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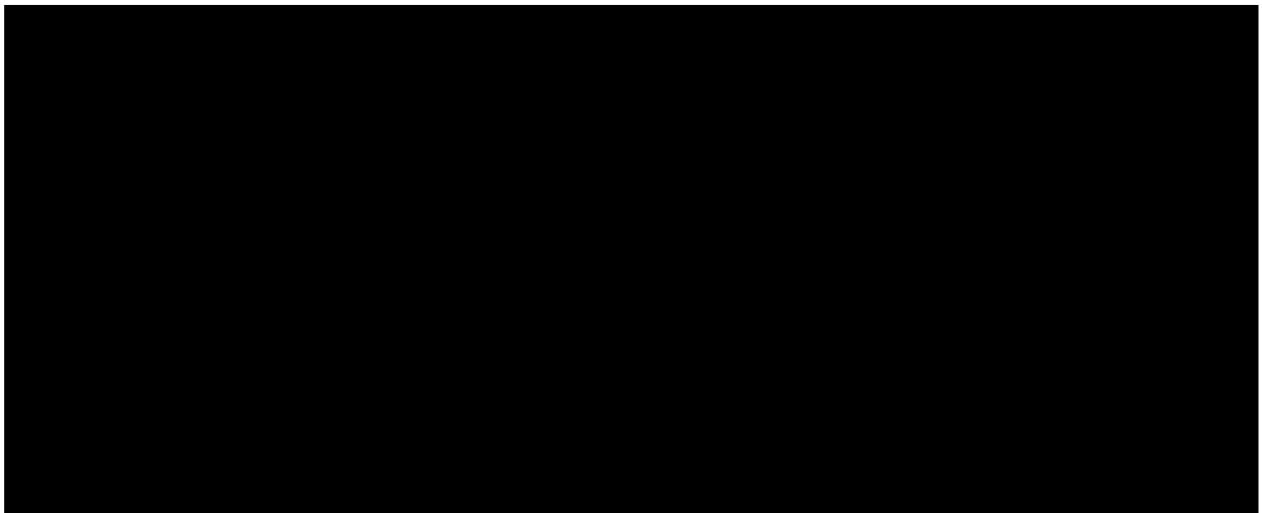
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**Traditional vs Comprehensive Prenatal Care and Low-Weight Births:
The Case of an Oregon County**

by
Brian Ilfeld

A Thesis

Submitted in partial satisfaction of the
requirements for the M.D. with Thesis Program
of the
University of California, San Francisco



ABSTRACT

Objective: To assess the impact of a comprehensive prenatal care program on the incidence of low-weight births.

Study Design: In this retrospective cohort study, low-income women who received expanded care from Healthy Start, a non-profit prenatal care program (n = 327), were compared with women who received more traditional care from private-practice physicians (n = 3335). Logistic regression was used to assess the relative odds of delivering a low-weight infant while controlling for other known factors associated with low birth weight.

Results: Of Healthy Start women, 4.0 percent delivered a low-weight infant compared with 3.9 percent of private-physician patients (relative risk of 1.0, 95% CI 0.6-1.8). However, Healthy Start women had on average, more sociodemographic risk factors that would predispose them towards having a low-birthweight infant. When these confounding factors were controlled in analysis, Healthy Start appeared to have a small protective effect, as compared to care from private physicians (odds ratio 0.8, 95% CI 0.4-1.4). However, this difference did not reach statistical significance ($p = 0.44$).

Conclusion: Among low-income women, comprehensive prenatal care providing non-medical ancillary services in addition to basic obstetric medical care may be more effective in reducing low-weight births than more traditional care, but further studies with more statistical power are needed for conclusive results.

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INTRODUCTION

Low birth weight is strongly associated with an increased risk of infant morbidity, mortality, and higher medical costs.¹⁻³ A number of maternal characteristics also are related to increased infant mortality, such as non-white race, age less than 18, and low education level.⁴ However, when other factors associated with infant mortality are controlled in analysis, low birth weight remains the major independent determinant of neonatal mortality.⁵⁻⁷ Therefore, preventing low-weight births has become a primary goal of the health-care community.⁸

Prenatal care. Inadequate prenatal care is highly correlated with the occurrence of low birth weight and associated morbidity and mortality.⁹⁻¹⁵ A number of studies suggest a direct causal relationship between prenatal care initiated early and continued consistently throughout pregnancy and low rates of low-weight births.¹⁵⁻¹⁸ Although all women fare better with prenatal care, many studies have shown that women at highest risk for low-weight infants benefit the most.^{10-14, 19} Because targeted health programs can improve access to prenatal care, intervention programs have been instituted in a variety of settings.

Comprehensive care. While most studies of low birth weight have investigated the relationship between the timing and amount of prenatal care and birth weight, few have assessed the relative impact of comprehensive versus standard care.⁸ In one study, a program with nurse practitioners providing expanded care, including home visitation, nutritional assessment and counseling, health education, and other services ancillary to basic obstetric medical care, had a greater impact on birth weight than more "traditional" prenatal care provided by private-practice physicians.²⁰

Additional studies have reported similar findings^{19, 20-21} and in a review of the literature, Starfield found that in high-risk populations, the scope and quality of care appeared to be more influential in reducing low birth weight than the number of prenatal care visits.²³

Hypothesis. In this study, the impact of a comprehensive prenatal care program--Healthy Start--on the incidence of low birth weight was examined. Low-income women who received expanded care from Healthy Start were compared with other women in Deschutes County (central Oregon) who received more traditional care from private-practice physicians. It was hypothesized that the comprehensive prenatal care would decrease the incidence of low birth weight, and the Healthy Start patients would have a lower rate of low-weight births than the patients who received more traditional prenatal care from private-practice physicians.

Healthy Start. The Healthy Start program began in July, 1989, as a non-profit partnership among the Deschutes County Health Department, the local medical center, and regional obstetricians. It offers a comprehensive, coordinated system of prenatal care for women whose monthly gross family income is at or below 185 percent of the Federal Poverty Level Index. Community outreach, transportation, and consolidation of services onto one site all help to remove barriers that have historically discouraged low-income women from utilizing traditional health-care systems. Each woman is assigned a case manager who serves as her advocate and helps coordinate all medical and ancillary care. Prenatal visits are thirty minutes each with roughly 25 percent of this time dedicated to obstetric medical care and the remainder spent on psychosocial issues.

Care includes intensive health education as well as nutritional assessment, counseling, and supplementation, with direct referral to the

Special Supplemental Food Program for Women, Infants, and Children.²⁴ Multiple social programs are available and encouraged when appropriate, addressing such issues as drug and alcohol abuse, smoking cessation, personal counseling, family support, general social work, and child-birth classes. Pharmaceutical services and ultrasound testing are provided when necessary.

One nurse practitioner and one midwife provide the majority of non-ancillary care. These providers generally emphasize patient education, support, satisfaction, and relate to their patients in a nonauthoritarian manner.⁸ All missed appointments are followed by a telephone call and home visits, if necessary. Furthermore, all patients have access to a Healthy Start nurse 24 hours a day by phone for any questions or problems.

METHODS

Data collection. Oregon birth certificate data for singleton, live-birth deliveries in Deschutes County for the years 1990 through 1992 were obtained from the Oregon State Center for Health Statistics (3817 deliveries). The Healthy Start program officially provides prenatal care for only Deschutes residents. However, some women residing in surrounding counties use the Healthy Start program. All women who received care from Healthy Start were included in this analysis, regardless of their county of residence. However, women who delivered in Deschutes County but resided in another county which did not receive Healthy Start care were excluded (141 women, 3.7 percent). Women who received no prenatal care also were excluded from the analysis (14 women, 0.4 percent).

Patient selection. The first step was to indicate which of the 3662 remaining Deschutes County resident birth certificates for 1990 through 1992 belonged to women who were in the prenatal care program of the health department. Healthy Start provided an anonymous list of the 334 women in the prenatal program specifying the date of delivery, maternal birth date, one- and five-minute APGAR scores, and infant birth weight. Computer and subsequent manual matching according to these variables resulted in successful identification of 327 birth certificates of infants born to Healthy Start participants (a matching rate of 98 percent). There were 7 (2 percent) birth certificates that could not be matched and these women were therefore included in the comparison group.

Other than the Healthy Start program, the only sources of prenatal care identified were several unlicensed midwives and 7-10 private-practice physicians (the exact number varied over the three year period examined).

All of the women in the comparison group reported prenatal care from private physicians. Therefore, 327 women who received prenatal care from Healthy Start were compared to 3335 women who received care from private-practice physicians.

Data from the two groups are comparable since all information used in this study originated from birth certificates. Within Deschutes County, birth certificate information is acquired after delivery by hospital nursing staff and supplied to the county health department. The nurses who record the information do so both for Healthy Start and non-Healthy Start patients, and are not aware of the patients' prenatal source of care, indicating little potential for bias between the two study groups in birth certificate data.

Risk factors. Factors associated with low birth weight (<2500 grams)⁹ and recorded on Oregon birth certificates were identified. These included maternal age less than 18 or greater than 34 years, non-white race, fewer than 12 years of education, single marital status, tobacco and alcohol use during pregnancy, parity over three, inadequate quantity of prenatal care, and a previous live birth with subsequent death.

Prenatal care. Quantity of prenatal care was assessed using the adequacy of prenatal care utilization index developed by Kotelchuck,²⁵ and currently used by the National Center for Disease Control and Prevention (Table I).²⁶ This index divides care into four categories by the timing of the first prenatal visit and by the appropriateness of the number of visits based on gestational age at the first prenatal visit and at delivery. For purposes of this analysis, quantity of prenatal care was dichotomized into adequate ("adequate plus," "adequate," and "intermediate" index) or inadequate ("inadequate" index).

Table I. Criteria for adequacy-of-care index levels *

Level of prenatal care	Dichotomized variable for this study	Month prenatal care began	Percentage of recommended prenatal visits [#]
Adequate plus	Adequate	< = 4 months	= > 110%
Adequate	Adequate	< = 4 months	80%-109%
Intermediate	Adequate	< = 4 months	50%-79%
Inadequate	Inadequate	< 5 months or = > 5 months	< 50% ----

* Adapted from M. Kotelchuck.²⁵

Based on the American College of Obstetricians and Gynecologists standard for month of gestation.²⁷

Data analysis. The two study groups were compared on low-weight births and selected sociodemographic factors associated with high risk for low birth weight. The percentage of mothers falling into each risk category was tabulated for the two groups, the relative risk for patients of Healthy Start determined, and 95 percent confidence intervals were calculated. Logistic regression was used to address the question of the effect of source of prenatal care on birth weight. The relative risks associated with low birth weight and 95 percent confidence intervals were calculated for each of the maternal risk factors using logistic regression.

Those risk factors found to be related to low birth weight were then included in the logistic regression analysis that determined the *adjusted* relative risks for low birth weight. These risks refer to the relative likelihood of women with the high-risk characteristics delivering a low-weight infant compared with women without these characteristics. Each relative risk estimates an independent effect after the effects of all other variables in the model are controlled. The p values refer to the probability that this effect is due to random variation, given the sample size and frequency of the variable.

Similarly, in assessing the effect of source of care on birth weight, it was necessary to control for other major influences on birth weight, for example, race, marital status, and tobacco use. The usual regression techniques are not appropriate when the dependent variable (birth weight) is dichotomous (<2500 or >2500 grams). Using logistic regression allows assessment of how source of prenatal care affects the odds of having a low-weight birth after other important influences are controlled. To assess whether Healthy Start might be particularly effective among women at

highest risk, models including an interaction between source of prenatal care and the number of risk factors also were considered.

Further analysis. As an adjunct to the central study, trends of prenatal care delivery in both the state of Oregon and Deschutes County were compared. State-published statistics were used to calculate the percentage of women who delivered with no prenatal care and inadequate prenatal care for each year from 1986 through 1993.²⁸ In addition, the average month in which prenatal care began was tabulated by year, and state and county totals were compared.

RESULTS

Sociodemographic Factors. During 1990 through 1992, the proportion of low-weight infants did not differ between groups. Healthy Start patients had a 4.0 percent rate of low-weight births while patients of private-practice physicians had a rate of 3.9 percent (relative risk 1.0, 95% CI 0.6-1.8). However, Healthy Start participants were more likely to be under 18, non-white race, and unmarried; to use tobacco during pregnancy; to have less than 12 years of education; and to receive inadequate prenatal care, as defined by Kotelchuck's index (Figure I, Table II).²⁵ All of these risk factors were found to be associated with low birth weight within the entire study population--patients of both Healthy Start and private-practice physicians (Table III).

Patients of Healthy Start were less likely to be over age 34 (RR=0.4, 95% CI 0.2-0.6) and older age was not associated with lower birth weight. There were no statistically significant differences between the two groups on the remaining risk factors.

Independent association. The independent effect of each maternal risk factor on birth weight was determined by statistically controlling for the other selected influences on birth weight (Table III). The logistic regression model identified several independent risk factors associated with low birth weight infants within the population examined; however, only non-white race was statistically significant at the 95 percent confidence level ($p=0.02$). Tobacco use, alcohol use, and unmarried marital status were of borderline significance.

FIGURE I

Risk Factors for Comparison Groups

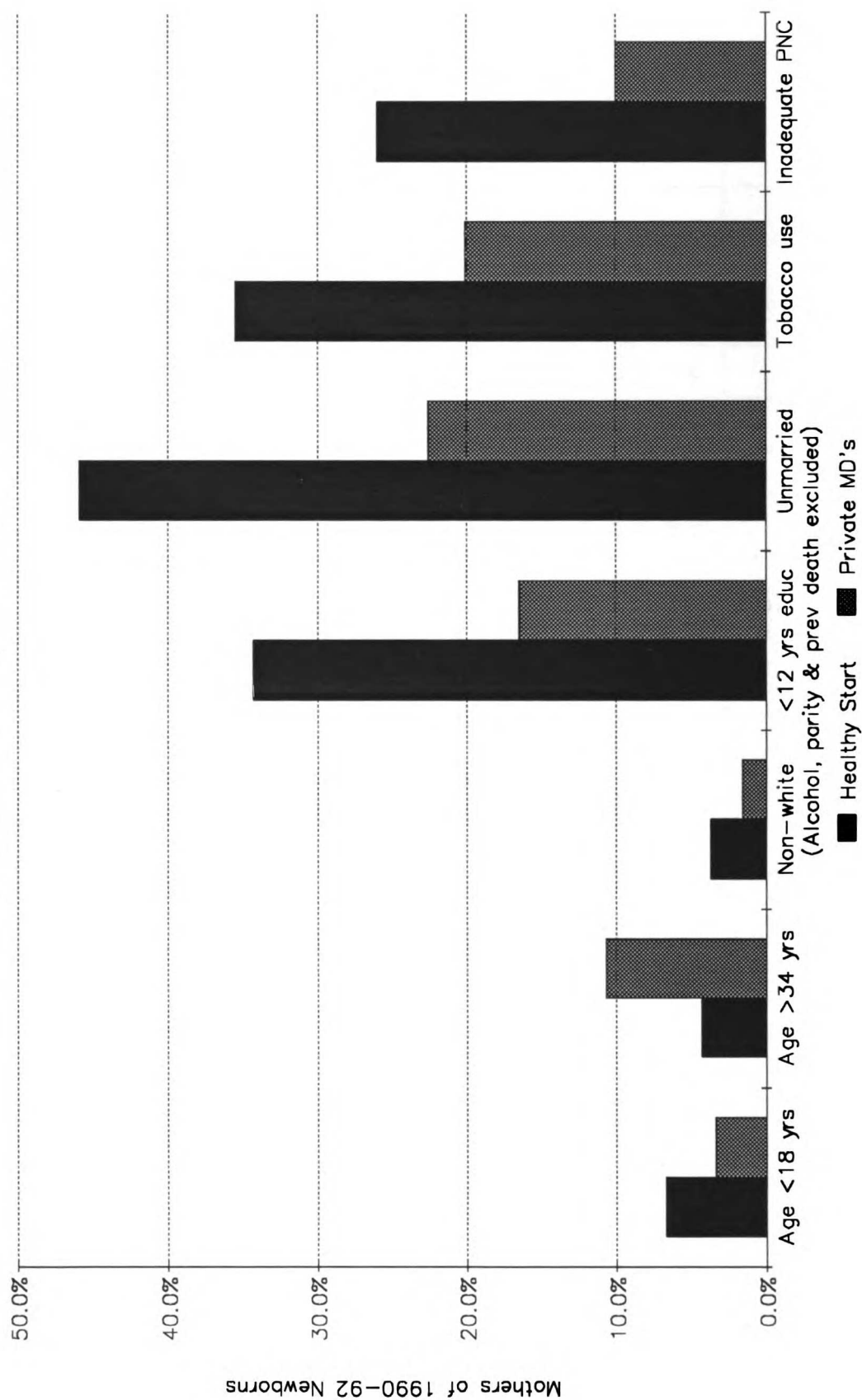


Table II. Prevalence of risk factors for low birth weight among women attending Healthy Start and private physicians, Deschutes County, Oregon, 1990-92.

	Healthy Start program (%)	Private practice M.D. (%)	Relative risk for Healthy Start	95% Confidence interval	<i>p</i>
Number of births	327	3335			
Birth wt. < 2500 gm	4.0	3.9	1.0	0.6-1.8	0.92
Maternal age < 18 years	6.7	3.4	2.1	1.3-3.3	<0.01
Maternal age > 34 years	4.3	10.7	0.4	0.2-0.6	<0.01
Non-white race	3.7	1.6	2.4	1.2-4.5	<0.01
Education < 12 yrs	34.3	16.5	2.6	2.1-3.4	<0.01
Unmarried	45.9	22.6	2.9	2.3-3.7	<0.01
Alcohol use	6.1	5.7	1.1	0.7-1.7	0.78
Tobacco use	35.5	20.1	2.2	1.7-2.8	<0.01
Parity > 3	3.1	3.0	1.0	0.5-2.0	0.93
Previous live-birth, with subsequent death	2.8	2.2	1.2	0.6-2.5	0.54
Prenatal care quantity inadequate*	26.0	10.0	3.2	2.4-4.1	<0.01

* As defined by Kotelchuck's index.²⁵

Table III. Association of risk factors for low birth weight and low-weight outcome, Deschutes County, Oregon, 1990-92.

	Unadjusted relative risk of low birth weight	95% Confidence interval	Adjusted risk for low birth weight [@]	95% Confidence interval	<i>p</i>
Maternal age < 18 years	2.2	1.2-4.0	1.1	0.5-2.5	0.62
Maternal age > 34 years	1.1	0.7-1.9	*	*	*
Non-white race	4.4	2.4-8.3	2.5	1.2-6.2	0.02
Education < 12 yrs	1.8	1.3-2.5	1.3	0.9-2.1	0.21
Unmarried	2.2	1.6-3.1	1.5	1.0-2.2	0.07
Alcohol use	2.3	1.4-3.8	1.7	0.9-2.9	0.09
Tobacco use	2.1	1.5-2.9	1.5	1.0-2.2	0.06
Parity > 3	1.6	0.8-3.2	*	*	*
Previous live-birth, with subsequent death	2.3	1.1-4.8	1.9	0.8-4.6	0.15
Prenatal care quantity inadequate [#]	1.8	1.2-2.6	1.1	0.7-1.8	0.81
Healthy Start provider of prenatal care (vs private- practice physicians)	1.0	0.6-1.8	0.8	0.4-1.4	0.44

[@] Variables in the logistic regression model included all of the factors in the table except those indicated by the "*" in the adjusted.

* Risk factors which were not found to be associated with low birth weight were not included in the logistic regression model.

[#] As defined by Kotelchuck's index.²⁵

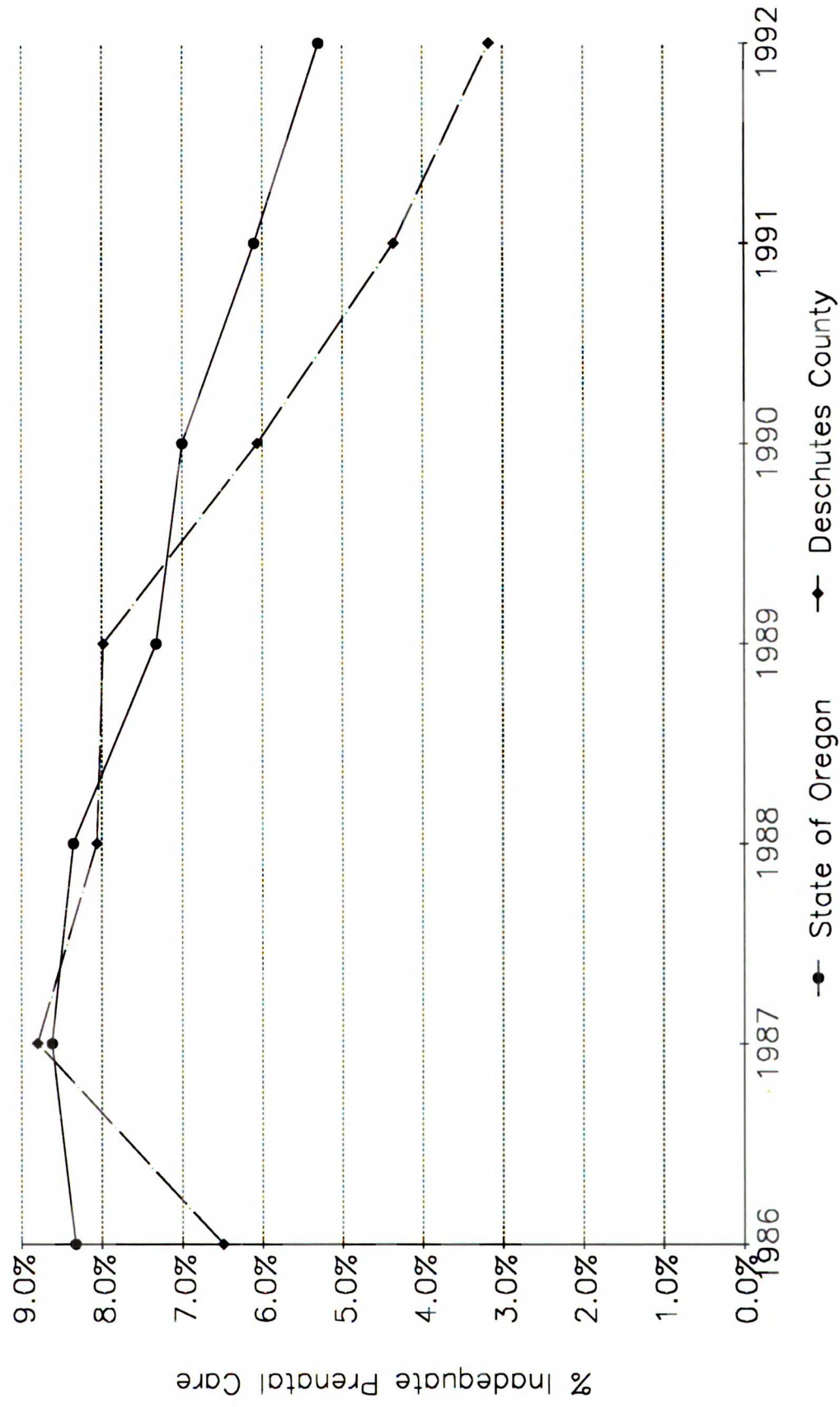
Source of care. Before taking low birth weight risk factors into account, 4.0 percent of Healthy Start patients delivered a low-weight infant compared with 3.9 percent of private-physician patients, making the relative risk for low birth weight as a Healthy Start participant 1.0 (95% CI 0.6-1.8). After controlling for all other selected risk factors thought to be associated with low birth weight, the relative risk for a Healthy Start patient delivering a low-weight infant compared to a comparable private patient was 0.8 (95% CI 0.4-1.4). However, this was not found to be statistically significant ($p = 0.44$).

Inadequate prenatal care. Oregon defines inadequate prenatal care to be care that begins after the first trimester or less than 5 total prenatal visits. In 1987, there was no difference in the percentage of women with inadequate prenatal care who delivered in Deschutes County and the State of Oregon as a whole (Figure II). In both the county and state, 8.8 percent of women delivering a live infant had received inadequate prenatal care. However, after Healthy Start began its program in July of 1989, the percentage of women delivering in Deschutes County with inadequate prenatal care fell yearly, and reached 3.1 percent by 1992. Within the State of Oregon this number also decreased, but only to 5.3 percent by 1992.

No prenatal care. Between 1987 and 1989, the percentage of women delivering in Deschutes County with *no* prenatal care varied between 1.0 and 1.8 percent (Figure III). However, after Healthy Start began its program in July of 1989, the percentage of women delivering without prenatal care fell yearly, and reached 0.1 percent by June 1993 (Figure III). No comparable drop for the State of Oregon was reported in State-published health statistics.

FIGURE II

Inadequate Prenatal Care 1986 – 1992

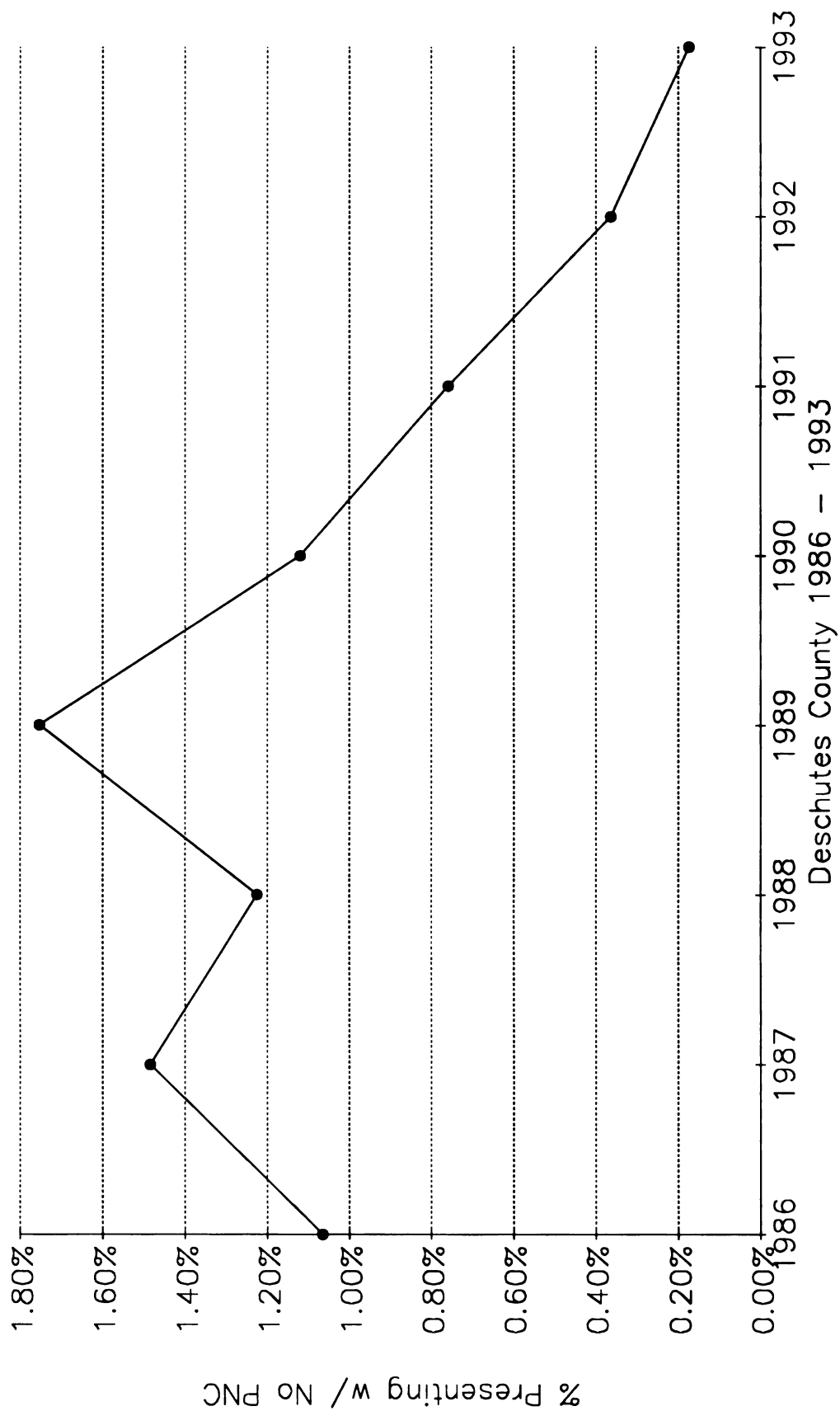


Month prenatal care began. In Deschutes County from January 1986 to December 1992, the average week of gestation in which prenatal care began fell from 13 to 11.3. This is a decrease of 13 percent overall, or less than two percent per year (1.9 per cent). From July 1989 to June 1993, the week prenatal care began for Healthy Start patients fell from 27 to 16. This is a decrease of 41 percent overall, or roughly ten percent per year.

Gestational age. The average gestational age for Healthy Start infants was 38.5 weeks as compared to 40.3 weeks for private-physician infants.

FIGURE III

Women Delivering with no PNC



DISCUSSION

Low birth weight rates. The Healthy Start group had more sociodemographic risk factors for low-weight delivery than the private patients receiving traditional prenatal care, but had comparable rates of low-weight infants. After controlling for the risk factors that were found to be associated with low birth weight, prenatal care from Healthy Start may have had a slight protective effect. However, the limited number of Healthy Start patients and small percentage of low-weight infants within each group provided inadequate power to detect a statistically significant difference between the two groups.

To find a statistically significant difference, Healthy Start would need a rate of low-weight births of 2 percent, or a relative risk for low birth weight of 0.5 compared to private patients. Therefore, the reduction of low birth weight for Healthy Start patients from 1.0 to 0.8 after controlling for risk factors suggests Healthy Start had a small protective effect, but a larger sample size is needed for definitive results. Furthermore, the effects of participation in Healthy Start may be beneficial in ways that were not evaluated in this analysis, such as on the health of the mother or her quality of life.

Previously published studies. The results of this study suggest that low-income women who received comprehensive prenatal care may demonstrate improved birth outcomes. This observation is consistent with other studies of high risk populations who received comprehensive prenatal care.¹⁹⁻²² The Healthy Start population was at an increased risk for low birth weight, and thus the findings of this study cannot be generalized to all pregnant women. For low-risk populations, there is little conclusive evidence that either the

timing or quantity of prenatal care by itself has a large effect on birth weight.²³ One study found that while their total study population did not benefit from comprehensive prenatal care, those women at highest risk *did* appear to benefit.¹⁹ This supports Fuchs' assertion that "for very risky pregnancies, the quantity and quality of care available may be critical; for pregnancies that present little risk... the quality of care may be of minor importance...."²⁹

Additionally, it was found that Healthy Start patients began their care an average of one month later than private patients (3.7 vs 2.7 months) which more than doubled their rate of "inadequate" prenatal care by Kottelchuck's index (26.0 vs 9.4 percent), yet still had nearly the same percentage of low-weight infants (4.0 vs 3.9). This suggests that for women at high risk, the quality and scope of care may be more critical than the timing of care initiation. This trend was also found by another investigator among high-risk women in a North Carolina county.²⁰

Several researchers have suggested that prenatal care reduces the likelihood of low birth weight mainly by increasing gestation, rather than by reducing intrauterine growth retardation (IUGR).^{14, 20} This analysis supports this assertion: there was no statistically significant difference between the percentage of term births that were low-weight for the two groups compared in this study, suggesting that Healthy Start reduced low-weight births by decreasing premature delivery among its patients, as opposed to decreasing IUGR occurrence (38.5 vs 40.3 weeks, 95% CI 0.4-2.5).

Inadequate prenatal care. One of Healthy Start's goals is to provide prenatal care to women who could not otherwise afford health care. Therefore, another indicator of Healthy Start's success is the decrease in the percentage of women in Deschutes County who gave birth after they

received inadequate prenatal care. In 1987, before Healthy Start began operations, there was no difference in the percentage of women with inadequate prenatal care who delivered in Deschutes County and the State of Oregon as a whole (8.8 percent). The Healthy Start program began providing services in July 1989, and within one year the Deschutes County rate of inadequate care began to decline at a faster rate than the State's. This trend continued, and within three years (1992) Deschutes County had a rate of only 3.1 percent while the State of Oregon had rate of 5.3 percent. This signified a 65 percent decrease in women delivering with inadequate care in the county compared to a 40 percent decrease for the state. No factors within Deschutes County were identified that affected this rate other than the initiation of the Healthy Start program.

Furthermore, the percentage of women delivering in Deschutes County with *no* prenatal care varied between 1.0 and 1.8 percent between 1987 and 1989. However, after Healthy Start began operations in July of 1989, the percentage of women delivering without prenatal care fell yearly, and reached 0.1 percent by June 1993. The only women who delivered without care in the last six months for which data are available were two women who resided in California and gave birth unexpectedly in Deschutes County while on vacation (personal communication: Mickie Brennan). Therefore, they could not have received care from Healthy Start, which serves only the central Oregon county. During the first half of 1993 (the latest state-provided data available), *all* women who resided in Healthy Start's target population of Deschutes County and delivered within the county received at least some prenatal care. There was no comparable drop for the State of Oregon during this same period of time.

Study Limitations. This study has a number of important limitations. First, there is a large selection bias as the study subjects were not randomly assigned into treatment groups, but rather self-selected into the two groups based mainly on income level. Since poverty is associated with a number of unmeasured low birth weight risk factors such as illegal substance use, it is important to control for income level when investigating low-weight births. Because there is no socioeconomic information included on Oregon birth certificates, income level was not a controlled risk factor within this study. However, the self-selection process should place the Healthy Start group at a *disadvantage* since this group's entire population is low-income, compared to only an unknown fraction of the private-physician group.

Although certain known risk factors for low birth weight were controlled for within this study, the two groups may differ on factors other than income-level which are associated with low birth weight, such as medical-obstetric risks.^{9, 22, 30} For example, medically high-risk women may self-select toward private physicians, resulting in a higher-risk private population that was not controlled for in this study. However, women who first presented to Healthy Start and were later referred to an obstetrician because of a serious medical risk (roughly four percent) were categorized as Healthy Start patients in the analysis. Patients who initially presented to private physicians but were later referred to Healthy Start because of financial reasons or need for supplementary care also were considered patients of Healthy Start, creating a bias towards not finding a difference between the groups.

Furthermore, prenatal care provided by private physicians is described in this study as "traditional" and assumed to lack Healthy Start's ancillary care. However, no objective study of local, private care was undertaken,

and this supposition is based upon informal interviews with local nurses and obstetricians. Finally, the study population was limited to live single births, excluding pregnancies that terminated in fetal deaths, stillbirths, or multiple births.

Future research. Further studies are needed to evaluate the effect of comprehensive prenatal care programs among socioeconomically disadvantaged women. A randomized study design could eliminate some of the comparability problems of this study by comparing exclusively low-income women from two sociodemographically similar areas receiving differing types of prenatal care, except given current knowledge, this design would not be ethical. In addition, central Oregon is a rural area with few ethnic minorities (98.6% white, 1.0% Latino, 0.4% African-American). Although previous related studies have investigated both rural^{19-20, 22} and urban populations,²¹⁻²² as well as geographic regions such as California,²² Ohio,²¹ and North Carolina,²⁰ it would be desirable to expand these data to other areas and populations. Further investigation into the specific aspects of comprehensive prenatal care that may affect birth weight is of particular importance. For instance, does smoking cessation account for most of the observed decrease in low birth weight incidence?

Conclusion. Recent studies have found *no* association between expansion of health coverage to uninsured low-income pregnant women and improved birth outcomes.³¹⁻³² However, the programs examined primarily provided financial compensation to existing prenatal care providers, and did not offer a comprehensive, coordinated, consolidated source of care. These findings, along with the apparent success of expanded prenatal care programs¹⁹⁻²² suggest that for high risk populations, Moore was correct in proposing that "to be successful, such a comprehensive program must

include outreach, transportation, education, and nutritional support, along with social, medical, and pharmaceutical services... and patients must be guided through by individual case management."³³

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