Behavioral, Health, and Cost Outcomes of an HMO-Based Prenatal Health Education Program

DANIEL H. ERSHOFF, DrPH
NEIL K. AARONSON, PhD
BRIAN G. DANAHER, PhD
FRED W. WASSERMAN DrPH

Dr. Ershoff, Dr. Aaronson, and Dr. Wasserman are with Maxicare Health Plans, Inc.—Dr. Ershoff as director of research, Dr. Aaronson as senior research analyst, and Dr. Wasserman as president and chief executive officer. Dr. Danaher is president of Brian G. Danaher and Associates, Pasadena, Calif.

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Tearsheet requests to Dr. Ershoff at Maxicare, 11633 Hawthorne Blvd., Hawthorne, Calif. 90250.

SYNOPSIS

This report presents the results of an evaluation of a prenatal health education program conducted within a health maintenance organization (HMO) setting. Specifically, the behavioral, birth, and treatment-cost outcomes for 57 women in an experimental group who received individual nutrition counseling and a home-correspondence smoking cessation program were evaluated against the outcomes for 72 women in a control group who received standard prenatal care.

In comparison with the controls, a greater percentage of women in the experimental group quit smoking during pregnancy (49.1 percent versus 37.5 percent). Of those who smoked throughout their pregnancy, women in the experimental group had a greater reduction in their mean rate of daily smoking. A significantly greater percentage of experimental group women adjusted their diets during the prenatal period (91 percent versus 68 percent), and particular success was achieved in increased consumption of dairy products and vegetables, decreased consumption of coffee, and adequate weight gain during pregnancy.

Analysis of birth outcome data revealed that infants born to the experimental group had a significantly higher mean birth weight than infants born to the controls (121.34 oz versus 113.64 oz). The experimental group also had fewer low birth weight infants (7.0 percent versus 9.7 percent for controls). Hospital treatment cost savings associated with the reduced incidence of low birth weight infants among experimental group women yielded an overall benefit-cost ratio for the prenatal program of approximately 2:1.

FROM THE INCEPTION OF THE HMO MOVEMENT, preventive and health education programs have often been linked with prepaid health plans because of the built-in incentive for such plans to maintain and improve the health status of their members. Unlike fee-for-service practices, health maintenance organizations (HMOs) bear the financial burden of patients' unhealthy lifestyles and "inappropriate utilization" of services. Thus it follows that HMOs have a direct interest in providing preventive health services—for example, screening and detection programs and health education programs in such areas as smoking cessation and weight reduction—since, in theory at least, these efforts could yield increased cost savings.

A limited number of health plans have made a strong commitment to providing prevention and health education programs for their enrolled populations (*1*). For the most part, however, rhetoric in this area has outpaced performance (*2,3*). In part, the lack of commitment to such efforts can be accounted for by the inherent difficulty of introducing preventive strategies into health care systems focused on curative care—the so-called medical model (*4,5*). Perhaps an equally important factor accounting for the limited involvement of HMOs with health education efforts is the paucity of evidence regarding the utility of these various interventions in reducing the risks of illness and the concomitant costs of patient care. Concerning the recent flurry of activity surrounding health promotion and disease prevention programs, Knobel states that "the 5 years of Federal support have produced little hard evidence that health promotion and disease [prevention] programs other than immunization, fluoridation, and early disease detection contribute signifi-

cantly to improved health status, to reducing medical care costs, or to increasing productivity" (*6*).

In an effort to obtain more evidence about the potential utility of prevention and health education programs, Maxicare, a southern California based HMO, in collaboration with the Department of Health and Human Services, undertook a demonstration project involving the design, implementation, and evaluation of a comprehensive prenatal health education program (*7*). Specifically, the project consisted of a combined prenatal nutrition counseling and smoking cessation program aimed at reducing the incidence of low birth weight infants.

The choice of prenatal health care as the target area of the intervention was based on a number of important criteria. First, it was desirable to address a health problem encountered by the majority of HMOs across the country. Second, there had to be adequate epidemiologic evidence suggesting that the incidence of adverse health outcomes could be significantly decreased through reduction in the level of one or more outstanding risk factors. Finally, HMO expenditures for the particular health outcome had to be sufficiently large so that a successful prevention program might be shown to more than pay for itself.

A prenatal health education program appeared to meet all of these selection criteria. First, on a national basis, a relatively large percentage of deliveries (approximately 7 percent) are classified as "low birth weight"—that is, birth weight less than 2,500 gm (89.28 oz). Low birth weight is an important predictor of adverse health status in the immediate postpartum period as well as in the early years of life (*8*). This health problem would appear to be particularly important to those prepaid plans whose membership includes a relatively large percentage of nonwhite and low income families, since the incidence of low birth weight infants is particularly high among these population subgroups.

Second, considerable epidemiologic and clinical data have demonstrated a relationship between both poor maternal nutrition and maternal smoking and low birth weight (*9–14*). Further, a growing number of reports have described apparently successful intervention strategies to modify nutrition and smoking habits of pregnant women (*15–19*).

Third, from an economic standpoint, direct costs associated with the care of low birth weight infants are substantial. In the experience of Maxicare, for example, an uncomplicated vaginal delivery normally requires 2 days of nursery care and a total hospitalization cost for the newborn infant of less than $300. Hospitalization charges for low birth weight infants are frequently 10, 20, or even 50 times this amount. Ongoing treatment expenses often associated with the care of low birth weight infants would magnify this cost differential.

Finally, prevention of low birth weight, unlike many other possible health education target areas, has the potential for generating both short- and long-term cost savings. Given the normal levels of membership turnover associated with HMOs, prevention and health education interventions targeted at disease entities with prolonged latency periods (heart disease and cancer, for example) may fail to produce sufficiently persuasive economic benefits even if they are successful in encouraging desired behavior change. Selection of the period of pregnancy for a health education effort minimizes the potential problems of disenrollment because a major proportion of anticipated cost savings from these interventions comes from the expense of the initial hospital stay for the low birth weight infant.

This article describes the results of the prenatal health education program, focusing on three distinct but interrelated questions. First, was the program successful in promoting appropriate behavior changes among participants, in comparison with changes experienced by a group of women who received standard prenatal care from the HMO? Specifically, did a greater percentage of women in the experimental group have adequate diets during the course of their pregnancy, and were program participants more successful than their control group counterparts in abstaining from or cutting back on cigarette consumption? Second, did women in the experimental group experience birth outcomes superior to those of the standard care controls (that is, a reduced incidence of low birth weight infants)? Third, could the intervention program be justified on a cost-benefit basis? That is, were sufficient hospital treatment cost savings derived from a reduced incidence of low birth weight infants to justify program expenditures?

Methodology

The setting of the demonstration project was Maxicare, an HMO in southern California serving approximately 150,000 members. Although Maxicare is classified as a "network model" HMO (*20*), conditions in this study more closely approximated a "group model," in that the sample was restricted to Maxicare patients who were served by a single multispecialty group of more than 100 physicians prac-

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ticing in five health centers. Although Maxicare currently hospitalizes many of its patients in its own facility, at the time of the study (1981) the health plan contracted with local community hospitals for all inpatient care.

Maxicare enrollees are a heterogeneous group with respect to both ethnicity and socioeconomic status. Approximately half the members are white, a third are black, and the majority of the remainder are Hispanics. Although only a small proportion of the membership is affiliated with the plan via Medicaid, approximately one-fifth of the adult population has less than a high school education and a family income of less than $15,000 per year. On the other hand, nearly 40 percent of members have at least some college education, and family incomes of these members often exceed $40,000 per year.

Experimental group. The multifaceted prenatal health education program was provided at Maxicare's largest health center, Hawthorne, which has an enrollment of approximately 40,000. With the exception of women who were unable to understand English at even the most elementary level and women who presented themselves for prenatal care beyond the 24th week of pregnancy, all women for whom a diagnosis of pregnancy was made at the Hawthorne facility during the period December 1980 through March 1981 were included in the experimental group. Thus, selection bias was not an issue in this study.

A total of 236 women were processed during the recruitment period, 195 of whom were delivered of infants as Maxicare members. Participant attrition was due primarily to miscarriage and disenrollment from the health plan. All 195 women in the experimental group received the nutrition counseling component of the prenatal health education program; however, data presented in this report are restricted to a subsample of 57 program participants who were smokers at the time of pregnancy testing and were therefore simultaneously enrolled in the smoking cessation program. It should be noted that, to obtain the widest possible recruitment, this *N* of 57 included both women who were smokers at the time of enrollment in the program and those who reported having stopped smoking when they first learned that they were pregnant. This latter group who had recently quit were enrolled in the program because of their potential for relapse during pregnancy. Specifically, health plan data suggested that a certain percentage of women stop smoking in the early months of pregnancy primarily because of nausea, only to return to smoking when the symptoms abate.

Once pregnancy was confirmed, the women received same-day appointments with a health educator and a nutritionist. These two sessions preceded the initial appointment with a physician. To avoid the possibility of study reactivity, the health education programs were not presented within a research context. As far as program participants were concerned, they were receiving standard prenatal care provided by Maxicare, for which the sessions with the health educator and the nutritionist represented a necessary introductory step.

Each woman participated in two 45-minute individual nutrition counseling sessions. The initial session included a review of the medical record and administration of a 24-hour dietary recall interview. General counseling focused on the importance of (*a*) diet to a healthy pregnancy, (*b*) weight gain during pregnancy, and (*c*) restricting intake of alcohol, caffeine, and other drugs. In addition, on the basis of information derived from the nutrition assessment, the nutritionist identified specific areas for improvement and discussed with patients recommendations for changes in their daily diets. Patients also were counseled to comply with the prescribed daily vitamin regimen.

Approximately 3 months after the initial sessions, all participants were contacted by phone for scheduling of a followup nutrition counseling session. All 57 members of the group agreed to participate. At this second session, the nutritionist assessed patients' nutritional status by plotting weight on a prenatal weight gain grid, reviewing the physician's progress notes in the medical record, administering a second 24-hour dietary recall interview, and obtaining self-reports of degree of adherence to recommended dietary changes. On the basis of this information, the nutritionist reinforced positive changes and offered further counseling when necessary.

The 8-week smoking cessation program employed a home-correspondence format. After a brief intro-

duction to the program by the health educator, participants received booklets at home each week that presented three sequential phases of quitting: preparing to quit (diary and relaxation), quitting (target data and "quit" contract), and maintaining nonsmoking over time (dealing with rationalizations, self-reward, and so on). A final feature of the program involved a telephone answering system. Specifically, participants were asked to make three calls per week to the system, which provided taped messages reinforcing the content of that week's booklet. A detailed description of the smoking cessation program is provided elsewhere (*7*).

Two distinct approaches were adopted for the two health education programs. While the nutrition program followed a more traditional clinical model of face-to-face counseling, the smoking cessation program relied on a self-care approach. Several factors contributed to the decision to employ these differing formats. In the case of nutrition counseling, the necessity of a detailed interview to determine specific areas of dietary deficiency, as well as the tailored nature of the advice provided, recommended the use of an individualized format. Such an approach was feasible because, except in the case of a few high risk patients, only two sessions were considered necessary to promote successful behavior change. The use of individual rather than group counseling also made it possible to arrange the patients' nutrition sessions to coincide with prenatal medical appointments, thus minimizing the potential for program attrition because of scheduling problems.

In contrast, successful change of smoking behavior was believed to require a more intensive and incremental approach than could be implemented in two sessions. While a traditional clinic approach could have been used, the high attrition that might have accompanied a multiple-session format would have jeopardized both the program's effectiveness and the integrity of the research design. The home-correspondence model was considered a viable alternative, since it allowed participants to receive the step-by-step set of behavioral change recommendations at their convenience, at home, over time.

Finally, it should be noted that no systematic effort was made to alter either the nature or the quantity of usual information exchanged between health professionals and their patients as part of prenatal medical care (patients routinely have monthly visits with an obstetrician over the course of pregnancy). Of course, as a result of the nutrition counseling services, obstetricians had a wealth of nutrition information which, under normal circumstances, might not have been included in patients' medical records. Physicians were simply asked to be supportive should their patients inquire about the advice received from the health educator or nutritionist.

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The various optional prenatal health education programs routinely offered by Maxicare remained intact for the duration of the research project. For example, if a patient chose to enroll in Lamaze classes, she might well have received additional information regarding nutrition and smoking during pregnancy.

Control group. The experimental group was evaluated against controls receiving standard prenatal care within the context of a quasi-experimental research design. Although random assignment is an optimal method of ensuring the internal validity of study findings, it was judged impractical for this study because of the high potential for cross-group subject contamination. Rather, controls were obtained from two sources: (*a*) a random sample of women, also enrolled at the Hawthorne facility, who began their prenatal care during a 4-month period (July through October 1980) preceding the experimental program, and (*b*) a random sample of women who began their prenatal care during the same period as the experimental group, but who were enrolled at Maxicare facilities other than Hawthorne. Like the experimental group, the sample was restricted to English-speaking women whose prenatal care was initiated no later than the 24th week of pregnancy. Combining controls from both sources, a sample of 405 women was identified, 333 of whom were delivered of infants as Maxicare members.

Importantly, neither the persons identified for inclusion in the control group nor their health providers were aware of their control group status. In effect, the experience of the control group was identical with that of women receiving routine pre-

'Both . . . components of the program were successful in encouraging appropriate behavior changes during the prenatal period. Further, . . . the reduced incidence of adverse birth outcomes translated into hospital treatment cost savings that more than offset the expense of the interventions.'

natal care at Maxicare. In addition to prenatal medical care (which was identical with that given the experimental group), various optional health education programs were available to control group women, including a single-session prenatal nutrition counseling class and a group-based smoking cessation program adapted from a program of the American Cancer Society. Approximately one-third of control group women attended the group nutrition counseling session, while only a very few chose to enroll in the smoking cessation program.

Data collection. Approximately 2 months postpartum, both experimental and control group subjects were interviewed by phone regarding their nutrition and smoking behavior during pregnancy. (All women were first sent letters explaining that Maxicare was interested in their impressions of the care they had received during their recent pregnancy.) It is important to note that this interview did not mention any connection with the research program. Rather, the interview was introduced as a normal part of Maxicare's assessment of patients' satisfaction.

To reduce the potential for socially desirable responses to questions pertaining to nutrition and smoking, these items were embedded in a 20-minute interview that covered other topics such as pregnancy-related health beliefs and attitudes, current infant feeding practices, method of transporting the infant in the car, and satisfaction with the physician and with hospital care.

Interviews were successfully completed with all 57 women in the experimental group and with 313 (94 percent) of the 333 women in the control group. On the basis of these data, 72 control group women were identified as smokers (that is, women who reported that they had smoked at any time during their pregnancy, including those who had stopped when they first learned that they were pregnant). This subset of control group smokers represented the appropriate comparison group for this analysis.

Pertinent medical and cost data associated with the experimental and control group pregnancies were abstracted from outpatient medical records and inpatient claims forms. Outpatient medical records yielded information on past pregnancy history (for example, parity, miscarriages, abortions, and previous premature deliveries) and complications during the pregnancy under study such as toxemia, infection, hypertension, and weight gain. Hospital records provided information on each infant's birth weight, Apgar scores, presence or absence of birth complications or abnormalities (for example, respiratory distress or need for neonatal intensive care), and the total cost of care associated with the hospital stay.

Finally, self-reports of smoking status were supplemented by thiocyanate assays of urine samples obtained during prenatal medical visits. Unfortunately, limited resources restricted these assays to the experimental group only; thus, between-group comparisons were not possible. Nevertheless, it should be noted that the thiocyanate data essentially corroborated the experimental group's self-reports of smoking status. A comprehensive discussion of these data are provided elsewhere (*7*).

Findings

Description of study groups. Table 1 provides demographic and prior-pregnancy characteristics of experimental and control group subjects. There were no statistically significant differences between the groups with respect to any of these background variables. The control group, however, had slightly larger percentages of whites, of those with less than a high school education, and of those with family incomes less than $15,000 per year, while the experimental group had a somewhat higher percentage of women with one or more previous miscarriages. Also, in comparison with controls (data not tabled), experimental group women reported a higher incidence of toxemia during previous pregnancies (6.7 percent versus 2.0 percent) and of premature deliveries (6.7 percent versus 0.0 percent).

Smoking cessation. Initial analysis of the postpartum interview data revealed that a slightly larger percentage of control group women reported interrupting their smoking at some time during pregnancy than was the case for experimental group women (54.2 percent versus 49.1 percent). This relatively crude measure was partitioned further to distinguish

Table 1. Demographic characteristics and prior pregnancy history of study population (percentage distribution)

Variables	Experimental group (N = 57)	Control group (N = 72)	Both groups (N = 129)
Race:			
White	47.4	55.6	51.9
Black	31.6	31.9	31.8
Hispanic	15.8	11.1	13.2
Other	5.3	1.4	3.1
Age:			
19 or less	14.0	15.3	14.7
20–24	38.6	41.7	40.3
25–29	29.8	27.8	28.7
30 or more	17.5	15.3	16.3
Marital status:			
Married	70.2	66.7	68.2
Single	29.8	33.3	31.8
Education:			
Under 12 years	14.0	23.6	19.4
High school graduate	43.9	43.1	43.4
Some college	31.6	26.4	28.7
College or more	10.5	6.9	8.5
Family income per year:			
Less than $15,000	21.1	29.2	25.6
$16,000–25,000	59.6	51.4	55.0
More than $25,000	19.3	19.4	19.4
Gravida:			
1	22.8	29.2	26.4
2	33.3	27.8	30.2
3	22.8	23.6	23.3
4 or more	21.1	19.4	20.2
Parity:			
0	56.1	58.3	57.4
1	26.3	23.6	24.8
2	14.0	11.1	12.4
3 or more	3.6	7.0	5.4
Abortions:			
0	63.2	63.9	63.6
1	21.1	27.8	24.8
2 or more	15.8	8.3	11.6
Miscarriages:			
0	73.7	84.7	79.8
1	22.8	12.5	17.1
2 or more	3.5	2.8	3.1

between "quitters" (women who stopped smoking and did not resume during the remainder of the pregnancy) and "transitory interrupters" (women who stopped smoking temporarily, only to resume later during pregnancy). Since smoking rate at pregnancy onset was expected to be related to the impact of the smoking cessation program, results are presented in table 2 according to two levels of smoking—less than one pack, or 20 cigarettes, smoked per day versus one pack or more per day.

As table 2 indicates, there were no transitory interrupters in the experimental group—women in this group who interrupted their smoking during pregnancy did not resume smoking and thus were classified as quitters. In the control group, on the other hand, although 54.2 percent of the women reported interrupting smoking during pregnancy, only 37.5 percent could be classified as quitters; 16.7 percent were transitory interrupters. Most of the transitory interrupters smoked throughout the majority of their pregnancy (that is, from the third month to the end), stopping only in the early months because of nausea. If quitting during pregnancy is redefined to include only the quitters and not the transitory interrupters, then 49.1 percent of the experimental group quit smoking during their pregnancy, compared with 37.5 percent of the controls. When prior smoking rate was controlled for by a log-linear statistical test, this difference reached marginally significant levels ($P < .10$).

One final point of interest regarding the data in table 2 is the differential effectiveness of the home-correspondence smoking cessation program as a function of smoking rate before onset of pregnancy. Experimental group women who reported smoking less than a pack a day at pregnancy onset experi-

Table 2. Smoking status of participants in smoking cessation program

Prior smoking level	Number of Participants	Quitters (percent)	Transitory Interrupters (percent) [1]	Smokers during entire pregnancy (percent)
Experimental group				
Less than 20 cigarettes per day	24	75.0	0.0	25.0
20 or more cigarettes per day	33	30.3	0.0	69.7
Total	57	49.1	0.0	50.9
Control group				
Less than 20 cigarettes per day	42	40.4	19.2	40.4
20 or more cigarettes per day	30	33.3	13.3	53.4
Total	72	37.5	16.7	45.8

[1] Stopped smoking temporarily but resumed later during pregnancy.

enced considerable success with the program (75.0 percent reported quitting, compared with only 40.4 percent of controls). Among heavy smokers, however, controls were slightly more successful in quitting during pregnancy than experimental group women (33.3 percent versus 30.3 percent). A log-linear test showed this interaction to be statistically significant ($P < .05$).

Women who smoked throughout pregnancy nevertheless tended to reduce their rate of smoking over time. When data for the experimental and control groups were combined, it was found that a significant reduction in smoking rate had occurred between pregnancy onset and time of delivery: from a mean of 19.50 cigarettes per day to a mean of 12.56 (correlated t test, $P < .001$).

When these results were examined for group differences, it was found that average daily cigarette consumption of the experimental group went from 21.75 to 11.68 while that of the control group dropped from 17.51 to 13.33. Adjusting for smoking rate at the onset of pregnancy by analysis of covariance yielded an average daily consumption of 10.73 cigarettes for the experimental group and 14.16 for the controls, a difference that approached statistical significance ($P < .10$). This suggests that those women in the experimental group who smoked during their entire pregnancies nonetheless reduced their smoking levels to a greater extent than did the controls.

Nutrition. The multifaceted nature of the nutrition counseling program provided an opportunity to obtain a variety of measures of program impact. Specifically, data were collected on prenatal vitamin-taking behavior, self-reported dietary change with respect to specific food groups, self-reported coffee and alcohol consumption, and maternal weight gain. With regard to coffee consumption, it should be noted that, although recent evidence has suggested that caffeine consumption may have a small or negligible effect on the outcome of pregnancy (*21*), during the time this study was planned and implemented we were clinically guided by the Food and Drug Administration recommendation that pregnant women avoid caffeine-containing foods and drugs. Thus, an integral part of the nutrition counseling program was to advise women who were coffee drinkers to reduce or eliminate coffee from their diets or to switch to a decaffeinated brand.

Vitamin-taking behavior. Both experimental and control group women were asked about the frequency with which they had taken prenatal vitamins during pregnancy. Approximately 88 percent of the experimental group reported taking vitamins every day during pregnancy, 10.5 percent reported taking them most or some of the time, and less than 2 percent stated that they did not take any vitamins. The corresponding figures for the control group were 90.2 percent, 2.8 percent, and 7.0 percent. Thus, the intervention did not appear to encourage any more thorough use of vitamins than that observed in the control situation. This finding may have reflected a ceiling effect, since both groups reported very high levels of adherence.

Dietary changes. All women were asked to describe any specific changes they had made in their diet during pregnancy. As indicated in table 3, approximately 91 percent of the experimental group reported making one or more changes in their diet during the prenatal period, compared with 68 percent of the controls ($P < .01$).

Analysis of the reported number of dietary behavior changes revealed that the experimental group had made a mean of 1.82 changes, compared with 1.14 for the controls ($P < .001$). An analysis of covariance, controlling simultaneously on sociodemographic variables, indicated that the group differences remained significant at the .001 level, with adjusted means of 1.79 for the experimental group and 1.16 for the controls.

Across groups, 47 specific diet changes during pregnancy were reported. These changes were grouped into five relatively homogeneous categories tapping important areas of prenatal behavior with respect to nutrition, including increased consumption of dairy products, protein foods, vegetables, and fruits and decreased consumption of fats and sweets.

As table 3 indicates, a significantly ($P < .01$) greater percentage of experimental group women than of controls increased their intake of dairy products (58 percent versus 28 percent) and vegetables (56 percent versus 22 percent). Group differences in reported intake of proteins, fruits, fats, and sugars failed to reach statistically significant levels.

Coffee and alcohol consumption. Table 3 also presents data on self-reported coffee consumption during pregnancy for the 30 experimental group women (53 percent) and 36 controls (50 percent) who were coffee drinkers. A greater percentage of the experimental group than of controls reported either not drinking coffee during pregnancy or switching to a decaffeinated brand (70 percent versus

Table 3. Behavioral outcomes for participants in nutrition counseling program

Behavioral change	Experimental group (N = 57)	Control group (N = 72)
Percent reporting dietary changes during pregnancy	[1] 91.2	68.1
Percent reporting increased consumption of—		
Dairy products	[1] 57.9	27.8
Proteins	33.3	23.6
Vegetables	[1] 56.1	22.2
Fruits	19.3	20.8
Percentage reporting decreased consumption of—		
Sugar and fats	15.8	19.4
Coffee [2]	70.0	47.2
Percent gaining at least 24 pounds during pregnancy [3]	90.4	77.0

[1] $P < .01$.
[2] Percentages are based on the number of self-reported coffee drinkers (*N* is 30 for the experimental group, 36 for the controls).
[3] Percentages are based on the number of subjects for whom self-report data on pre-pregnancy weight were available (*N* is 52 for the experimental group, 61 for the controls).

47 percent), a difference that approached statistical significance ($P < .10$).

Experimental group women were also advised to refrain from drinking any alcohol during the prenatal period. Respondents were accordingly asked to report the number of alcoholic beverages (hard liquor, wine, and beer) consumed during pregnancy. Although the response categories were originally intended to reflect the number of drinks consumed per day or per week, the majority of women in both the experimental and the control groups who reported drinking during the prenatal period (52.6 percent and 54.2 percent, respectively) stated that their alcohol consumption was limited to one or two drinks during the entire course of pregnancy. Only a small fraction of the total sample (approximately 2 percent) reported regular alcohol consumption (that is, one or two drinks on a weekly basis). Although it would appear that use of alcohol was not a significant problem for the study population as a whole, it is unclear to what extent response bias (that is, social desirability) may have influenced these self-reported estimates.

Weight gain. Data regarding weight gain during pregnancy were obtained from the participants' medical records, including both self-reported pre-pregnancy weight and weight recorded at each prenatal visit. These data were examined using the California Department of Health's Maternal and Child Health Unit standard of 24 pounds for a lower limit of adequate maternal weight gain (*22*).

Table 3 reports the percentages of experimental and control group women who gained at least 24 pounds during the prenatal period. Sample sizes for this analysis were reduced somewhat because of missing self-report data on pre-pregnancy weight (*N* is 52 for the experimental group and 61 for the controls). A greater percentage of experimental group women than of controls achieved "adequate weight gain" during pregnancy—90.4 percent versus 77.0 percent, a difference that approached statistical significance ($P < .10$).

Summary of behavioral outcomes. The results of this study reveal that both the smoking cessation and the nutrition counseling programs were moderately successful in encouraging appropriate behavior change. With respect to smoking, although a greater percentage of control group women interrupted their smoking habit during the course of pregnancy, more detailed analysis revealed that a greater percentage of experimental group women were true quitters, as opposed to transitory interrupters. The program was found to be particularly helpful for women who had smoked less than a pack per day. Among those women who smoked throughout pregnancy, experimental group women were more successful than their control counterparts in cutting back on their smoking consumption during the course of their pregnancy.

With respect to the effects of nutrition counseling, experimental group women were found to have made a significantly greater number of appropriate changes in their diet than the controls, were more likely to have abstained from coffee consumption, and were more successful in achieving adequate weight gain during the course of their pregnancy. The remainder of this report examines whether these observed group differences in behavioral outcomes had an impact on the incidence of adverse birth outcomes and associated medical care costs.

Birth and cost outcomes. All 129 women in the experimental and control groups delivered live infants. (Note: There were two sets of twins in both groups. All twins were born healthy and of normal weight. In each instance, the twin with the highest birth weight and lowest treatment costs was chosen for the analysis.) Although there were no differences between groups in 1-minute Apgar scores (a mean of 7.46 for the experimental group versus 7.85 for the controls) or 5-minute Apgar scores (a mean of 8.83

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for the experimental group versus 8.81 for the controls), relatively large differences were observed with respect to mean birth weight—121.34 ounces for the experimental group, compared with 113.64 for the controls ($P < .05$).

Table 4 presents the results of a series of covariance analyses performed to determine whether the mean difference in birth weight observed between the experimental group and the controls could be accounted for by differences between the groups in sociodemographic characteristics or pregnancy history. In each instance, the adjusted group means were statistically significant.

Although the birth weight differential between the experimental group and the controls varied somewhat as a function of sociodemographic and pregnancy-related background characteristics, these interactions were statistically nonsignificant except with regard to ethnicity. As noted in table 4, black control group women bore infants of slightly higher mean weight than infants of black experimental group women (the only comparison in table 4 in which the control group outperformed the experimental group). Among the remaining groups (whites, Hispanics, and "others"), infants born to women of the experimental group were of substantially higher mean weight.

While birth weight provides an important measure of program effectiveness, a more direct and clinically significant measure of the success of the interventions is the incidence of low birth weight infants. For purposes of analysis, "low birth weight" was divided into two categories: preterm infants (infants born before the 37th week of gestation, regardless of their birth weight) and small-for-date (SFD) infants (infants of at least 37 weeks' gestation but weighing less than 2,500 gm (89.28 oz). All deliveries not falling into one of these two categories were classified as "other." (This classification does not imply, however, that the delivery was uneventful—for example, included in "other" was an infant born with Down's syndrome.)

Table 4. Mean birth weight (in ounces) by sociodemographics and prior pregnancy history

Variables	Experimental group (N = 57)	Control group (N = 72)	Both groups (N = 129)
Race:			
White	124.37	113.97	118.16
Black	113.94	114.95	114.51
Hispanic	126.55	107.85	118.37
Other	122.50	111.00	120.20
Means [1]	([2])	([2])	
Age:			
19 or less	124.62	113.45	118.15
20–24	112.34	110.36	111.22
25–29	130.47	114.52	122.05
30 or more	123.90	121.27	122.52
Means [1]	121.15	[3]113.80	
Marital status:			
Married	122.51	113.75	117.78
Single	118.52	113.43	115.60
Means [1]	121.31	[3]113.67	
Education:			
Under 12 years	124.88	117.81	120.36
High school graduate	122.08	112.61	116.83
Some college	116.16	111.52	113.78
College or more	128.50	114.80	122.27
Means [1]	121.50	[3]113.50	
Family income:			
Less than $15,000	120.75	118.76	119.48
$16,000–25,000	119.97	108.05	113.92
More than $25,000	126.36	120.35	123.00
Means [1]	121.70	[4]113.35	
Gravida:			
1	123.76	119.45	121.15
2	117.94	112.10	114.98
3	124.23	106.11	113.96
4 or more	121.00	116.71	118.77
Means [1]	121.50	[3]113.51	
Parity:			
0	122.90	117.14	119.67
1	119.80	103.64	111.21
2	117.77	111.25	114.70
3 or more	124.00	122.80	124.14
Means [1]	121.66	[4]113.38	
Abortions:			
0	120.32	116.48	118.21
1	118.58	108.65	112.37
2 or more	129.22	109.00	121.13
Means [1]	121.05	[3]113.08	
Miscarriages:			
0	121.52	112.81	116.40
1	119.71	117.78	118.95
2 or more	129.00	120.00	124.50
Means [1]	121.25	[3]113.70	

[1] Adjusted means as determined by analysis of covariance.
[2] Because of significant interaction effect, adjusted means were not calculated.
[3] $P < .05$.
[4] $P < .01$.

Table 5 presents the incidence rates and associated hospitalization costs of preterm, SFD, and other deliveries for the experimental and control groups. The experimental group had a reduced, although

Table 5. Incidence rate and treatment costs associated with preterm, small-for-date, and other deliveries among experimental and control group subjects

Variables	Experimental group		Control group		Both groups	
	Incidence (percent)	Cost per delivery	Incidence (percent)	Cost per delivery	Incidence (percent)	Cost per delivery
Deliveries:						
Low birth weight	7.0	$1,771	9.7	$2,914	8.6	$2,498
Preterm	1.7	4,138	6.9	3,959	4.7	3,989
Small-for-date	5.3	982	2.8	301	3.9	709
Other	93.0	315	90.3	452	91.4	391
Average cost per delivery		417		692		570
Adjusted cost per delivery		466		649		

statistically nonsignificant, incidence of low birth weight infants relative to the controls (7.0 percent versus 9.7 percent). A more detailed examination of birth outcome data revealed differing proportions of preterm and SFD infants among experimental and control group women. In the experimental group, the majority of low birth weight infants were SFD rather than preterm (1.7 percent premature, 5.3 percent SFD). Among controls, low birth weight infants were primarily premature (6.9 percent; 2.8 percent were SFD).

The distinction between categories of birth outcomes is relevant because hospitalization costs associated with the treatment of SFD and preterm infants vary substantially: the average treatment costs of a preterm delivery are approximately six times those of an SFD delivery (table 5). As a result, charges per delivery for the experimental group were substantially lower than those for the control group (actual mean charges per delivery were $417 for the experimental group, compared with $692 for the controls). Standardizing hospitalization charges for both groups (for the total sample, the mean preterm delivery cost was $3,989, the SFD delivery cost was $709, and the "other" delivery cost was $391) resulted in a mean cost differential between the groups of $183 per delivery ($466 per delivery for the experimental group versus $649 for the controls).

A detailed discussion of the costs associated with providing the prenatal nutrition counseling and smoking cessation programs is provided elsewhere (7). Briefly, however, the combined programs—including staff salaries, program development, implementation costs, and overhead—were provided for a total cost of $93 per patient. Given the calculated hospitalization cost savings of $183 per delivery, the prenatal health education programs yielded a benefit-cost ratio of approximately 2:1. This ratio probably is a conservative estimate of program impact because our analyses were restricted to short-term cost outcomes. The fact that preterm and SFD infants experience a higher incidence of various diseases during childhood years than infants of normal birth weight implies that the benefit-cost ratio of the intervention would be increased substantially if the analysis were extended beyond the immediate postnatal period.

Discussion

This demonstration project sought to test the effectiveness of a multifaceted prenatal health education program from behavioral, health benefit, and cost outcome perspectives. Both the smoking cessation and the nutrition counseling components of the program were successful in encouraging appropriate behavior changes during the prenatal period. Further, the health education initiative was found to be economically viable, since the reduced incidence of adverse birth outcomes in the experimental group translated into hospital treatment cost savings that more than offset the expense of the interventions.

The home-correspondence smoking cessation program seemed especially well suited to women who smoked less than a pack of cigarettes a day at pregnancy onset. This is not to say that those who smoked more heavily should be excluded from this approach. Instead, results of our research suggest that some additional effort might be required to improve the program's impact on heavier smokers. It is possible, for example, that the program could be made more personalized, and hence more effective, by scheduling telephone conversations between patients and the health educator rather than using the recorded message system. Alternatively, program content might be altered to emphasize the particular concerns and characteristics of heavy smokers. One largely unexplored area in this study is the extent to

which the spouse or "significant other" could be encouraged to stop smoking also and provide more active support for the patient. Finally, special invitations might be extended to heavier smokers to participate in group or individual meetings, using the more traditional smoking-clinic model.

With regard to the nutrition counseling program, we believe that the clinical style and techniques employed in this demonstration project reflected the state of the art in the field. From a nutrition assessment standpoint, the use of both specific self-report questionnaires and a 24-hour dietary recall protocol was found to be quite important in the identification of areas of nutritional deficiency. The counseling itself would appear to be best accomplished by tailoring recommendations to the educational, ethnic, and cultural background of the patient. Limiting recommendations to a reasonable number (three or four) would seem advisable to avoid overburdening the woman with behavioral change tasks.

It should be noted that the initial nutrition counseling session (which preceded the first prenatal medical visit) allowed early identification of high-risk women who had greatest need of such counseling. Although it is possible that such screening could be carried out by an obstetrician or a nurse practitioner at the time of the first prenatal medical encounter, the issue of HMO access problems must be considered in such a situation. All too often, appointment delays cause prenatal care in HMOs to begin late in the first trimester or even as late as the second trimester of pregnancy, when poor nutrition may already have had an adverse effect on the fetus. Potential access problems might be circumvented by initiating prenatal care with a nutritionist. In that way, by the time the physician first examined the patient, a well-documented nutrition history and a summary of recommendations would be available in the medical chart. For women at high nutritional or medical risk, procedures could be established for immediate initiation of prenatal medical care.

Regarding the feasibility of implementing our programs in other health care settings, the home-correspondence smoking cessation approach lends itself to use in all prepaid health settings and seems particularly well suited to the decentralized individual practice association, where clinic group programs would be less practical. On the other hand, the nutrition counseling program we employed is perhaps best suited for relatively large group practices, given scheduling and other logistical difficulties that would be associated with providing such a program in small settings scattered over a wide area.

Despite the overall positive findings of this study, a note of caution should be introduced in interpretation of the results. A number of outcomes were those expected but failed to achieve significance at conventional levels of statistical testing. This was particularly evident with respect to birth and cost outcome analyses, in which differential rates of low birth weight deliveries between groups—while of practical significance from clinical and treatment-cost perspectives—could not be confirmed statistically. However, given the consistent direction of findings favoring the experimental group in the areas of smoking reduction, adequacy of nutrition, maternal weight gain, mean birth weight of infants, and reduced incidence of low birth weight infants, the observed differences appear to be real and not the product of sampling error.

Further, it should be kept in mind that the nutrition counseling and smoking cessation programs were tested against a "standard" rather than a "no treatment" control situation: control group participants, as part of their prenatal medical care, often received advice from their obstetricians and ancillary medical staff regarding the importance of eating properly and avoiding smoking during pregnancy. Although it is unlikely that the depth and consistency of such counseling matched that given experimental group participants, it certainly represents something more than "no treatment," particularly given the regularity of contact between patients and their physicians. The availability to the control group of a variety of optional prenatal health education classes (including group nutrition counseling, clinic smoking cessation programs, and Lamaze) further underscores the fact that this demonstration project involved the comparison of two prenatal programs whose health education components varied in intensity. From this perspective, the favorable behavioral, birth, and cost outcomes associated with the experimental group experience become all the more meaningful.

Our experience encourages us about the feasibility of conducting small-scale evaluations of health education and health promotion programs within HMOs. We found that it was possible to conduct a rigorous evaluation without disrupting the efficient medical care operations of the HMO.

In undertaking our research, we recognized from the outset that a single small-scale demonstration project would encounter a host of methodological problems (for example, sample-size limitations, necessity of employing a quasi-experimental design, and difficulties in measuring behavior change reliably over extended periods) that would preclude our

making definitive statements regarding the efficacy of the health education programs. Nevertheless, we believe that research of this nature can both guide policy decisions within a given operational setting and contribute to the knowledge base documenting the clinical and economic viability of disease prevention and health education interventions.

We hope that our favorable clinical and fiscal findings will prompt and guide further investigation in this field. Through a process of replication in which similar small-scale demonstration projects are evaluated within diverse health care settings such as public health clinics, county hospitals, and solo fee-for-service practitioners' offices, it should be possible to gain a better understanding of the conditions under which such programs will be successful.

As the cost of health care in this country has continued its alarming rise, health care providers, government agencies, insurance carriers, employers, and consumers alike have intensified their search for effective cost containment strategies. For the most part, these efforts have involved tightening administrative loopholes, monitoring expenditures more closely to reduce unnecessary charges and utilization, and increasing financial barriers such as copayments and deductibles. Programs that encourage and facilitate healthful lifestyle changes represent an alternative—or at least a complementary strategy—to traditional methods of curtailing health care expenditures. There is good reason to believe that such an approach will yield savings in human as well as economic terms.

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