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Maternal Pregravid Weight, Age, and Smoking Status as Risk Factors for Low Birth Weight Births

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Synopsis

The Illinois Department of Public Health, in cooperation with the Centers for Disease Control (CDC), monitors trends in the prevalence of prenatal risk factors that are major predictors of infant mortality and low birth weight (LBW). Analyzed data from CDC are available to the department annually. During 1988, a total of 26,767 records of Illinois women giving birth were submitted to CDC. These surveillance data support the fact that women older than 30 years who smoke and enter pregnancy underweight are at greatest risk of delivering LBW babies. Overall, 13.9 percent of underweight smokers had LBW infants compared with 8 percent of underweight nonsmokers.

Prevalence of LBW among underweight and smoking women older than 34 years was much higher (29.6 percent) than among those between ages 30 and 34 (15.2 percent). The prevalence of LBW decreased as the pregravid weight increased among normal weight smokers (10 percent) and overweight smokers (8.6 percent).

FACTORS EXISTING BEFORE PREGNANCY and factors occurring during pregnancy have extensive influence on the condition of the infant at birth. Since birth weight has a strong correlation with infant survival (*1-3*), attention has been given to strategies that will reduce the proportion of infants with low birth weight (LBW), defined as less than 2,500 grams (g). Similar to national patterns (*1*), the infant mortality rate in Illinois has decreased from 25.0 deaths per 1,000 live births in 1960 to

11.2 in 1988, yet there has not been a comparable decrease in the incidence of LBW infants (table 1). In 1960, LBW infants accounted for 7.5 percent of live births; in 1988, a total of 13,817 LBW babies were born in Illinois, representing again 7.5 percent of all Illinois births. Therefore, with no reductions in the proportion of LBW infants, the reduction in infant mortality was mainly accomplished by improving the survival of LBW infants, often, as shown in other areas, through the increased use of intensive care (*3,4*).

The Illinois experience has been consistent with that pattern. The mortality rate for 1988 LBW births in Illinois was 95.1 per 1,000 LBW births compared with the rate of 4.3 per 1,000 for births which were not LBW. These statistics show the possibility that further reductions in infant mortality could be realized more easily if the incidence of LBW could be reduced. It is expected that programs to reduce the number of LBW infants will contribute to reducing infant mortality in Illinois.

Among the factors known to be related to low birth weight are maternal age, education, race, marital status, prepregnancy weight, length of gestation, weight gain during gestation, parity, and smoking status (*4–11*). To test the importance of these factors among Illinois women, a data set has become available to the Illinois Department of Public Health (IDPH). In 1984, the IDPH began tracking nutritional status during pregnancy and pregnancy outcome information of low-income women in the U.S. Department of Agriculture's Supplemental Food Program for Women, Infants and Children (WIC) in cooperation with the Nutrition Division of the Centers for Disease Control (CDC) in Atlanta, GA. This tracking system, the Pregnancy Nutrition Surveillance System (*12*), monitors trends in the prevalence of prenatal risk factors that are major predictors of LBW and infant mortality.

By using surveillance data to compare risk factors, pregnant women who are at high risk of delivering LBW babies can be identified. In this study we examine data from WIC clients to determine the relative importance of these risk factors and pregnancy outcomes among low-income pregnant women in Illinois.

Method

Currently, 221 WIC clinics in Illinois provide data on low-income pregnant women. These clinics are operated through 82 local agencies. In addition to demographic information, the following information for clients is manually coded on worksheets by local agency WIC staff at the initial visit:

- health data—height, weight, hematocrit or hemoglobin, and blood pressure;
- behavioral factors—smoking (yes or no), taking vitamin and mineral supplements, participating in food stamps program, and breastfeeding practices at postpartum visit;
- pregnancy outcome—gestational ages less than 37 weeks, infant's status at birth (multiple births, dead at post-partum visit, stillborn), and birth weight.

Table 1. Number and percent of infants with low birth weight and infant mortality rate in Illinois, by year

Year	Low birth weight		Deaths per 1,000 live births
	Number	Percent	
1988.....	13,817	7.5	11.2
1987.....	13,391	7.4	11.6
1986.....	13,173	7.5	12.0
1980.....	13,729	7.2	14.7
1970.....	16,874	8.2	21.5
1960.....	18,020	7.5	25.0

SOURCE: Illinois Department of Public Health.

The completed worksheets from local agencies are sent to the IDPH, where they are edited for obvious measurement errors or inconsistent recording of data and keyed onto computer tapes. These tapes are forwarded to CDC, where the data are analyzed. Hard copies of analyzed reports from the CDC then are sent to the State for use.

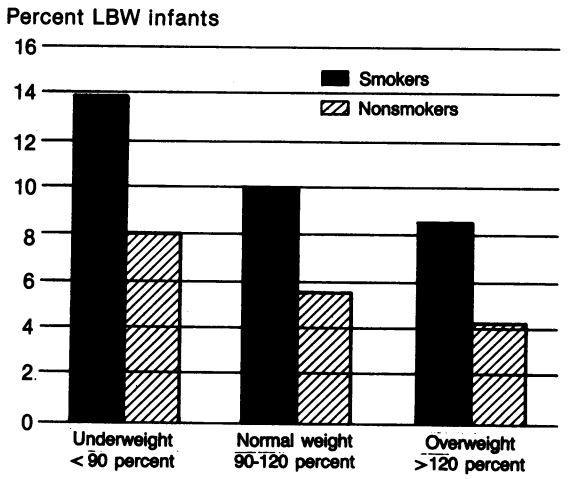
A specific question, "Are you smoking cigarettes now?" was asked of each pregnant woman at her initial visit to the WIC Program. The response was recorded only as "yes or no" and did not provide information on quantity of cigarettes. At a postpartum visit, the infant's record was matched with the mother's initial visit data, and this consolidated data set was used to examine the effect of smoking on pregnancy outcome.

This study was based on tabulations provided by CDC.

Results

During 1988, the 26,767 WIC records of Illinois women who had babies were collected at prenatal and post-partum clinic visits by the State and analyzed by CDC. The majority of mothers were in the 20- to 24-year age group (35.7 percent), and those under 20 years were the next largest group (29.5 percent). The maternal age distribution follows:

Figure 1. Percentage of smoking and nonsmoking women with low birth weight (LBW) infants, by pregravid weight, Illinois, 1988



SOURCE: Illinois Pregnancy Nutrition Surveillance System, tables 5E and 5G.

Maternal age group	*Percent of 1988 WIC records*
Under 20 years	29.5
20–24 years	35.7
25–29 years	21.6
30–34 years	9.7
35 years and older	3.5

Subsequent analyses compared the effects of smoking status, age, and pregravid weight on LBW outcomes.

In the first part of the analysis we compare the LBW prevalence among smokers and nonsmokers for three weight groups. The underweight group consists of women entering pregnancy below 90 percent of the 1959 Metropolitan median weight tables (*13*), normal weight includes women who were between 90 and 120 percent of the 1959 Metropolitan median weight, and overweight includes those women who were above 120 percent of the Metropolitan median weight when their pregnancy began. In each weight group, women who smoked had a higher prevalence of LBW babies than did the nonsmokers (fig. 1). Among both smokers and nonsmokers, however, the prevalence of LBW decreases for women who were heavier. The lowest prevalence of LBW occurred among overweight women who did not smoke; in this group, only 4.2 percent of the births were below 2,500 g. LBW was highest (13.9 percent) among underweight smokers.

In further analyses, we investigated the effects of age on LBW. In each age group and each weight group, women who smoked had a higher proportion of LBW babies than did nonsmokers. Differences in LBW were most pronounced among women who were underweight and among older women. In the underweight group, smoking had less effect among women younger than age 20—12.1 percent LBW for smokers and 8.6 percent for nonsmokers, a difference of 3.5 percent (fig. 2). Underweight women ages 35 and older who smoked had the largest difference (22.8 percent) between smokers (29.6 percent LBW) and nonsmokers (6.8 percent LBW).

Women in the normal weight group had a lower prevalence of LBW (fig. 2). Again, women older than 34 years who smoked had a higher prevalence of LBW (18.8 percent) than younger smokers (8.2 percent). Women who entered pregnancy overweight experienced the lowest prevalence of LBW infants. The lowest prevalence among all women (3.6 percent LBW) was among overweight nonsmokers ages 25 to 29 (fig. 2).

In general, among the nonsmokers, there was no noticeable increase in the prevalence of LBW in the older age groups. This held true for all three weight groups. For the smokers, a very different pattern emerged. In all weight groups, smokers experienced increased prevalence of LBW as age increased.

To test the effect of each variable on LBW outcomes while controlling for the other factors, a logistic regression analysis was conducted using the SAS CATMOD procedure (*14*). The dependent variable of LBW (2 categories: less than 2,500 g, 2,500 g or more) was regressed on three main effect variables: age group (5 categories), pregravid weight (3 categories), and smoking status (2 categories). In addition, the combined effect of independent variables as two-factor and three-factor interactions was tested.

The effects of age, weight, and smoking on birth weight described earlier are readily seen in table 2. Model 1 describes the effects of the independent variables (age, pregravid weight, and smoking status) on birth weight. Each independent variable in this model has a significant influence on the LBW outcome while controlling for the other two factors ($P = .0001$). Smoking status has the strongest effect on low birth weight as shown by the chi-square value of 168.26. The pregravid weight has the second strongest influence on LBW (chi-square = 86.06). The age of the mother has less direct impact than the other two variables, although still significant (chi-square = 28.43).

Interaction effects of the independent variables were tested by introducing them in subsequent models. The combined effects of age and weight; weight and smoking status; and age, weight, and

Table 2. Categorical modeling of main and interactive effects on low birth weight outcomes, Illinois, 1988

Variable	Model 1			Model 2		
	df	Chi-square	P	df	Chi-square	P
Intercept	1	4,990.54	0.0001	1	4,828.36	0.0001
Age group	4	28.43	0.0001	4	28.61	0.0001
Weight group	2	86.06	0.0001	2	84.09	0.0001
Smoking status	1	168.26	0.0001	1	152.75	0.0001
Age × smoking	...	...	...	4	29.69	0.0001
Likelihood ratio	22	48.65	0.0009	18	18.08	0.4507

NOTE: df = degrees of freedom.

smoking status were not significant in these tests. However, the joint effect of age and smoking status contributes significantly to LBW as shown in model 2 of table 2. Model 2 indicates that smoking and age have a strong independent as well as a strong combined effect on LBW, supporting the finding that nonsmokers showed little change in LBW across age groups while smokers showed pronounced increases in LBW as age increased.

Discussion

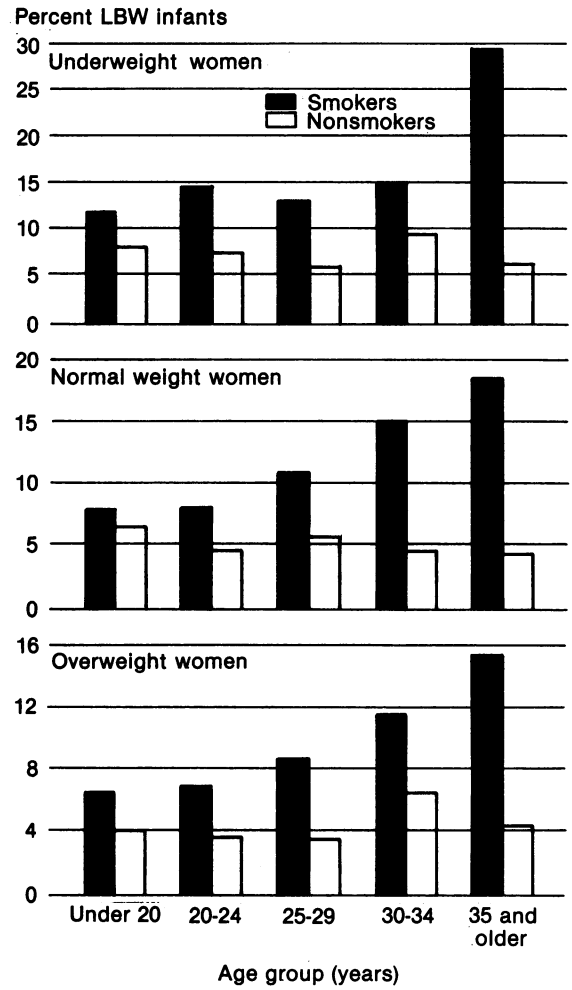
The importance of reducing infant mortality makes reducing the number of LBW infants an important focus for public health policy. This study among low-income Illinois women has demonstrated that smoking has strong effects on the birth weight outcomes of pregnant women. The increased likelihood of having a LBW infant for smokers, for those who were underweight before pregnancy, and for those who were at younger ages, is consistent with previous studies (*4–7,11*). The strongly interactive effect of age on LBW must be noted and explored further. We found that among nonsmokers, low birth weight remained stable or showed a very slight tendency toward a curvilinear relationship for age groups in the three prepregnancy weight categories. However among the smokers, low birth weight increased sharply with increasing age among women in all three weight categories. While many studies point out the relationship of age of mother and of smoking on low birth weight, as we have also observed, very few studies have examined an interactive effect in the statistical model. In a study among women in Puerto Rico, Becerra and Smith found an apparent interaction between age and smoking in the effects on low birth weight, although there was not as distinct a pattern as that seen in our study (*15*), and the interaction of age and smoking status on the risk of low birth weight was observed in a study of national data from the Pregnancy Nutrition Surveillance System, although no statistical model was tested for an interaction term (*5*).

Possible explanations for the increased risk with age are that older women may smoke more intensively, or the years of smoking may have had a cumulative effect on the body. The risks associated with smoking also appear to be substantially higher for those who are underweight than for those who are at normal weight or overweight.

This study examined the relationships of these variables for low-income women in the WIC Program; it did not test the relationships among the non-WIC population in Illinois. The differences for race groups were not tabulated in this data set and could not be examined. In other studies, the birth weight of black infants has been lower than that of white infants with greater differences for nonsmokers in some instances (*7*) and for smokers in other studies (*5*). Since this study examined data for low-income women, a higher proportion of black women probably are in the study than in the population at large. Because some studies (*6,7,11,16*) indicate that black women smoke less than white women, the effects of the race factor in this study are not certain. The data gathered on smoking status in this study did not provide measures for the intensity of smoking, nor did it measure any changes in the pattern of smoking during the pregnancy, each of these conditions having been shown to affect the pregnancy outcomes (*7,11,17*).

Another factor, exposure of the pregnant woman to passive smoke or smoking by the father, has been shown to affect the outcome of pregnancy (*18,19*) but, again, the data from this study do not provide information in that area. A further factor that could not be controlled in this study is the effect of program interventions on the WIC clients. There may be differences among WIC sites in the uniformity of prenatal education and guidance provided to the women, and there also may be differences in the uniformity of using the nutrition

Figure 2. Percentage of smoking and nonsmoking women with low birth weight (LBW) infants, by age group and pregravid weight, Illinois, 1988



supplements provided. In a larger test, these differences might be examined for variation of site effects.

A policy recommendation stemming from this study is to encourage smoking cessation among pregnant women—especially those who are older than 30 years and entering pregnancy underweight because they are at greatest risk of delivering LBW babies. An earlier intervention during school years also is warranted. Educating students about the effects that smoking will have on their health and on the health of others, including future children, is a very important task for school health teachers.

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