
OBSTETRICS

Risk Factors of Low Birth Weight Infants in Multnomah County, Oregon in 1997 and 1998

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ABSTRACT

Objective To identify risk factors for low birth weight infants in Multnomah County, Oregon.

Study design Case-control study

Methods All single live births with birth weight less than 4,000 g. were analyzed from the 1997 and 1998 Oregon birth certificate records. The dependent variable was low birth weight, classified as low birth weight (less than 2,500g.), normal birth weight (2,500g. - 4,000g.). Independent variables included maternal, paternal, and infant characteristics. Among the maternal variables examined were race, education, age, complications of pregnancy, complications of labor and delivery, illnesses during pregnancy, prenatal care, Hispanic origin, public health care coverage, tobacco use, alcohol use, illicit drug use, heroin use, cocaine use, methamphetamine use, marijuana use, antenatal procedures, intrapartum procedures, marital status, birth order, birth space, and maternal weight gain. Paternal variables were race, education, age, and Hispanic origin. Infant variable included gestational age and sex.

Results Pre-term infants were 17 times more likely than normal term infants to have low birth weights. Mothers who used cocaine were seven times more likely to have low birth weight infants than were mothers who did not use cocaine. Mothers who had complications during pregnancy were three times more likely to have low birth weight infants than were mothers who had no complications during pregnancy. Mothers who had complications of labor and delivery were twice as likely to have low birth weight infants than were mothers who had no complications of labor and delivery. Mothers who had inadequate prenatal care were twice as likely to have low birth weight infants than were mothers who had adequate prenatal care.

Conclusion Pre-term infants, cocaine use, having complications during pregnancy, having complications of labor and delivery, and having inadequate prenatal care were significantly related to low birth weight infants in Multnomah County, Oregon.

Key words: Risk factors, low birth weight, Oregon

Low birth weight infants have an increased risk of morbidity and mortality. To improve perinatal outcomes, researchers have tried to identify the attributes associated with higher rates of low birth

weight. A review of literature indicated that a variety of maternal, paternal and infant characteristics were related to low birth weight. Maternal variables that have been associated with low birth weight include

race,^(2-4,7,8) education,^(2-4,6,8) age,^(2,6,8) complications of pregnancy,^(3, 8) complications of labor and delivery,⁽⁸⁾ illness during pregnancy,⁽⁸⁾ inadequate prenatal care,^(1,4,6,8) Hispanic origin,⁽⁸⁾ socioeconomic status,^(1,3,8) tobacco use,^(1,2,3,8) alcohol use,^(1,2,3,8) illicit drug use, antenatal procedures,⁽⁸⁾ intrapartum procedures,⁽⁸⁾ gestational age,⁽⁸⁾ marital status,^(2,3,8) birth order,⁽²⁾ birth spacing,⁽²⁾ and maternal weight gain.^(2,3,8) Paternal variables associated with low birth weight have included race,^(2-4,7,8) education,^(4,8) age,⁽⁸⁾ and Hispanic origin.⁽⁸⁾ Infant variables related to low birth weight include gestational age and gender.^(3,8)

The purpose of this study was to identify risk factors for low birth weight infants in Multnomah County, Oregon.

Materials and Method

All single live births were selected from the 1997 and 1998 Oregon birth certificate records. Infants weighing more than 4,000 g. were excluded from the analysis because the risk factors for high birth weight are different from the risks factors for low birth weight infants.⁽³⁾ The dependent variable was low birth weight. For the purpose of this analysis, very low birth weight (less than 1,499 g.) and moderate low birth weight

(1,500g. - 2,499g.) were combined. Independent variables included in the analyses were maternal, paternal and infant characteristics. Maternal variables examined in this study were race, education, age, complications of pregnancy, complications of labor and delivery, illnesses during pregnancy, prenatal care, Hispanic origin, public health care coverage, tobacco use, alcohol use, illicit drug use, heroin use, cocaine use, methamphetamine use, marijuana use, antenatal procedures, intrapartum procedures, marital status, birth order, birth spacing, and maternal weight gain. Paternal variables were race, education, age, and Hispanic origin. Infant variables were sex and gestational age. Chi-square tests, Simple Logistic Regression, and Multiple Logistic Regression were used. All analyses were conducted using SPSS software.

Results

The number of births and mean birth weights for females and males are displayed in Table 1. The upper portion of the table shows total births, the lower portion shows the births and mean birth weights for infants included in the analyses.

Table 1. Infant Birth Weight Classified by Gender and Year

Variables	Year		
	1997	1998	1997 and 1998
Number of births	9007 (49.2%)	9303 (50.8%)	18,310
■ Female	4412 (49.0%)	4528 (48.7%)	8940
■ Male	4595 (51.0%)	4775 (51.3%)	9370
Mean birth weight of total # of births	3378.65 (SD. = 587.56)	3383.73 (SD.= 578.95)	3381.23 (SD.=583.19)
■ Female	3314.50 (SD. = 576.62)	3317.79 (SD. = 571.01)	3316.17 (SD. = 573.75)
■ Male	3440.25 (SD. = 591.42)	3446.27 (SD. = 579.56)	3443.31 (SD. = 585.38)
Number of single births and birth weight not more than 4,000g.	7,717 (49.2%)	7,955 (50.8%)	15,672
■ Female	3,883 (50.3%)	4,013 (50.4%)	7,896
■ Male	3,834 (49.7%)	3,942 (49.6%)	7,776

Variables	Year		
	1997	1998	1997 and 1998
Mean birth weight of total # of single births and birth weight not more than 4,000g.	3290.95 (SD. = 478.67)	3293.49 (SD. = 476.38)	3292.24 (SD. = 477.49)
■ Female	3250.15 (SD. = 473.13)	3257 (SD. = 483.44)	3253.69 (SD. = 478.38)
■ Male	3332.27 (SD. = 480.76)	3330.53 (SD. = 466.24)	3331.39 (SD. = 473.42)

Chi-square tests and Simple Logistic Regression analysis were used to identify significant ($p < .05$) associations between low birth weight and maternal variables, paternal variables and infant variables. The results are shown in Table 2 for 1997 and in Table 3 for 1998.

For 1997, the variables significantly associated with low birth weight infants were mother's race, father's race, mother's education, father's education, mother's age, complications of pregnancy, complications of labor and delivery, inadequate care, Kessner index, public coverage, tobacco use, alcohol use, illicit drug use, cocaine use, marijuana use, gestational age, marital status, maternal weight gain, and infants' gender.

Variables included in the analyses but not significantly associated with low birth weight were father's age, illness during pregnancy, mother's Hispanic origin, father's Hispanic origin, antenatal procedures, intrapartum procedures, heroin use, methamphetamine use, birth order, and birth space.

For 1998, the variables significantly associated with low birth weight infants were mother's race,

mother's education, father's education, father's age, complications of pregnancy, complications of labor and delivery, inadequate care, father's Hispanic origin, public health care coverage, tobacco use, alcohol use, heroin use, cocaine use, gestational age, marital status, maternal weight gain, and infants' sex.

Variables that were not significantly associated with infant low birth weight were father's race, mother's age, illnesses during pregnancy, Kessner index, mother's Hispanic origin, antenatal procedures, intrapartum procedures, illicit drug use, methamphetamine use, marijuana use, birth order, and birth space.

Results for 1997 and 1998 show nearly the same significant associations with low birth weight except for father's race (African-American VS White) and mother's age. Father's race and mother's age had significant associations with low birth weight in 1997, but not in 1998. Also, father's age and father's Hispanic origin had significant associations with low birth weight infants in 1998 but not in 1997 (see Table 4).

Table 2. Significant Relationships between Birth Weight and All Variables Classified by Tests in Year 1997

	X ² test Including all GA	X ² test Excluding GA less than 37 wk.	Simple Logistic Regression	Multiple Logistic Regression (Simultaneous method)
Mother's race	**	**	**African-American VS White	NS.
Father's race	**	**	**African-American VS White	NS.
Mother's education (<12 yrs VS ≥12 yrs)	NS	NS	** (cont.)	NS.
Father's education (<12 yrs VS ≥12 yrs)	NS	NS	** (cont.)	NS.
Mother's age (<18, 18-34, ≥18 yrs)	**	NS	NS. (cont.)	NS.
Father's age (<18, 18-34, ≥18 yrs)	NS	NS	NS. (cont.)	-
Complications of pregnancy	**	**	**	**
Complications of labor and delivery	**	**	**	**
Illnesses during pregnancy	NS.	NS.	NS.	-
Inadequate care	**	NS.	**	NS.
Kessner index	**	*	**	NS.
Mother's Hispanic origin	NS.	NS.	NS.	-
Father's Hispanic origin	NS.	NS.	NS.	-
Public coverage	**	**	**	NS.
Tobacco use	**	**	**	**
Alcohol use	*	*	*(P = .059)	NS.
Antenatal procedures	NS.	NS.	NS.	-
Intrapartum procedures	NS.	NS.	NS.	-
Illicit drug flag	**	**	**	NS.
Heroin flag	NS.	NS.	NS.	-
Cocaine flag	*	**	**	*
Methamphetamine flag	NS.	NS.	NS.	-
Marijuana	NS.	*	NS.	NS.
Gestational age (<37, 37-40, >40)	** (<37, 37-40, >40)	* (37-40, >40)	** (<37 VS 37-40) * (37-40 VS >40) ** (cont.)	** (<37 VS 37-40)
Marital status	**	**	**	NS.
SEX (babies) (1= female)	NS.	**	NS.	**
Birth order (cont.)	-	-	NS.	NS.
Birth space (cont.)	-	-	NS.	NS.
Weight gain (cont.)	-	-	** (cont.)	** (cont.)

*P-value < .05

**P-value < .01

cont. = Continuous variable

Kessner index = Prenatal care index computed by coding 0 = adequate, 1 = inadequate.

Adequate = Month care began within first 3 months and gestation age < 14 weeks and number of visits 1 or more
 = Month care began within first 3 months and gestation age 14 -17 weeks and number of visits 2 or more
 = Month care began within first 3 months and gestation age 18 -21 weeks and number of visits 3 or more
 = Month care began within first 3 months and gestation age 22 -25 weeks and number of visits 4 or more
 = Month care began within first 3 months and gestation age 26 -29 weeks and number of visits 5 or more
 = Month care began within first 3 months and gestation age 30 -31 weeks and number of visits 6 or more
 = Month care began within first 3 months and gestation age 32 -33 weeks and number of visits 7 or more
 = Month care began within first 3 months and gestation age 34 -35 weeks and number of visits 8 or more
 = Month care began within first 3 months and gestation age 36 -45 weeks and number of visits 9 or more

Inadequate = Others.

Table 3. Significant Relationships between Birth Weight and all Variables Classified by Tests in Year 1998

	X ² test Including all GA	X ² test Excluding GA less than 37 wk.	Simple Logistic Regression	Multiple Logistic Regression (Simultaneous method)
Mother's race	**	**	** African-American VS White	*
Father's race	NS.	NS.	NS.	-
Mother's education (<12 yrs VS ≥12 yrs)	NS.	NS.	* (cont.)	* (cont.)
Father's education (<12 yrs VS ≥12 yrs)	NS.	*	** (cont.)	NS.
Mother's age (<18, 18-34, ≥18 yrs)	NS.	NS.	NS.	-
Father's age (<18, 18-34, ≥18 yrs)	*	NS.	*, * (cont.)	* (cont.)
Complications of pregnancy	**	**	**	**
Complications of labor and delivery	**	NS.	**	**
Illnesses during pregnancy	NS.	NS.	NS.	-
Inadequate care	**	*	**	NS.
Kessner index	NS.	NS.	NS.	-
Mother's Hispanic origin	NS.	NS.	NS.	-
Father's Hispanic origin	NS.	*	Model (P=.0517) Coeff. (P=.0461)	NS.
Public coverage	**	NS.	**	NS.
Tobacco use	**	**	**	**
Alcohol use	NS.	*	NS.	NS.
Antenatal procedures	NS.	NS.	NS.	-
Intrapartum procedures	NS.	NS.	NS.	-
Illicit drug flag	NS.	NS.	NS.	-
Heroin flag	NS.	*	NS.	NS.
Cocaine flag	**	NS.	**	NS.
Methamphetamine flag	NS.	NS.	NS.	-
Marijuana	NS.	NS.	NS.	-
Gestational age (<37, 37-40, >40)	** (<37, 37-40, >40)	** (37-40, >40)	** (<37 VS 37-40) ** (37-40 VS >40) ** (cont.)	** (<37 VS 37-40) ** (37-40 VS >40)
Marital status	**	**	**	NS.
SEX (babies) (1= female)	**	**	**	**
Birth order (cont.)	-	-	NS.	-
Birth space (cont.)	-	-	NS.	-
Weight gain (cont.)	-	-	** (cont.)	** (cont.)

* P-value < .05

** P-value < .01

cont. = Continuous variable

Kessner index = Prenatal care index computed by coding 0 = adequate, 1= inadequate.

Adequate = Month care began within first 3 months and gestation age < 14 weeks and number of visits 1 or more
 = Month care began within first 3 months and gestation age 14 –17 weeks and number of visits 2 or more
 = Month care began within first 3 months and gestation age 18 –21 weeks and number of visits 3 or more
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 = Month care began within first 3 months and gestation age 30 –31 weeks and number of visits 6 or more
 = Month care began within first 3 months and gestation age 32 –33 weeks and number of visits 7 or more
 = Month care began within first 3 months and gestation age 34 –35 weeks and number of visits 8 or more
 = Month care began within first 3 months and gestation age 36 –45 weeks and number of visits 9 or more

Inadequate = Others.

Table 4. Summary the Results of Simple Logistic Regression and Multiple Logistic Regression Analyses Classified by Year

Year	1997			1998			1997			1998		
	B	Sig	Exp(B)	B	Sig	Exp(B)	B	Sig	Exp(B)	B	Sig	Exp(B)
Mother's race Afri-Amer VS White	.607	.000	1.835**	.6024	.0001	1.8265 **	-.312	.346	.732	.5992	.0115	1.8206*
Father's race Afri-Amer VS White	.569	.000	1.767**	-	-	-	.562	.061	1.753	-	-	-
Mother's edu ©	-.044	.010	.957**	-.0343	.0384	.9663 *	.029	.412	1.029	.0790	.0295	1.08*
Father's edu ©	-.063	.000	.939**	-.0506	.0029	.9507 **	-.023	.462	.977	-.0576	.1188	.9441
Father's age ©				-.0167	.0497	.9834				-.0246	.0260	.9757*
Complications of pregnancy	.812	.000	2.253**	1.0144	.0000	2.7578 **	.735	.000	2.085**	.7015	.0000	2.0169**
Complications of labor and delivery	.885	.000	2.424**	.6352	.0000	1.8873 **	.627	.000	1.872**	.6492	.0000	1.9139**
Inadequate care	.801	.000	2.227**	.7746	.0000	2.1697 **	.117	.679	1.124	.3881	.1847	1.4742
Kessner index	.296	.009	1.345**	-	-	-	.113	.479	1.120	-	-	-
Father's Hispanic origin	-	-	-	.2661	.0461	1.3049 *	-	-	-	.1611	.4565	1.1748
Public coverage	.379	.000	1.461**	.4043	.0001	1.4982 **	.021	.892	1.021	.1165	.4940	1.1236
Tobacco use	.633	.000	1.883**	.6257	.0000	1.8695 **	.647	.000	1.910**	.5889	.0024	1.802**
Alcohol use	.604	.059	1.830	.4557	.1718	1.5772	-.833	.646	1.660	.0682	.9200	1.0705
Illicit drug flag	.974	.004	2.647**	-	-	-	-.433	.772	.649	-	-	-
Heroin flag	-	-	-	1.8108	.1172	6.1152	-	-	-	2.4961	.0893	12.1352
Cocaine flag	1.901	.005	6.690**	1.9995	.0008	7.3853 **	3.433	.052	30.969	1.6466	.4406	5.1894
Post-term VS Term	-.418	.040	.658*	-1.1609	.0000	.3132 **	-.316	.152	.729	-1.1064	.0012	.3307**
Pre-term VS Term	2.696	.000	14.826**	2.7756	.0000	16.0482 **	2.748	.000	15.614**	2.8821	.0000	17.8517**
Marital status	.317	.002	1.373**	.4715	.0000	1.6024 **	.106	.516	1.112	.1168	.5048	1.1239
SEX F=1, M=0	.100	.326	1.105	.2904	.0045	1.3370 **	.394	.004	1.483**	.4448	.0011	1.5602**
Weight gain ©	-.048	.000	.953**	-.0371	.0000	.9636 **	-.035	.000	.966**	-.0290	.0000	.9714**

© Continuous variable

Table 5. Summary the Adjusted Relative Odds for Infant Low Birth Weight of Simple Logistic Regression and Multiple Logistic Regression Analysis Classified by Year

Year	Simple Logistic Regression		Multiple Logistic Regression		Range of OR
	1997	1998	1997	1998	
Mother's race Afri-Amer VS White	1.835**	1.8265 **	.732	1.8206*	1.82-1.83**
Father's race Afri-Amer VS White	1.767**	-	1.753	-	1.70-1.77**
Mother's edu ©	.957**	.9663 *	1.029	1.08*	0.96-1.08*
Father's edu ©	.939**	.9507 **	.977	.9441	0.94-0.95**
Father's age ©	-	.9834		.9757*	0.97-0.98*
Complications of pregnancy	2.253**	2.7578 **	2.085**	2.0169**	2.01-2.76**
Complications of labor and delivery	2.424**	1.8873 **	1.872**	1.9139**	1.87-2.42**
Inadequate care	2.227**	2.1697 **	1.124	1.4742	2.17-2.22**
Kessner index	1.345**	-	1.120	-	-
Father's Hispanic origin	-	1.3049 *	-	1.1748	1.30-1.31*
Public coverage	1.461**	1.4982 **	1.021	1.1236	1.46-1.50**
Tobacco use	1.883**	1.8695 **	1.910**	1.802**	1.80-1.91**
Alcohol use	1.830	1.5772	1.660	1.0705	-
Illicit drug flag	2.647**	-	.649	-	2.60-6.64**
Heroin flag	-	6.1152	-	12.1352	-
Cocaine flag	6.690**	7.3853 **	30.969	5.1894	6.69-7.39**
Post-term VS Term	.658*	.3132 **	.729	.3307**	-
Pre-term VS Term	14.826**	16.0482 **	15.614**	17.8517**	14.83-17.85**
Marital status	1.373**	1.6024 **	1.112	1.1239	1.37-1.60**
SEX F=1, M=0	1.105	1.3370 **	1.483**	1.5602**	1.34-1.51**
Weight gain ©	.953**	.9636 **	.966**	.9714**	0.95-0.97**

© Continuous variable

All variables with significant associations with low birth weights were employed in Multiple Logistic Regression analysis. Table 4 presents a summary of the results of Simple Logistic Regression and Multiple Logistic Regression classified by year. We found that the Odds Ratios for infant low birth weight from Simple Logistic Regression and Multiple Logistic Regression in 1997 and 1998 were nearly identical. Table 5 presents a comparison of the adjusted relative Odds Ratio (OR) for infant low birth weight from Simple Logistic Regression and Multiple Logistic Regression for 1997 and 1998. The range (1997 and 1998 compared) of the adjusted relative Odds for infant low birth weight are also presented in Table 5.

- ❖ From Simple Logistic Regression analysis in 1997 and 1998, as father's education increases the estimated probability of low birth weight infants decreases with the range of the OR = 0.94-0.95.
- ❖ From Multiple Logistic Regression analysis in 1998, as father's age increases the estimated probability of low birth weight infants decreases with the range of the OR = 0.97-0.98.
- ❖ From Simple and Multiple Logistic Regression analysis in 1997 and 1998, as maternal weight gain increases the estimated probability of low birth weight infants decreases with the range of the OR = 0.95-0.97.
- ❖ From Simple and Multiple Logistic Regression analysis in 1997 and 1998, mothers who had higher education were 0.96-1.08 times as likely to have low birth infants than were mothers who had lower education.
- ❖ From Simple Logistic Regression analysis in 1998, fathers of Hispanic origin were 1.30-1.31 times as likely to have low birth weight infants than fathers who were not of Hispanic origin.
- ❖ From Simple Logistic Regression analysis in 1997

and 1998, mothers who had public health care coverage were 1.46-1.50 times as likely to have low birth weight infants than were mothers who did not have public coverage.

- ❖ From Simple and Multiple Logistic Regression analysis in 1997 and 1998, female infants were 1.34-1.51 times as likely to have low birth weights than were male infants.
- ❖ From Simple Logistic Regression analysis in 1997 and 1998, mothers who were unmarried or divorced were 1.37-1.60 times as likely to have low birth weight infants than were mothers who were married or separated.
- ❖ From Simple Logistic Regression analysis in 1997, African-American fathers were 1.70-1.77 times as likely to have low birth weight infants than White fathers.
- ❖ From Simple and Multiple Logistic Regression analysis in 1997 and 1998, African-American mothers were 1.82-1.91 times as likely to have low birth weight infants than White mothers.
- ❖ From Simple and Multiple Logistic Regression analysis in 1997 and 1998, mothers who used tobacco were 1.80-1.91 times as likely to have low birth weight infants than were mothers who did not use tobacco.
- ❖ From Simple Logistic Regression analysis in 1997 and 1998, mothers who had inadequate prenatal care were 2.17-2.22 times as likely to have low birth weight infants than were mothers who had adequate prenatal care.
- ❖ From Simple and Multiple Logistic Regression analysis in 1997 and 1998, mothers who had complications of labor and delivery were 1.87-2.42 times as likely to have low birth weight infants than mothers who had no complications of labor and

delivery.

- ❖ From Simple Logistic Regression analysis in 1997, mothers who used illicit drug were 2.60-2.64 times as likely to have low birth weight infants than were mothers who did not use illicit drugs.
- ❖ From Simple and Multiple Logistic Regression analysis in 1997 and 1998, mothers who had complications during pregnancy were 2.01-2.76 times as likely to have low birth weight infants than were mothers who had no complications during pregnancy.
- ❖ From Simple Logistic Regression analysis in 1997 and 1998, mothers who used cocaine were 6.69-7.39 times more likely to likely to have low birth weight infants than were mothers who did not use cocaine.
- ❖ From Simple and Multiple Logistic Regression analysis in 1997 and 1998, pre-term infants were 14.83-17.85 times likely to have low birth weight than were normal term infants.

Discussion

Our results show the significant contribution that parental and infant characteristics have on explaining the risks of low birth weight. The results from two years data birth records (1997-1998) are very similar. As might be expected, preterm delivery had the strongest association with low birth weight. Preterm infants are highly related to high incidence of low birth weight. From this study, preterm infants were 16 times more likely to have low birth weights than full term infants. After controlling for other factors, the adjusted odds ratio indicates that preterm infants are nearly 18 times more likely to be low birth weight. However, the underlying cause of preterm a growth-restricted infants remains unknown.⁽⁷⁾ After controlling for other factors, however, cocaine use was not significantly related to low birth weight at the 95% level of confidence. Other

factors strongly associated with low birth weight include complications of labor and delivery, tobacco use, being an African-American. African-American parents are nearly 2 times more likely to have low birth weight infants than White parents.⁽²⁾ However, due to the way data are compiled on the birth certificate, some variables probably are underreported. For example, complications of labor and delivery included both maternal and infant variables such as moderate meconium and excessive bleeding. Those variables should be collected in using different variables. Assuming these complications are underreported on the birth certificate, the true risk associated with these conditions is probably higher or lower than this result.⁽⁴⁾

The absence of a significant adjusted odds ratio when other factors are controlling for includes inadequate prenatal care, being single, and using public health coverage. The results of the analysis does not indicate that a particular factor (for example, inadequate prenatal care) is not important, but rather that its relationship to low birth weight is not independent of its relationship with other factors. Thus, inadequate prenatal care, being single, and having public health coverage are associated with low birth weight but with other variables included in the analysis as well.

The relationship between mother's education and low birth weight deserves comment. As will be seen in the report, the simple relationship between mother's education and birth weight indicates that as mother's education increases, the probability of having a low birth weight infant increases. The results from the multiple regression, however, indicate that after controlling for other factors, mothers with more education are 1.08 times more likely to have a low birth weight infant than are mothers with a high school education or less. Keep in mind that 1.08 is only slightly above one and represents a relatively small risk. When this analysis was repeated using 1997 data, the relationship between mother's education and low birth weight was not significant after controlling for other factors.

In conclusions, pre-term infants, cocaine use,

having complications during pregnancy, using illicit drugs, having complications of labor and delivery, having inadequate prenatal care, tobacco use, mother's race, father's race, marital status, infants' gender, public coverage, father's Hispanic origin, mother's education, maternal weight gain, father's age, and father's education were significantly associated with low birth weight infants in Multnomah County, Oregon.

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