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PREVALENCE OF LOW BIRTH WEIGHT AND PRETERM DELIVERY IN RELATION TO THE INTERVAL BETWEEN PREGNANCIES AMONG WHITE AND BLACK WOMEN

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Abstract *Background.* The higher mortality rate among black infants than among white infants in the United States results largely from the greater frequency of low birth weight and prematurity among black infants. Higher rates of low birth weight and preterm delivery have been associated with shorter intervals between pregnancies.

Methods. We studied a racially mixed population of women in military families, who had access to free, high-quality health care. A total of 1922 white and black women had two consecutive, singleton pregnancies during the study period. We determined the outcome of the second of each pair of pregnancies and the length of time between the pregnancies.

Results. Short interpregnancy intervals (calculated from delivery to the next conception) were more frequent among black than among white women. A total of 7.7 percent of the 298 black women and 3.2 percent of the 1628 white women delivered premature, low-birth-weight infants ($P<0.001$). Among the black women, an interpregnancy interval of less than nine months was associated with a significantly greater prevalence of preterm delivery and low birth weight in the neonates (11.6 percent, vs. 4.4 percent for longer interpregnancy intervals; $P=0.020$). Among the white women, only intervals of less than three months between pregnancies were associated with a greater prevalence of prematurity and low birth weight in the infants (11.8 percent vs. 2.8 percent; $P<0.001$). Of the black women, 46.3 percent had interpregnancy intervals of less than nine months; 4.2 percent of the white women had interpregnancy intervals of less than three months.

Conclusions. A short interval between pregnancies is a risk factor for low birth weight and preterm delivery, and such intervals are more common among black than among white women. The relative frequency of intervals of less than nine months between pregnancies may be an important factor in the wide disparity in pregnancy outcomes between white and black women in the United States. (N Engl J Med 1995;332:69-74.)

IN the United States, mortality among black infants is currently twice that among white infants.[1] This disparity is strongly linked to the two-to-threefold greater prevalence of low birth weight and prematurity among black infants.[2] Mortality directly attributable to low birth weight and preterm delivery occurs 4.5 times more frequently among black infants than among white infants.[1] These disparities in pregnancy outcome have been attributed in large part to wide differences between the races in socioeconomic status and the associated effects on maternal health and access to preventive health care.[3-6]

These demographic differences are greatly attenuated among U.S. military personnel and their dependents, who have guaranteed access, at no cost, to high-quality health care. Mortality rates among black infants approach those among white infants in the ethnically diverse military population served by our medical center.[7] However, higher rates of low birth weight and preterm birth persist among black infants in this population.

An increased prevalence of unfavorable pregnancy outcomes, including low birth weight and preterm delivery, has been reported to be associated with intervals of less than six months between pregnancies.[8-18] We hypothesized that the persistent interracial differences in pregnancy outcomes at our medical center might result in part from differences in the spacing of pregnancies. To test this hypothesis, we investigated the relation of the interval between pregnancies to the outcome of the second of two consecutive, singleton pregnancies with the same partner among women who delivered their babies at our medical center from July 1983 through June 1993.

METHODS

Pairs of pregnancies were identified by matching the mother's social security number, first and last names, and number of pregnancies, as documented in medical records and institutional birth logs. Pairs of pregnancies with intervening live births or fetal loss and pregnancies with multiple gestation were excluded. Race was determined by asking the women for this information.

The interpregnancy interval was defined as the length of time from the first delivery to the next conception, calculated as the interval between consecutive deliveries minus the gestational age of the second child at birth. Intervals were computed in weeks and were converted

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to months (13 weeks = 3 months). Low birth weight was defined as a birth weight of less than 2.5 kg. Gestational ages were estimated according to standard obstetrical dating criteria, with clinical confirmation by the Ballard method for the assessment of gestational age.[19] Preterm delivery was defined as delivery before 37 completed weeks of gestation. Intrauterine growth retardation was considered present in infants whose birth weights were below the 10th percentile for gestational age of all infants delivered at the medical center during the study period.

The statistical methods used in the study included the chi-square test, Student's t-test, and stepwise logistic-regression analysis.[20,21] All P values are two-tailed. The study was conducted to identify patterns of differences between the races in the prevalence of pregnancy outcomes likely to result in an increased risk of infant mortality. Thus, comparisons of outcomes among the white and black women focused on the prevalence of preterm delivery of a low-birth-weight infant.

RESULTS

The entry criteria were met by 2115 women with pairs of pregnancies; 1624 (76.8 percent) of the women were white, 298 (14.1 percent) were black, and 193 (9.1 percent) were of other races. Only the white and black women (total, 1922) are included in this report. The white women were similar to the black women in age and parity at the time of the second delivery. The mean family income among the black women was one Government Service pay grade (approximately 10 percent) lower than that among the white women. As a group, the women with interpregnancy intervals of less than six months were younger and had lower family incomes than the women with longer intervals between pregnancies (Table 1).

The prevalence of several recognized risk factors for unfavorable pregnancy outcome varied with the mother's race. A greater proportion of black women (9.4 percent) than white women (3.4 percent) were unmarried at the time of the second delivery ($P<0.001$). Conversely, a greater proportion of white women (20.4 percent) than black women (14.4 percent) smoked during the second pregnancy ($P = 0.017$). Within each racial group, the proportions of unmarried women and women who smoked did not differ between those with interpregnancy intervals of less than six months and those with longer intervals (Table 1).

Table 1. Demographic Characteristics and Obstetrical Risk Factors among the Women, According to Race and Interpregnancy Interval.*

VARIABLE	INTERPREGNANCY INTERVAL <6 MO	INTERPREGNANCY INTERVAL ≥6 MO	P VALUE
White			
No.	286	1338	
Age — yr	23.5±4.2	25.8±4.6	<0.001
Parity	2.7±1.1	2.7±1.0	0.924
Family Government Service pay grade	5.0±2.4	6.0±2.9	<0.001
Unmarried — no. (%)	11 (3.8)	45 (3.4)	0.685
Smokers — no. (%)	63 (22.0)	268 (20.0)	0.446
Late prenatal care — no. (%)†	11 (3.8)	24 (1.8)	0.030
Preterm labor — no. (%)	13 (4.5)	57 (4.3)	0.829
History of low birth weight or premature delivery — no. (%)	39 (13.6)	104 (7.8)	0.002
Black			
No.	89	209	
Age — yr	24.3±4.5	25.1±4.4	0.183
Parity	2.9±1.1	2.7±1.2	0.381
Family Government Service pay grade	4.4±1.0	5.1±2.0	0.003
Unmarried — no. (%)	9 (10.1)	19 (9.1)	0.782
Smokers — no. (%)	16 (18.0)	27 (12.9)	0.255
Late prenatal care — no. (%)†	4 (4.5)	5 (2.4)	0.332
Preterm labor — no. (%)	13 (14.6)	13 (6.2)	0.019
History of low birth weight or premature delivery — no. (%)	12 (13.5)	30 (14.4)	0.843

*Plus–minus values are means ±SD. Low birth weight was defined as a weight below 2.5 kg, and preterm delivery as delivery before 37 weeks' gestation.

†Late prenatal care was defined as care beginning after the completion of the first trimester of pregnancy.

There was no interracial difference in the proportion of women who first received prenatal care after the completion of the first trimester of pregnancy. The prevalence of pregnancy-induced hypertension did not differ between the races and was similar among the women with interpregnancy intervals of less than six months and those with longer intervals. The only obstetrical complication that was more frequent among women with interpregnancy intervals of less than six months than among those with longer intervals was preterm labor; this difference was significant only among the black women (Table 1).

A greater proportion of black women (14.1 percent) than white women (8.8 percent) had delivered low-birth-weight or preterm infants in the first of the paired pregnancies ($P = 0.004$). This risk factor was less common among white women with interpregnancy intervals of six months or more than among those with shorter intervals. There was no interracial difference in the prevalence of this risk factor among women with interpregnancy intervals of less than six months.

The prevalence of intrauterine growth retardation was 15.8 percent among the black women and 6.2 percent among the white women ($P<0.001$). Within each racial group, the prevalence of intrauterine growth retardation did not differ significantly between the women with interpregnancy intervals of less than six months and those with longer intervals (Table 2).

The frequency distribution of interpregnancy intervals among black women was strongly shifted toward shorter intervals, as compared with that among white women (Fig. 1). Intervals of less than six months occurred between the pregnancies of 29.9 percent of the black women, as compared with 17.6 percent of the white women ($P<0.001$).

Premature, low-birth-weight infants were born to 7.7 percent of the black women, as compared with 3.2 percent of the white women ($P<0.001$; relative risk, 2.41; 95 percent confidence interval, 1.45 to 4.00). These race-specific rates were similar to those among all other multiparous women who delivered at our medical center during the study period. In the study population, the prevalence of preterm delivery and low birth weight was 14.6 percent among the infants born to black women with interpregnancy intervals of less than six months, as compared with 4.8 percent among the infants born to black women with longer intervals between pregnancies ($P = 0.004$; relative risk, 3.05;

Table 2. Prevalence of Intrauterine Growth Retardation and Preterm Delivery and Low Birth Weight, According to Race and Interpregnancy Interval.

RACE AND OUTCOME*	INTERPREGNANCY INTERVAL		P VALUE
	<6 MO	≥6 MO	
White			
No.	286	1338	
Intrauterine growth retardation — no. (%)	17 (5.9)	83 (6.2)	0.869
Preterm delivery and low birth weight — no. (%)	13 (4.5)	39 (2.9)	0.155
Black			
No.	89	209	
Intrauterine growth retardation — no. (%)	13 (14.6)	34 (16.3)	0.719
Preterm delivery and low birth weight — no. (%)	13 (14.6)	10 (4.8)	0.004

*Intrauterine growth retardation was defined as a birth weight below the 10th percentile for gestational age, preterm delivery as delivery before 37 weeks' gestation, and low birth weight as a weight below 2.5 kg.

95 percent confidence interval, 1.28 to 7.26). Among the white women, these rates did not differ significantly between the women with interpregnancy intervals of less than six months and those with longer intervals (Table 2).

In order to determine more accurately the interpregnancy intervals at which the prevalence of preterm delivery and low birth weight begins to change significantly, we reanalyzed the data according to ranges of three-month increments in the interpregnancy interval (Table 3). Within each racial group, the prevalence of low birth weight and prematurity was compared between women with interpregnancy intervals in each range and all the women with longer intervals. Among the black women, the longest interval associated with significantly increased rates of preterm delivery and low birth weight was less than 9 months (11.6 percent, as compared with 4.4 percent for ≥9 months; $P=0.020$; relative risk, 2.65; 95 percent confidence interval, 1.06 to 6.65). Among the white women, the longest interval associated with significantly increased rates was less than 3 months (11.8 percent, as compared with 2.8 percent for ≥3 months; $P<0.001$; relative risk, 4.16; 95 percent confidence interval, 1.88 to 9.22). These disadvantageous interpregnancy intervals occurred among 138 (46.3 percent) of the black women (<9 months) and 68 (4.2 percent) of the white women (<3 months).

The number of premature, low-birth-weight infants born to the black women in excess of the number expected on the basis of the prevalence among white women was computed for three-month increments in the interpregnancy interval. Over 85 percent of the excess rate occurred among women with interpregnancy intervals of less than nine months. There were no interracial differences in the prevalence of preterm delivery and low birth weight among women with interpregnancy intervals of less than three months or among those with intervals of nine months or more (Fig. 2).

The first of the paired pregnancies of 185 white and black women were complicated by low birth weight or preterm delivery (Table 4). This outcome was closely linked with preterm delivery and low birth weight in the second of the two pregnancies ($P<0.001$; relative risk, 10.46; 95 percent confidence interval, 6.43 to 17.02). When these high-risk women were excluded from the analysis, the prevalence of preterm delivery and low birth weight decreased in both racial groups (Table 4). The differences between and within the racial groups in the prevalence of low birth weight and preterm delivery according to the interpregnancy interval were similar to those for the group as a whole, with the exception that the difference in prevalence between white women with interpregnancy intervals of less than three months and white women with longer intervals was no longer statistically significant. The difference in prevalence between black women with interpregnancy intervals of less than nine months and black women with longer intervals remained significant (8.5 percent and 2.2 percent, respectively; $P=0.020$; relative risk, 3.96; 95 percent confidence interval, 1.06 to 14.75).

Among the infants born to white women at high risk, the prevalence of preterm delivery and low birth weight was 46.2 percent for the group with interpregnancy intervals of less than three months, as compared with 17.7 percent for those with longer intervals ($P=0.015$; relative risk, 2.61; 95 percent confidence interval, 0.80 to 8.49). Among the infants born to black women in the high-risk group, the number of subjects was insufficient to show any clear relation between interpregnancy interval and the outcome of pregnancy.

We performed a stepwise logistic-regression analysis

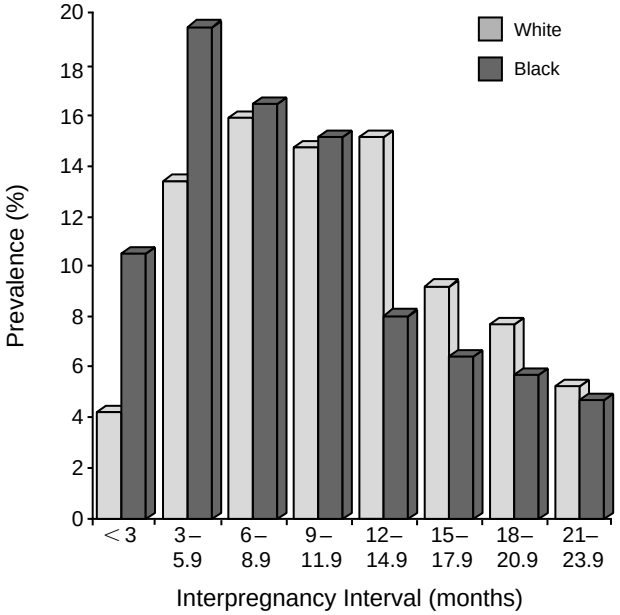

Figure 1. Frequency Distribution of Intervals between Pregnancies among White and Black Women.

The distribution among black women is strongly shifted toward shorter intervals than among white women.

to gauge the relative strength of the associations between 10 obstetrical risk factors (independent variables) and the prevalence of preterm delivery and low birth weight within each racial group (dependent variable). Maternal age below 21 years and family Government Service pay grade below 5 (income below $1,200 per month) had been previously recognized as obstetrical risk factors in the population served by our medical center. Unmarried status, smoking during pregnancy, late entry into prenatal care, and a history of low birth weight or preterm delivery in the previous pregnancy are recognized obstetrical risk factors. Four categories of short interpregnancy interval (<3 months, <6 months, <9 months, and <12 months) were also selected as risk factors. Among white women, the strongest predictor of low birth weight and preterm delivery in the second pregnancy was a history of low birth weight or preterm delivery in the first ($P<0.001$, $r=0.56$), followed by an interpregnancy interval of less than three months ($P<0.001$, $r=0.18$) and smoking during pregnancy ($P=0.025$, $r=0.08$). When the obstetrical history was excluded, the leading predictors were late entry into prenatal care ($P=0.006$, $r=0.11$) and an interpregnancy interval of less than three months ($P=0.006$, $r=0.11$). Among black women, the strongest predictor of low birth weight and preterm delivery was also a history of low birth weight or preterm delivery ($P<0.001$, $r=0.31$), followed by an interpregnancy interval of less than six months ($P=0.004$, $r=0.20$) and an interpregnancy interval of less than nine months ($P=0.020$, $r=0.14$). When the obstetrical history was excluded, the leading risk factors were an interpregnancy interval of less than six months ($P=0.002$, $r=0.21$) and an interpregnancy interval of less than nine months ($P=0.023$, $r=0.14$).

In the study population as a whole, the rate of infant mortality directly attributable to illness related to preterm delivery was 1 in 298 live births (3.4 per 1000) among black infants, similar to that among white infants (5 in 1624 live births, or 3.1 per 1000). Among the infants born to women with interpregnancy intervals of less than nine months, in contrast, this rate was 1 in 138 births (7.2 per 1000) for black infants and 2 in 542 births (3.7 per 1000) for white infants. This difference was not statistically significant because of the small number of infant deaths in each racial group. A power analysis revealed that this difference would become significant if the study were continued until the study population reached four times its current size.

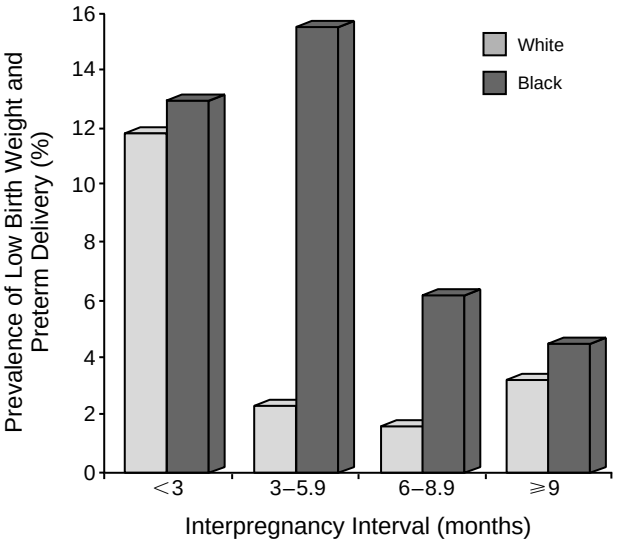

Figure 2. Prevalence of Preterm Delivery and Low-Birth-Weight Offspring among White and Black Women, According to Interval between Pregnancies.

The race-specific prevalence of preterm delivery and low birth weight was similar among women with interpregnancy intervals of less than three months (11.8 percent for white women and 12.9 percent for black women) and among those with intervals of nine months or more (3.2 percent and 4.4 percent, respectively).

Table 3. Prevalence of Preterm Delivery and Low Birth Weight According to Race and Interpregnancy Interval.

Interval	White			Black			P Value
	Women	Preterm delivery and low birth weight		Women	Preterm delivery and low birth weight		
	no.	*no. (%)*		*no.*	*no. (%)*		
All	1624	52 (3.2)		298	23 (7.7)		<0.001
<3 Mo	68	8 (11.8)		31	4 (12.9)		0.872
3–5.9 Mo	218	5 (2.3)		58	9 (15.5)		<0.001
6–8.9 Mo	256	4 (1.6)	44 (2.8)*	49	3 (6.1)	16 (11.6)†	0.051
≥9 Mo	1082	35 (3.2)		160	7 (4.4)		0.456

*P<0.001 for the comparison with women with intervals of less than three months.

†P=0.020 for the comparison with women with intervals of nine months or more.

Discussion

Many investigators have proposed an epidemiologic link between short intervals between pregnancies and unfavorable pregnancy outcomes. The majority have reported an increased prevalence of low birth weight and intrauterine growth retardation in association with short intervals between pregnancies.[8-18] An increased prevalence of preterm delivery and increased perinatal mortality have also been linked to short interpregnancy intervals.[22-24]

A hypothetical "critical" interpregnancy interval has been proposed, indicating the threshold for significant increases in the prevalence of unfavorable outcomes. This critical interval has varied among published reports, ranging from 6 months in developed, industrialized nations to 18 months or longer in developing countries. The mechanism of the putative adverse effect of short interpregnancy intervals has not been determined. The leading theory involves the incomplete restoration of physiologically critical nutrient reserves in the mother that are depleted in the course of the preceding pregnancy.[25,26]

Table 4. Prevalence of Preterm Delivery and Low Birth Weight, According to Race, Obstetrical History, and Interpregnancy Interval.

Group and Interval	White			Black			P Value
	Women	Preterm delivery and low birth weight		Women	Preterm delivery and low birth weight		
	no.	*no. (%)*		*no.*	*no. (%)*		
No history of low birth weight or preterm delivery							
All	1481	22 (1.5)		256	13 (5.1)		<0.001
<3 Mo	55	2 (3.6)		26	3 (11.5)	10 (8.5)*	0.168
3–5.9 Mo	192	0 (0.0)		51	5 (9.8)		<0.001
6–8.9 Mo	234	1 (0.4)		40	2 (5.0)		0.010
≥9 Mo	1000	19 (1.9)		139	3 (2.2)		0.836
History of low birth weight or preterm delivery							
All	143	29 (20.3)		42	10 (23.8)		0.622
<3 Mo	13	6 (46.2)		5	1 (20.0)		0.308
3–5.9 Mo	26	4 (15.4)	23 (17.7)†	7	4 (57.1)		0.022
6–8.9 Mo	22	3 (13.6)		9	1 (11.1)		0.849
≥9 Mo	82	16 (19.5)		21	4 (19.0)		0.962

*P = 0.020 for the comparison with the women with intervals of nine months or more.

†P = 0.015 for the comparison with the women with intervals of less than three months.

A short interpregnancy interval is not universally accepted as an important, independent risk factor for unfavorable pregnancy outcomes, however. Several investigators have noted that short intervals are frequently linked to other accepted obstetrical risk factors, such as unfavorable outcomes of previous pregnancies, poverty, young maternal age, and tobacco use during pregnancy.[27-31] A small number of studies have shown little or no linkage between short interpregnancy intervals and unfavorable pregnancy outcomes when the subjects were selected according to criteria designed to control for these confounding variables.[32,33] Race-specific outcomes among these selected subjects were not reported.

The population we investigated was drawn from a larger population — military personnel and their families — that has been shown to have far lower mortality rates for black infants than are reported for the United States as a whole.[7] The quality of prenatal care and access to and use of such care were comparable among the study subjects, who were representative of the larger military population with respect to obstetrical outcomes. The subjects were not screened for obstetrical risk factors, and race-specific differences in the prevalence of several obstetrical risk factors were identified. Multivariate analysis revealed that among these risk factors, a short interpregnancy interval was exceeded only by a history of poor outcome in the preceding pregnancy as a predictor of preterm delivery and low birth weight.

In contrast to other reports, our findings do not support a relation between an increased prevalence of intrauterine growth retardation and a short interpregnancy interval. This lack of correlation may result from the fact that in our study, infants with growth retardation were identified with an intrauterine-growth curve derived from the population under study.

Our findings reveal a clear association among black women between interpregnancy intervals of less than nine months and a significantly higher prevalence of preterm delivery of low-birth-weight infants. This relation was independent of the increased prevalence of intrauterine growth retardation among black infants and persisted when women at high risk because of unfavorable outcomes in the preceding pregnancy were excluded. Nearly half the black women enrolled in the study had interpregnancy intervals of less than nine months.

A link between short interpregnancy intervals and unfavorable pregnancy outcomes was also observed among the white women, but this relation was weakened by the short range of interpregnancy intervals linked with poor pregnancy outcomes among the white women and by the small number of white women with intervals in this range. The increased risk with shorter intervals between pregnancies was evident primarily among women whose preceding pregnancies had resulted in the delivery of low-birth-weight or preterm infants. The mechanism of these interracial differences remains obscure, but it may involve a greater prevalence among black women of environmental or familial risk factors for unfavorable pregnancy outcomes, as has been proposed in several recent articles.[34-36]

We conclude that a short interpregnancy interval is an important risk factor for low birth weight and preterm delivery. Our results suggest that short interpregnancy intervals occur frequently, especially among black women. Among the black women in our study population, intervals of less than nine months between consecutive pregnancies were strongly associated with a higher prevalence of preterm delivery and low birth weight; this association largely accounts for the greater frequency of these outcomes among black infants. The infants born to black women with interpregnancy intervals of nine months or more had a low prevalence of preterm delivery and low birth weight; the rates in this group were similar to those among whites. Conversely, white women with interpregnancy intervals of less than three months had a high prevalence of adverse outcomes, similar to the rate among black women.

These findings have important implications for health policy in the United States, which currently has a far higher than expected prevalence of low birth weight and preterm delivery as well as large disparities in these rates between the races. Initiatives directed toward reducing the frequency of short interpregnancy intervals could have beneficial effects, especially among black Americans. This prospect is exciting because, unlike many currently recognized risk factors for unfavorable pregnancy outcome, interpregnancy intervals are potentially within the control of individual women.

The relation between the interpregnancy interval and pregnancy outcome among white and black women should be studied further in larger populations. In the interim, public health strategies to reduce the currently high prevalence of low birth weight, preterm delivery, and infant mortality should include counseling that strongly encourages intervals of nine months or more between pregnancies.

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