fewer women were enrolled in Medicaid in 1986 and increases in participation were not as large. We may, however, observe more effects from the expansions for married African American women with a high school education or some college relative to white women since a larger percentage of African American women in this group have incomes below 185 percent of poverty (details available from the authors).

Statistical Analysis

We first present obstetrical outcomes at three points in time: 1980, 1986, and 1993. The years 1986 and 1993 bracket the implementation of the major changes in Medicaid embodied in the Omnibus Reconciliation Acts of 1985, 1986, 1987, and 1989 and the Medicare Catastrophic Care Act of 1988 (Frost et al. 1993). This series of legislation eventually mandated that states cover pregnant women with incomes up to 133 percent of the FPL under the Medicaid program and allowed states to cover women with incomes up to 185 percent of the FPL. In addition, many states took advantage of the option to cover "enhanced services," such as smoking cessation as well as nutritional and psychosocial counseling under Medicaid (Frost et al. 1993). States were also permitted to make changes to their enrollment systems to facilitate more timely enrollment for pregnant women. Finally, states were required to raise fees for obstetricians to levels that were adequate to ensure access to care comparable to that of privately insured women. In contrast, no major Medicaid program initiatives affected pregnant women between 1980 and 1986.

We begin the analysis by comparing changes in obstetrical outcomes between 1986 and 1993 by socioeconomic strata and race. If the Medicaid expansions were effective, we should observe improvements in prenatal care and low birth weight among women of low relative to high socioeconomic status. The difference in outcomes between 1986 and 1993, however, may not measure the effects of the Medicaid expansions due to confounding from *time-varying* factors over this period. To address this possibility, we use changes in outcomes between 1980 and 1986 within socioeconomic strata as estimates of changes that would have occurred between 1986 and 1993 had the Medicaid expansions not been implemented. Specifically, we subtract the difference in outcomes between 1980 and 1986 from the difference in outcomes between 1986 and 1993 within socioeconomic strata as a means of reducing confounding from time-varying factors. We refer to these estimates

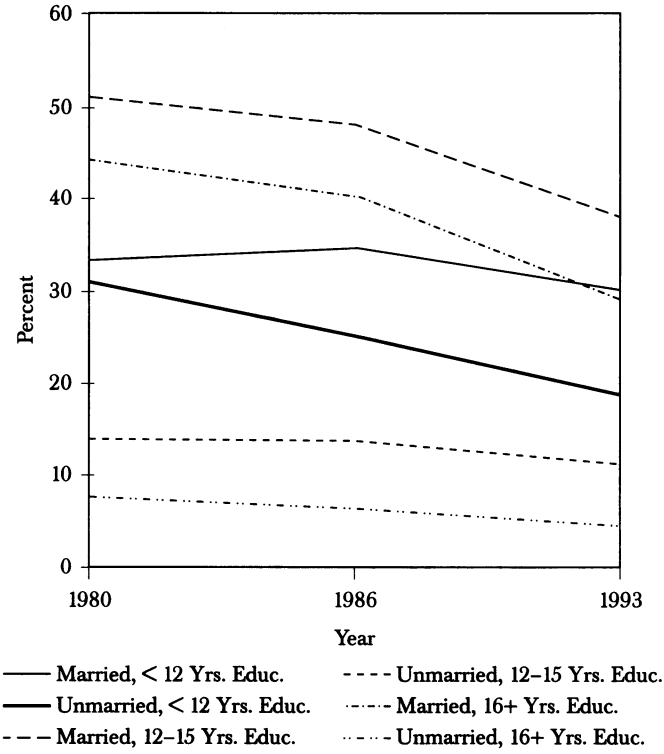
as "difference in differences" within socioeconomic strata (Gruber 1994; Joyce and Kaestner 1996).

The secular decline in smoking during pregnancy offers a good illustration of potential confounding. We could not control for changes in the prevalence of smoking during pregnancy over the period because data on smoking are only available on national natality files after 1988 and may be of questionable quality. From 1989 to 1993 the percentage of women who smoked during pregnancy fell from 36 to 31 percent among white, married women with less than 12 years of schooling. The prevalence of smoking during pregnancy for this same group of women was 43 percent in 1980, based on data from the National Natality Survey (Kleinman and Kopstein 1987). Thus, the decline in smoking over the 13 years of our study appears substantial. As long as the percentage point decline in smoking was relatively constant within a group between 1980 and 1993, as it appears to be, subtracting changes in outcomes between 1980 and 1986 from changes between 1986 and 1993 will minimize confounding from smoking.

To assess whether further confounding exists, we also present changes in obstetrical outcomes for married women with 16 or more years of schooling. This group of highly educated women is unlikely to be eligible for Medicaid. Consequently, we should not observe improvements in early initiation of prenatal care and rates of low birth weight among highly educated married women between 1986 and 1993 adjusted for trends between 1980 and 1986. Should we find similar changes in our outcomes among women of high and low socioeconomic status between 1986 and 1993 adjusted for trends, we would conclude that changes in outcomes associated with the Medicaid expansions were indistinguishable from factors affecting outcomes of all women.

An alternative strategy to minimize confounding is to subtract changes in obstetrical outcomes between 1986 and 1993 among women of high socioeconomic strata from changes in outcomes among women of low socioeconomic strata over the same period. We refer to this as difference in differences across strata. The advantage of this approach is that we eliminate confounding due to time-varying factors specific to the years 1986–93 that affect all women equally. The disadvantage of using difference in differences across strata is that we must assume that changes in obstetrical outcomes among married, college-educated women, for example, are a good counterfactual for changes that would have occurred among unmarried women with much less schooling. For whites, trends in prenatal care and low birth weight by socioeconomic strata are not consistent with this assumption. We observe, for example,

Figure 1: Percentage of White Women Initiating Prenatal Care After the First Trimester

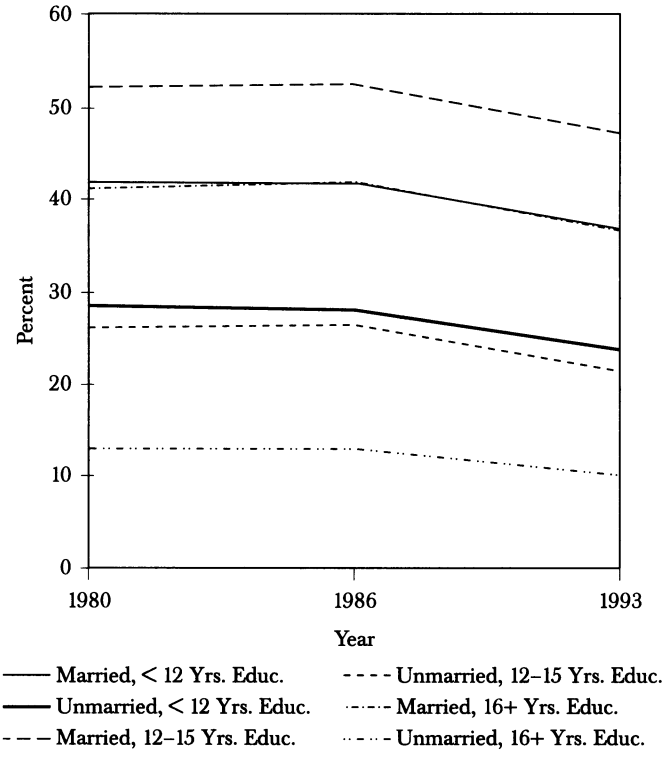


noticeable declines in delayed initiation of prenatal care (Figure 1) and low birth weight (Figure 2) between 1980 and 1986 among unmarried women regardless of schooling and almost no change among married women. For African Americans, the pattern of change in outcomes between 1980 and 1986 is more consistent across socioeconomic strata (Figures 3 and 4).

Our preferred strategy for minimizing confounding is to use difference in differences within socioeconomic strata. We recognize that the identifying assumption of this approach—that changes between 1980 and 1986 are a good proxy for what would have occurred in the absence of the Medicaid policy changes—is not testable. Consequently, we also discuss estimates based on difference in differences across socioeconomic strata for the period 1986–93.

The analysis is based on 6.6 million births for whites and 1.5 million births for African Americans. To facilitate computation, we aggregate the

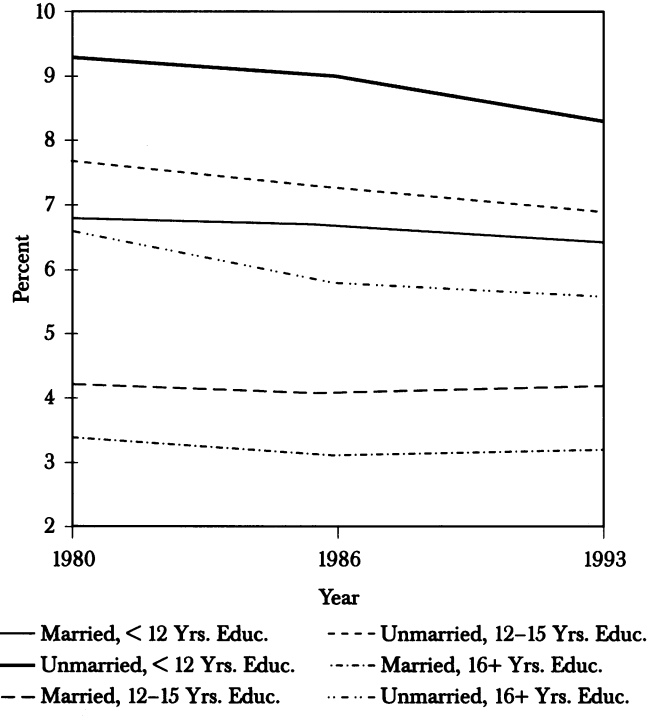
Figure 2: Percentage of African American Women Initiating Prenatal Care After the First Trimester



individual data into 360 mutually exclusive cells based on three years, six socioeconomic groups, five age groups, two parity groups, and two racial groups. The five age categories are younger than 20, 20–24, 25–29, 30–34, and 35 and older. For parity we distinguish between first and higher order births.

We estimate separate models for each race and socioeconomic stratum. We estimate race-specific models because of the known disparities in outcomes by race within socioeconomic strata (Schoendorf et al. 1992). An additional reason we stratify by race is that evidence from the CPS suggests that income and thus Medicaid eligibility varies by race within stratum. Each model includes controls for year, age, parity, and age and parity interactions. Observations missing parity are dropped from the multivariate analysis. Inclusion of these observations did not change our results appreciably. These

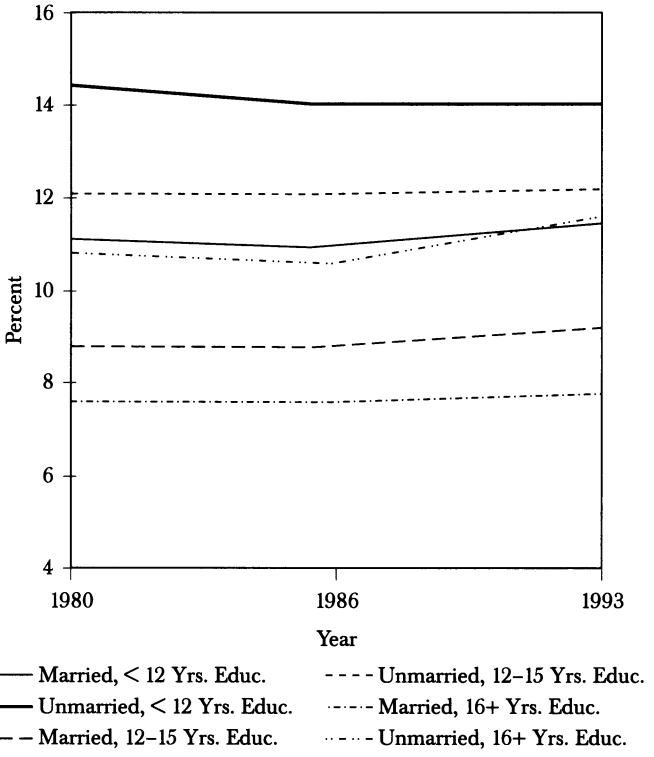
Figure 3: Percentage of White Women with Low Birth Weight Births



specifications are used to test whether changes in obstetrical outcomes between 1986 and 1993 differed from changes between 1980 and 1986 within race and socioeconomic strata.

We use maximum likelihood methods to estimate parameters of the model. We assume the random component of each individual outcome follows a binomial distribution. We apply an identity link function to relate the expected value of the outcome to the explanatory variables (Agresti 1996). We use an identity link function instead of the commonly used logistic link function in order to present percentage point differences in outcomes as measures of association rather than odds ratios. Inferences are not sensitive to the choice of link function. We use the generalized linear models (GLM) procedure in STATA, a comprehensive statistical software package (release 5), to obtain estimates and standard errors (StataCorp 1997).

Figure 4: Percentage of African American Women with Low Birth Weight Births



RESULTS

Differences in Outcomes by Socioeconomic Status

Table 3 presents data for 1980, 1986, and 1993 on the percentage of women initiating prenatal care after the first trimester by race and socioeconomic status for the study states. Differences in delayed initiation of prenatal care by socioeconomic strata are large. Among whites, the percentage of women initiating prenatal care after the first trimester ranges from 38.3 percent in 1993 to 51.0 percent in 1980 for unmarried women with less than 12 years of education and ranges from 5.0 percent in 1993 to 7.8 percent in 1980 for married women with more than 16 years of education . For both whites and African Americans, differences by marital status are particularly

striking, even among women with 16 or more years of schooling. In 1993, for instance, highly educated, unmarried women, regardless of race, were about 14 percentage points more likely to initiate prenatal care late, after the first trimester, as compared to their married counterparts.

In Table 4 we present data on the percentage of low birth weight births by race, year, and socioeconomic status. Again a notable pattern is the dramatic difference in outcomes by marital status. Among African Americans, there is approximately a three percentage point difference in the rate of low birth weight by marital status within each educational strata; for whites the difference is about 2.3 percentage points. For example, the rate of low birth weight for children born to married African American women with less than 12 years of completed schooling was 10.9 percent in 1986 but 14.0 percent for those born to unmarried women with the same level of schooling in that year. Based on the same comparison for whites, the rate of low birth weight was 6.7 and 9.0 percent for married and unmarried women, respectively.

Trends in Outcomes by Socioeconomic Status

Temporal variation in delayed initiation of prenatal care and low birth weight by race and socioeconomic strata are illustrated in Figures 1–4. The proportion of women initiating prenatal care after the first trimester declines between 1980 and 1993 for all 12 groups. The declines, however, are not the same across strata. Among whites, for example, there is a marked downturn between 1986 and 1993 for unmarried women with less than 16 years of schooling. Yet, among white women who have completed college, there is no change in delayed initiation of prenatal care after 1986. A similar pattern is evident for unmarried African American women also with less than 16 years of schooling. In contrast to whites, the proportion of births to women who begin care after the first trimester declines among all six groups of African American women, although the downturn is more pronounced and is therefore relatively greater among women with less schooling.

Trends in low birth weight for whites and African Americans are shown in Figures 3 and 4. Among whites, rates of low birth weight are essentially flat between 1980 and 1993 for children born to women with 12 or more years of schooling. Only among children born to unmarried women with less than 12 years of schooling is there a noticeable decline in the incidence of low birth weight after 1986. For African Americans, there is little visual evidence that the rate of low birth weight declined more between 1986 and 1993 than between 1980 and 1986. In fact, rates of low birth weight among several groups of African American women rise after 1986.

Table 3: Percentage of Women Initiating Prenatal Care After the First Trimester and Percent Distribution of Births by Race and Socioeconomic Status, 1980, 1986, and 1993

	Whites					
	1980		*1986*		*1993*	
Outcome/ Socioeconomic Indicator	*Mean Percentage*	*Percent Distribution*	*Mean Percentage*	*Percent Distribution*	*Mean Percentage*	*Percent Distribution*
Prenatal care after 1st trimester	$N = 2{,}111{,}253$		$N = 2{,}182{,}428$		$N = 2{,}196{,}806$	
Unmarried, <12 years education	51.0	5	48.2	7	38.3	9
Married, <12 years education	33.2	15	34.7	11	30.2	8
Unmarried, 12–15 years education	44.2	5	40.3	7	29.0	12
Married, 12–15 years education	14.1	59	14.0	56	11.3	47
Unmarried, 16+ years education	31.2	0	24.9	0	18.8	1
Married, 16+ years education	07.8	15	06.6	19	05.0	22
	African Americans					
	1980		*1986*		*1993*	
	Mean Percentage	*Percent Distribution*	*Mean Percentage*	*Percent Distribution*	*Mean Percentage*	*Percent Distribution*
Prenatal care after 1st trimester	$N = 431{,}200$		$N = 472{,}398$		$N = 522{,}299$	
Unmarried, <12 years education	51.9	27	52.3	26	47.2	27
Married, <12 years education	41.6	9	42.0	5	36.6	3
Unmarried, 12–15 years education	40.9	29	42.1	35	36.5	41
Married, 12–15 years education	26.2	29	26.5	26	21.0	20
Unmarried, 16+ years education	28.5	1	28.0	1	23.4	2
Married, 16+ years education	13.1	5	13.3	6	10.0	6

Source: 1980, 1986, 1993 National Natality Files. Tabulations exclude births from California, Texas, Washington, and upstate New York.

Note: Percentage initiating care after the first trimester includes those with no care. Percentages may not add to 100 due to rounding.

Table 4: Percentage of Women With Low Birth Weight Births and Percent Distribution of Births by Race and Socioeconomic Status, 1980, 1986, and 1993

Whites						
	1980		*1986*		*1993*	
Outcome/ Socioeconomic Indicator	*Mean Percentage*	*Percent Distribution*	*Mean Percentage*	*Percent Distribution*	*Mean Percentage*	*Percent Distribution*
Low birth weight	$N = 2{,}150{,}385$		$N = 2{,}213{,}534$		$N = 2{,}232{,}728$	
Unmarried, <12 years education	9.3	5	9.0	7	8.3	9
Married, <12 years education	6.8	15	6.7	11	6.4	8
Unmarried, 12–15 years education	7.7	5	7.3	7	6.9	12
Married, 12–15 years education	4.2	59	4.1	56	4.2	47
Unmarried, 16+ years education	6.6	0	5.8	0	5.6	1
Married, 16+ years education	3.4	15	3.1	19	3.2	22
African Americans						
	1980		*1986*		*1993*	
	Mean Percentage	*Percent Distribution*	*Mean Percentage*	*Percent Distribution*	*Mean Percentage*	*Percent Distribution*
Low birth weight	$N = 445{,}411$		$N = 485{,}969$		$N = 539{,}384$	
Unmarried	14.4	28	14.0	27	14.0	28
Married, <12 years education	11.1	9	10.9	5	11.5	3
Unmarried, 12–15 years education	12.1	29	12.1	35	12.2	41
Married, 12–15 years education	8.8	28	8.8	26	9.2	20
Unmarried, 16+ years education	10.8	1	10.6	1	11.6	2
Married, 16+ years education	7.6	5	7.6	6	7.8	6

Source: 1980, 1986, 1993 National Natality Files. Tabulations exclude births from California, Texas, Washington, and upstate New York.

Note: Percentages may not add to 100 due to rounding.

Table 5: Percentage Point Changes in the Percent of Women Initiating Prenatal Care After the First Trimester and in the Percent of Women with Low Birth Weight Births by Socioeconomic Status, Whites

Outcome/ Socioeconomic Indicator	Δ *1980–1986* *(1)*	Δ *1986–1993* *(2)*	*Difference in Differences* *(3)*	*CI of DD* *(4)*
Prenatal care after 1st trimester				
Unmarried, <12 years education	−2.7*	−10.0*	−7.3*	*−8.0 to −6.7*
Married, <12 years education	1.6*	−4.1*	−5.8*	*−6.2 to −5.3*
Unmarried, 12–15 years education	−3.5*	−11.2*	−7.7*	*−8.3 to −7.1*
Married, 12–15 years education	0.2*	−2.3*	−2.5*	*−2.6 to −2.3*
Unmarried, 16+ years education	−5.4*	−5.7*	−0.3	*−2.6 to 2.0*
Married, 16+ years education	−1.3*	−1.6*	−0.4*	*−0.6 to −0.2*
Low birth weight				
Unmarried, <12 years education	−0.35*	−0.73*	−0.38*	*−0.73 to −0.02*
Married, <12 years education	−0.01	−0.29*	−0.29*	*−0.54 to −0.06*
Unmarried, 12–15 years education	−0.54*	−0.55*	0.00	*−0.31 to 0.31*
Married, 12–15 years education	−0.10*	0.07*	0.17*	*0.09 to 0.26*
Unmarried, 16+ years education	−0.85**	−0.30	0.55	*−0.70 to 1.80*
Married, 16+ years education	−0.36*	−0.02	0.33*	*0.20 to 0.46*

Source: 1980, 1986, 1993 National Natality Files. Tabulations exclude births from California, Texas, Washington, and upstate New York.

Note: Percentage of women initiating prenatal care after first trimester includes those with no care. Percentage point changes were obtained by maximum likelihood estimation of a linear probability model. Figures are based on coefficients (columns 1 and 2) or linear combinations of coefficients (column 3) on the indicator variables for year. We estimate separate models for each socioeconomic stratum and adjust for maternal age, parity, and age and parity interactions. Observations missing parity were excluded.

In Tables 5 and 6, we present statistical tests of whether prenatal care timing and low birth weight improve more during the period of the Medicaid expansions (1986–93) than in the pre-expansion period (1980–86) for whites and African Americans, respectively. Estimates in Tables 5 and 6 have been adjusted for age, parity, and age and parity interactions. In column one of each table we show percentage point differences in outcomes between 1980 and 1986. Figures in column two are differences in outcomes between 1986 and 1993. Column three shows the difference in differences from 1980 to 1986 subtracted from that between 1986 and 1993. For example, the proportion of white, unmarried women with less than 12 years of schooling who initiate

Table 6: Percentage Point Changes in the Percent of Women Initiating Prenatal Care After the First Trimester and in the Percent of Women with Low Birth Weight Births by Socioeconomic Status, African Americans

Outcome/ Socioeconomic Indicator	Δ *1980–1986* *(1)*	Δ *1986–1993* *(2)*	*Difference in Differences* *(3)*	*CI of DD* *(4)*
Prenatal care after 1st trimester				
Unmarried, <12 years education	0.2*	−5.3*	−5.4*	*−6.1 to −4.8*
Married, <12 years education	0.3	−5.3*	−5.6*	*−7.1 to −4.1*
Unmarried, 12–15 years education	1.6*	−5.6*	−7.2*	*−7.8 to −6.6*
Married, 12–15 years education	0.7*	−4.8*	−5.6*	*−6.2 to −5.0*
Unmarried, 16+ years education	0.1	−4.7*	−4.9*	*−7.5 to −2.3*
Married, 16+ years education	0.2	−3.1*	−3.4*	*−4.4 to −2.4*
Low birth weight				
Unmarried, <12 years education	−0.55*	−0.13	0.42**	*−0.04 to 0.88*
Married, <12 years education	−0.06	0.57**	0.64	*−0.31 to 1.58*
Unmarried, 12–15 years education	−0.15	−0.27*	−0.11	*−0.50 to 0.27*
Married, 12–15 years education	−0.01	0.23**	0.24	*−0.15 to 0.64*
Unmarried, 16+ years education	−0.63	0.69	1.32	*−0.48 to 3.12*
Married, 16+ years education	−0.07	0.01	0.05	*−0.72 to 0.83*

Source: 1980, 1986, 1993 National Natality Files. Tabulations exclude births from California, Texas, Washington, and upstate New York.

Note: Percentage of women initiating prenatal care after the first trimester includes those with no care. Percentage point changes were obtained by maximum likelihood estimation of a linear probability model. Figures are based on coefficients (columns 1 and 2) or linear combinations of coefficients (column 3) on the indicator variables for year. We estimate separate models for each socioeconomic stratum and adjust for maternal age, parity, and age and parity interactions.

care after the first trimester decreases by 2.7 percentage points from 1980 to 1986 and by 10 percentage points between 1986 and 1993. The difference in differences, therefore, indicates that the decrease between 1986 and 1993 was 7.3 percentage points greater (95% CI: —8.0 to —6.7) than the decrease from 1980 to 1986. We obtain similar results for two other groups: married whites with less than 12 years of schooling and unmarried whites with 12 to 15 years of schooling. Among white women of higher socioeconomic status, there is little evidence of a decline in delayed initiation of prenatal care after 1986.

Decreases in the rate of low birth weight among whites are limited primarily to women with less than 12 years of schooling. The rate of low

birth weight for children born to unmarried women with less than a high school degree falls 0.35 percentage points between 1980 and 1986 and 0.73 percentage points between 1986 and 1993. Thus, the rate of decline in low birth weight is 0.37 percentage points greater between 1986 and 1993 than in the previous six years (Table 5). A decline of this magnitude represents a relative fall of 4.1 percent in the rate of low birth weight evaluated at the 1986 level of 9.0 percent. A similar pattern also exists for married white women with less than 12 years of completed schooling.

There are no important changes in the rate of low birth weight among other groups of white women. For example, the rate of low birth weight falls 0.54 percentage points for children born to unmarried women with 12 to 15 years of schooling between 1986 and 1993 compared with a decline of 0.55 percentage points between 1980 and 1986. Thus, there is no differential change in the rate of low birth weight between 1986 and 1993 relative to the period 1980–86. Married white women with 12 to 15 years of schooling experience a change of about 0.1 percentage points in both periods—changes of little clinical significance.

The percentage of African American women who initiated prenatal care after the first trimester rises between 1980 and 1986 but decreases between 1986 and 1993 for all six socioeconomic groups (Table 6). Thus, changes in delayed initiation of prenatal care between 1986 and 1993 compared to the period 1980–86 are always negative; difference-in-differences estimates range from –3.4 to –7.2 percentage points. Changes are smallest for women with the highest level of schooling. We do, however, see improvements in prenatal care timing for married African American women with a high school degree and some college. As mentioned previously, a relatively large percentage of these women were likely made eligible for Medicaid as a result of the expansions, which may account for the increase in timely prenatal care among women in this group.

Although delayed initiation of prenatal care decreased significantly among African American women between 1986 and 1993, there is no meaningful improvement in the rate of low birth weight. In fact, when we subtract the slight decline in the rate of low birth weight between 1980 and 1986 from the change between 1986 and 1993, we obtain relative increases. For unmarried African American women with less than 12 years of schooling, the difference-in-differences estimate yields a relative *increase* of 0.42 percentage points that is marginally significant (90% CI: –0.04 to 0.88).

Sensitivity Analysis

As mentioned in the methods section, we assessed whether our results were sensitive to the method we chose to control for secular trends in prenatal care use and birth outcomes. Despite limitations associated with differences in outcomes across strata, the figures in the second column of Tables 5 and 6 indicate that our results would not have differed notably if we had used changes in college-educated women between 1986 and 1993 to "de-trend" changes among women of lower socioeconomic status. We still obtain substantial increases in early prenatal care among the women affected by the Medicaid expansion, especially among whites. To illustrate, the percent of unmarried white women with less than 12 years of schooling who initiate prenatal care late fell 10.0 percentage points between 1986 and 1993. We subtract from this the 1.6 percentage point decline in delayed initiation of prenatal care among married white women with at least 16 years of schooling. The net change, 8.6 percentage points, represents the differential change in prenatal care timing among women of low as compared to high socioeconomic status between 1986 and 1993. We do obtain somewhat greater improvements in low birth weight among unmarried white women with less than 16 years of schooling by differencing across strata. The improvements in low birth weight among whites remain unimpressive, however, because they are only slightly larger than the declines that occurred between 1980 and 1986 within these strata.

For African Americans, difference in differences across socioeconomic strata between 1986 and 1993 yields less improvement in prenatal care than difference in differences within strata. The decline in delayed initiation of prenatal care for unmarried African Americans with less than 12 years of schooling is 2.2 percentage points (5.2 – 3.1, Table 6) as compared to 5.4 percentage points when we difference within strata over time. Results for low birth weight are largely unaffected whether we use difference in differences within or across socioeconomic strata.

We analyzed but did not report changes in rates of preterm, very low birth weight, and prenatal care initiated after the sixth month. The rate of preterm birth rose slightly in 8 of the 12 race and socioeconomic strata between 1986 and 1993 and in 11 of the 12 strata between 1980 and 1986. We found no statistically significant changes in the rate of very low birth weight. We believe this is a reasonable finding because there are few, if any, interventions that have been shown to prevent such extreme prematurity (Collaborative Group on Preterm Birth Prevention 1993). Finally, our results

for prenatal care do not differ substantially if we use the proportion of women who receive no or inadequate prenatal care as measured by the Adequacy of Prenatal Care index, despite a large number of missing cases in 1980 (Kotelchuck 1994).

We also tested the sensitivity of our estimates to the choice of end points. Our conclusions are unchanged substantively if we use 1992 instead of 1993 data or if we use changes between 1980 and 1986 subtracted from changes between 1987 and 1993. Data from both 1987 and 1992, however, are potentially contaminated. Some states commenced their Medicaid initiatives in 1987, and other states may not have fully implemented changes by 1991, affects of which would not have been observed until 1992. Use of either 1987 or 1992 data, therefore, might have biased downward estimated effects of the expansions.

DISCUSSION

In this study we found that delayed initiation of prenatal care decreased substantially between 1986 and 1993 among women of low socioeconomic status irrespective of race. Moreover, the changes between 1986 and 1993 substantially exceeded the changes observed between 1980 and 1986. Finally, we detected no change in the rate of delayed prenatal care initiation among white women of high socioeconomic status and only modest increases among African American women in the same strata. The pattern of these changes is consistent with one of the major goals of the Medicaid eligibility expansions: to decrease delayed initiation of prenatal care among poor and near-poor pregnant women.

There is less evidence to suggest that the Medicaid expansions had an important impact on rates of low birth weight. For white women with less than 12 years of schooling, we found improvements in the rate of low birth weight between 1986 and 1993. We found no improvement among white unmarried women with 12 to 15 years of schooling despite significant improvements in prenatal care timing among women in this group. We also reported an *increase* in rates of low birth weight among African American women of low socioeconomic status, again despite substantive increases in early initiation of prenatal care. In sum, the inconsistent pattern of changes in low birth weight over time and across race and strata preclude firm conclusions as to the impact of the expansions on infant health.

A potential limitation of our study is that we could not identify the treatment group precisely. Nevertheless, stratification by year, race, schooling,

and marital status enabled us to test whether the Medicaid reforms between 1986 and 1993 were broadly consistent with improvements in obstetrical outcomes among women of low socioeconomic status. A point that has not been discussed in previous evaluations is that other Medicaid policy reforms during this period affected women who were already eligible for Medicaid. For instance, by January 1992, 37 states had initiated programs that offered enhanced prenatal services from case management to nutritional counseling to all pregnant Medicaid recipients (Frost et al. 1993). In addition, changes in enrollment procedures such as presumptive eligibility have been associated with increased Medicaid participation (Joyce 1999; Dubay et al. 1995; Ellwood and Kenney 1995; Piper, Mitchel, and Ray 1994b) and early initiation of prenatal care among women who would have been eligible for Medicaid in absence of increases in income eligibility thresholds (Yazici and Kaestner 2000). Finally, obstetrical providers increased participation in the Medicaid program as reimbursement became more generous, which in turn affected current and potential Medicaid recipients (Dubay et al. 1995). In short, our focus on outcomes of women of low socioeconomic status was the most effective means available to address the fact that the Medicaid reforms were broad and not limited to women in the expanded income categories.

We tried to minimize temporal confounding by subtracting changes in outcomes between 1980 and 1986 from changes that occurred between 1986 and 1993. As long as changes between 1980 and 1986 are a reasonable estimate of changes that would have occurred between 1986 and 1993, confounding from time-varying factors should be minimized. This strategy will not eliminate confounding from unmeasured changes specific to a particular period and socioeconomic stratum. The crack cocaine epidemic of the mid- to late 1980's, for instance, is a possible confounding factor, especially for African Americans of low socioeconomic status. There are very limited data on cocaine use over time. What is clear from the best prevalence studies is that exposure to cocaine, especially crack cocaine, was dramatically higher among African Americans than among whites or Hispanics (Vega et al. 1993; NIDA 1996). Moreover, exposure was greater among women with less than 16 years of completed schooling relative to those with 16 years or more of schooling (NIDA 1996). Importantly, we stratified outcomes by race, unlike all previous evaluations. If the crack cocaine epidemic was concentrated among African Americans, exposure to cocaine may not be an important source of confounding among whites and may explain the lack of improvement in low birth weight for African Americans (NIDA 1996).

Given the potential for confounding from time-varying factors specific

to the 1986–93 period, we subtracted changes in obstetrical outcomes between 1986 and 1993 among women from the highest socioeconomic stratum from changes in outcomes among women from the lower socioeconomic stratum over the same period. Despite previously noted limitations associated with difference in differences across strata, our results were not altered appreciably. We still obtained substantial increases in early prenatal care among the women affected by the Medicaid expansion, especially among whites, and little change in birth outcomes for both races.

Our finding that early initiation of prenatal care was associated with the Medicaid expansions is inconsistent with two early evaluations (Piper, Ray, and Griffin 1990; Haas et al. 1993). These studies have relied on linkages among birth certificates, Medicaid administrative files, and hospital discharge data to approximate treatment groups and have compared outcomes for these groups before and after changes in eligibility. Since no national data with the requisite information on income, insurance status, and birth outcomes exist, linkages must be done on a state-by-state basis, which has resulted in state-specific evaluations. The limitations to this strategy are not often recognized. Not only might results from single-state evaluations not generalize to the nation, but the number of women actually affected by the policy change is often small, which may account for the failure of these studies to detect small but meaningful effects in prenatal care use and birth outcomes.

The evaluation of Healthy Start in Massachusetts illustrates these limitations. The treatment group consisted of uninsured women prior to Healthy Start and uninsured women and program participants three years later. Researchers found that access to prenatal care worsened slightly for women in the treatment group and found no improvement in birth outcomes. The results, however, may be specific to circumstances within that state. The Massachusetts economy grew so rapidly during the study period that it was termed the "Massachusetts Miracle" in the popular press. The swift growth in employment may have altered the distribution of risk factors among the uninsured between 1984 and 1987, as uninsured women at low risk for adverse outcomes obtained private insurance.

The second limitation of the Healthy Start evaluation was the relatively small number of women affected by the intervention. Only 2,715 women in the post-intervention "treatment" group were enrolled in the program, despite an analytic database of over 120,000 births. Using standard formulas for sample size determination, we estimate that researchers in Massachusetts needed 4,200 women *affected by the policy* to detect a 0.5 percentage point change in a pre-intervention rate of low birth weight of 7.0 percent (Fleiss

1981). Given the small magnitude of changes in the rate of low birth weight we observe in our analysis, we question whether there was sufficient power to detect small but plausible effects in the Healthy Start evaluation.

Our results are also inconsistent with the one study that found improvements in birth outcomes in Florida associated with an increase in the income eligibility threshold from 100 to 150 percent of FPL (Long and Marquis 1998). Researchers reported that the expansion led to a statistically significant decline in the rate of low birth weight. However, this study did not attempt to control for temporal confounding. The study found that the rate of low birth weight declined from 6.7 to 6.1 percent among women newly enrolled in Medicaid. Over the same period, the rate of low birth weight fell from 7.2 to 6.8 percent among births to women from poor neighborhoods who were not covered by Medicaid or private coverage. Thus, the relative change in the rate of low birth weight was only 0.2 percentage points, [(6.7 – 6.1) – (7.2 – 6.8)], a statistically insignificant difference. Therefore, we question whether improvements in birth weight in Florida can be attributed to the expansions.

Our findings are similar to a recent evaluation of the Medicaid expansions in Tennessee that examined changes in prenatal care and birth outcomes between 1983 and 1991 (Ray, Mitchel, and Piper 1997). The long study period allowed researchers to assess whether the series of incremental reforms associated with the Medicaid expansions between 1985 and 1990 had any measurable impact on the rates of preterm birth, very low birth weight birth, and inadequate prenatal care. Data were stratified by marital status and schooling, but not race. The authors found no statistically significant declines in the rate of adverse birth outcomes but substantial and statistically significant declines in the rate of inadequate prenatal care among women with large increases in Medicaid enrollment. Our findings regarding the lack of effect of the expansions on low birth weight are consistent with the one published national study that examined the impact of the broad expansions in eligibility (Currie and Gruber 1996). Finally, the increase in timely prenatal care initiation we observe over this period is consistent with a recent study that examined changes in prenatal care use in general but that did not focus on the impact of the expansions (Kogan, Martin, Alexander, et al. 1998).

The Balanced Budget Act of 1997 included $40 billion to extend health insurance to children who are uninsured over the next ten years. We believe that the extension of Medicaid coverage to poor and near-poor pregnant women and infants over a decade earlier offers insights as to what might be expected to occur among uninsured children over the next ten years. The substantial increase in early prenatal care among low income women over the

period of the Medicaid expansions is compelling evidence that the extension of health insurance to uninsured children will enhance access to primary care. Given evidence linking health insurance and access to primary care for children (Newacheck et al. 1998), we expect increased utilization of health services by poor and near-poor children over the next ten years. Greater access to primary care should improve rates of immunization and allow for earlier screening of potentially ameliorable conditions such as lead poisoning and asthma.

Whether increased access to primary care will have a substantial impact on child health, however, or narrow differences in health by socioeconomic status is much more difficult to predict. As we show, there are large differences in early initiation of prenatal care and low birth weight by race, marital status, and schooling. Despite gains in early prenatal care associated with the Medicaid expansions, large differences in prenatal care timing and low birth weight persist. In fact, the African American/white rate ratio for low birth weight actually increased over the period of the Medicaid expansions. These large discrepancies in infant health by race and socioeconomic status reflect complex and deeply rooted interactions among poverty, race, parents' behavior, and access to high quality health services. The ability of health care to offset these other deficits, however, may be limited. The emerging lesson from the Medicaid eligibility expansions is that increased access to prenatal care is not enough, if the goal is to narrow the gap in health between poor and nonpoor populations.

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