
Prenatal Care Needs Assessment Comparing Service Use and Outcomes in Fresno, CA

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The study was undertaken on behalf of the Perinatal Advisory Council of Fresno, which disseminated the findings. The study was funded by the Irvine Foundation through the Hospital Foundation of Northern and Central California, in part by the Agency for Health Care Policy and Research under grant 2T32HS00026, and by the Pew Charitable Trusts.

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Synopsis

The authors performed a prenatal care needs assessment for Fresno County, CA, using data from a sample of 11,878 birth certificates for the county for 1989. Birth records, patterns of prenatal care utilization, and low birth weight outcomes in the county were compared with those in a random sample of 11,826 certificates derived from births in

the remainder of the State. Bivariate techniques were used in calculating care utilization rates. Multivariate logistic regression analysis was used in associating rates of prenatal care visits and gestational month of initiation of prenatal care with low weight birth outcomes.

County women entered prenatal care as early as women in the remainder of the State, but did not return as often for prenatal care visits. Their rate of return for followup visits was 29.9 percent, compared with 24.8 percent for women in all other counties ($P < 0.001$). County women with the lowest rates of visits had 1.4 to 1.9 times the risk of having a low weight birth than other county women with higher rates of visits, and a significantly higher risk than for women of all other counties. An intensive visit schedule for high-risk care was provided 28.9 percent of county women, compared with 33.0 percent of women in all other counties ($P < 0.001$). County women who received a high-risk intensive visit schedule were 2.5 times more likely to have a low weight birth than county women who did not receive the schedule. For all other women in the State, the comparable risk was 2.1 times.

Improvements in the number and content of prenatal care visits were shown to have a high likelihood of substantially improving birth weight outcomes for pregnancies among Fresno County women.

A MAJOR FACTOR IN LOW BIRTH WEIGHT is the use and adequacy of prenatal care services. That factor is reflected in, for example, the reporting requirements for States for participation in the Maternal and Child Health Block Grant Program (1). One requirement is for county-level prenatal care needs assessments.

Two of the required indicators of prenatal care program needs are a county's low birth weight rates and the rates of use of prenatal care services. Low birth weight outcomes of pregnancy have been linked to specific risk factors for pregnant women and to problems with prenatal care use (2a, 2b). The level of use of prenatal care is considered

adequate if prenatal care visits begin early in a pregnancy and continue throughout (3-5).

A county's low birth weight rates, if they exceed the rates observed for women with comparable levels of risk in other counties, imply the need for better prenatal care. If high rates are associated with delayed or insufficient care, the need is indicated for increased levels of prenatal care. However, if high rates persist after adjustments for timing and amount of prenatal care visits, there may be problems with the adequacy of the content of the prenatal care.

Indices have been developed for use in assessing the adequacy of prenatal care visits (6, 7). A

schedule of expected prenatal care visits for women with low-risk pregnancies has been recommended by the American College of Obstetricians and Gynecologists (ACOG). Using that schedule, Kotelchuck defined categories of adequacy for the onset and continuity of visits in an Adequacy of Prenatal Care Utilization Index (8). The index permits independent analysis of those two components of use. The approach is useful, because the factors that lead women to return infrequently for prenatal care may not be the same factors that lead them to delay starting care (9). The extent to which poor continuity of prenatal care visits, rather than late onset of visits, contributes to poor birth outcomes has not been studied.

Counties that seek to lower their rates of low weight births by improving their prenatal care programs need to determine the extent to which pregnancy outcomes in the county are associated with each of two factors: inadequate use of effective prenatal care and adequate use of ineffective prenatal care. We describe a study that assessed prenatal care needs for a county with higher rates of low weight births than those observed for the remainder of the State. We analyzed the extent to which the higher rates stemmed from higher proportions of women in high-risk groups and from higher levels of risk for women of any high-risk group. The risks of low weight births found for women in the State were used to compute how much lower the rates might be in the county if its pregnant women were at no higher risk than pregnant women in the rest of the State. The role of improved prenatal care in achieving lower rates is discussed.

That analytic approach offers advantages to State and county planning efforts. The first advantage is that it makes use of widely available birth certificate data. The second is that it can be applied in making decisions about allocating resources and about whether investments in prenatal care are likely to improve birth weight outcomes. The third advantage of the analytic approach is that it demonstrates how techniques of statistical adjustment can produce county-specific and State-specific odds ratios that can be directly compared in determining the efficacy of prenatal care for different sociodemographic groups of women.

Methods

Automated birth certificate data for 1989 from Fresno County and the State of California's Department of Health Services were used to select all

single live births in the county to residents of the county, a total of 13,117 births. From those, a final sample of 11,878 was obtained. Three separate random samples of single births to noncounty residents were created, each with the same number of births. Three samples were used to ensure that the small proportion of all births in the State that those samples represented, 1.5 percent, produced unbiased results. All three samples provided nearly the same results. The results of only one sample are presented.

Prenatal care utilization was classified using the Adequacy of Prenatal Care Utilization Index, based on two dimensions of access to care: the timing of onset of care and the continuity of visits attended (8). The first dimension is based on the gestational month of the first prenatal care visit; the second is expressed as the proportion of visits actually kept to the number of visits expected for the period from the gestational age at onset of care to the gestational age at birth, given the ACOG schedule of visits for a normal, low-risk pregnancy (4).

The timing of the onset of care was categorized into four gestational groups: months 1 and 2, months 3 and 4, months 5 and 6, and more than 6 or no prenatal care. The proportion of recommended visits kept was categorized into four groups, 0 to 49 percent, 50-79 percent, 80-109 percent, and 110 percent or more. Missing data for either the month that prenatal care began, or for prenatal care visits, resulted in the most inadequate classification. Missing values for date of last menstrual period, used to calculate the gestational age at birth, were imputed from birth weight (8), adjusted for the sex, but not the race, of the infant.

To compare the use of prenatal care by women in the county to that of women in the rest of the State, the proportion of women giving birth in each of the categories of onset of care and of continuity of care was calculated for both samples. Differences in proportions were tested using the Chi-square statistic. Because of the problems of spurious significance with multiple testing, the more restrictive criterion of statistical significance of $P < 0.01$ was used, instead of the more usual $P < 0.05$.

The designation of adequate amounts of prenatal visits must be interpreted with caution because the birth certificates did not contain information on the medical or obstetric risk status of the mother. Given that women with medical or obstetric risks should have more prenatal visits scheduled at some

Table 1. Distribution of characteristics in a model sample 1 used in a prenatal care needs assessment for Fresno County, CA, 1989

Characteristic	County		State	
	Number	Percent	Number	Percent
Total	11,878	...	11,826	...
Race or ethnicity:				
African American	894	7.5	982	8.3
Southeast Asian	380	3.2	317	2.7
White, Hispanic	5,416	45.6	4,908	41.5
Other race or ethnicity	475	4.0	695	5.9
White, non-Hispanic	4,712	39.7	4,924	41.6
Maternal age (years):				
Younger than 18	815	6.9	635	5.4
18 to 19	1,165	9.8	1,025	8.7
20 to 34	8,986	75.7	9,094	76.9
Older than 34	912	7.7	1,071	9.1
Number of previous births:				
None	4,251	35.8	4,529	38.3
1 to 3	6,634	55.9	6,499	55.0
4 or more	993	8.4	798	6.7
Maternal education (years):				
Fewer than 8	1,936	16.3	1,809	15.3
8 to 11	6,926	58.3	7,584	64.1
More than 11	3,016	25.4	2,433	20.6
Payor source:				
Medi-Cal	6,367	53.6	4,790	40.5
Other government source	428	3.6	358	3.0
Health maintenance organization	1,651	13.9	2,365	20.0
Self-pay or unknown	926	7.8	1,157	9.8
Private insurance	2,506	21.1	3,156	26.7
Prenatal care onset:				
After 6th month	510	4.2	599	5.1
Months 5 or 6	1,329	11.2	1,277	10.8
Months 3 or 4	3,667	30.9	3,560	30.1
Months 1 or 2	6,372	53.6	6,390	54.0
Prenatal care frequency:				
Less than 50 percent of visits	864	7.3	620	5.2
50 to 79 percent of visits	2,688	22.6	2,319	19.6
80 to 110 percent of visits	4,890	41.2	4,979	42.2
More than 110 percent of visits	3,436	28.9	3,908	33.0

¹ There were 13,117 single live births in the county sample. An equal number were selected at random from the State single live births records; 1 or more of the model variables were missing for 1,235 (9.4 percent) of the births in the county and for 1,287 (9.8 percent) births in the State sample.

point during pregnancy, it is likely that some of the women who appear to have received an adequate amount of prenatal care, based on this index, were actually high-risk women who received an inadequate amount of visits. We know, however, that the women who received less than 80 percent of expected visits received less than the adequate number, regardless of their risk status. Women who received 110 percent of expected visits or more almost certainly had high-risk pregnancies.

The outcome of prenatal care in the county was

measured by the percentages of newborns with low birth weight, less than 2,500 grams (g), in each of 16 categories of onset of care and continuity of care. The percentages were compared with those for the same group in the rest of the State. A multivariate logistic regression model was estimated to adjust for potential confounding by variables in the data set, such as maternal age, race or ethnicity, the number of previous live births (parity), years of mother's education, and the source of payment for prenatal care (Medicaid, other government source, health maintenance organization, private insurance, or self pay) (10a). Estimates of regression coefficients were expressed as odds ratios with 95 percent confidence intervals (10b).

Plausible interaction terms were tested, including racial or ethnic groups with onset of care and proportion of visits kept, racial or ethnic groups with payment source, and onset of care with proportion of visits kept. None approached statistical significance ($P > 0.05$). Family income variables available at the census tract level of analysis were tested in the models, but they were not included because of their collinearity with the individual education level variable on the birth certificate. Individual maternal education was more strongly associated with low birth weight outcomes than with census tract data on family incomes, which was dropped from the model.

The county's objective was to improve its birth weight outcomes to the level of rates no lower than the expected rates for women residents, given the outcomes for women in the remainder of the State. If separate regression models were estimated to compare the county and the State, the coefficients would not be directly comparable, because the reference categories would be different for each model. To allow direct comparison of State and county models, we pooled the data and estimated models, using the reference categories of both data sets as common references. Instead of estimating a model for one of the locations, with interaction terms for each variable of the other location, we used interaction terms for both locations.

In this way, instead of estimates of the odds ratio for the county in terms of odds for the State, we had comparable direct estimates of the odds ratios for both the county and State. Because all of the terms in the model were binary, the odds ratios we obtained for the State in this way were the same as if we had only included interaction terms for the county. The interaction terms for the county were those obtained for the sum of the parameters of the State and those of the county when interaction

terms were included only for the county. County and State versions of each variable in the model were created so that they were mutually exclusive, with the county version and the State observations not being part of the other. The model was estimated on the resulting block diagonal matrix (11). The reference categories were pooled, since it is not possible to estimate this model if all the county reference categories are included as regressors; if more than one of the county reference categories were to be included, it would cause perfect collinearity. Except for differences in the reference groups, the pooled model was equivalent to estimating the models separately.

An advantage of the method was that the resulting county and State estimates could be used to generate an odds ratio for any subgroup in the county or State without invoking the odds ratio of the other location. To confirm that the pooling of the reference categories did not bias our findings, we reestimated the model, with each iteration including one of the county reference categories. We could not reject the hypotheses that the county and the State reference categories were different for any of the reference categories (the *P*-values for those tests ranged from 0.56 to 0.76).

Finally, the risks of low weight births for the women in the State were used to compute how much lower the rates of low weight births might be in the county if the risks levels of the subgroups of women in the county could be lowered to those no higher than in the rest of the State. The estimated rates were obtained by applying the estimated coefficients for the State to each characteristic of each birth in the county to obtain the sum of products from the regression for the birth, and transforming the logistic expression to the predicted probability of low birth weight for each birth (11). Summing the probabilities across all births in any group provided the expected low birth weight rate for that group, based on statewide averages.

Results

Characteristics of women giving birth. The characteristics of women giving birth in the county were found to be similar to those in the rest of the State. The greatest difference was in the proportion of women for whom Medicaid (Medi-Cal in California) was the principal payor source for prenatal care (53.6 percent in the county, compared with 40.5 percent for the rest of the State) (table 1). As a result, proportionately fewer births were to women with private coverage (health maintenance

'We found in Fresno County that improvements in low birth weight rates would be obtained from increasing both the rate at which women return for care and the quality and cultural appropriateness of prenatal care visit content.'

organization members or the privately insured). We found that there were more births to women of Hispanic descent in the county (45.6 percent) than in the rest of the State (41.5 percent), and more women in the county who gave birth had 12 years or more of schooling. Otherwise, the distribution of risk characteristics between the two populations was largely the same (within two percentage points).

Use of prenatal care. Overall, women in the county entered care as early as women in the rest of the State, but they did not return for care as often (table 1). There were no differences in the proportions of women starting care at different stages of gestation. Slightly more than half (53.6 percent in the county and 54.0 percent in the State) started in the first 2 months. A small fraction entered care after the sixth month or not at all (4.2 percent in the county and 5.1 percent in the State). However, proportionately more women in the county received less than 80 percent of their expected prenatal care visits (7.3 percent + 22.6 percent = 29.9 percent) compared with women elsewhere in the State (5.2 percent + 19.6 percent = 24.8 percent) ($P < 0.001$); the pattern persisted regardless of when the women entered care (table 1). Their rate of return for followup visits was 29.9 percent, compared with 24.8 percent for women in all other counties ($P < 0.001$).

A smaller proportion of women in the county (28.9 percent) attended the high-risk schedule of visits (more than 110 percent of the recommended visits for a low-risk woman) than in the rest of the State (33.0 percent, $P < 0.001$). That occurred primarily because significantly fewer women who started care early (in the first 2 gestational months) in the county continued with a high-risk schedule of visits (15.1 percent) than in the rest of the State (18.1 percent, $P < 0.001$).

Table 2. Low birth weight rates with use

Gestational month prenatal visits began	Expected prenatal care visits completed							
	Total				Less than 49 percent			
	County		State		County		State	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Total	11,878	6.1	11,826	5.2	864	6.8	620	5.0
None or 7-9	510	8.4	599	5.3	88	8.0	84	3.6
5-6	1,329	6.7	1,277	5.0	149	8.1	98	4.1
3-4	3,667	6.0	3,560	5.1	316	5.1	249	4.8
1-2	6,372	5.1	6,390	4.7	311	7.7	189	6.3

'The county's objective was to improve its birth weight outcomes to the level of rates no lower than the expected rates for women residents, given the outcomes for women in the remainder of the State.'

Outcomes of prenatal care. Women in Fresno County had higher unadjusted rates of low weight births (6.1 percent) than women in the rest of the State (5.2 percent) ($P < 0.005$) (table 2). Higher unadjusted rates of poor outcomes occurred among county women attending care infrequently (less than 50 percent and less than 80 percent of recommended visits), regardless of when they started care. Women obtaining the number of visits recommended for a pregnancy without complication (80-110 percent of visits), who entered care late (after the sixth month of pregnancy), also contributed to the poor outcomes. Finally, county women with a high-risk frequency of visits, who entered care before the seventh month of pregnancy, also had higher rates of poor outcomes.

But women who started care in the first 6 months and came regularly for care (80-110 percent of visits) had low rates of low weight births, rates similar to those for women in the rest of the State. For example, for women entering in the first 2 months, the rates were 3.1 percent for both the county and the State. Women who received an augmented schedule of visits while entering care after the sixth month of pregnancy also had a lower rate of poor outcomes in the county (7.5 percent) compared with those for the State (9.5 percent), but this was not significant ($P > 0.05$).

After adjusting for differences in risks of low weight births, the lack of continuous care had more to do with the poor birth outcomes in the county

than how late in the pregnancy women started care (table 3). In fact, poor birth weight outcomes were not associated with the onset of prenatal care, either for the county or the State (odds ratios not different from 1.00 at the 95 percent confidence level). For the same amounts of care, women in the county in all but one group did worse than women in the rest of the State.

County women with the lowest frequency of visits (less than 50 percent) had 1.93 times (OR[*county*] 1.93, CI 1.40,2.67) the chance of a low weight birth compared with women with the recommended frequency of visits for low risk pregnancies (the reference group, OR[*county and State*] 1.00). Women with 50 to 79 percent of the recommended number of visits had 1.44 times the risk (OR[*county*] 1.44, CI 1.15,1.82). That differed from women in the rest of the State who received reduced frequencies of care, but did not experience significantly higher rates of low weight births. Poor continuity of prenatal care was seen to be associated with worse outcomes only for women residing and delivering in the county and not those in the rest of the State.

Women in the county with certain risk characteristics had poorer outcomes that could not be explained by inadequate use of care. Women for whom Medicaid was the payor source for prenatal care did significantly worse than women who were privately insured in the county (OR[*county*] 1.42; CI 1.12,1.79), but not in the rest of the State (OR[*State*] 1.26; CI 0.99,1.61), even after adjusting for the timing of onset and amount of visits they received. Southeast Asian women were at significantly greater risk of a low weight birth in the county than white, non-Hispanics (OR[*county*] 2.20, CI 1.47,3.30), but not in the rest of the State (OR[*State*] 1.17, CI 0.64,2.17). Greatest risk was noted among African American women in both the county and the State when compared with white,

Expected prenatal care visits completed											
50-79 percent				80-110 percent				More than 110 percent			
County		State		County		State		County		State	
Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
2,688	5.3	2,319	3.8	4,890	3.5	4,979	3.5	3,436	9.0	3,908	7.4
133	9.8	138	2.2	115	8.7	156	3.2	174	7.5	221	9.5
346	4.3	304	4.6	339	5.6	357	5.3	495	8.7	518	5.2
927	5.7	847	4.5	1,455	3.2	1,433	3.8	969	10.6	1,031	7.5
1,282	4.8	1,030	3.1	2,981	3.1	3,033	3.1	1,798	8.3	2,138	7.6

non-Hispanics (OR[*county*] 3.37, CI 2.63,4.31 and OR[*State*] 3.03, CI 2.39,3.86).

Women who had not graduated from high school, and women who previously had not given birth were at greater risk of a poor outcome in both the county and the State. The only characteristic studied that was a risk in the rest of the State, but not in the county, was being of a race or ethnic group other than African American, Southeast Asian, or white (Hispanic or non-Hispanic).

If women in each risk group in the county had low birth weight outcomes no worse than their counterparts in the rest of the State, the rate of low weight births in the county could be reduced 18 percent overall, from 6.1 percent to 5.0 percent (table 4). Those predicted low birth weight rates were actually rational health objectives for the women in the county. For women receiving less than 50 percent of expected visits, the low weight birth rate could be expected to fall from 6.8 percent to 4.8 percent. For women with more than 110 percent of expected visits, that rate would fall from 9.0 percent to 7.4 percent.

However, the potential gains within certain groups were more significant. If African American women in the county did no worse than expected for women with their risk characteristics in the rest of the State, they could have expected a more than 50 percent reduction in their low birth weight rate, from 17.2 percent to 11.3 percent. For Southeast Asians, a 25 percent decline from 8.0 percent to 6.2 percent was rational objective. For Medicaid women, a small improvement from 7.2 percent to 5.9 percent could have been expected.

In the period since this study was undertaken in 1989, there has been an infusion of State money into this and other counties for (a) outreach efforts and recruiting low-income women into Medi-Cal and AIM for prenatal care (AIM is a private insurance pilot program for low income women whose assets or income disqualify them for the care

under Medi-Cal) and (b) to increase the numbers of obstetric care providers who see women eligible for Medi-Cal and those who provide them comprehensive perinatal care. Fresno County, which had difficulties with health care providers treating women eligible for Medi-Cal, now has a greatly increased number who see them. A followup study of changes in the use of health care and outcomes in Fresno County is in the planning stage.

Discussion

Numerous studies have shown that delayed entry into prenatal care is associated with problems in access to care (5) and poorer birth weight outcome (9). In fact, the term *use of care* is often presented interchangeably with *onset of care* (9). But this study indicates that failure to continue care at sufficient levels also can be associated with poor birth outcomes. Continuity of care is a special case of access to care. Women may fail to return as scheduled both because of the same types of barriers to care that made starting care difficult in the first place and because, once they start care, they may find the care unacceptable or inappropriate.

Continued utilization of care has been linked to satisfaction with care, a patient's understanding of the importance of care, and the quality and appropriateness of the care provided (12, 13). With a few exceptions, little is known about the actual content and quality of services women receive during prenatal care visits (14, 15). In one study, the quality of prenatal care was found to fail even minimally acceptable standards for many women, especially those with sociodemographic risk characteristics (16). Study of Medicaid populations has shown that despite the availability of providers and extended eligibility, Medicaid women used care less continuously than non-Medicaid women, regardless of when they entered care (15). Assessing the

Table 3. Adjusted risks of low birth weight outcomes in a prenatal care needs assessment for Fresno County, CA, 1989

Characteristic	County		State	
	Odds ratio	Confidence interval ¹	Odds ratio	Confidence interval ¹
Race or ethnicity:				
African American..	23.37	2.63–4.31	23.03	2.39–3.86
Southeast Asian..	22.20	1.47–3.30	1.17	0.64–2.17
White, Hispanic..	0.99	0.81–1.21	1.14	0.91–1.43
Other race or ethnicity.....	1.03	0.67–1.60	21.50	1.09–2.05
White, non-Hispanic.....	1.00	1.00	1.00	1.00
Maternal age (years):				
Younger than 18..	1.24	0.92–1.68	0.84	0.77–1.82
18 to 19.....	0.79	0.60–1.06	1.21	0.90–1.62
20 to 34.....	1.00	1.00	1.00	1.00
More than 34....	1.31	0.97–1.79	1.24	0.94–1.64
Number of previous births:				
None.....	21.27	1.06–1.52	21.41	1.18–1.68
1 to 3.....	1.00	1.00	1.00	1.00
4 or more.....	0.91	0.66–1.24	1.28	0.88–1.86
Maternal education (years):				
Less than 8.....	0.98	0.74–1.29	1.07	0.79–1.46
8 to 11.....	21.45	1.17–1.80	21.37	1.06–1.76
More than 11....	1.00	1.00	1.00	1.00
Payor source:				
Medi-Cal.....	21.42	1.12–1.79	1.26	0.99–1.61
Other government source.....	1.14	0.62–2.10	0.95	0.58–1.57
Health maintenance organization.....	1.07	0.80–1.42	1.07	0.85–1.35
Self-pay or unknown.....	1.09	0.71–1.65	1.17	0.87–1.58
Private insurance..	1.00	1.00	1.00	1.00
Prenatal care onset:				
After 6th month..	1.33	0.93–1.92	0.87	0.59–1.29
Months 5 or 6....	0.98	0.76–1.26	0.85	0.63–1.13
Months 3 or 4....	1.00	0.83–1.20	1.00	0.83–1.22
Months 1 or 2....	1.00	1.00	1.00	1.00
Prenatal care visit frequency:				
Less than 50 percent.....	21.93	1.40–2.67	1.24	0.83–1.85
50 to 79 percent..	21.44	1.15–1.82	0.98	0.75–1.27
80 to 110 percent	1.00	1.00	1.00	1.00
More than 110 percent.....	22.50	2.08–3.01	22.11	1.76–2.54

¹ Significantly different from 1.00 at the 95 percent confidence level.
² 95 percent confidence interval.

independent components of utilization of care, such as the onset and frequency of visits, can provide strategic additional information that can be used to design improvements in prenatal health service content and delivery.

By applying the Adequacy of Prenatal Care Utilization Index in the prenatal care needs assessment for Fresno County, we found that poor birth weight outcomes were likely to be improved with

improvements in the care. Women in Fresno County tended to start prenatal care as readily as women in the rest of the State, but they returned less frequently. The less frequently they returned, the worse were their birth weight outcomes. Furthermore, for the same amount of care received, women in the county had poorer outcomes than women in the rest of the State. That finding points to possible weaknesses in the acceptability or content of the prenatal care the women received, rather than their reluctance to use care at all. That finding is crucial to county resource allocation decisions, as interventions designed solely to get women into care early may have no concurrent beneficial effect on women's continued use of services or their poor birth outcomes without concomitant attention to the content of care.

The smaller proportion of women in Fresno County receiving a high-risk level of care may indicate that women who might have benefited from such care were not receiving it. Excess rates of low weight births to women receiving lesser amounts of care in the county may indicate that some women were at high risk and were not assigned to, or did not use, high-risk care. Either failure to appropriately identify high-risk women in need of additional visits, or failure to engage and maintain them in the enhanced schedule of visits, may have occurred. Women may not be easily convinced that they are at high risk and therefore in need of extra surveillance (16). Southeast Asians had significantly worse outcomes in the county than in the rest of the State, yet among Southeast Asians in the county, only 20 percent had received more than 110 percent of expected visits, compared with 30 percent for the rest of the State.

African American women and Medicaid-eligible women, regardless of race, were similarly underrepresented in high-risk care in Fresno County. Many low-income women received care at sites where long waits and cumbersome eligibility forms were common, and members of ethnic minorities often deal with a lack of cultural competence on the part of the health care provider. Cultural gaps have been shown to adversely affect care-seeking behaviors among pregnant women and may play such a role in Fresno (9).

Finding a group of women in both the county and the State that enters care early, attends continuously, and has good outcomes might be attributed to the effectiveness of the care. However, it may simply be a reflection of the process of self-selection, in which women who seek prenatal care early in pregnancy and maintain the suggested

schedule of visits generally are better educated, of higher sociodemographic status, and have more positive attitudes toward health care in general than those who have worse outcomes (17).

Potential alternative explanations for the findings of the study include the presence of risk factors, not included in the adjustments, that are more prevalent among pregnant women who do not seek care frequently in the county than those in the rest of the State. Clinical population-based data would allow an assessment of the role of clinical psychosocial and nutritional complications. Other county characteristics, such as the system capacity and distribution of the prenatal care providers, could be contributing factors.

Both the quality and the completeness of birth certificate data are the chief limitations to the needs assessment approach using the Adequacy of Prenatal Care Utilization Index (6, 18, 19). Should there be any significant differences between the county of interest and the rest of the State in the quality or completeness of birth certificate data, the results could be biased. Because it is impossible to remove such bias, it is important to characterize how known components of bias could affect results. In the index, values are imputed for missing data on gestational age. Therefore, it is important to determine how imputation of missing values could have affected county and State findings differently. Where data on prenatal care visits were missing, the computer program deleted those observations. In the study, the county rate of missing data for prenatal care visits (4.0 percent) was comparable to that of the State for prenatal care visits (5.7 percent).

There was concern that the use of birth weight to impute values for missing data on gestational age in the computation of the percent of expected visits variable could have affected the analyses in one of three ways. It could violate the assumptions for tests of association with the dependent variable, low birth weight; it could introduce biases with differential rates of missing data on gestational age in the county and State; or it could introduce biases with differential rates of births to blacks, since the imputation was not adjusted for race.

The first issue was not a problem because the calculation of the percent of expected visits left the variable independent of the birth weight or gestational age used to compute its value. The second issue could have been a problem as a result of imputing missing values of gestational age from birth weights, because biases would be introduced with newborns who were small or large for true

Table 4. Low birth weight rate health objectives in a prenatal care needs assessment for Fresno County, CA, 1989

Characteristic	Observed rates		Potential rates for county if State rates prevailed
	County	State	
Race or ethnicity:			
African American.....	17.2	12.7	11.3
Southeast Asian.....	8.0	6.0	6.2
White, Hispanic.....	5.4	4.7	4.9
Other race or ethnicity..	5.2	5.8	6.1
White, non-Hispanic....	4.7	3.9	4.0
Maternal age (years):			
Younger than 18.....	10.6	7.6	7.7
18-19.....	6.7	7.7	7.0
20-34.....	5.6	4.8	4.5
Older than 34.....	5.7	5.8	5.7
Number of previous births:			
None.....	6.8	6.1	6.2
1-3.....	5.6	4.4	4.2
4 or more.....	6.1	6.9	5.9
Maternal education (years):			
Less than 8.....	5.5	4.5	5.0
8 to 11.....	8.4	6.6	6.2
More than 11.....	5.1	5.1	4.6
Payor source			
Medi-Cal.....	7.2	6.6	5.9
Other government sources.....	4.7	4.3	5.2
Health maintenance organization.....	4.4	4.9	4.1
Self-pay or unknown....	7.2	5.6	4.2
Private insurance.....	3.8	4.2	3.9
Prenatal care onset:			
After 6th month.....	8.4	5.3	5.2
Months 5-6.....	6.7	5.0	5.6
Months 3-4.....	6.0	5.1	5.0
Months 1-2.....	5.1	4.7	4.9
Prenatal care visit frequency:			
Less than 50 percent...	6.8	5.0	4.8
50-79 percent.....	5.3	3.8	4.3
80-110 percent.....	3.5	3.5	3.8
More than 110 percent..	9.0	7.4	7.4
Total.....	6.1	5.2	5.0

gestational age (19, 20). Although the rates for such births in the United States are low, for those infants who are small, gestational age at birth would tend to be underestimated and the expected number of visits would be underestimated. Thus, for any given number of visits, their calculated continuity of care would be overestimated. For those newborns who are large for gestational age, the bias would be reversed.

Because the question asked in the analysis was to what extent are low rates of prenatal care visits associated with high rates of low weight births, biases with birth weight imputation of missing gestational ages for newborns small for gestational age tended to reduce the chance of finding an association. The rate for missing data on gesta-

tional age in the county was 1.7 percent and 3.3 percent in the State. Therefore, it may have been slightly easier to find such an association in the county than in the State. Since the birth weights used to impute gestational age for the index were adjusted for sex but not race or ethnicity, different proportions of newborns of different races could affect measures of association. That could be adjusted with use of race-specific birth weights as a function of gestational age.

In spite of its limitations, the Adequacy of Prenatal Care Utilization Index is an important improvement over the Kessner Index (7) in describing the critical components of use of prenatal care. Kotelchuck's index, when properly used, provides expanded information to health departments as they develop strategies to reduce low birth weight outcomes.

We found in Fresno County that improvements in low birth weight rates would be expected from increasing both the rate at which women return for care and the quality and cultural appropriateness of prenatal care visit content.

Outreach and followup for women who do not return for scheduled visits should include an assessment of the factors contributing to poor compliance. A focus on client satisfaction as well as a better understanding of how to make prenatal care culturally relevant, for example, could significantly enhance utilization among African American and Southeast Asian women in the county.

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