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Young Maternal Age and Infant Mortality: the Role of Low Birth Weight

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Synopsis

In 1980, there were 562,330 babies born in the United States to teenage mothers (19 years of age or younger). The offspring of teenage mothers have long been known to be at increased risk of infant mortality, largely because of their high prevalence of low birth weight (less than 2,500 grams).

We used data from the National Infant Mortality Surveillance (NIMS) project to examine the effect of young maternal age and low birth weight on infant mortality among infants born in 1980 to U.S. residents. This analysis was restricted to single-delivery babies who were either black or white, who were born to mothers ages 10-29 years, and who were born in one of 48 States or the District of Columbia. Included were 2,527,813 births and 28,499 deaths (data from Maine and Texas were excluded for technical reasons). Direct standardization was used to calculate the relative risks, adjusted for birth weight, of neonatal mortality (less than 28 days of life) and postneonatal mortality (28 days to less than 1 year of life) by race and maternal age.

There was a strong association between young maternal age and high infant mortality and between young maternal age and a high prevalence of low birth weight. Neonatal mortality declined steadily with increasing maternal age. After adjusting for birth weight, the race-specific relative risks for babies born to mothers less than 16 years of age were still elevated from 11 to 40 percent,

compared with babies born to mothers 25-29 years of age. Otherwise, all the relative risks were nearly equal to 1. By contrast, most of the association between young maternal age and postneonatal mortality persisted after birth weight adjustment in all maternal age groups.

These results suggest that the prevention of neonatal mortality and, to a lesser extent, postneonatal mortality among babies born to teenagers depends on preventing low birth weight. The prevention of postneonatal mortality may depend more on other factors, such as assisting teenagers with better parenting. Finally, although there may be few biological reasons to postpone childbearing, teenage childbearing continues to place the mother and her baby at a social disadvantage.

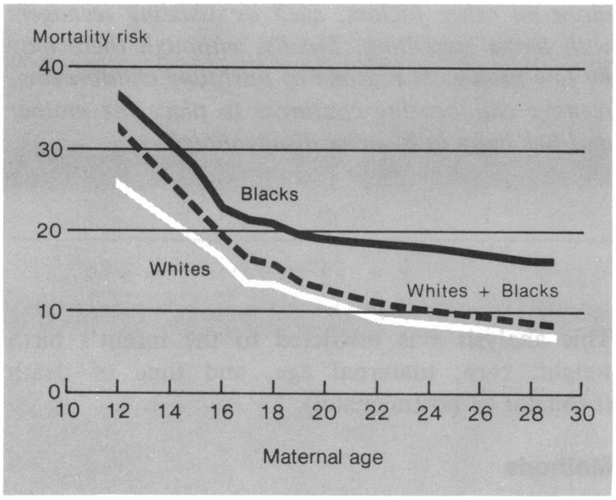
In 1980, there were 562,330 babies born in the United States to teenage mothers (19 years of age or younger); this number represented 16 percent of all resident births (*1*). Babies born to teenagers are known to be at increased risk of neonatal and postneonatal mortality. The earlier literature suggested that this risk is a biological effect mediated by the mother's physiological immaturity. Studies performed during the last 10 years have tried both to redefine what role, if any, is played by age per se, and to understand what factors place the babies born to teenagers at elevated risk (*2*). A central finding from this research is that the babies of teenagers are more likely to be of low birth weight—less that 2,500 grams (g) (*3*). This tendency toward low birth weight is probably explained by the fact that teenagers who give birth are less likely than older mothers to receive adequate prenatal care (*1, 4*). Evidence supporting the importance of prenatal care comes from studies that have examined the independent effects of maternal age and prenatal care. These studies indicate that the offspring of teenagers who receive good prenatal care do not have elevated risks of low birth weight or high mortality (*4-6*).

In this study, we used data from the National Infant Mortality Surveillance (NIMS) project to examine the association between young maternal age and infant mortality for infants born in 1980 to U.S. residents. We were especially interested in examining the contribution of low birth weight to the higher infant mortality of babies born to teenage mothers. The major strength of the NIMS data for addressing this question is the complete coverage of all births and infant deaths (*7*); hence, there are enough events to permit single-year age strata for maternal ages 15-19 and birth weight strata of 250-g intervals for babies with birth weights under 1,500 g. The major weakness of the NIMS data is that prenatal care, parity, and maternal age are not available simultaneously (*8*). This analysis was restricted to the infant's birth weight, race, maternal age, and time of death (neonatal or postneonatal).

Methods

Population and data sources. The methods, including data collection and evaluation, are described in detail elsewhere (*7-9*). In brief, 53 vital statistics reporting areas participated in the project: 50 States, New York City, the District of Columbia, and Puerto Rico. These national level tabulations do not include Puerto Rico. All 53 reporting areas (subsequently referred to as States) linked birth and death certificates for infants who were born alive in 1980 and who died within the first year of life in 1980 or 1981. The completeness of birth and death certificate linkage is estimated to be approximately 95 percent (*7-9*). States provided the Centers for Disease Control (CDC) with the number of infant deaths by birth weight, age at death, and other infant and maternal characteristics. CDC generated corresponding numbers of births from the computer tape of 1980 natality records produced by the National Center for Health Statistics (NCHS), with exceptions for Maine and New Mexico as previously described (*7*). State of residence was defined as the State of mother's residence at the time of birth; race of infant was based on the race of both parents, with the use of the NCHS algorithm (*10*). For logistic reasons, categories for race of infant were limited to white, black, and all races combined. Birth weight was collected in 250-g intervals from 227 g to 1,499 g, in 500-g intervals from 1,500 g to 4,499 g, and in a single interval from 4,500 g to 8,165 g; infants with birth weights outside the range of 227-8,165 g, were considered to have an unknown birth weight. All infants with birth weights within the range of 227-499 g were assumed to have died in the neonatal period. Maternal age was collected in

Figure 1. Infant mortality risk (deaths per 1,000 live births) by race and maternal age, National Infant Mortality Surveillance project, 48 States and DC, 1980



1-year intervals for maternal ages 10–19 years and in 5-year intervals for maternal ages 20–49 years; cases with maternal age outside the range of 10–49 years were considered to have an unknown maternal age (*1, 7*).

The present analysis was restricted to single-delivery babies who were black or white, whose mothers' ages were known, and who were born in 1 of 48 States or the District of Columbia. Data from Maine were excluded because an examination of the birth weight distributions suggested that Maine had a reporting problem with birth weight that could not be corrected in the maternal age tabulations (*7*). Data from Texas were excluded because Texas was not able to furnish birth weights in 250-g intervals. Hence, 3,141,257 births (88.7 percent of the NIMS single-delivery births) and 34,327 deaths (88.3 percent of the NIMS single-delivery infant deaths) were eligible for inclusion in this subanalysis. This paper is further restricted to consideration of events related to mothers 10–29 years of age; there were 2,527,813 births to mothers in this age group and 28,499 of their babies died.

There are two possible reasons why relatively more births than deaths were eligible for this subanalysis. Overall, NIMS is missing about 5 percent of deaths (*8*); to the extent that babies in the unknown maternal age category would be more likely to die, there would be a relative undercount of such babies in this analysis. Second, the fact that the NIMS counts of births and deaths were derived from different sources may contribute to an undercount of deaths. When NCHS prepared the source of the birth data, values for birth records that were missing a value for race (0.4 percent) or maternal age (0.03 percent) were imputed (that is, inserted into the record) (*10*). By contrast, when the States prepared the death data, values for death records with missing information about race were not imputed and were excluded from this analysis, as were the 106 (0.3 percent) of 34,433 death records that were missing data on maternal age. Hence the number of deaths as a proportion of births was undercounted by at most 0.43 percent. The net effect of these missing deaths would be to reduce very slightly the absolute risks of death; however, the relative risks probably will be relatively unaffected (see Discussion).

Analysis. We calculated the neonatal mortality risk (NMR) as the number of neonatal deaths (less than 28 days of life) per 1,000 live births, the postneonatal mortality risk (PNMR) as the number of postneonatal deaths (28 days to less than 1 year of life) per 1,000 neonatal survivors (that is, newborns who survive the neonatal period), and the infant mortality risk (IMR) as the number of infant deaths (less than 1 year of age) per 1,000 live births. These risks were calculated for the 1980 birth cohort. Because the NIMS data are for a birth cohort, rather than for births and deaths occurring in a given year, we use the term mortality "risk" instead of "rate."

Direct standardization was used to adjust mortality risks. The birth weight distribution of babies born to mothers 25–29 years of age (or, for postneonatal mortality, the birth weight distribution of their neonatal survivors) served as the standard. Crude and adjusted relative risks (RR) (the risk for a given group divided by that for another group) and the associated 95 percent confidence limits were calculated for neonatal and postneonatal mortality by maternal age (*11*). Separate analyses were performed for blacks and whites; the 5,457 (0.2 percent) births and 759 (2.7 percent) deaths for which a corresponding birth weight was not known were excluded.

Results

Infant mortality, race, and maternal age. There was a strong association between young maternal age and high IMRs (fig. 1). As maternal age increased, the IMR declined steadily, with a pause for blacks with maternal age 18. At each maternal age, blacks had higher IMRs than whites; the

Table 1. Births and percent[1] low birth weight (less than 2,500 g) and very low birth weight (less than 1,500 g), single-delivery infants, by race and maternal age, 48 States[2] and DC, 1980

	Whites			Blacks		
Maternal age	Births	Percent birth weight less than 2,500 g	Percent birth weight less than 1,500 g	Births	Percent birth weight less than 2,500 g	Percent birth weight less than 1,500 g
10–14 years	3,549	10.8	2.4	5,331	16.7	3.9
15 years	12,794	9.6	2.0	11,522	14.0	2.8
16 years	34,625	8.6	1.6	20,359	13.1	2.5
17 years	64,424	7.6	1.2	28,642	13.5	2.4
18 years	97,715	7.0	1.1	35,863	13.1	2.4
19 years	133,831	6.3	0.9	41,048	12.2	2.1
20–24 years	881,038	4.9	0.7	190,662	11.4	2.1
25–29 years	843,188	4.2	0.6	123,222	9.9	1.9

[1] As a percent of those births with known birth weight.
[2] Maine and Texas excluded.

SOURCE: National Infant Mortality Surveillance project.

absolute gap was narrowest for babies born to teenagers 16–19 years of age.

Low birth weight, race, and maternal age. There was a strong association between young maternal age and a high percentage of babies of low birth weight (less than 2,500 g) and very low birth weight (less than 1,500 g); this association held for both races (table 1). At each maternal age, black infants were at higher risk of low birth weight and very low birth weight than were white infants. These results suggested that part of the effects of both maternal age and infant race on the increased mortality noted in fig. 1 was mediated through birth weight. To understand better the effect of each of these factors on mortality, we calculated crude and adjusted relative risks for the two ages at death.

The effect of birth weight and maternal age on mortality. In general, the NMR declined steadily with increasing maternal age, although there was a pause in the NMR decline for white infants born to mothers 18 years of age, and an increase for black infants born to mothers 17 years of age (table 2). However, after the adjustment for differences in the birth weight distribution, the association between young maternal age and an elevated NMR was, with some exceptions, virtually eliminated. The exceptions included whites born to mothers 10–14 years of age, who had a risk of death that was 40 percent increased, and blacks born to mothers 10–15 years of age, who had a risk that was increased by 11 to 14 percent. Otherwise, the adjusted risks were within 6 percent of that of the standard population for both race groups (table 2).

'. . . teenagers enrolled in good prenatal care programs can have babies with birth weights that are comparable to birth weights of babies born to mothers in their twenties. Unfortunately, in 1980, 20.1 percent of mothers 10–14 years of age and 10.3 percent of mothers 15–19 years of age received no prenatal care before the third trimester . . . .'

Birth weight had a different effect on the PNMR, and more race-specific effects were noted (table 3). Among whites, the PNMR increased with increasing maternal age until maternal age 17, then declined steadily. Moreover, the association between young maternal age and higher mortality persisted after adjustment for birth weight, although the adjusted RRs were lower in all cases. Among blacks, the adjusted RR declined quite steadily with increasing maternal age, with the exception of an increase at maternal age 18.

To what extent did the summary relative risks hold true across birth weight strata? Figures 2–5 display the crude mortality risks by maternal age and birth weight, after collapsing the original 12 strata into 7 strata and deleting the 227–499-g group (their NMR was defined as 1,000). Given the small number of deaths in any one stratum, these figures must be interpreted with caution. The findings of an increased NMR for whites born to

Table 2. Neonatal deaths, mortality risks (NMR)[1], and crude and adjusted relative risks[2], single-delivery infants, by race and maternal age, 48 States[3] and DC, 1980

	Whites				*Blacks*			
Maternal age	*Deaths*	*NMR*	*Crude relative risk*	*Adjusted relative risk*	*Deaths*	*NMR*	*Crude relative risk*	*Adjusted relative risk*
10–14 years	71	20.05	3.67	1.40 (1.07–1.82)	124	23.33	2.08	1.11 (0.95–1.30)
15 years	163	12.78	2.34	1.02 (0.86–1.23)	188	16.36	1.46	1.14 (1.02–1.28)
16 years	355	10.28	1.88	1.02 (0.92–1.13)	259	12.75	1.14	1.05 (0.95–1.16)
17 years	491	7.64	1.40	0.94 (0.86–1.02)	380	13.30	1.18	1.03 (0.95–1.13)
18 years	745	7.64	1.40	0.99 (0.92–1.06)	425	11.87	1.06	0.98 (0.90–1.06)
19 years	966	7.23	1.32	1.05 (0.99–1.11)	482	11.76	1.05	1.05 (0.97–1.13)
20–24 years	5,070	5.77	1.06	0.99 (0.96–1.03)	2,243	11.79	1.05	1.00 (0.96–1.06)
25–29 years	4,597	5.46	1 (Referrent)	. . .	1,380	11.23	1 (Referent)	. . .

[1] Neonatal deaths per 1,000 live births.
[2] Adjusted to the birth weight distribution of babies born to mothers 25–29 years of age.
[3] Maine and Texas excluded.

NOTE: Numbers in parentheses are 95 percent confidence limits for adjusted relative risk.
SOURCE: National Infant Mortality Surveillance project.

Table 3. Postneonatal deaths, mortality risks (PNMR)[1], and crude and adjusted relative risks[2], single-delivery infants, by race and maternal age, 48 States[3] and DC, 1980

	Whites				*Blacks*			
Maternal age	*Deaths*	*PNMR*	*Crude relative risk*	*Adjusted relative risk*	*Deaths*	*PNMR*	*Crude relative risk*	*Adjusted relative risk*
10–14 years	17	4.90	2.12	1.88 (1.09–3.23)	68	13.10	2.43	2.27 (1.66–3.10)
15 years	74	5.88	2.62	2.18 (1.67–2.83)	117	10.35	1.92	1.77 (1.44–2.17)
16 years	203	5.94	2.65	2.31 (1.97–2.70)	191	9.52	1.77	1.63 (1.38–1.93)
17 years	391	6.13	2.74	2.39 (2.13–2.68)	213	7.56	1.40	1.26 (1.07–1.47)
18 years	562	5.81	2.59	2.26 (2.05–2.49)	315	8.90	1.65	1.49 (1.30–1.72)
19 years	632	4.77	2.13	1.93 (1.76–2.11)	301	7.43	1.38	1.31 (1.14–1.51)
20–24 years	2,974	3.40	1.52	1.45 (1.37–1.53)	1,214	6.46	1.20	1.14 (1.04–1.26)
25–29 years	1,875	2.24	1 (Referent)	. . .	654	5.38	1 (Referent)	. . .

[1] Postneonatal deaths per 1,000 neonatal survivors.
[2] Adjusted to the birth weight distribution of the neonatal survivors with mothers 25–29 years of age.
[3] Maine and Texas excluded.

NOTE: Numbers in parentheses are 95 percent confidence limits for adjusted relative risks.
SOURCE: National Infant Mortality Surveillance project.

mothers 10–14 years of age and for blacks born to mothers 10–15 years of age generally held true across birth weights (figs. 2, 3). The finding of increased PNMRs for whites until maternal age 17 generally held true across birth weight strata, as did the lack of such a pattern for blacks (figs. 4,5).

Discussion

We found that for births in 1980 to U.S. residents, there was a strong association between young maternal age and an increased risk of infant mortality. Babies born to teenagers had from 1.5 to 3.5 times the risk of mortality, compared with those born to mothers 25-29 years of age. Furthermore, blacks had from 1.3 to 2.2 times the risk of mortality of whites, depending on maternal age. However, when the data were analyzed by race and age at death and adjusted for differences in birth weight distributions, we found that the high NMR of babies born to white teenagers more than 14 years of age and to black teenagers more than 15 years of age was accounted for by the increased prevalence of low birth weight. By contrast, the high PNMR in this group was only in small part accounted for by the prevalence of low birth weight among neonatal survivors; the remainder was attributed to maternal age-associated effects.

We believe that biases are unlikely to account for these findings. The biases in the overall NIMS data are discussed extensively elsewhere (*7-9*); only those biases most germane to this study will be elaborated here.

Approximately 5 percent of deaths could not be linked to their birth certificates and do not appear

Figure 2. Neonatal mortality risk (deaths per 1,000 live births) for white infants, by birth weight and maternal age, National Infant Mortality Surveillance project, 48 States and DC, 1980

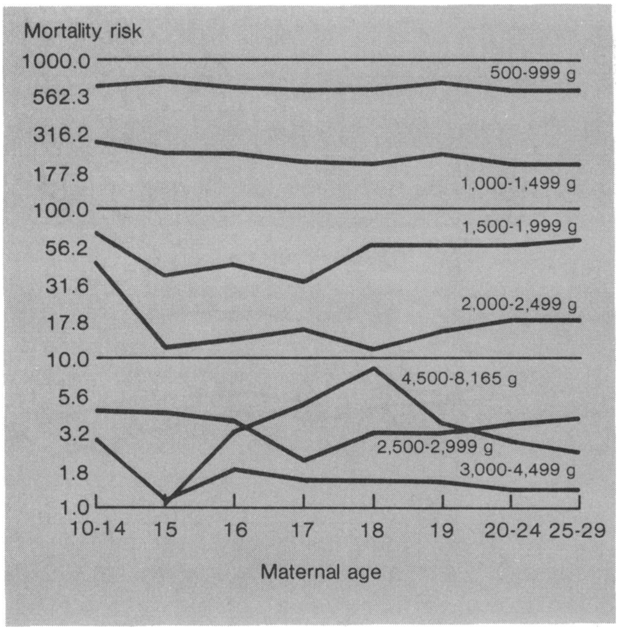
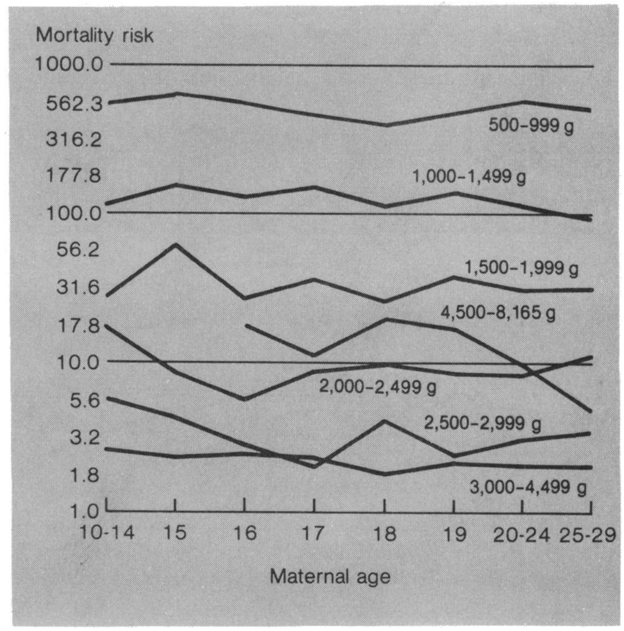


Figure 3. Neonatal mortality risk (deaths per 1,000 live births) for black infants, by birth weight and maternal age, National Infant Mortality Surveillance project, 48 States and DC, 1980



in NIMS at all. This omission led to a small underestimate of all the crude mortality risks (*8,9*). Because this subanalysis was restricted to whites and blacks and to cases with known maternal age (that is, categories where deaths were relatively undercounted compared with births), the effect of incomplete linkage would be more pronounced. On the average, it would not be expected to cause more than an additional 0.4 percent lowering of the crude mortality risk, although there may be cases where it would exceed this amount.

Two kinds of biases could theoretically have affected the relative risks. To the extent that there was an association between maternal age and the probability of linkage, the crude relative risk would have been biased. Similarly, to the extent that there was an association between maternal age and the probability that a baby with a given birth weight would be included in the study, the adjusted relative risk would have been biased because the adjustment for the prevalence of low birth weight would have been incomplete (that is, there would have been residual confounding). In each of these two cases, it is difficult to estimate either the strength or direction of these effects. However, given the very large amount of data that were available for this analysis and the consequently narrow confidence intervals, there would have to have been substantial biases for the results to be meaningfully altered.

Previous studies of populations within the United States during a similar period (1974–78) also found that adjustment for birth weight greatly diminished the association between young maternal age and elevated NMRs; as in this study, the pattern held true for different race groups (*3, 12*). Moreover, although several studies have shown that babies born to teenagers have a higher prevalence of low birth weight, this prevalence is probably not mediated by young maternal age per se, but rather by factors associated with young maternal age such as prepregnancy weight, weight gain during pregnancy, and smoking and drug use (*5,6,13*). Our study and others have found that babies born to the very youngest mothers (ages 10–15 years) may be at special risk of neonatal mortality, which is closely associated with low birth weight. Given that prenatal care may exert its impact by modifying some of these risk factors, it is not surprising that teenagers enrolled in good prenatal care programs can have babies with birth weights that are comparable to birth weights of babies born to mothers in their twenties (*5,6*). Unfortunately, in 1980, 20.1 percent of mothers 10–14 years of age and 10.3 percent of mothers 15–19 years of age received no prenatal care before the third trimester, compared with 3.1 percent of mothers 25–29 years of age (*1*).

Our study, among others, has found that birth weight adjustment has a much stronger effect on

Figure 4. Postneonatal mortality risk (deaths per 1,000 survivors) for white infants, by birth weight and maternal age, National Infant Mortality Surveillance project, 48 States and DC, 1980

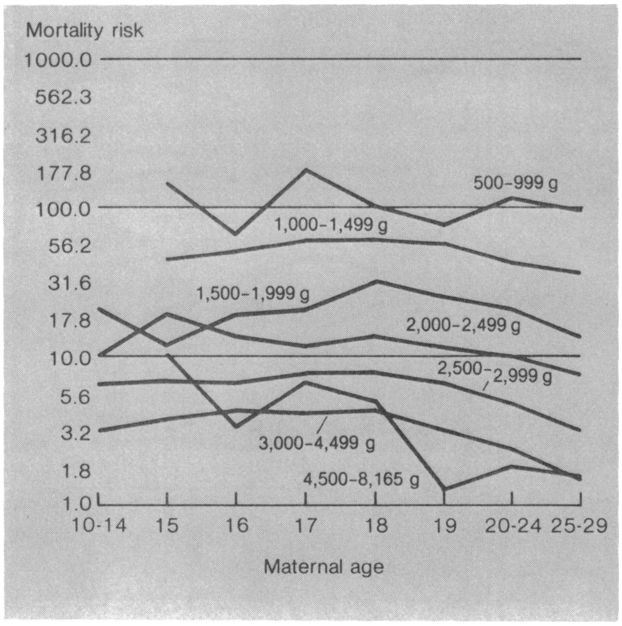
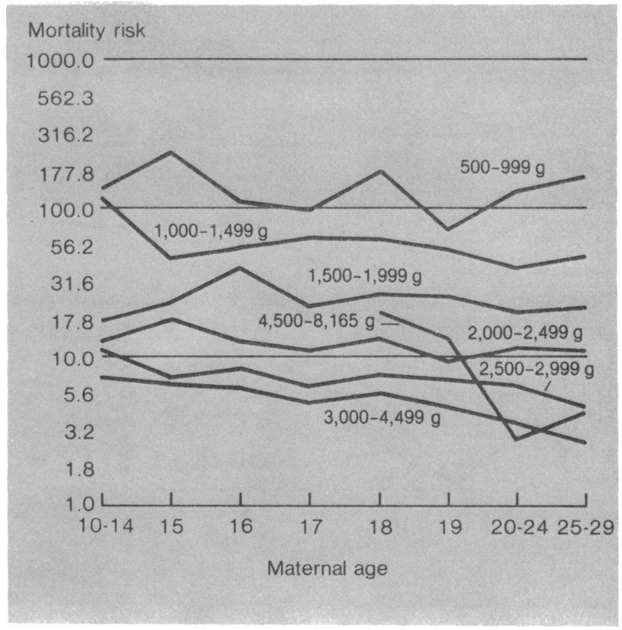


Figure 5. Postneonatal mortality risk (deaths per 1,000 survivors) for black infants, by birth weight and maternal age, National Infant Mortality Surveillance project, 48 States and DC, 1980



'. . . even if we are able to reduce infant mortality among babies born to adolescents, the teenage mother and her offspring probably will continue to be at a social disadvantage. We must continue to seek new ways to help teenagers postpone childbearing.'

NMRs than on PNMRs (*3*). This is probably because the causes of neonatal deaths are more closely linked to low birth weight than are the causes of postneonatal deaths (*14*). More than 66 percent of neonatal deaths are attributable to conditions originating in the perinatal period, which in turn are linked to low birth weight. By contrast, perinatal conditions account for less than 6 percent of postneonatal deaths. In the postneonatal period, the important causes of death include the sudden infant death syndrome (36 percent), congenital anomalies (18 percent), infections (14 percent), and injuries (9 percent). These causes of death may be relatively more susceptible to prevention by close medical followup and supervision in the home. Women who give birth as adolescents may be less able to provide adequate care for their postneonates than women who delay childbearing. Social and behavorial characteristics of young mothers could explain in part why the association between young maternal age and elevated PNMRs persists after birth weight is controlled. This idea is supported by the fact that the offspring of teenagers are at especially high risk of injuries (*15,16*). Further analyses have shown the effect of young maternal age on infant mortality to be nearly eradicated by controlling for indicators of socioeconomic status, suggesting that the effect is mediated by factors that are associated with childbearing at a young age, rather than young age per se (*16*).

Moreover, when additional caretakers care for the babies of teenagers, the babies may have reduced morbidity (*4*). This may explain in part one surprising finding: White infants born to mothers 10–14 years of age had lower PNMRs than those born to older teenagers. This may be because these very young mothers received more help with parenting, either by other family members or social agencies; alternatively, some of their babies may have been placed for adoption. Data for 1982 indicate that among premarital births, 17.2 percent of whites born to mothers 17 years of age or younger were placed for adoption, compared with 1.0 percent of blacks. For babies born premaritally to women 18–19 years of age, the figures were 10.1 percent for whites and 0.0

percent for blacks (*17*).

In conclusion, this analysis of data from NIMS, a population-based study, has confirmed the previously observed relationships between young maternal age, low birth weight, and increased infant mortality. Moreover, we have been better able to delineate the contribution of low birth weight in the association between high neonatal mortality and young maternal age. New data sources could further our understanding of these patterns. The availability of a national linked birth-infant death file that would allow for the simultaneous consideration of the effects of maternal age, parity, prenatal care, and maternal education would be a major step forward (*18*). Improving vital records and linking them to data from programs such as the Special Supplemental Food Program for Women, Infants, and Children (WIC) or Aid to Families with Dependent Children (AFDC) could open new avenues for research on the biological, social, and economic aspects of maternal age and reproductive outcomes.

In the meantime, we must continue to develop new strategies to lower the mortality risk of babies born to teenagers and to eliminate the racial disparity at all maternal ages. For neonatal mortality, this endeavor will include reducing the risk of low birth weight, providing adequate family planning services to reduce unwanted pregnancies, and renewing efforts to provide teenagers with early and complete prenatal care. Reducing the risk of postneonatal mortality may depend more on assisting teenagers to enhance their parenting skills. Finally, even if we are able to reduce infant mortality among babies born to adolescents, the teenage mother and her offspring probably will continue to be at a social disadvantage (*19*). We must continue to seek new ways to help teenagers postpone childbearing (*20,21*).

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