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IN THIS ISSUE

Author
Phillip Mitchell, MS
Research Analyst

Low Birth Weight Births, 1990 - 1998

Historically, Alaska has had one of the lowest low birth weight rates in the United States. In 1990, only seven states had a low birth weight rate as low as Alaska. Although Alaska's low birth weight rate was not statistically lower than any of these other states, it did have the lowest reported low birth weight rate. However, by 1997 one state had a low birth weight rate statistically lower than Alaska and nine states had a rate as low as Alaska.[1] Thus, comparatively, Alaska has lost ground to other states in improving low birth weight rates.

While the vast majority of low birth weight children have normal outcomes, as a group they have higher rates of subnormal growth, illness, and neurodevelopmental problems.[2] These problems increase as the child's birth weight decreases.[2] At school age, children who were born low birth weight are more likely than children of normal birth weight to have mild learning disabilities, attention disorders, developmental impairments, and breathing problems such as asthma.[2] Much higher proportions of low birth weight children than normal birth weight children are enrolled in special education programs.[2]

According to one national assessment, 35% of health care costs for infants are due to the costs incurred by low birth weight infants.[3] Babies with birth weights between 1,000 and 2,500 grams without respiratory distress syndrome were, on average, six times as costly as normal birth weight babies.[3] Incremental costs associated with the care of these babies accounted for 19% of the annual cost of health care for infants.[3] Clearly, low birth weight is a significant public health concern.

This newsletter will look at trends in low birth weight rates by health characteristics of the infant and by maternal demographic, health, and lifestyle characteristics for resident births from 1990 to 1998.

METHODS

The information for this report came from the medical and demographic information reported on the infant's birth certificate. Low birth weight (LBW) was defined as any live birth weighing less than 2,500 grams (5½ pounds). For further analysis, low birth weight infants were also stratified into three groups. Very low birth weight (VLBW) was defined as any live birth weighing less than 1,500 grams (3½ pounds) and extremely low birth weight (ELBW) was defined as any live birth weighing less than 1,000 grams (2 pounds, 3 ounces). Moderately low birth weight (MLBW) was defined as any live birth weighing between 1500 and 2499 grams.

Definitions. Births were stratified into groups based on demographic characteristics (mother's age, race, and educational attainment) and medical characteristics (gestation, smoking during pregnancy, month prenatal care began, and short interpregnancy interval). These characteristics were chosen because other studies have shown these to be risk factors for low birth weight and their availability on the birth certificate.[4,5] Mothers were separated into two age groups: mothers less than 20 years old or 40 and above (40+) and mothers of age 20 to 39 years old. **Preterm birth** was defined as any birth with less than 37 weeks gestation; **Very preterm** was any birth with less than 32 weeks gestation. **Term birth** was any birth with at least 37 weeks gestation. Mothers with less than 12 years education were defined as having **low educational attainment** and mothers with 12 or more years education had **high educational attainment**. The **interpregnancy period** was defined as the period between delivery and conception and was computed as the interval between two consecutive deliveries minus the gestational age of the second infant. A birth was defined as having **short interpregnancy** if the interpregnancy period was less than one year. **Unwed mothers** were those who reported they were not married, while **married mothers** were those who reported they were married. **Native** mothers were those who reported their race as Aleut, Eskimo, Indian, or mixed Native. All other mothers were classified as **non-Native**. When reading about health outcomes reported by race, remember that race or ethnicity by itself is rarely a reason for good or poor health. Instead it can be considered a surrogate measure or marker of a complex interplay of economic, social, cultural, and biologic factors. Note that the birth information for 1998 is preliminary and subject to revision.

Most of the results presented in this report are for singleton births only, since infants from multiple births are much more likely to be born preterm and with low birth weight. Some results, for comparison to national rates, are based on all live births. Because rates based on few events are subject to considerable year-to-year random variation, rates were calculated using three year moving averages. Although calculating single-year rates would not be a problem for low birth weight births, only an average of 40 extremely low birth weight births occur each year. When comparing rates, however, the same amount of averaging should be applied to all the rates. Therefore, all tests for trends are based on three-year moving averages. **To simplify the reading of this report, all three-year average rates will be referred to as average rates.** Chi-square tests, the Mantel-Haenszel test for linear association, and logistic regression methods were used to investigate trends in low birth weight rates. Each risk factor was tested separately (univariate analysis) to see if it was linearly associated with low birth weight. For the factors found significant, a multivariate model was constructed. Relative risks (RR), low birth weight rates and their confidence intervals (CI) for the entire report period were also calculated. These results are summarized in Table 2, page 8. Records with missing values were excluded from analyses.

Highlights from this Report

- From 1990 to 1998, the low birth weight rate for all births increased 22.6%.
- For single births only, the LBW rate increased an average of 2.4% per year during this period, compared with 3.1% for the VLBW rate and 2.9% for the ELBW rate.
- Native and non-Native mothers had similar low birth weight rates.
- Unwed mothers were 1**2** times more likely to give birth to a low birth weight infant, compared with mothers who were married.
- Younger and older mothers had an elevated risk of low birth weight, as did mothers with less than 12 years of education.
- Of all risk factors investigated, preterm birth was the most significant. Preterm infants had almost 20 times the risk to be born with low birth weight, compared with term infants.

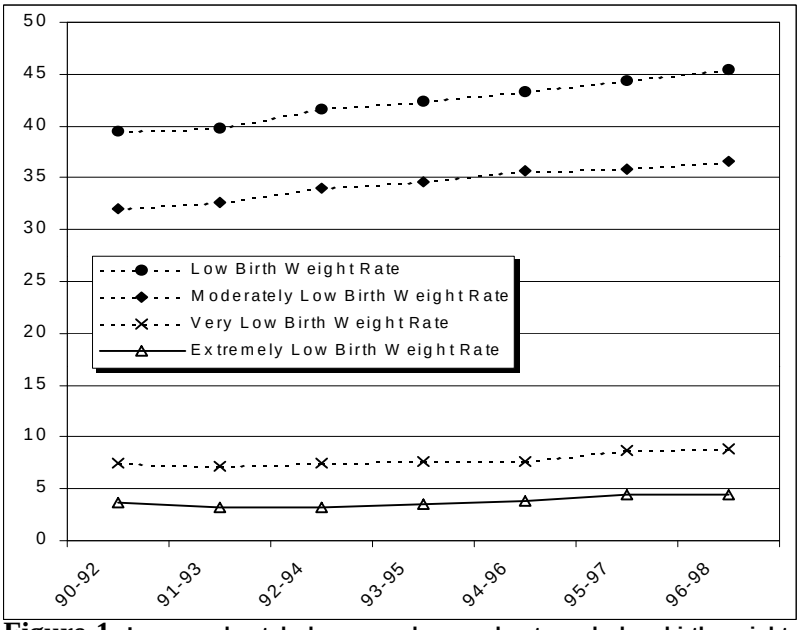

Figure 1. **Low, moderately low, very low, and extremely low birth weight rates, singleton births only: Alaska, 1990 - 1998. Rates are based on three-year moving averages.**

RESULTS

Between 1990 and 1998, resident mothers gave birth to 97,206 infants, an average of 10,801 live births per year. During the entire period, 5,080 infants were born with low birth weight, for a rate of 52.4 LBW births per 1,000 live births. The birth weight was not recorded on 202 birth certificates. In 1990, Alaska had a LBW rate of 48.3 per 1,000 live births [95% confidence interval (CI) 44.4, 52.3]. By 1998 the rate had increased to 59.2 (95% CI 54.4, 64.0). Since the two confidence intervals do not overlap, this is a statistically significant increase — an increase of 22.6% this decade. In comparison, the US LBW rate was 70.0 in 1990 and 75.0 in 1997, a 7.1% increase.[1]

In Alaska, the number of low birth weight births has remained constant (575 in 1990 and 584 in 1998). Yet the number of births per year has decreased significantly during this period, causing higher LBW rates.

The preceding LBW rates were calculated using all births and are single year rates. All subsequent analyses will be for singleton births only and will use three-year moving averages to calculate the rates. Of all live births during this period, 94,845 (97.6%) were single births. Of these single births, 121 had unknown birth weight. For single births, the average low birth weight rate was 39.4 (95% CI 37.3, 41.5) in 1990-92 and was 45.5 (95% CI 43.0, 47.9) in 1996-98, an average increase of 2.4% per year.

From 1990 to 1998, 752 singleton births had very low birth weight, an average of 84 births per year or .8% of all births. Very low birth weight births comprised about one of every five (18.8%) low birth weight births. Nationally, very low birth weight infants make up 1% of all births and less than 15% of all low birth weight births.[1]

In Alaska, the very low birth weight rate for single births was 7.4 (95% CI 6.5, 8.3) in 1990-92 and was 8.9 (95% CI 7.8, 9.9) in 1996-98. Although it appears that these two rates are not statistically different, the confidence interval for the difference of the two rates (95% CI 0.1, 2.9) shows the rate is higher in 1996-98. On average, the very low birth weight rate for single births increased 3.1% per year during this period (χ^2 for trend=7.6, p=.006).

During this report period, 364 singleton infants were born with extremely low birth weight, or approximately half (48.4%) of very low birth weight births had birth weight less than 1,000 grams. The extremely low birth weight rate for 1990-1992 was 3.7 (95% CI 3.1, 4.4) and was 4.4 (95% CI 3.6, 5.1) in 1996-98. Although these two rates are not statistically different (χ^2=1.7, p=.195), the average extremely low birth weight rate has increased an average of 2.9% per year (χ^2 for trend=6.4, p=.011).

Mother's Race

From 1990 to 1998, Native and non-Native mothers had similar low birth weight rates (Table 2, page 8). As shown in Figure 2, the average LBW rate for singleton births has been increasing an average of 2.9%

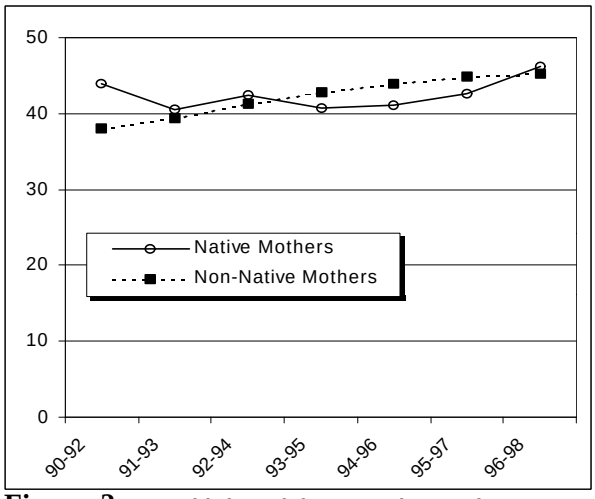

Figure 2. **Low birth weight rates by mother's race, singleton births only: Alaska, 1990 - 1998. Rates are based on three-year moving averages.**

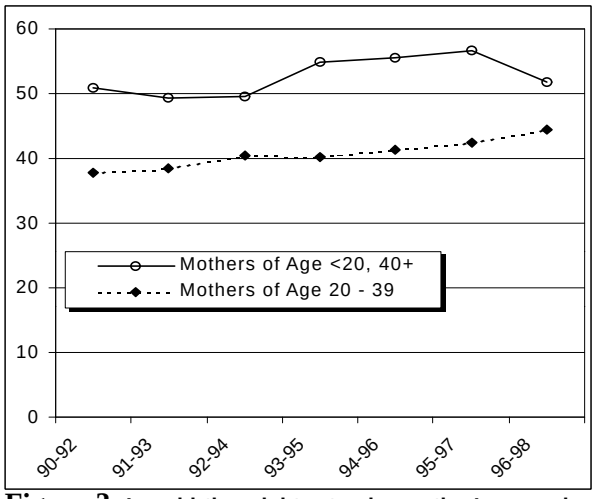

Figure 3. **Low birth weight rates by mother's age, singleton births only: Alaska, 1990 - 1998. Rates are based on three-year moving averages.**

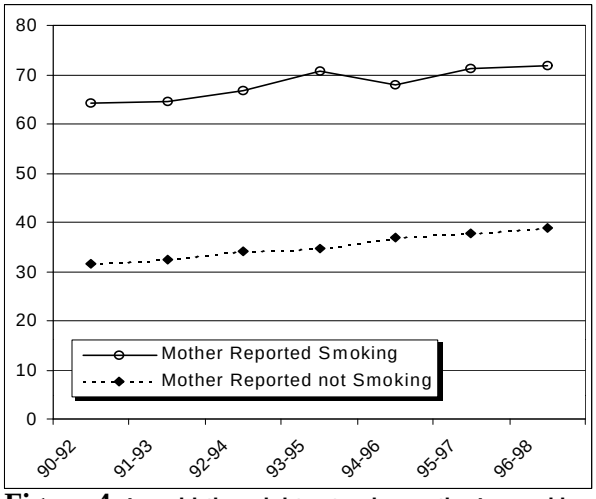

Figure 4. **Low birth weight rates by mother's smoking status, singleton births only: Alaska, 1990 - 1998. Rates are based on three-year moving averages.**

per year for non-Native mothers (χ^2 for trend=26.8, p=.001). No trend in the Native low birth weight rate was observed (χ^2 for trend=.499, p=.48). Very low birth weight rates for Native and non-Native mothers were also similar. For the entire period, the very low birth rate for Native mothers was 8.5 (95% CI 7.7, 9.3) and was 7.6 (95% CI 7.2, 8.0) for non-Native mothers.

Mother's Age

Infants of younger and older mothers are more likely to be born with low birth weight (Table 2, page 8). This agrees closely with national data, where infants of younger and older mothers have 1.4 times the risk of being born with low birth weight.[1] However, the evidence also suggests this difference may be diminishing (Figure 3). The average LBW rate for younger and older mothers has shown no clear trend (χ^2 for trend=1.66, p=.198), but has been increasing 2.8% per year for mothers age 20 to 39 (χ^2 for trend=20.9, p=.001).

Smoking During Pregnancy

Mothers who reported smoking during pregnancy have twice the risk of giving birth to a low birth weight infant during this report period (Table 2, page 8). Other studies have found that mothers who smoked 1 to 5 cigarettes a day had low birth weight rates 61% higher than for nonsmoking mothers.[6] As shown in Figure 4, the average LBW rates for both mothers who smoked or did not smoke during pregnancy have been increasing. However, the average low birth weight rate has been increasing an average of 1.8% per year for mothers who reported smoking during pregnancy (χ^2 for trend=5.4, p=.02), but has been increasing 3.0% per year for mothers who reported they did not smoke during pregnancy (χ^2 for trend=33.4, p=.001).

Mother's Education

Compared with mothers with high educational attainment, mothers with low educational attainment are at risk to give birth to a low birth weight infant (Table 2, page 8). During this period, the average LBW rate has been increasing 2.2% per year for mothers with high educational

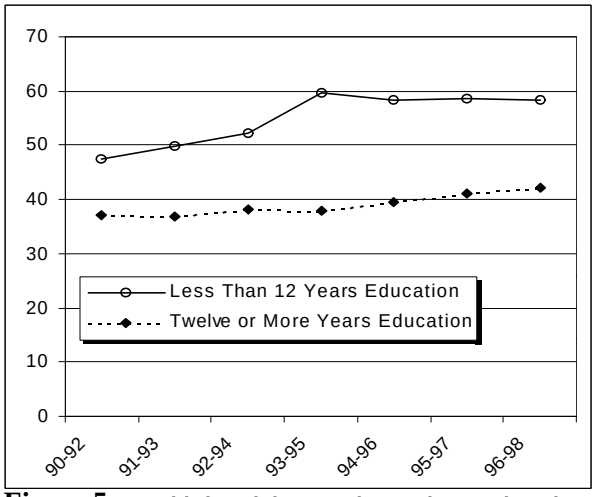

Figure 5. Low birth weight rates by mother's education, singleton births only: Alaska, 1990 - 1998. Rates are based on three-year moving averages.

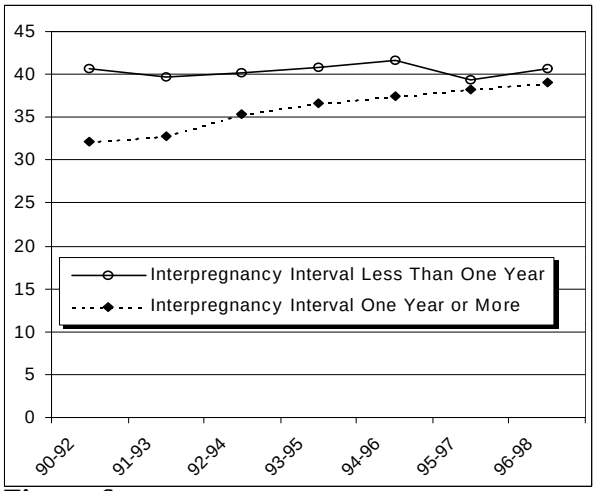

Figure 6. Low birth weight rates by interpregnancy interval, singleton births only: Alaska, 1990 - 1998. Rates are based on three-year moving averages.

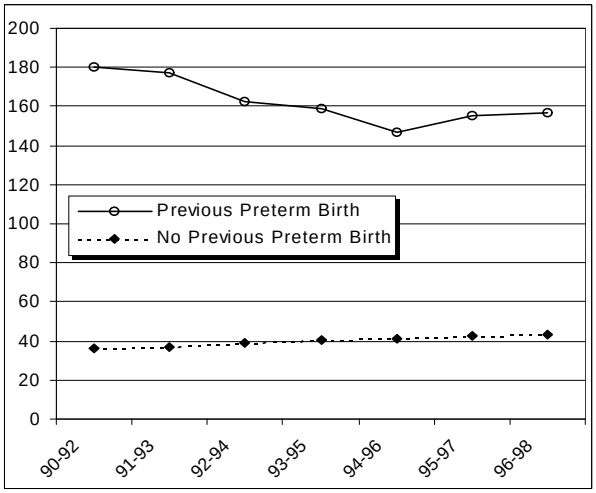

Figure 7. Low birth weight rates by previous preterm birth, singleton births only: Alaska, 1990 - 1998. Rates are based on three-year moving averages.

attainment (χ^2 for trend=16.1, p=.001), but has been increasing 3.5% per year for mothers with low educational attainment (χ^2 for trend=10.5, p=.001). As shown in Figure 5, however, most of this increase occurred from 1990 to 1995.

Interpregnancy Interval

Mothers with a shorter interpregnancy interval were more likely to give birth to a low birth weight infant (Table 2, page 8), compared with mothers who had an interpregnancy interval of more than one year. Yet as shown in Figure 6, the difference in these two groups has clearly diminished. The average low birth weight rate for shorter interpregnancy births has remained unchanged (40.6 per 1,000 live births), compared with an average increase of 3.9% for mothers with an interpregnancy period of more than one year (χ^2 for trend=18.6, p=.001). Unfortunately, the variables needed to calculate the interpregnancy interval were missing on 36,918 (39%) birth records, so these results may not generalize to all births.

Previous Preterm Birth

During this report period, mothers with a previous preterm birth or small-for-gestational-age infant were more than four times as likely to have subsequent low birth weight birth, compared with mothers who did not have a previous preterm birth (Table 2, page 8). Yet as shown in Figure 7, the average LBW rate has decreased significantly for mothers with a previous preterm birth (χ^2 for trend=8.56, p=.003). On average, the LBW rate has been decreasing 2.3% per year for mothers with a previous preterm birth, compared with an average increase of 2.9% for mothers without a previous preterm birth (χ^2 for trend=30.6, p=.001).

Marital Status

Unwed mothers were 12 times more likely to give birth to a low birth weight infant (Table 2, page 8), compared with mothers who were married. The average low birth weight rate has been increasing 2.1% per year for both married (χ^2 for trend=9.4, p=.002) and unwed mothers (χ^2 for trend=8.9, p=.003). Recall that the average low birth weight rate has been increasing an average of 2.4% per year for all births.

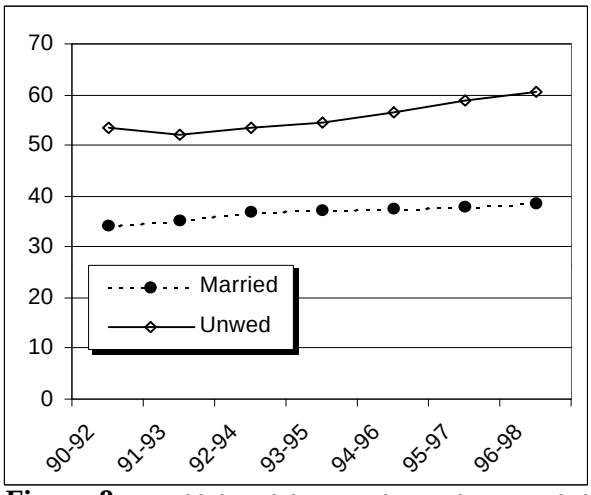

Figure 8. **Low birth weight rates by mother's marital status, singleton births only: Alaska, 1990 - 1998. Rates are based on three-year moving averages.**

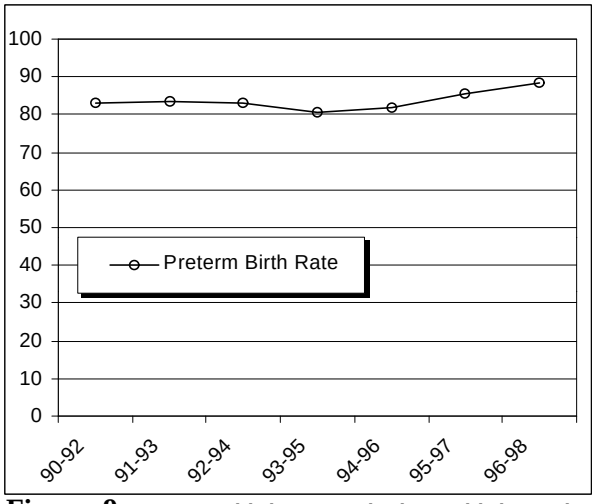

Figure 9. **Preterm birth rate, singleton births only: Alaska, 1990 - 1998. Rates are based on three-year moving averages.**

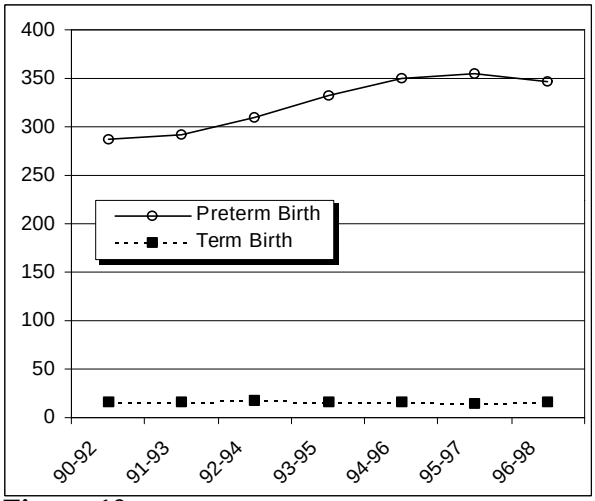

Figure 10. **Low birth weight rates by gestation, singleton births only: Alaska, 1990 - 1998. Rates are based on three-year moving averages.**

Preterm Birth

Many factors contribute to low birth weight, but the most significant is preterm birth. During this report period, 64% of singleton low birth weight births were also preterm. Preterm infants had almost 20 times the risk to be born with low birth weight, compared with term infants (Table 2, page 8). This is higher than the national risk, where preterm infants are 14.6 times more likely (95% CI 14.5, 14.7) to be born with low birth weight.[1] As shown in Figure 9, the average preterm birth rate has been increasing an average of 1.1% per year (χ^2 for trend=5.0, p=.025).

Figure 10 shows that the average LBW rate for preterm births has been increasing 3.2% per year. In 1990-1992, the average low birth weight rate for preterm births was 287.2, compared with 346.7 in 1996-1998. If the average preterm LBW rate had remained unchanged during this period, 153 fewer low birth weight births would have occurred in 1996-1998. Conversely, the LBW rate for term births has decreased slightly (1.0% per year) during this period (χ^2 for trend=4.09, p=.043).

Multivariate Analysis

As seen so far, most factors have individually shown a significant association with low birth weight. One exception was the mother's race, where no linear trend was noted for Native mothers. Simultaneously exploring the relationship between low birth weight and all the risk factors permits finding which factors influence low birth weight, controlling for the effect of the other risk factors. For ease of interpretation, the only interactions considered for this report were the interactions between the year of birth and the risk factors gestation, interpregnancy period, and previous preterm birth.

Initially, the multivariate model contained all the risk factors (including mother's race) and the three interactions. Mother's race was included, despite the inconclusive results, due to the interest in birth outcomes by mother's race. Of these factors, mother's education (p=.197), mother's age (p=.2555), interpregnancy period (p=.1033), and the interaction between year and interpregnancy period (p=.0959) were found to have no association with

low birth weight when controlling for all other factors. Results of the multivariate analysis, after eliminating the factors showing no association, are shown in Table 1.

Since the year of birth is included in the final model, all the estimated risk ratios will change slightly over time. For comparative purposes, the year 1994 was used to estimate the risk ratios for mother's race, smoking status, and marital status. Because the interactions between the year of birth, previous preterm birth and gestation were found significant, an estimate of the risk ratio cannot be made for gestation and previous preterm birth without specifying a birth year. For these two interactions, risk ratios were estimated for the beginning (90-92) and the end (96-98) of the report period.

Table 1 Multivariate Logistic Regression Coefficients for Low Birth Weight Rates, by Characteristics of the Mother or Infant

Risk Factor	Coefficient	Risk Ratio		95% CI
Year*	-.0083	1996-98 1990-92	.95 Referent	.8, 1.1
Mother's Race	-.6682	Non-Native Native	2.0** Referent	1.7, 2.3
Mother's Reported Smoking Status	.6639	Smoked Did Not Smoke	1.9** Referent	1.7, 2.1
Previous Preterm Birth	14.5143	Yes No	N/A	
Mother's Marital Status	.2251	Unwed Married	1.25** Referent	1.1, 1.4
Gestation	-4.4441	Preterm Term	N/A	
Year-Previous Preterm Birth Interaction	-.1437	90-92 Previous PTB 90-92 No Previous PTB 96-98 Previous PTB 96-98 No Previous PTB	4.0 Referent 1.8 Referent	3.6, 4.4 1.5, 2.0
Year-Gestation Interaction	.0832	90-92 PTB 90-92 Term Birth 96-98 PTB 96-98 Term Birth	17.4 Referent 25.0 Referent	15.8, 18.9 22.5, 27.5

Unless noted, p<.001 for all coefficients.
PTB = Preterm Birth
* p=.3441
** 1994 estimate

The negative coefficient for the interaction between year of birth and previous preterm birth shows that the risk of a mother with a previous preterm birth having a subsequent low birth weight birth has been decreasing with time. Conversely, the positive coefficient for the year of birth-gestation interaction shows the risk of a preterm birth being born with low birth weight has increased during this report period. Note also that the multivariate model predicts that infants of non-Native mothers have almost twice the risk of infants of Native mothers to be born with low birth weight, when controlling for the other significant factors.

DISCUSSION

Throughout this report, we have seen evidence that the low birth weight rate has been steadily increasing an average of 2.4% per year. Of particular concern is that the very low and extremely low birth weight rates (3.1% and 2.9%, respectively) have been increasing faster than the moderately low birth weight rate. Compared with moderately low birth weight infants, these infants are more at risk to have a variety of neurodevelopmental disorders and later suboptimal health.[2]

Differences in low birth weight rates by demographic, lifestyle, and health characteristics were observed. Yet for some characteristics, the evidence suggests the difference is lessening. For instance, the low birth weight rate for younger and older mothers has increased only about half as fast as mothers age 20 to 39. Mothers with a short interpregnancy period were more likely to give birth to a low birth weight infant at the beginning of the report period, but were not at risk by the end of the report period.

Mothers with a previous preterm or small-for-gestational-age infant showed a decrease in the proportion of infants born with low birth weight. However, researchers from other states have found that birth certificate data

Table 2 Low Birth Weight Rates, by Characteristics of the Mother or Infant Alaska 1990 - 1998

		LBW Rate	95% CI	RR	95% CI	Observations
Mother's Race	Native	43.6	40.8, 46.4	1.0	.97, 1.12	22,066
	Non-Native	41.8	40.3, 43.3	Referent		72,598
Mother's Age	<20, 40+	52.5	48.5, 56.5	1.3*	1.2, 1.4	12,363
	20 - 39	40.7	39.3, 42.1	Referent		82,329
Mother's Smoking Status	Smoked	68.5	64.9, 72.1	2.0*	1.8, 2.1	20,080
	Did not smoke	34.9	33.6, 36.2	Referent		74,329
Mother's Education	<12 years	54.7	50.8, 58.6	1.4*	1.3, 1.5	13,517
	12+ years	38.9	37.5, 40.3	Referent		79,829
Interpregnancy Period	< 1 year	40.6	38.1, 42.7	1.1*	1.05, 1.20	12,305
	1+ years	35.8	34.7, 36.9	Referent		57,806
Previous Preterm Birth	Yes	166.4	147.2, 185.6	4.2*	3.8, 4.7	1,731
	No	39.7	38.4, 41.0	Referent		92,774
Mother's Marital Status	Unwed	56.2	53.4, 59.0	1.5*	1.45, 1.64	67,358
	Married	36.6	35.2, 38.0	Referent		27,266
Gestation	Preterm	320.5	308.0, 333.0	19.4*	18.6, 20.3	7,923
	Term	16.5	15.6, 17.4	Referent		86,639

* Significant at the .05 level.
N = 94,724

were in exact agreement with medical records only 58.5% of the time.[7] No recent studies have looked at the accuracy of the medical information on Alaskan birth certificates. Thus, the results for previous preterm or small-for-gestational-age birth could be due in part to recording errors and should be viewed with caution.

Also, the LBW rate for both unwed and married mothers increased an average of 2.1% per year, which is less than the overall increase of 2.4%. Note that the overall LBW rate is a weighted average of the married and unwed LBW rates. The reason both increases could be less than the overall increase is that the proportion of unwed mothers increased from 27% in 1990-92 to 31% in 1996-98. Thus, the much higher LBW rate for unwed mothers contributes more to the overall LBW rate in 1996-98 than in 1990-92.

Some interesting results were also observed for the multivariate analysis. The regression estimates predict that non-Native mothers have twice the risk of Native mothers to give birth to a LBW infant, when controlling for all other factors. However as previously noted, Native and non-Native mothers had similar LBW rates. One possible reason the predicted and the actual results are so dissimilar is that Native mothers are more likely to be unwed and to smoke during pregnancy, compared with non-Native mothers. Native mothers are also more likely to deliver preterm and to have had a previous preterm birth. Using estimates from the regression analysis, it is predicted that Native mothers who reported smoking have the same risk of having a LBW infant, compared with non-Native mothers who did not smoke. Thus, the difference between the observed and predicted risk of a LBW birth for non-Native mothers can partially be explained by the fact that Native mothers are more likely to be unwed and to report smoking during pregnancy.

For this report, gestational age was estimated as the interval between the date of the mother's last menses and the infant's birth date, as recommended by the National Center for Health Statistics. When the information was missing or implausible, the estimated gestational age was used. Since the mother's last menses is self reported information, it is subject to recall bias. As previously mentioned, some studies have questioned the accuracy of medical information on the birth certificate. Thus, the results for preterm births may also be partly due to reporting issues.

Mothers who reported smoking during pregnancy showed slower growth in the LBW rate, compared with nonsmoking mothers. Smoking during pregnancy is self reported information on the birth certificate. Some studies have found this information is under reported on the birth certificate.[8,9] This may partially explain why mothers who smoked showed a slower increase in the low birth weight rate. If some mothers who smoked during pregnancy re-

ported they did not smoke, this could artificially inflate the low birth weight rate for mothers who truly did not smoke during pregnancy. Also, the reported information on the birth certificate only records if a mother smoked during pregnancy. It does not tell when she smoked during her pregnancy or if she was smoking and then stopped smoking sometime during her pregnancy.

The results of this study show that the low birth rate has been increasing, more so for infants weighing less than 1500 grams. A substantial part of this increase may be due to the increase in the number of preterm infants born with low birth weight. Since rates of abnormal outcomes increase as the birth weight decreases, this trend merits close monitoring and further study to examine causes to see what, if anything, has changed.

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A Note to the Reader

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The Bureau had temporarily ceased publication of the Vital Signs Newsletter during the past year. We apologize for the delay in publishing this report. The Bureau plans to continue publishing the Vital Signs Newsletter biannually.