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The Association of Prenatal Nutrition and Educational Services with Low Birth Weight Rates in a Florida Program

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Support was provided by the Florida Department of Health and Rehabilitative Services under contract MN811 and the March of Dimes Birth Defects Foundation grant CPE-97/14-60. Portions were presented at the annual meeting of the American Public Health Association, Chicago, IL, October 23, 1989.

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Synopsis

Nutrition services and education, provided as components of normal prenatal care, have a key role in preventing preterm delivery and low birth weight (LBW). To determine the influence of these components on a woman's risk of having a LBW infant, the authors examined groups of patients who were receiving the services.

Bivariate analyses were made of 9,024 prenatal charts of single births. Most women received nutrition education, prescriptions for nutrient supplements, screenings for anemia, and dietary assessments. A greater proportion of the women at high risk received the interventions than did women at lower risk. The presence of educational components and assays for anemia were associated with a lower risk of a LBW delivery in the total group and in the high risk groups.

PROVIDING PREGNANT WOMEN WITH PRENATAL EDUCATION and other components of prenatal care has been shown to reduce the prevalence of preterm labor, one of the primary causes of low birth weight (LBW) (*1-3*).

Many recommended programs of prenatal care include identifying risk factors and early signs of complications of pregnancy, monitoring the course of the pregnancy with an established schedule of visits and evaluations, providing a broad range of information and education to prepare families for birth and to help prevent adverse outcomes, and diagnosing and treating medical and psychosocial problems (*4-8*). However, interventions, passive or active, need to be directed toward factors that can be changed during pregnancy and that can influence the health of the mother and the development of the fetus.

Many evaluations of prenatal services have reported program outcomes, but have not identified the effects of individual program components (*5, 9-12*). Currently, prenatal care programs may be made up of different components in the absence of clear evidence of the effectiveness of individual components in preventing LBW. Studies that have attempted to evaluate specific aspects of prenatal care usually have examined special prenatal packages, such as smoking cessation programs, childbirth education, and nutrition counseling, without investigating other components of regular prenatal care (*13-18*).

Two components of normal prenatal care, nutri-

tional and educational interventions, can be directed at behavioral and other psychosocial factors that are modifiable during the prenatal period to help promote fetal development (*16, 19, 20*), but their relative effectiveness in improving pregnancy outcomes as part of normal prenatal services needs to be measured.

We examined prenatal care programs in public health settings to identify their components and to determine their effects on LBW deliveries among the participating mothers. Our objectives were to determine if intervention strategies were being delivered to high-risk patients and which components were associated with a lower risk of LBW.

Methods

All single births at nine county public health units in Florida between January 1, 1985, and December 31, 1986, a total of 9,014 prenatal charts, were included in the retrospective review. Eight units provided records for both years (5,226 records). The largest unit provided records for 1986 only (3,788 records). LBW was defined as an infant weighing 2,500 grams or less at delivery.

Data collection was conducted by nurses, public health students, and medical records staff who were familiar with the filing systems of the counties. Demographic data were recorded for age, race, marital status, and county of residence. Prenatal data included the trimester of the first prenatal visit, calculated from the date of the last menstrual period; smoking more than 10 cigarettes per day; primigravida; the number of reported first and second trimester abortions; the presence of preterm labor or birth occurring in a previous pregnancy; and having been classified as at high risk by one of two March of Dimes Birth Defects Prenatal Risk Assessments (*21*).

The assessment was developed to provide clinicians, including physicians, nurses, and nurse midwives, with a mechanism to identify women at risk for preterm labor and to guide intervention strategies at prenatal clinics. In the Florida setting, interventions that were undertaken for women at high risk were more frequent prenatal visits and cervical examinations until the 37th week of gestation. Other interventions, such as conducting studies for dietary intake and iron status, seeing the same clinician at each visit, and providing education, were given to all women.

Women were classified as anemic before the 29th gestational week if the hemoglobin count was less than 11 grams per deciliter, or if the hematocrit was less than 32 percent. Prenatal care program components examined in this study were

- education on early signs and symptoms of preterm labor
- having a blood test for a hemoglobin or hematocrit value on the initial visit or at between the 28th and 32nd week of gestation
- the use of iron, folate, calcium, vitamins, or mineral supplements
- the presence on the prenatal chart of a record of dietary recall, and

Table 1. Characteristics of women receiving prenatal care program nutrition and educational interventions and percent delivering low birth weight infants

Characteristic	Number	Percent of population	Percent LBW
Age (years):			
16 and younger	258	3.1	10.8
16.1–17.9	833	10.1	8.6
18.0–20.9	2,205	26.8	8.2
21.0–34.9	4,686	57.0	8.2
35 and older	234	2.8	6.1
Race:[1]			
White	5,460	60.7	7.0
African American	2,882	32.1	11.4
Other	649	7.2	6.4
Marital status:[1]			
Single	5,355	59.5	9.6
Married	3,638	40.5	6.7
Region:			
Urban	3,788	42.0	9.7
Rural	5,226	58.0	7.5
Smoker:[1]			
Yes	1,966	21.8	10.9
No	7,048	78.2	7.7
First prenatal visit:			
1st trimester	2,326	25.8	9.2
2d trimester	4,644	51.5	8.3
3rd trimester	2,044	22.7	7.7
Primigravida:			
Yes	3,062	34.1	8.3
No	5,916	5.9	8.6
1st trimester abortions:			
None	6,909	76.7	8.3
1	1,534	17.0	8.4
2	410	4.5	10.5
3 or more	158	1.8	9.9
2d trimester abortions:			
None	8,617	95.6	8.4
1	321	3.6	9.0
2 or more	74	0.8	13.6
Previous preterm labor or birth:[1]			
Yes	625	6.9	21.8
No	8,389	93.1	7.4
High-risk score at any evaluation:[1]			
Yes	1,782	20.5	14.0
No	6,895	79.5	7.0

[1] Significant differences existed in the percent of LBW infants among groups, using chi-square analysis with P less than 0.001.
NOTE: LBW = low birth weight.

Table 2. Number and percentage of women receiving prenatal care program intervention strategies, by patient characteristics

Characteristic	Received education[1]	Had same clinician[2]	Evaluation of iron status[3]	Cervical examination[4]
Age (in years):				
Number	*8,798*	*8,532*	*9,014*	*1,430*
16 and younger[5]	87.9	[5]33.6	97.3	[6]25.4
16.1–17.9	84.2	35.2	95.8	40.2
18–20.9	81.3	31.6	95.6	36.5
21–34.9	77.4	31.0	95.5	37.9
35 and older	78.6	35.8	95.3	48.3
Race:				
Number	*8,776*	*8,510*	*8,991*	*1,427*
White	77.4	[5]31.1	[5]95.4	[5]34.3
African American	76.6	35.2	97.0	42.8
Other	77.3	31.6	89.4	24.2
Marital status:				
Number	*8,778*	*8,513*	*8,993*	*1,427*
Single	[7]76.3	32.9	95.5	[7]38.4
Married	78.4	31.7	95.4	33.2
Region:				
Number	*8,981*	*8,532*	*9,014*	*1,430*
Urban	[5]55.2	[5]26.0	[5]96.8	[5]26.9
Rural	93.0	37.6	94.4	39.8
Smoker:				
Number	*8,798*	*8,532*	*9,014*	*1,430*
Yes	78.2	31.9	95.7	33.5
No	76.8	32.7	95.4	38.6
First visit:				
Number	*8,798*	*8,532*	*9,014*	*1,430*
1st trimester	77.5	[5]30.0	[5]97.4	[5]43.2
2d trimester	79.0	30.8	97.4	37.1
3rd trimester	72.5	36.1	88.8	25.2
Primigravida:				
Number	*8,774*	*8,508*	*8,978*	*1,426*
Yes	[5]80.2	33.8	[5]94.4	36.4
No	75.6	31.9	96.2	36.8
1st trimester abortions:				
Number	*8,797*	*8,531*	*9,011*	*1,430*
None	77.7	33.2	[5]95.0	37.6
One	76.0	31.1	96.4	36.9
Two	74.8	27.4	97.8	34.2
Three or more	71.5	31.8	98.7	20.4
2d trimester abortions:				
Number	*8,797*	*8,531*	*9,012*	*1,430*
None	77.1	[6]32.2	95.4	36.8
One	75.8	36.3	97.2	3.71
Two or more	85.1	47.0	97.3	29.6
Previous preterm labor or birth:				
Number	*8,798*	*8,532*	*9,014*	*1,430*
Yes	77.8	[7]36.1	96.2	39.4
No	77.1	32.2	95.4	35.2
High risk on assessment:				
Number	*8,551*	*8,289*	*8,677*	...
Yes	[5]83.6	[5]37.0	96.5	...
No	76.1	31.7	97.3	...

[1] Percent of women given prenatal education on early signs and symptoms of preterm labor.
[2] Percent of women who saw the same clinician during at least 75 percent of their prenatal visits.
[3] Percent of women who had a hemoglobin or hematocrit assay during at least 1 of their prenatal visits.
[4] Percent of high risk women who had weekly cervical examinations until their 37th gestational week.
[5] *P* less than 0.001.
[6] *P* less than 0.01.
[7] *P* less than 0.05.

• seeing the same clinician on at least 75 percent of the prenatal visits.

A woman was classified as having seen the same clinician if the initials of the same nurse, nurse-midwife, or physician were on the chart for 75 percent or more of the visits. The use and effectiveness of weekly cervical examinations until the 37th week were studied in women classified as high risk at any visit. Women were classified as at high risk by obtaining 10 or more points from the prenatal risk assessment score (*21*). Birth weight was recorded from the hospital discharge records on the prenatal charts as the primary outcome variable. When birth weights were not present, vital statistic records and hospital logs were reviewed. In total, only 10 percent of the birth weights were missing. There were no significant differences between women with and without missing birth weight data in the charts with regard to week of gestation at the first visit and to age. However, birth weight data were more often missing for women who ended prenatal care in the first trimester of pregnancy and least often missing among African American women. Further, in 10 percent of the cases with missing data, the women were verified to have moved out of the county of study.

Data were transferred directly from the prenatal records to optical scanning forms. The forms were read directly onto a computer tape by an optical scanner. Any variable item that was double coded was automatically rejected by the optical scanner, corrected, and reentered. Data were checked and corrected before any analyses were conducted. A value was classified as missing if it was obviously recorded incorrectly and it could not be corrected by verifying its value with the original data form. These missing values are reflected in the results section because sample sizes vary across analyses.

Data were analyzed to determine which components of prenatal care were associated with the demographic characteristics of the patients and their prenatal risk factors for having a LBW infant using chi-square analysis. Cross-tabulations were conducted to determine associations between the components of prenatal care and LBW. The association of nutrient supplementation with LBW was studied when the patients were stratified by their anemic classification before the 12th week of gestation using Mantel-Haenszel analysis (*22*).

Multivariate logistic regression equations were calculated to determine the association between the components of prenatal care and LBW (*23*). A separate regression equation was calculated for

each prenatal component when variables were included to control for known factors associated with LBW. A logistic regression equation was calculated when all prenatal components were entered simultaneously in the equation.

A second series of equations were calculated for the group of women that were identified as at high risk. This step was conducted to determine if the risks associated with the nutritional or educational components differed among the high-risk women compared with the total group. Weekly cervical examinations were included in this series of equations.

The unadjusted and adjusted odds ratios and 95 percent confidence intervals (95 percent) are presented for the components of prenatal care in the results for the logistic regression equations. The statistical analyses for this study were conducted using SAS software on a Sun 3/50 Workstation (*24*).

Results

Sample population. A majority of the women were single (59.5 percent). White women represented 60.7 percent of the population, with 32.1 percent classified as African American and 7.2 percent classified as other (table 1). Nearly half of the women were from the single urban county used in the study (42 percent). More than half the records were for women between 21 and 35 years of age (52 percent). Those younger than 18 years of age were 10.1 percent of the population. One-quarter of the women started prenatal care in their first trimester of pregnancy, and half started in their second. Smoking 10 or more cigarettes per day was reported by 21.8 percent of the women. Primigravidas were 34.1 percent of the population, and 6.9 percent of the women had had a previous pregnancy that included preterm labor or ended in a preterm birth. Twenty percent of the women were classified as being at high risk for delivering a preterm or LBW infant at either their first or second risk evaluation. The presence of these and other prenatal risk factors and their association with LBW are presented in table 1. The overall LBW rate for the sample was 8.4 percent.

Delivery of normal prenatal components. Prenatal education on the signs and symptoms of preterm labor was recorded in 77.1 percent of all the prenatal charts. Less than one-third of the women (32.5 percent) saw the same clinician during 75 percent or more of their prenatal visits. Among the high-risk women, weekly cervical examinations were recorded for 36.6 percent of those who were classified as at high risk at either their first or second prenatal assessment. However, it was difficult to determine from the records if weekly cervical examinations were conducted in 19.8 percent of the high risk women. For these women the values were considered to be missing.

'...women who received education on the early signs and symptoms of preterm labor had significantly fewer LBW infants than women who did not . . .'

These components of prenatal care appeared to be directed at women who were considered to be at higher risk for delivering a LBW infant. A greater percentage of women who were younger, primigravida, from rural counties, and were classified as high risk for preterm labor received the education component. (table 2). Significantly more of the women who saw the same clinician during 75 percent or more of their visits were from rural counties, African American, had high risk scores for preterm labor, started prenatal care during their third trimester of pregnancy, or had a greater number of second or third trimester abortions (table 2).

Among women who had high-risk scores for preterm labor, weekly cervical examinations were conducted more often for women who were 35 years of age or older or between 16 and 18 years of age, African American, from the rural counties, or single (table 2). There was a significant decrease in the percentage of women who received the cervical examinations according to the trimester in which they started prenatal care (table 2).

Delivery of nutritional components. Hemoglobin and hematocrit values were determined for 81 percent of the patients who entered prenatal care before the 28th week of gestation and for 75 percent of the women who entered between the 28th and 32nd week. Overall, 95.5 percent of the women had a hematocrit or hemoglobin value documented in their prenatal charts. Of women assessed before the 28th week, 10.1 percent were considered anemic. Although there were some statistically significant differences in the type of patient that received a hematocrit or hemoglobin test, the actual percentage differences were small (table 2).

Table 3. Numbers and percentage of women receiving prenatal care program nutritional interventions, by patient chacteristics

Characteristic	Dietary recall[1]	Iron supplement[2]	Vitamin supplement[3]	Folate supplement[4]
Age in years:				
Number	*8,981*	*9,003*	*9,003*	*9,003*
16 and younger	[5]92.6	[5]76.0	[5]92.2	[5]13.2
16.1–17.9	89.2	77.5	92.8	18.9
18–20.9	89.8	76.4	90.2	19.0
21–34.9	89.3	76.4	90.6	18.0
35 and older	85.8	72.2	90.2	21.4
Race:				
Number	*8,959*	*8,980*	*8,980*	*8,980*
White	89.5	[5]74.8	[5]90.0	[5]14.7
African American	91.8	84.6	92.9	24.1
Other	71.7	40.1	77.5	7.4
Marital status:				
Number	*8,961*	*8,982*	*8,982*	*8,982*
Single	[5]89.6	[5]78.6	[6]90.8	20.3
Married	88.0	70.9	88.8	12.6
Region:				
Number	*8,981*	*9,003*	*9,003*	*9,003*
Urban	[5]93.2	[5]88.0	[5]91.3	[5]0.21
Rural	85.9	66.3	89.1	29.5
Smoker:				
Number	*8,981*	*9,003*	*9,003*	*9,003*
Yes	[5]91.1	75.3	[7]91.4	16.4
No	88.3	75.5	89.6	17.4
First visit:				
Number	*8,981*	*9,003*	*9,003*	*9,003*
1st trimester	89.8	[5]75.9	[5]91.4	[5]19.7
2d trimester	90.3	78.5	92.3	18.2
3rd trimester	84.9	67.9	83.2	11.8
Primigravida:				
Number	*8,949*	*8,967*	*8,967*	*8,967*
Yes	[6]90.0	74.7	89.9	17.2
No	88.7	76.1	90.3	17.3
1st trimester abortions:				
Number	*8,978*	*9,000*	*9,000*	*9,000*
None	[6]88.2	[5]74.3	[6]89.4	17.4
One	90.9	78.2	91.8	16.2
Two	92.2	81.2	92.4	17.8
Three or more	94.3	84.2	92.4	17.1
2d trimester abortions:				
Number	*8,979*	*9,001*	*9,001*	*9,001*
None	88.8	[7]75.5	[7]90.0	17.2
One	92.8	77.0	92.8	16.5
Two or more	89.2	63.5	83.8	16.2
Previous preterm labor or birth:				
Number	*8,981*	*9,003*	*9,003*	*9,003*
Yes	87.8	76.0	89.1	[5]22.2
No	89.0	75.4	90.1	16.7
High risk on assessment:				
Number	*8,677*	*8,677*	*8,677*	*8,677*
Yes	87.2	[5]71.3	90.7	[5]26.5
No	91.6	78.6	91.5	15.4

[1] Percent of women whose prenatal records showed a dietary recall.
[2] Percent of women given a written or oral prescription for iron supplements.
[3] Percent of women given a written or oral prescription for vitamin supplements.
[4] Percent of women given a written or oral prescription for folate supplements.
[5] *P* less than 0.001.
[6] *P* less than 0.01.
[7] *P* less than 0.05.

A prescription for nutrient supplements was recorded for iron on 75.4 percent of the charts, on 90 percent for multivitamins, and on 17.2 percent for folate. Calcium (15.1 percent) and other mineral supplements (20.5 percent) were recorded on some charts, but no statistical associations were found for these with the other components of prenatal care or LBW, and further data are not presented.

Supplements tended to be prescribed for patients considered to be at greater risk for having a LBW infant (table 3). A greater percentage of women received supplements if they were African American, compared with white, and single compared with married (table 3). Iron supplements were prescribed least often to women who started prenatal care during the final trimester of pregnancy. Iron supplements were prescribed more often for patients classified as anemic before the 28th week of gestation (85.4 percent), compared with nonanemic patients (77.6 percent).

A dietary recall was included in 90 percent of the prenatal charts. Dietary recalls were present more often for patients who were younger than 16 years of age, African American, single, from the urban county, who smoked, were primigravida, or had one or more first trimester abortions (table 3). The rate for dietary recalls in the charts did not differ statistically by the presence or absence of anemia at the 28th week.

None of the nutritional or other components were correlated highly with each other. The highest Pearson correlation between any two components was 0.43 between vitamin and iron supplements. The next highest correlations were between having a hemoglobin-hematocrit test and iron supplements ($r = 0.31$), iron and folate supplementation ($r = 0.23$), and having preterm education and folate supplementation ($r = 0.22$). The rest of the correlations had coefficients of less than 0.20.

Prenatal components and LBW. The percentages of women who had LBW infants, classified by the components of the prenatal services they received, are shown in table 4. A major finding was that women who received education on the early signs and symptoms of preterm labor had significantly fewer LBW infants (7.6 percent) than women who did not have this education documented. This pattern was consistent in seven of the nine counties that participated in the study. The two exceptions had less than 20 patients who did not have education documented; neither had a LBW infant.

The presence of a hematocrit or hemoglobin test

Table 4. Percentage of women delivering LBW infants and number and percentage who were anemic at the 28th gestational week or earlier, shown by nutritional components of the prenatal care program

Component	Percent of deliveries resulting in LBW infants	Mothers who delivered LBW infants and who were tested for anemia at 28th week or earlier			
		Anemic		Not anemic	
		Percent	Number	Percent	Number
Dietary recall:[1]					
Yes	8.4	9.86	620	7.6	5,557
No	7.5	6.6	45	7.6	542
Iron supplement:[2]					
Yes	8.2	9.3	571	7.5	4,746
No	9.1	11.2	98	8.0	1,366
Vitamin supplement:[3]					
Yes	[4]8.2	9.8	617	7.5	5,652
No	10.4	15.4	52	8.7	460
Folate supplement:[5]					
Yes	8.4	7.3	124	8.8	1,287
No	8.4	10.1	545	7.3	4,825

[1] Women whose prenatal records contained a dietary recall.
[2] Women given a written or oral prescription for iron supplements.
[3] Women given a written or oral prescription for vitamin supplements.
[4] *P* less than 0.05.
NOTE: LBW = low birth weight.

and vitamin supplementation was associated significantly with fewer LBW infants (table 4). The presence of dietary recalls or iron or folate prescriptions was not associated with LBW infants. However, there was a consistent pattern for a lower percentage of LBW infants for women who were advised to take nutrient supplements with iron, folate, or vitamins when stratified by the anemic status of patients before the 28th week (table 5).

Having seen the same clinician for 75 percent of the prenatal visits was not associated with fewer LBW infants (table 4). There was a slightly greater percentage of LBW infants in women who did see the same clinician on 75 percent or more of their clinic visits, representing the more consistent care by individual physicians of the high risk patients. Weekly cervical examinations were not associated with fewer LBW infants in the high risk group (table 4). Several of the interventions were associated with fewer LBW infants when other prenatal risk factors were controlled, using multiple logistic regression (table 6).

The adjusted odds ratios (AOR) resulted in protective values (less than 1) for education (AOR 0.81; 95 percent CI, 0.73–0.91), hematocrit-hemoglobin tests (AOR 0.56; 95 percent CI, 0.50–0.62), and iron supplementation (AOR 0.87; 95 percent CI, 0.78–0.98). Vitamin supplementation tended to be associated with LBW after adjusting for the other risk factors (AOR 0.87; 95 percent CI, 0.82–1.01).

When all interventions factors were controlled simultaneously, education and having a hematocrit-hemoglobin assay remained significantly associated with fewer LBW infants (table 6).

Among high risk women, education remained significant when entered alone (AOR 0.74; 95 percent CI, 0.60–0.91) or with the other components of prenatal care (AOR 0.69; 95 percent CI, 0.54–0.90). The presence of a hemoglobin or hematocrit was significant alone (AOR 0.56; 95 percent CI, 0.47–0.67), or with the other components of prenatal care (AOR 0.49; 95 percent CI, 0.39–0.62). Cervical examinations, dietary recalls, and nutrient supplements were not significantly associated with LBW in the logistic equations among high risk women (table 7).

Discussion

The potential importance of low cost prenatal education makes it necessary to accurately examine the effectiveness of educational strategies used to decrease the rate of LBW infants. The results from this study suggest that higher quality prenatal care was associated with a lower percentage of LBW infants, as measured by the presence of nutritional and educational components. The advantage of this study was that it investigated women who were within the prenatal care system. This provided a mechanism to measure the association between components of prenatal care and birth outcomes without the bias of comparing women who sought no care with those women who did receive prenatal care. The timing of these interventions was planned to be given before the third trimester of pregnancy, or during the first prenatal visits for women who attended their first prenatal clinic during their third trimester. This approach, and the use of multiple logistic regression, allowed the analysis to adjust

Table 5. Numbers of women receiving prenatal care program nutrition and educational interventions and percentage who delivered LBW infants, by component of prenatal program

Component	Number receiving component	Percent LBW deliveries
Education:[1]		
Yes	6,295	[2]7.6
No	1,671	11.2
Same clinician:[3]		
Yes	2,479	9.3
No	5,283	8.1
Hemoglobin or hematocrit assay:[4]		
Yes	6,606	[5]6.8
No	1,535	15.5
Weekly cervical examination:[6]		
Yes	510	12.9
No	814	14.1
Dietary recalls:[2]		
Yes	7,290	8.4
No	740	8.9
Iron supplement:[7]		
Yes	6,326	8.2
No	1,805	9.1
Folate supplement:[8]		
Yes	1,483	8.4
No	6,648	8.4
Vitamin supplement:[9]		
Yes	7,390	[10]8.2
No	741	10.4

[1] Women who received prenatal education concerning early signs and symptoms of preterm labor.
[2] Women whose prenatal records showed a dietary recall.
[3] Women who saw the same clinician during at least 75 percent of their prenatal visits.
[4] Women who had a hemoglobin or hematocrit assay conducted during at least 1 prenatal visit.
[5] P less than 0.001.
[6] High risk women who had weekly cervical examinations until the 37th gestational week.
[7] Women who had a written or oral prescription for iron supplements.
[8] Women who had a written or oral prescription for folate supplements.
[9] Women who had a written or oral prescription for vitamin supplements.
[10] P less than 0.05.
NOTE: LBW = low birth weight.

for demographic and behavioral differences among women and the components of prenatal care when determining the association between interventions and the frequency of LBW infants.

Education on early signs and symptoms of preterm labor and having a hemoglobin or hematocrit assay conducted were highly associated with fewer LBW infants, after controlling for other significant factors. These factors were significant in the total population and within the group of pregnant women that was identified as being at high risk. The inclusion and documentation of nutritional supplements tended to decrease the risk of having a LBW infant. However, there were other factors that did not tend to decrease the risk of having a LBW infant, such as seeing the same clinician, even within the high risk population, or the inclusion of dietary history data in the prenatal records.

The association between the educational intervention and LBW was statistically significant and consistent in seven of the nine counties that participated in the study. This consistency was important evidence supporting a relation between prenatal education and birth outcomes, since it occurred among clinics that had different health care providers and staff-patient ratios, and that served diverse populations. More important, the education component remained significant even though it was more often given to women who were classified as being high risk, and its relative importance did not vary according to many of the strata that were examined, such as race, smoking, and trimester of first prenatal visit. Unfortunately, exactly what, when, and how much education was provided were unknown. However, in general, this education does inform women to be aware of menstrual-like cramps, abdominal cramping, pelvic pressure, an increase in vaginal discharge, and lower back pain (*25*).

The finding that documentation of prenatal education and the presence of early signs and symptoms of preterm labor were associated with LBW may indicate more than just the importance of a single piece of information. Our measure of prenatal education could well have been a marker for other types of education or prenatal care services. Seldom is only one education message provided to women, and improved birth outcomes have been reported to occur when education is provided on smoking cessation, stress reduction, and other behavioral changes (*18, 19, 26*).

The education variable may have been related to the fact that a clinician, either a nurse, a nurse-midwife, or a physician, took the time to record this piece of information. This special concern given to women in addition to just the time spent with them may not have been captured with the other data elements available to the study. A study by Timm suggested that education messages may be helpful in other ways (*23*). For example, women who attended childbirth education significantly reduced the use of anesthesia during labor, compared with women who spent the same amount of time with intervention counselors, but without the education message (*26*).

Our study supports the findings of others that show that successful implementation of prenatal education is dependent on efforts to change the behavior of all pregnant women and not only women who are considered to be at high risk for poor pregnancy outcomes (*19, 27, 28*). Although we cannot differentiate between the education that was given to low- and high-risk women, the signifi-

Table 6. Odds ratios for a LBW delivery for those receiving prenatal care program nutrition and educational intervention, by program component

Component	Number of subjects	Odds ratio[1]	95 percent confidence intervals	Adjusted odds ratio[2]	95 percent confidence intervals	Chi square value	P
Education[3]	[4]7,724	0.65	0.54–0.78	0.81	0.73–0.91	14.4	0.001
Including all components[5]	7,455	...	...	0.86	0.77–0.96	7.4	0.007
Same clinician[6]	7,524	1.07	0.98–1.38	1.07	0.98–1.18	2.5	NS
Including all components[5]	7,455	...	...	1.07	0.98–1.18	2.4	NS
Hemoglobin or hematocrit assay[7]	7,825	0.40	0.33–0.47	0.56	0.50–0.62	117.3	0.001
Including all components[5]	7,455	...	...	0.55	0.49–0.62	107.2	0.001
Dietary recall[8]	7,807	0.94	0.71–1.23	0.94	0.81–1.09	0.6	NS
Including all components[5]	7,455	...	...	1.02	0.86–1.20	0.0	NS
Iron supplement[9]	7,825	0.89	0.74–1.08	0.87	0.78–0.97	6.3	0.01
Including all components[5]	7,455	...	...	1.00	0.88–1.16	0.0	NS
Folate supplement[10]	7,825	1.00	0.82–1.24	1.00	0.88–1.13	0.02	NS
Including all components[5]	7,455	...	...	1.11	0.97–1.27	2.4	NS
Vitamin supplement[11]	7,825	0.77	0.60–1.00	0.87	0.76–1.01	3.3	0.07
Including all components[5]	7,455	...	...	0.98	0.82–1.17	3.3	NS

[1] Unadjusted odds ratio. Values in parentheses are 95 percent confidence intervals.

[2] Adjusted odds ratio. Variables used to control for possible confounders were 5 age groups, race (white, black, and other), region (urban and rural), marital status (single and married), trimester of first prenatal visit, primigravida, smoking more than 10 cigarettes per day, high prenatal risk score on any assessment, anemic status before 28th gestational week, more than 2 1st trimester abortions, and more than 1 2d trimester abortion.

[3] Women who received prenatal education concerning early signs and symptoms of preterm labor.

[4] Numbers in parenthesis represent the sample size for the separate logistic regression equations.

[5] Adjusted odds ratios with all components of prenatal care included in the logistic regression equation. Sample size for this equation was 7,455.

[6] Women who saw the same clinician during at least 75 percent of their prenatal visits.

[7] Women who had a hemoglobin or hematocrit assay conducted during at least 1 of their prenatal visits.

[8] Women whose prenatal records included a dietary recall.

[9] Women who had been given a written or oral prescription for iron supplements.

[10] Women who had been given a written or oral prescription for folate supplements.

[11] Women who had been given a written or oral prescription for vitamin supplements.

NOTE: NS = Not significant. LBW = low birth weight.

Table 7. Odds ratios for a LBW delivery by high-risk women receiving prenatal care program nutrition and educational intervention, by program component

Component	Number of subjects	Odds ratio[1]	95 percent confidence intervals	Adjusted odds ratio[2]	95 percent confidence intervals	Chi square value	P
Cervical examination[3]	[4]1,316	0.90	0.64–1.27	0.92	0.77–1.10	0.9	NS
Including all components[5]	1,307	...	...	0.92	0.76–1.13	0.6	NS
Education[6]	1,598	0.54	0.37–0.77	0.74	0.60–0.91	8.54	0.004
Including all components[5]	1,307	...	...	0.69	0.54–0.90	8.30	.004
Same clinician[7]	1,577	1.05	0.78–1.42	1.06	0.91–1.23	0.50	NS
Including all components[5]	1,307	...	...	1.08	0.92–1.21	0.7	NS
Hemoglobin or hematocrit assay[8]	1,614	0.37	0.27–0.51	0.56	0.47–0.67	40.1	0.001
Including all components[5]	1,307	...	...	0.49	0.39–0.62	38.1	0.001
Dietary recall[9]	1,610	1.09	0.68–1.74	0.99	0.78–1.26	0.0	NS
Including all components[5]	1,309	...	...	1.15	0.85–1.54	0.9	NS
Iron supplement[10]	1,614	1.27	0.90–1.80	0.97	0.80–1.16	0.1	NS
Including all components[5]	1,307	...	...	1.13	0.87–1.47	0.9	NS
Folate supplement[11]	1,614	1.19	0.87–1.63	1.13	0.94–1.36	1.9	NS
Including all components[5]	1,307	...	...	1.23	0.96–1.57	2.8	NS
Vitamin supplement[12]	1,614	1.07	0.63–1.84	0.98	0.75–1.29	0.02	NS
Including all components[5]	1,307	...	...	0.94	0.67–1.30	0.2	NS

[1] Unadjusted odds ratio. Values in parenthesis are 95 percent confidence intervals.

[2] Adjusted odds ratio. Variables used to control for possible confounders were 5 age groups, race (white, black, and other), region (urban and rural), marital status (single and married), 1st trimester prenatal visit, primigravida, smoking more than 10 cigarettes per day, anemic status before 28th gestational week, more than 2 1st trimester abortions, and more than 1 2d trimester abortion.

[3] Women who received weekly cervical examinations until their 37th gestational week.

[4] Numbers in parentheses represent the sample size for the separate logistic regression equations.

[5] Adjusted odds ratios, with all components of prenatal care included in the logistic regression equation. Sample size for this equation was 1,307.

[6] Women who received prenatal education concerning early signs and symptoms of preterm labor.

[7] Women who saw the same clinician during at least 75 percent of their prenatal visits.

[8] Women who had a hemoglobin or hematocrit assay conducted during at least 1 of their prenatal visits.

[9] Women whose prenatal records contained a dietary recall.

[10] Women who had been given a written or oral prescription for iron supplements.

[11] Women who had been given a written or oral prescription for folate supplements.

[12] Women who had been given a written or oral prescription for vitamin supplements.

NOTE: LBW = low birth weight.

'The basic interventions that appeared to be effective were prenatal education on early signs and symptoms of prenatal care, hematological assessments, and iron supplements in the total group. The question remains whether there are other assessments which need to be universal.'

cant association that education had in the total group was accompanied by the same relationship within the high-risk group. The importance of this approach is that group change will foster individual change.

The effect of the nutrition components needs to be examined as to why they may be important. Conducting a screening for anemia was strongly associated with a lower risk for having a LBW infant. These results support the recommendations of the American College of Obstetrics and Gynecology and the American Association of Pediatrics (*7*). These are low cost screens, and since lower hemoglobin and hematocrit values were highly associated with lower birth weights, it seems judicious to continue their practice.

Other studies reporting benefits of nutritional interventions have often had nutrition counselling and education as part of a larger education program and thus have not been able to identify nutrition as an independent factor in the program's effectiveness (*13, 29*). Studies showing significant increases in birth weights have used food supplements to increase total energy intake, but to be effective they needed to be directed to a smaller percentage of women who were at greatest risk for inadequate energy intakes (*30–33*). Only recently have some studies suggested that specific vitamins may be able to decrease the risk for birth defects and may be most effective in women who have a past history of children with neural tube defects (*34–36*). The current study suggests that prescribing vitamins and iron supplements may be effective in decreasing LBW. This observation is counter to many past studies that have not been able to find a similar association (*4, 37*). The current results may be from the metabolic properties of the supplements, or because of the statistical control used in the logistic equation. However, without actual intake data, it is possible to suspect that the supplement prescriptions may have acted as daily reminders to women that nutrition was an important part of their pregnancy. Another important feature in understanding these results is that it was the recording of the patient's vitamin-mineral prescription that was used as the predicting factor. Therefore, the lack of documentation of iron or vitamin use may have been an indicator of which women received slightly less attention in the clinics.

The nonstatistical association between the presence of dietary recalls and a lower risk for LBW may have been confounded by the participation of a large percentage of these women in the Special Supplemental Feeding Program for Women, Infants, and Children (WIC). One of the primary components of WIC is the provision of dietary counseling based on assessments of food intake (*38*). It is possible that many of the women who did not have the data recorded in their prenatal chart had this intervention during their WIC clinics. It is important to recognize that nearly all women had this assessment, leaving little opportunity to measure the differences between groups because of insufficient statistical power.

Weekly cervical examinations were not significantly associated with a lower risk for having a LBW infant in the high risk group. However, the validity of these findings is limited. It was very difficult to determine which women actually had cervical examinations, and nearly one-fifth of the records were recorded as missing. Nonetheless, these results highlight the difficulty with systematically implementing this procedure in a statewide program, using many providers and clinic settings. Thus, these results do not support either side of the debate on the effect of weekly cervical examinations (*39–41*). However, these results have led to modifications of the Florida State procedures for documenting, using a consistent method, the occurrence, values, and results of weekly cervical examinations.

These results put into question the weight of risk factors associated with LBW in past studies. The studies identified many determinants of LBW and preterm labor, but rarely controlled for the prenatal care (*42–48*). Consistent associations between having a prior pregnancy with preterm labor, or associations between preterm birth with poverty, being part of a minority group, adolescence, primiparity, cocaine use, alcohol abuse, and smoking, with a higher risk for a LBW infant, support these factors as important predictors of poor birth outcomes. Further, the true weight of risk factors for LBW or preterm labor can only be measured precisely under unethical situations in which only

monitoring of risk factors occur without any interventions.

The usefulness of our results depend on the validity of using prenatal charts as a measure of prenatal care. In this regard, the greatest error is to have interventions that were given but not recorded, which would bias the results. However, if this occurs it may be an indication that other parts of the prenatal care system were not present. It is possible that a lack of information may indicate less quality in the prenatal visit, although inadvertently, even when a prenatal intervention was delivered. For example, when a clinician does not chart completely it may represent a rushed clinic or a client that did not receive a visit that included a conscientious effort to provide comprehensive and compassionate care. If this is the case, the usefulness of auditing charts remains a valid indicator of care. Although the precision for a specific intervention may not be good, it would be valid for measuring total care, which was also an objective of the current study.

The basic interventions that appeared to be effective in this study were prenatal education on early signs and symptoms of prenatal care, hematological assessments, and iron supplements in the total group. The question remains whether there are other assessments which need to be universal. How assessments should be done has been addressed by the Office of Maternal and Child Health at the Florida Department of Health and Rehabilitative Services. It has initiated testing of a new set of assessment procedures that will place women in one or more paths of care depending on whether they are classified as having medical, psychosocial, or preterm labor risks. This system is based less on scores and more on the presence of risk factors that identify the appropriate paths of care.

We believe that our results support the need to replace the common practices of defining inadequate prenatal care as patients who reported late in pregnancy, who were poor attenders, or who had no antenatal care, as this relates only to the utilization of care (*4*). It may be more efficacious to measure the occurrence of important interventions during clinic visits, as they represent one part of the quality of care and assistance given to women during their pregnancy. It is unmistakable that the delivery of proper prenatal services needs to include comprehensive and continuous care and the elimination of barriers to receiving early care. These changes will increase the delivery of quality care and the quality of life of women during their pregnancies (*8, 49*).

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