EVALUATING THE IMPACT OF PRENATAL BEHAVIOR MODIFICATION ON MATERNAL AND INFANT OUTCOMES: BRITISH COLUMBIA'S PREGNANCY OUTREACH PROJECTS

By

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ABSTRACT

Since the introduction of enhanced prenatal care programs for high risk women in the late seventies, their effectiveness has been questioned. Recent studies in Canada and the United States have documented mixed results regarding the impact of comprehensive prenatal care programs on infant outcomes. This study was undertaken to explore the impact of British Columbia's Pregnancy Outreach Projects (POP).

Data from the UBC Perinatal Study for the years 1990 to 1991, was used to obtain maternal, delivery and birth outcomes data for the 106 POP clients and 318 matched controls included in this study.

POP clients obtained on average significantly more prenatal visits (7.9) than their matched controls (7.2). They had slightly better results for initiation of prenatal care, adequacy of prenatal care and maternal morbidity. Although both groups of infants were similar with regard to measures of growth, measures of morbidity were mixed. POP infants had significantly higher rates of preterm birth 15.1% versus 8.8% and congenital anomalies 14.2% versus 4.7%. However, they had a significantly lower rate of small for gestational age, 8.5% versus 12.3%.

With the exception of maternal morbidity, early entry POP clients (less than 20 weeks gestation) had significantly better maternal outcomes than their controls. Infant outcomes in the early entry subanalysis mirrored the overall analysis,

with significantly less POP infants (6.7%) born small for gestational age compared to their control infants (10.6%).

There were no differences in maternal outcomes between POP clients who entered late (between 21 and 28 weeks gestation) and their matched controls. Fewer late entry POP infants were born small for gestational age, though not significantly so.

The POP exerted its effect through reductions in the rate of small for gestational age for program infants. This trend was seen for the overall group and in the subanalysis based on entry into the program.

Results of the subanalysis based on risk group, showed aboriginal smokers, in addition to single and adolescent caucasians were the subgroups of POP clients who received the most benefit from the program. Their infants had lower rates of both small for gestational age and preterm birth.

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OVERVIEW

The past two decades has been a period of unprecedented growth in the area of prenatal care for women at risk for adverse pregnancy outcomes. With increased knowledge of the multiplicity of risk factors for perinatal complications, prenatal care programs for high risk women have evolved from single focus programs to multidimensional care. Currently, comprehensive prenatal care programs that encompass prenatal education, infant care, lifestyle assessment, social support and nutritional supplements are viewed as the most effective means of enhancing perinatal outcomes in high risk populations.

In order to determine the effectiveness of comprehensive prenatal care, many programs undergo formal program evaluations. On the whole these evaluations are process oriented and concerned with program implementation and consumer satisfaction. Outcome analysis is usually limited to maternal behavioral changes during pregnancy and infant birth weight and gestational age. In general, infant birth outcomes are compared with city, province, or national averages. Although these evaluations provide valuable information on program clients, they do not reveal the degree of impact possible for high risk women. True program impacts can only be demonstrated through the use of comparison groups.

The BC Pregnancy Outreach Projects provide a vehicle for completing this type of evaluation. Three Vancouver Island Pregnancy Outreach Project sites were chosen to participate in a study to document the impact of comprehensive prenatal care programs.

The primary questions of interest in this study were:

i. What were the characteristics of the women who attended a Pregnancy Outreach Project during 1990-1991?

ii. Were any statistically significant differences in maternal outcomes between Pregnancy Outreach Project clients and controls?

iii. Were there any statistically significant differences in infant outcomes between the infants of Pregnancy Outreach Project clients and infants of controls?

The secondary questions of interest in this study were:

iv. Were there any differences in maternal and infant outcomes between women who entered the Pregnancy Outreach Projects prior to mid pregnancy and their matched controls?

v. Were any differences in maternal and infant outcomes between women who entered the Pregnancy Outreach Projects after mid pregnancy and their matched controls?

vi. Were there any subgroups of women at risk, for who measurable program effects were shown?

This report, which describes the above study, is organized as follows:

Chapter 1: reviews low birth weight as a problem in Canada and very briefly describes the impact of low birth weight in terms of infant mortality and morbidity; economic and social costs; and manifestations of the complication. It describes the shift in focus from treatment of low birth weight infants to prevention, through comprehensive prenatal care programs that target high risk pregnant women,

Chapter 2: presents a critical review the literature pertaining to comprehensive prenatal programs for socially disadvantaged women, with respect to maternal, infant and longterm outcomes,

Chapter 3: describes the purpose, goal, objectives and structure of the BC Pregnancy Outreach Projects. Client specific information is provided about the three Vancouver Island sites participating in the study,

Chapter 4: describes the rational for and the methods used in the study,

Chapter 5: presents the results of the study,

Chapter 6: discusses the results and limitations of the study and recommends further actions to be considered to clarify the issues raised.

CHAPTER 1

INTRODUCTION

Birth weight is an important indicator of the health status of a country's population. An infant's weight at birth is the single strongest predictor of survival. Thus, low birth weight is widely considered to be the most important risk factor for infant mortality and childhood disability. Worldwide, 17% of all infants are born with low birth weight (UNICEF, 1991). In developed countries the rate of low birth weight is considerably lower. In 1989, 4.7% of single live infants born in Canada weighed less than 2500 grams at birth (Statistics Canada, 1991).

Two thirds of infants who die in the first year of life are low birth weight infants, the majority of these infants die during the neonatal period; low birth weight infants are 40 times more likely to die than infants of normal birth weight. The risk of early death is nearly 200 times greater for infants weighing less than 1,500 grams (Levitt et al., 1993). In Canada, low birth weight accounts for almost 75% of early neonatal mortality (Levitt et al., 1993) and 70% in the U.S. (Casiro et al., 1993) Steady reductions in infant mortality over the past 20 years have been accomplished through improved survival of very low birth weight infants made possible by technological and medical advances in neonatal care, based on a better understanding of neonatal physiology and pathology.

In this century, the infant mortality rate decreased from 100/1000 live births at the beginning of the century (Shapiro et al., 1968); to 8/1000 live births in 1988

for Canada and 9.7/1000 for the US (Statistics Canada, 1991; Annual Vital Statistics Report, 1990). A recent B.C. study that examined trends in low birth weight mortality since 1952 found birth weight specific declines in the rate of infant mortality. Since the early 1950's infants weighing 2000-2499 grams have experienced a steady decline in mortality from 69/1000 single live births to 29/1000 in 1988. For infants weighing 1000-1499 grams, the decline in infant mortality started in the mid 1960's and decreased from 583/1000 to 149/1000 in 1988. The biggest gains have been made for infants weighing 750-999 grams. In 1952, the rate of infant mortality for this group of infants was 862/1000. This rate remained virtually unchanged until the early 1970's. Since then, the infant mortality rate has declined sharply to a rate of 382/1000 in 1988[1].

The trend towards better survival of infants with birth weights between 1000 and 1999 grams has been reported since the early 1980's. Since this time period significant reductions in mortality have been shown for infants weighing 1501-2000 grams at birth (Casiro et al, 1993; Kitchen et al, 1992) or having reached 34 weeks of gestation (Jijon & Jijon-Letort, 1995). One recent U.S. study found that once infants reached a threshold of 1600 grams, the rates of both morbidity and mortality declined sharply (DePalma et al., 1992).

Compared with the decrease in infant mortality during this century, the decrease in the rate of low birth weight has been very modest. In 1950, the national rate of low birth weight in the US was 7.5% and 7.2% in Canada. For the next thirty years the incidence of low birth weight declined slowly and steadily to a rate of 5.4% in Canada, and 6.8% in the US. However, since 1980,

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[1] Personal communication, Sandi Wiggins.

this rate has remained virtually unchanged in both countries (Public Health Service, 1988; Statistics Canada, 1991).

The economic costs associated with low birth weight care are high. Birth weight has a direct impact on hospital length of stay and therefore health care costs. Quebec hospital data show the average length of stay for infants weighing over 2,500 grams was 4.5 days, compared with 8 days for infants weighing 2,000-2,499 grams, 21 days for infants weighing 1,500-1,999 grams, and 33 days for infants 1,000-1,499 grams at birth (Lepage et al.,1989). One recent Canadian study found the minimum cost of hospital care for low birth weight infants was $873 per day (Casiro, et al, 1992). Other Canadian studies have estimated the per diem cost of caring for a low birth weight infant ranges from $500-2,500 (Heleva & Heaman, 1989; D'Alton 1988; Creasy, 1988). In the US the price of care is even higher, admission alone to a neonatal intensive care unit is estimated at $9,600 and per diem costs range from $776-1,918 (Kay et al., 1991). While infants weighing between 500 and 1499 grams make up about 2% of the neonatal population, they consume over one-third of the total neonatal care budget (Schwartz, 1989).

The longterm social costs of low birth weight are even more profound. Low birth weight infants have more birth complications and are more likely than other infants to have deficits in their physical and mental development. Low birth weight survivors have an increased incidence of disability from a broad range of conditions, including: congenital anomalies, respiratory illnesses, neurodevelopmental handicaps and complications from neonatal intensive care treatment (Millar, et al., 1993; Aylward et al., 1989; Dunn, 1981; Fitzhardinge, 1976; Hack & Fanaroff, 1984 & 1989; Kramer, 1987; Ramey et al., 1978; Shapiro et al., 1980, Teberg et al., 1988).

While technological advances will no doubt continue to improve the survival of low birth weight infants, real improvements in the health status of all infants will be realized through a reduction in the rate of low birth weight. Further reductions in low birth weight appear to be possible as many western nations have a smaller percentage of low birth weight infants than does Canada. In Sweden, Finland, Norway and Ireland only 3-4% of infants are born with low birth weight. The World Health Organization states that a low birth weight rate of 3/100 live births is the probable threshold achievable (World Health Organization,1986). In the US a national objective has been set to reduce the incidence of low birth weight to 5% of all live births and no higher than 9% in any subpopulation (Institute of Medicine, 1985). In Canada, Ontario has targeted the reduction the incidence of low birth weight to less than 4% by the year 2000 (Ministry of Health, Government of Ontario, 1989).

Infant birth weight is determined both by intrauterine growth and gestational age at birth. Major contributors to low birth weight, therefore, include intrauterine growth retardation, preterm birth, and a combination of these two. In Canada and other developed countries, intrauterine growth retardation accounts for about one third of low birth weight infants, and preterm birth about two thirds. Incomplete understanding of the underlying mechanisms of both intrauterine growth retardation and premature labour have been major obstacles in the prevention of low birth weight In place of adequate specific information about causes, extensive research has been conducted to determine risk factors associated with low birth weight.

Risk factor studies in both developed and developing countries demonstrate that causality of low birth weight is multifactorial, and that many risk factors are interrelated (Kramer, 1987; Institute of Medicine, 1985; Silins et al., 1985). While the underlying etiologies of intrauterine growth retardation and premature labour are different, the risk factors associated with these complications overlap.

In developed countries, where preterm birth accounts for the majority of low birth weight infants, medical attention for the prevention of preterm birth has focused on arresting preterm labour via early detection. Methods include frequent cervical examination and ultrasonography, ambulatory home monitoring, patient and provider education, hospitalization, bed rest, fluids, tocolytic drug therapy and cervical cerlage (Creasy, 1988; Holbrook et al., 1987; Iams, 1989; Morrison et al., 1987; Papiernik et al., 1985). These approaches are costly, carry inherent risks and have met with variable success. Where success in prevention has been shown, it remains unclear if medical care was the most effective intervention, or if results were achieved from changes in maternal behavior and increased social support. Although traditional medically oriented prenatal care has drastically reduced the rate of adverse outcomes for low risk women, it has done little to improve infant outcomes for high risk women.

Currently, attention is shifting away from medically oriented prevention programs towards health promotion programs. The traditional medical model is not sufficient on its own to prevent low birth weight, because of uncertain and multiple etiologies of intrauterine growth retardation and premature labour (Iams, 1989). The traditional approach to prenatal care does not encompass biological, behavioral and socioeconomic factors that influence

infant birth weight. New programs that enhance prenatal care through the provision of health promotion approaches including: prenatal education, environmental support, behavior modification and nutrition supplementation are now viewed as more effective means of reducing the incidence of low birth weight.

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CHAPTER 2

THE IMPACT OF COMPREHENSIVE PRENATAL CARE PROGRAMS FOR SOCIALLY DISADVANTAGED PREGNANT WOMEN

A REVIEW OF THE LITERATURE

INTRODUCTION

The effectiveness of prenatal care in reducing low birth weight and other adverse pregnancy outcomes has been the subject of many decades of research, with somewhat mixed results. A number of early studies reported finding no association between prenatal care and low birth weight, prematurity or neonatal mortality (Drillien, 1957; Shwartz, 1962; Terris & Gold, 1969). In 1966, Abramowicz and Kass presented an overview of the results of studies that had been published over the past decade, and concluded that the published evidence supporting a positive relationship between prenatal care and birthweight was inconclusive. Conversely, studying 130,000 births in upstate New York in 1973, Stickle and Ma (1977) found that prenatal care, initiated in the first trimester was associated with better pregnancy outcomes.

Inadequate or absent prenatal care has often been cited as a risk factor for low birth weight. Using data from the 1988 National Maternal and Infant Health Survey, Sanderson et al (1991) found the absence of prenatal care to be associated with low birth weight. After controlling for social and demographic confounding variables, Greenberg (1983) found that women who failed to seek prenatal care were at increased risk for delivery of low birth weight infants. Several studies have also found that women who delayed initiating prenatal care or who obtained few prenatal care visits were more likely to experience adverse pregnancy outcomes, in particular, low birth weights, preterm birth and

neonatal mortality (Sanderson et al 1991; Schlesinger & Kronebusch, 1990; Leveno et al, 1985).

The finding of an association between inadequate prenatal care and low birth weight has been clouded by issues of confounding. Characteristics of women who obtained adequate prenatal care, rather than care itself, may have increased their chances of delivering a normal birth weight infant. Hall et al (1980) initiated this debate when they questioned whether the purported benefits of prenatal care were attributable to the care per se, or rather social, demographic and medical determinants of the utilization of prenatal services. Women who obtained adequate prenatal care generally were of optimal childbearing age, had high levels of education, were married, and had incomes above the poverty line. Conversely, women who did not receive adequate prenatal care may have delivered infants of low birth weight because they were characterized by other risk factors, including childbearing at extremes of the age spectrum, poor education, single marital status, minority status and low income. Studying birth certificate data, Taffel (1978 & 1980) found that maternal education and ethnic group were more important than initiation of prenatal care in determining low birthweight. Recent studies have confirmed that the association between minority race (black) and low birth weight is significantly higher than the association between prenatal care and low birth weight (Hulsey et al., 1991; Collins et al., 1990; Miller & Jekel, 1987).

Several studies have demonstrated that the benefits of prenatal care varied by social status. Mothers at highest risk for low birth weight, who received adequate prenatal care, benefited the most from preventive efforts. Gortmaker (1979) found that prenatal care was associated with a significant reduction in the

rate of low birth weight and infant mortality, even after social and demographic influences were considered. Greenberg (1983) demonstrated an association between prenatal care and higher birthweight that varied somewhat but persisted after controlling for mother's race and education. Prenatal care had the greatest observed impact for socially disadvantaged women, because of their high overall risk for delivery of low birth weight infants. He concluded that the efficacy of prenatal service was modified by social situation. Showstack et al (1984), after controlling for: prenatal care, length of gestation and sociodemographic factors, found that adequate prenatal care was associated with a significant and substantial increase in birth weight, especially for infants of black women.

Data from the 1988 U.S. National Maternal and Infant Health Survey found a relative decline in the rate of entry into early prenatal care (Sanderson et al., 1991). In fact, since 1980, the percentage of births to women with no prenatal care or care only in the third trimester of pregnancy had increased, especially among black women, whose rate of late entry rose from 8.8% in 1981 to 10.3% in 1985 (Brown, 1988). Young women, minority women and women with low incomes, in particular, were delaying prenatal care.

Researchers have conducted numerous studies to determine the barriers to prenatal care access. Socioeconomic factors were related to the utilization of prenatal care. However, other factors were often as important or more important than financial barriers. Young et al (1989) in a study of 201 women who entered prenatal care during their third trimester, found the psychosocial aspects of obtaining care, including denial and concealment of pregnancy, family crisis and lack of child care, often delayed initiation of prenatal care. In a

study of 227 women with no prenatal care, Scupholme et al (1991) found that barriers to prenatal care were system related, patient related and financial. Lack of information about service providers, problems completing required paperwork and the negative attitude of staff and providers were the main barriers to prenatal care services. Harvey and Faber (1993) in a study of 236 women who received inadequate or no prenatal care, found 13 financial, personal and organizational barriers to access. In a logistic regression analysis that controlled for social and demographic characteristics, six barriers were significant predictors of inadequate care: poor understanding of/or low value given to prenatal care; financial difficulties; difficulty scheduling appointments; excessive physical or psychological stress; lack of information on providers of services; and ambivalence or fear regarding the pregnancy. Shlessinger & Kronenbusch (1990) found that barriers affecting prenatal care access were age related. Finances, difficulty scheduling appointments, transportation barriers and child care difficulties were barriers for older women. Ambivalence about the pregnancy, belief that care was not important and lack of knowledge about prenatal care were barriers for younger women. The literature would suggest that removal of financial barriers and improved access to traditional medical prenatal care alone, has not generally improved the pregnancy outcomes of socially disadvantaged high risk women.

Issues in Studying the Effects of Prenatal Care

The impact of prenatal care on birth weight has received considerable attention, in part because, among the major risk factors, prenatal care is probably the most amenable to change through deliberate health programs. However, the effectiveness of prenatal care in reducing low birth weight and neonatal

mortality, has been complicated by a number of data and methodological limitations.

The major constraint to this line of inquiry has been the inability of researchers to apply experimental protocols, specifically the use of random assignment to prenatal care treatment (and nontreatment), for obvious ethical reasons. Researchers have been forced to use nonrandomized studies, relying on differences in comparison groups or before-after studies to examine prenatal care effectiveness.

A second limitation, not independent of the first, is the presence of selection bias in the study of natural populations of prenatal care users and nonusers. The self-selection of some women into prenatal care and others to avoid prenatal care confounds the causal relationship between care use and outcomes. Women who entered care early in pregnancy and who obtained many prenatal visits may have (or have had) problematic pregnancies or medical risks which required additional care, or they may have been healthy low-risk women who simply want to obtain good prenatal care. Conversely, women who entered care late in pregnancy may have had very healthy previous pregnancies and, consequently, did not perceive a need for early care, or they may have been women who did not know they were pregnant or did not understand the need for prenatal care (two common reasons for insufficient prenatal care). Because of this lack of homogeneity within categories of prenatal care use, the relationships between traditional measures of prenatal care and birth outcomes remains unclear.

Another methodological concern is the adequate measurement of prenatal care use. Popular measures of prenatal care, such as trimester of entry and the number of prenatal visits are more prevalent than those based on the content of prenatal care. However, these indicators may be misleading. Women who deliver prematurely often had fewer prenatal visits than those who deliver at term, even if they followed the recommended visit schedule until delivery. Unless a statistical adjustment was made, early deliveries were almost always associated with fewer prenatal visits. This confounding of cause and effect has been most commonly addressed through use of the Kessner Index of Prenatal care. The index, is an algorithm that includes trimester of pregnancy prenatal care began, number of prenatal visits and length of gestation, compared to the expected norm for visits (Kessner, 1973).

Another concern revolves around the content of prenatal care. Although most researchers try to solve the quantitative issue of prenatal care, the problem of defining the content of care, equally as important, has infrequently been addressed. Traditionally, the content of prenatal care has been tailored to the individual woman and her pregnancy, thus each woman may have received somewhat different care.

Some of the variables that influence the receipt of prenatal care also influence pregnancy outcome. In order to determine the independent effects of prenatal care, confounding variables must have been controlled. Most studies control for some sociodemographic and obstetrical variables, however, it is impossible to know or include all confounding variables.

Finally, the validity of information recorded in data sources remains a problem. In large studies, the biggest source of data on prenatal care and low birth weight comes from vital statistics reports. Several researchers have found that while birthweight information was generally well recorded, information on gestational age, initiation of prenatal care and number of prenatal visits was somewhat unreliable.

These and other reasons hamper the production of conclusive evidence concerning the effectiveness of prenatal care. Currently, attention is shifting away from medically oriented prenatal programs towards health promotion programs. The traditional medical model has not been sufficient on its own to prevent low birth weight, because of uncertain and multiple etiologies of intrauterine growth retardation and premature labour (Iams, 1989). The traditional approach to prenatal care does not encompass the biological, behavioral and socioeconomic factors that influence infant birth weight. New programs that enhance prenatal care through the provision of health promotion approaches including: prenatal education, environmental support, behavior modification and nutrition supplementation are now viewed as more effective means of reducing the incidence of low birth weight.

THE EMERGENCE OF COMPREHENSIVE PRENATAL CARE

The traditional approach to prenatal care with its focus on medical management doesn't address the psychological and social barriers to prenatal care. In addition, traditional prenatal care does not focus on the social and behavioral problems of of high risk women, problems that impact on pregnancy. Since the mid 1970's there has been an emphasis on programs that

alter the content of prenatal care by addressing medical, social and behavioral issues during pregnancy. In 1986, the Expert Panel on Prenatal Care, conveyed by the Department of Health and Human Services Low Birth Weight Prevention Work Group, reviewed prenatal care content and recommended changes. The panel determined that the definition of prenatal care had to change and proposed a more contemporary definition of care:

> Prenatal care consists of health promotion, risk assessment, and intervention linked to the risks and conditions uncovered. These activities require the co-operative and coordinated efforts of the woman, her family, her prenatal care providers, and other specialized providers. Prenatal care begins when conception is first considered and continues until labour begins. The objectives of prenatal care for the mother, infant, and family relate to outcomes through the first year following birth (Mortimer et al., 1991, pg. 783).

The Expert Panel on Prenatal Care defined the basic components of prenatal care as: " early and continuing risk assessment, health promotion, and medical and psychosocial interventions and their follow-up. Prenatal care should add to the traditional medical concerns a new emphasis on the psychosocial dimensions of that care, maintaining a balance among factors" (Mortimer et al., 1991, pg. 783) . Further, they stated that prenatal care programs should have preset, specific purposes and activities for defined populations and groups. Positive outcomes of prenatal care programs should include the newborn's gestational age and birth weight and the mother's medical condition and health habits.

Comprehensive programs are multidimensional that focus on pregnancy and labour education, lifestyle behavior modification, nutritional education and psychosocial support, in addition to traditional medical care. Empirical studies have been completed and the literature as a whole suggests that adequate, comprehensive prenatal care contributes to healthy birth outcomes among high risk women. Research has shown that programs which provided outreach to pregnant women or free prenatal care, reduced perinatal morbidity (Moore et al,1986); improved access to prenatal care and birth outcomes (Corman & Grossman, 1985; Norris & Williams 1984; Schlesinger & Kronebusch 1990); and were cost effective (Institute of Medicine, 1985; Moore et al 1986). Although the exact mechanism(s) through which comprehensive prenatal care impacted infant health remains unknown, studies suggest that improved nutrition (Geronimus, 1986), preterm delivery education (Harris, 1982) and screening of risk factors that arose during pregnancy (Institute of Medicine, 1988) were some of the mechanisms through which prenatal care for low income women improved infant outcomes.

ANALYSIS OF THE IMPACT OF COMPREHENSIVE PRENATAL CARE PROGRAMS: MATERNAL AND INFANT OUTCOMES

This literature review examined the quality and results of published primary evaluations of comprehensive prenatal care programs for socially disadvantaged women intended to optimize the health of mothers and infants. Comprehensive care refers to preventive services provided between conception and delivery, consisting of pregnancy and labour education, lifestyle behavior modification, nutritional education and psychosocial support, in addition to traditional medical care. The programs had preset, specific purposes and activities for defined populations and groups. The outcomes of these studies

were evaluated relative to indicators for high risk status, clarity of program description, adequacy of comparison group, inclusion of other risk factors in design and/or analysis, appropriateness of the analysis and clarity of the results. Outcomes of comprehensive programs included gestational age, birth weight, rates of low birth weight, preterm birth and infant mortality. If available, maternal outcomes and longterm impacts were also included.

The studies were published in English between January 1980 and December 1982. 1980 was chosen as a starting point to have approximately a decades worth of data reflecting the shift in focus to, and increased accessibility of, comprehensive prenatal care begun in the 1970's. The evaluations adapted methods from clinical and social science research to produce credible information about the efficacy and effectiveness of interventions and programs. Only evaluations of programs that aimed to integrate medical and social services to improve the health outcomes of mothers and infants were included.

There were 33 studies that adequately met the criteria. The vast majority of these were case-control studies that assessed program effectiveness. Nine randomized trials that assessed program efficacy were included in this analysis. Five randomized trials assessed the overall efficacy of comprehensive care, while four trials had more specific aims. The studies were characterized according to program focus and mode of delivery as follows: multidisciplinary provision - large programs; multidisciplinary provision - small programs; case management and home visitation.

Multidisciplinary Provision - Large Programs

Programs targeted at mothers and infants have traditionally occupied a basic position in the evolution of health services in the United States. The premise has been that intervention early in the life cycle offered maximum preventive health benefits. Maternity and Infant Care (MIC) programs and Improved Pregnancy Outcome (IPO) projects were two major federal comprehensive prenatal care initiatives.

In 1963 a renewed national commitment to prental care programs followed amendment of Title V of the Social Security Act, resulting in more than 50 maternity and infant care (MIC) projects that extended to all parts of the country (Kessner et al, 1973). MIC projects were originally intended to reduce the incidence of mental retardation and other handicapping conditions associated with pregnancy. In 1967, the explicit goal of reducing infant mortality was added to the legislation. The hypothesis of MIC was that accessible and attractive services would encourage women to receive early and regular prenatal care which, in turn, would contribute to fewer prenatal complications, low birth weight infants and fetal and neonatal deaths. Projects were located in low-income areas and provided routine prenatal care and multidisciplinary supportive services. There have been two published evaluations of MIC projects since 1980.

In a large case-control study, Sokol et al (1980) evaluated the social, medical-obstetrical and perinatal impact of Cleveland Metropolitan General Hospital's Maternity and Infant Care (MIC) Project during 1976 and 1977._MIC registrants

were women who resided in specific underprivileged and impoverished target areas. The comparison group was comprised of women who resided outside the catchment area of the MIC Project. Women who were referred to Cleveland Metropolitan General Hospital for high risk obstetrical pregnancies, and those who received no antenatal care, were excluded from the comparison group, to decrease allocation bias in the study. All study participants received the medical aspects of prenatal care in the same teaching hospital clinic and delivered in the same hospital, thus source and nature of prenatal care were the biggest differences between the groups.

In addition to routine antepartum medical care, each MIC registrant received an organized multidisciplinary assessment, which was followed by counseling for needed paramedical services. The registrants received health education, nutritional counseling and parenting guidance. If indicated, home visits were made by community health aides and professional staff. The comparison group received traditional prenatal care, but not multidisciplinary assessment or counseling.

Results were available for 3307 MIC registrants, and after exclusions (430), 1679 comparison mothers. MIC registrants and the comparison group were similar with regard to sociodemographic (race, age, parity, marital status and socioeconomic status) characteristics. MIC registrants were seen significantly earlier for prenatal care, on average at 16 weeks gestation compared with 19 weeks. Over 47 percent (47.6%) of MIC registrants initiated care in the first trimester compared with 34.0% of the comparison group. The number of prenatal visits made by each woman was not available for study. MIC registrants had significantly higher antepartum risk scores for intrauterine

growth retardation. There were no differences between the study groups with regard to risk scores for preterm birth. The intrapartum courses were similar for both groups.

Fewer preterm infants (less than 38 weeks) were born to MIC mothers (17.9%) than to comparison group mothers (23.9%). This 25% reduction was clinically and statistically significant. Although the authors found a statistically significant difference in the rate of low birth weight between the two groups, 11.7% for MIC infants compared with 14.0% for the comparison group, the 16% reduction was not clinically significant.. The most striking differences between the two groups occurred in the rate of perinatal mortality. Comparison group infants experienced a 2.6 fold increase in total perinatal mortality. Subcomponent evaluation revealed that both antepartum stillbirth (6.3% versus 14.8%) and neonatal death (8.7% versus 24.0%) occurred at higher rates in comparison group infants. The authors observed:

> "The key finding of this study is that with similar social and medical-obstetric risks, patients who received care from the M&C projects experienced a significantly lower perinatal mortality than those who did not. Given that all study patients received the same care during labor and delivery, it is reasonable to infer that the observed differences in outcome may have been related to differences in care during the antepartum period. The major difference in antepartum care lies in the ancillary services of the M&C project. Thus, the authors consider it more likely that the entire M&C ancillary support system...plays an important role in achieving these results" (Sokol et al., 1980, pgs. 185-186).

While the two groups were balanced with respect to various biosocial factors they were significantly different with respect to antepartum risk scores. Sixty two percent (62.7%) of MIC registrants had high risk scores compared with 56.3% of the comparison group. An analysis that compared women with

similar risk scores would have provided a more refined method of determining maximim program effects. Given the large sample size and the number of variables collected, the use of multivariate analysis to isolate the independent effect of the MIC program would have greatly added to the analysis.

In their excellent review, Peoples and Seigel (1983) used more discerning methods of data analysis to study the impact of the North Carolina MIC Project. The birth results of 5822 MIC registrants in three counties, who gave birth between 1970 and 1977 were compared with 11,447 births from three comparison counties with similar socioeconomic status, health resources and perinatal status. The data were analyzed by means of a weighted least squares procedure, after controlling for race; marital status; education; age/parity and reproductive risk. Group membership (MIC or comparison) was included as an independent variable in the analysis to test the significance of the relationship between group membership and infant outcomes.

MIC participants had significantly higher proportions of risk factors for low birth weight than did the comparison group. Unadjusted results showed that MIC services improved use of prenatal care but had no impact on the incidence of low birth weight. In a refined analysis, adjusting for maternal characteristics, the authors found differential MIC effects. There was no evidence of MIC influence on subpopulations at lowest risk, but improvements in use of care and birth weight were found among women characterized as high risk. In addition, the greater the number of risk characteristics, the greater the impact MIC. Black adolescents had a significantly lower rate of low birth weight (12.6%) than blacks in the comparison group (14.4%). Improvements in the quantitative sufficiency of prenatal care in conjunction with MIC

comprehensive services appeared to contribute to a reduction in the incidence of low birth weight for high risk subpopulations. The authors suggested two alternative explanations for their findings: (1) that high risk clients were more responsive to MIC services; or (2) that MIC services were provided differentially to high and low risk clients. Although the authors found a statistically significant difference in the rate of low birth weight between the two groups of black adolescents, the 12.5% reduction was not clinically significant.

In 1976, the federal Improved Pregnancy Outcome (IPO) project was initiated by the Bureau of Community Health Services to foster the development of state-based systems of maternity care.(Committee on Perinatal Health, 1976). The ultimate goal of the IPO project was to improve maternal and pregnancy outcome in states that had contributed heavily to the incidence of infant mortality. In contrast to MIC, states were encouraged to develop their own methods for using IPO funds. By 1980, 34 states had received IPO funding. North Carolina and Florida completed evaluations of their IPO projects.

In North Carolina, IPO funds were used to develop a comprehensive care program in two counties with inadequate maternity services. Certified nurse midwives provided prenatal, intrapartum and postpartum care to low income and adolescent mothers. The local health departments worked in conjunction with midwives to provide nutritional counseling, social services, and health education. Interdisciplinary teams planned, coordinated, and monitored patient care. Peoples et al (1984) evaluated IPO effects for the period July 1979 to August 1981, by comparing the pregnancy outcomes of (1) all black women in the two counties served by the IPO program (N=1254) with those of all black women in two neighboring counties (N=1063) with similar socioeconomic

composition; (2) all black women IPO registrants (N=648) with all black women in the comparison counties; (3) all black adolescents (age 10-19) IPO registrants (N=297) with all black adolescents (N=318) in the comparison counties.

Adequacy of prenatal care and low birth weight information were obtained from vital statistics. After controlling for group membership, maternal age, education level, parity, marital status and reproductive risk using a weighted least squares procedure, the investigators reported significantly more IPO registrants (41.2%) than controls (30.3%) received adequate prenatal care. The magnitude of difference was greatest among adolescents as 37.8% of IPO adolescents (10-19 years) obtained adequate prenatal care compared with 18.3% of control adolescents. Despite apparent improvements in the adequacy of prenatal care, there was no significant difference in the incidence of low birth weight between IPO groups and comparison groups. The authors suggest three possible reasons why the IPO program did not meet its basic goal of decreasing low birth weight.: (1) the program did not include specific protocols for managing high risk women (such as preterm labour education or smoking interventions); (2) the intensity of care was inadequate to the degree of risk; or (3) the comparison group women were at less risk and this was not completely controlled in the analysis.

In Florida, IPO funds were initially used to establish a system of prenatal care delivery for low income women in five rural counties with no prenatal services. In 1982, the program was expanded statewide to cover all low income women in Florida. IPO services focussed on both intrauterine growth retardation and preterm birth. Services included case management by nurse practitioners with ancillary service provision by multidisciplinary teams. The

components of care included preterm labour screening, pregnancy and parenting education, home visits, postpartum and well baby care, and family services. Participants were also referred to the Special Supplemental Food Program For Women, Infants and Children (WIC)[2] services.

Clarke et al (1992) evaluated the statewide IPO program for the period 1985 to 1988, by compared rates of low birth weight and neonatal mortality[3] for program participants and a synthetically matched comparison group. The comparison group consisted of nearly poor women, matched to IPO participants on race, maternal care, education, marital status and number of prenatal visits.

For the study years, IPO participants in both racial groups (white and black) experienced lower rates of low birth weight than their matched comparison group. The difference in the rate of low birth weight ranged from 7.5%-7.7% for whites to 7.6%-11.7% for blacks. None of the differences were statistically or clinically significant.

IPO participants in both racial groups experienced lower rates of neonatal mortality than their matched comparison group. For black IPO participants the rate of neonatal mortality declined dramatically over the study years decreasing from 9.1 to 6.8/ 1000 deaths. In contrast, the neonatal mortality rates for the comparison group during the study period increased overall, from 9.1 to 9.8 deaths. The 30% difference in mortality rates was both statistically and clinically significant. Although the relative rates for neonatal mortality were

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[2] WIC program provides food supplements and nutrition education to low income families with children, with particular focus on pregnant women.

[3] Although Florida's IPO program also focussed on preterm birth prevention, this outcome was not analyzed due to poor documentation of gestational age infaormation and lack of provider compliance with preterm birth prevention protocols. Personal communication, Dr. L. Clarke.

considerably lower for whites than for blacks, the trends in neonatal mortality over time were similar for both racial groups. In 1985, the rate of neonatal mortality among white IPO participants (7.06) was 12% less than the white comparison group rate (8.05). By the end of the study period, the rate of neonatal mortality was 27% lower for white IPO participants (4.66 compared with 6.42). Again, this difference was both clinically and statistically significant.

The nonsignificant difference in the rate of low birth weight may have partially been attributed to by study design. The authors appeared to have overmatched the comparison groups, by retrospectively matching on five variables. By overmatching they may have created two groups that were too similar, therefore diminishing the observed impact of the IPO program. The results may also have been confounded by differences in socioeconomic status between the two groups. Given the fact that IPO participants were medicaid eligible, and that medicaid income cutoff was well below the poverty line, IPO participants could have been significantly economically disadvantaged over their nearly poor comparison group.

In response to limited federal funding and increasing rates of poor infant outcomes, many states initiated their own programs to improve maternal care coordination and thereby infant outcomes. California, North Carolina and Kentucky have evaluated state sponsored initiatives.

In the late 1970's, an increase in physicians refusing to accept Medi-Cal patients, coupled with increases in the number of Medi-Cal eligible and other pregnant women reporting difficulties in obtaining prenatal care, led to the development

of OB Access. The Obstetrical Access Pilot Project (OB Access) was piloted from 1979 until 1982 in 13 counties in California.

The project's goals were (1) to provide better access to comprehensive obstetrical services for Medi-Cal eligible mothers in areas with inadequate obstetrical care resulting from the lack of a resident obstetrician or from the decision of providers not to participate in Medic-Cal; and (2) to reduce the incidences of low birth weight, perinatal morbidity and perinatal and infant mortality. OB Access offered a specified maternity benefit package that included psychosocial and nutritional assessment and counselling, perinatal and parenting education and counselling, prenatal vitamins, laboratory tests and well baby exams, in addition to routine prenatal, intrapartum, postpartum care.

Two evaluations of the OB Access project were undertaken. Korenbrot (1984) evaluated the impact of OB Access for the 5244 participants who delivered between 1979 and 1982. A comparable group of Medi-Cal reimbursed clients who gave birth in 1978, was matched on race/ethnicity, age, parity, multiple gestation, infant sex and county of residence. Information was retrieved from OB Access records for project participants and from Vital Statistics record for the comparison group. The comparison group was chosen from women who gave birth in 1978, as this was the only year for which Medi-Cal indicators were available. There was only a slight reduction in the low birth rate for California from 1978 until 1982.

No information is provided regarding the similarity of the two study groups after the matching process. Adequacy of prenatal care and maternal complications were not included in the analysis. The overall rate of low birth

weight was 4.7% for OB Access participants and 7.1% for the matched comparison group. This 33% reduction was both clinically and statistically significant. The rate of very low birth weight was reduced 61% for OB Access infants (0.5%) compared with (1.3%) for matched comparison infants. Although the 61% reduction in the rate of very low birth weight would be considered clinically significant, the rates were very low in both groups of infants.

Lennie et al (1987) reevaluated the OB Access Project results for 2825 women who participated in the full package of OB Access services in order to determine program effectiveness. Full-care OB Access was defined by a minimum of 8 prenatal exams including a comprehensive initial exam, a psychosocial health education and nutritional needs assessment, at least one birth education class and prenatal vitamin supplements. Sociodemographic information was not provided for Full-care or remaining OB Access clients. This information would have been useful in determining if there were any differences in the two groups of OB Access mothers.

The rate of low birth weight was 3.1% for infants of Full-care OB Access mothers compared with 7.7% for infants of matched Medi-Cal cases. This 60% reduction in the rate of low birth weight was clinically and statistically significant. The rate of very low birth weights was more profound with only one infant (less than 0.1%) of Full-care OB Access mothers experiencing birth weight less than 1500 grams, compared with 1.3% of matched comparison group infants.

Although the OB Access studies made an effort to reduce self-selection bias by obtaining the comparison group from a time period prior to the introduction of project, they were prone to several methodological errors. Overmatching was a problem as the comparison group was matched to OB Access participants on six variables, instead of the recommended four variables. Overmatching would tend to decrease the differences between the groups and diminish the observed impact of the intervention. In addition, given that data were obtained from two data sources, systematic differences in recording could have occurred, introducing another source of bias into the results. The authors did not document the maternal characteristics of the study groups after matching, therefore it remains unclear if there were significant differences between the two groups of study participants. Thus, it was feasible that the results could have occurred due to confounding.

In 1984 the Guilford County Health Department in North Carolina piloted a comprehensive case managed prenatal care program for indigent women who were not receiving adequate prenatal services. This group of women did not receive Medicaid because their incomes were above the Medicaid limit. Buescher et al (1987) evaluated the effects of pilot program in1984 by comparing the live birth outcomes for 396 health department participants to 362 Medicaid eligible women who received traditional prenatal care from obstetricians.

The Guilford County health department provided a comprehensive, coordinated system of prenatal care. Each woman was evaluated on entry and an individual prenatal care plan developed. Special provisions were made to screen and educate women about preventing preterm labour. Health education, counseling and other health department services were also provided

for the women. Women at nutritional risk were referred to the WIC program, administered through the health department. Both study groups received intrapartum and post partum care in the same hospital.

Data was obtained from Vital Statistics and WIC records. A significantly greater proportion of the control group were single and black. Fewer health department participants received adequate prenatal care than controls. Further analysis revealed that health department participants started prenatal care later but obtained more visits than controls. Health department participants had a significantly (clinically and statistically) significantly lower rate of low birth weight than did controls, at 8.3% compared with 19.3%. The low birth rate among health department participants was only slightly higher than for the remaining Guilford county population at 7.1%. The program's success in preventing low birth weight was almost entirely through reducing preterm births rather than reductions in intrauterine growth retardation. The proportion of births that were term and low birth weight was similar for both groups. Women who didn't obtain an adequate quantity of prenatal care made the most significant gains in decreased low birth weight rates.

The authors appropriately used logistic regression analysis to determine the impact of comprehensive prenatal care (health department) on low birth weight, after controlling for the effects of race, marital status, WIC, quantity of prenatal care and other measured risk factors. Controls were on average twice a likely (RR=2.1) to have a low birth weight infant. Other characteristics with a strong, independent effect on the probability of a low birth weight infant were: multiple birth, inadequate prenatal care, WIC non-participation, single marital status, adolescence and previous poor obstetrical history.

The authors note that the respective low birth weight results could have been influenced by selection bias. Medicaid controls may have been more socioeconomically disadvantaged than health department participants as the income level for Medicaid in North Carolina was extremely low. There were also substantial differences between the two study groups with regard race and marital status that were not controlled in the analysis. These differences decrease the credibility of the findings.

The authors cleverly chose to address these concerns by examining a subset of study participants that had similar sociodemographic and economic backgrounds. They examined the birth results of 138 health department participants who were Medicaid eligible and compared them with other Medicaid women. The proportion of the health department subgroup that experienced low birth weight was significantly and clinically lower at 9.4% for health department participants compared with 19.4% for the comparison group. The authors concluded that a coordinated comprehensive approach to prenatal care was essential for women in poverty, and that the ancillary services of the health department program appear to be most beneficial among those women who start prenatal care late or have an insufficient number of visits.

In October 1987, in response to concerns over North Carolina's high infant mortality rate, and the preliminary results of the Guilford County pilot, the state Medicaid program (Baby Love Program) was expanded statewide to offer maternity care coordination services for women at 100% of Federal poverty level. In order to ensure that a comparison group of nonrecipients could be

obtained, the Baby Love Program was evaluated before the statewide system was fully developed.

Buescher et al (1991) examined all the Medicaid live births in 1988 and 1989 to evaluate the effect of the program. For the study years, live birth results were available for 15,526 Medicaid women who received coordinated care and 34,463 women who received traditional care. The authors compared birth outcomes for the two study groups overall, and by length of participation in coordinated care.

Women receiving coordinated care were slightly more likely to be black, single, less than 18 years and poorly educated. Due to large numbers of participants, these differences were statistically significant, though not clinically so. Other risk factors including poor obstetrical history, inadequate prenatal care, maternal complications of pregnancy and percentage of smokers were similar between the groups.

The authors found significant differences in all measured outcomes favoring women who received coordinated care. The rate of low birth weight rate was 8.7% among infants of coordinated care women compared with 10.5% for control infants; the rate of very low birth weight was 1.2% compared with 2.0 %; and the infant mortality rate was 9.9% compared with 12.2%. None of these differences appear to have been clinically significant.

In order to determine the direct impact of coordinated care, the authors once again utilized logistic regression analysis. They found that women who received standard care were 1.2 times as likely to have a low birth weight infant

than women who received coordinated care. Given this relative risk, the program can only be said to have had a modest impact on low birth weight. Although the effect on low birth weight was modest, the authors confirmed a positive financial value of coordinated prenatal care. For each $1.00 spent on coordinating services, Medicaid saved $2.02 in medical cost for infant up to 60 days of age.

Kentucky implemented a similar program to North Carolina's Baby Love Program for Medicaid eligible women in 1984. Using a similar study design, Buescher and Ward (1992) examined all Medicaid single live births in 1985 and 1986. Birth results were available for 4,978 women who received coordinated care through health departments and 18,083 women who received traditional care.

Results of the study were stratified by race. Black controls had slightly more sociodemographic risk factors for low birth weight than coordinated care recipients. There were no significant differences in maternal characteristics between the caucasian study participants. Regardless of race, significantly more coordinated care recipients obtained WIC benefits and received adequate prenatal care. The rate of low birth weight and very low birth weight was significantly lower for coordinated care recipients of both races. Caucasian coordinated care infants had rates of low birth weight and very low birth weight of 6.4% and 0.58% compared with 8.2% and 1.3% for traditional care infants. The rates were higher for black infants at 8.3% and 0.98 % for coordinated care infants compared with 11.7% and 1.87% for traditional care infants. Only the outcomes for black infants appear to have been clinically significant.

Results of the logistic regression analysis, controlling for selected risk factors, showed the relative risk of having a low birth weight infant for women who received traditional care was 1.26 for caucasians and 1.37 for blacks. The relative risks again indicate differential program impacts with blacks obtaining the most benefit from coordinated care.

Although six of the eight studies found statistically significant differences in the rates of low birth weight favoring comprehensive prenatal care participants, only three of these differences would be considered clinically significant. All five studies that examined very low birth weight found differences that were statistically significant. These results were questionable in three studies as the rates of very low birth weight were similar to population norms. It was impossible to determine if comprehensive care programs exerted their greatest impact on preventing preterm delivery or intrauterine growth retardation, as many studies examined only differences in low birth weight. The effect of comprehensive care on infant mortality appears more conclusive, as all three studies found statistically significant results.

Comprehensive prenatal programs appeared to have differential effects based on severity of risk. When results were stratified by race, black comprehensive care participants obtained clinically and statistically favorable low birth weight rates compared to non participants. Results of logistic regression analysis for blacks confirmed a moderately elevated relative risk for nonprogram participants. The effects of comprehensive care for white participants appear to have been modest at best.

In summary, although the comprehensive care studies were sufficiently large to have adequate power, there were a number of factors which may have affected how the above findings were interpreted. With one exception, all the major studies were susceptible to selection bias, and this would be a feasible alternative explanation for the findings. The use of vital statistics data limits the design and analysis. Many confounding variables, especially behavioral variables, were not collected in vital statistics data. Therefore, they could not be controlled in the analysis. Using vital statistics information also limited program measures mainly to birth outcomes, therefore the extent to which comprehensive programs effects were seen in other areas could not be measured. Both studies that utilized matching were prone to overmatching, potentially decreasing the differences between the groups, therefore negating the observed impact of comprehensive programs.

Multidisciplinary Provision - Small Programs

The examination of smaller studies can provide more detailed analysis of program impacts for both mothers and infants at birth and beyond. Six studies comparing the maternal and infant outcomes of women who received multidisciplinary comprehensive care have been reported. Two studies had very small sample sizes, less than 60 per group, and their results are not reported. Results of the remaining four are detailed here. One program enrolled low income women within a health maintenance organization, the other programs were adolescent focussed.

Ershoff et al (1983) reported the results of maternal behavioral changes and infant outcomes for low income women in and out of a health education

program in a health maintenance organization. All women presenting for prenatal care between December 1980 and March 1981 at Hawthorne Health Center who were English literate and less than 24 weeks gestation, received enhanced prenatal care that focussed on nutritional assessment, counselling and smoking cessation. Comparison group women, subject to the same inclusion criteria, were chosen from two groups; (1) a random sample of women who received prenatal service at Hawthorne Health Center in the four months preceding program initiation; or (2) a random sample of women who delivered in other facilities affiliated with the health maintenance organization (HMO). The comparison group received standard HMO prenatal care that included medical care and optional health education programs.

Study results were presented for a subpopulation of women who were smoking on initiation of prenatal care; 57 program participants and 72 controls. The program participants were at greater sociodemographic risk, as a greater proportion were black or hispanic, less educated and poor. Significantly more program participants decreased cigarette consumption, ceased smoking and attained adequate weight gain than did controls. Adequacy of prenatal care was not reported. There was a large birth weight difference with program participant infants weighing on average 170 grams more than control infants. Program participant infants obtained a 28% reduction in low birth rate, 7.0% compared with 9.7% for control infants. Although this result was not statistically significant, likely due to small sample size, the result was clinically significant. When low birth weight was analyzed according to intrauterine growth retardation and preterm birth, most of the difference was due to reductions in the rate of preterm birth as 1.7% of program infants were born preterm versus 6.9% of control infants. The 75% reduction was clinically

significant. The program results were somewhat unexpected as the intervention did not include preterm labour prevention or education. There is general agreement in the literature, that enhanced weight gain and smoking reduction influence have the largest impact on intrauterine growth retardation not preterm birth.

This evaluation was particularly useful as it controlled for smoking, the confounding variable with the biggest impact on infant birth weight. However, as the analysis was not stratified according to differences in maternal demographic variables, other variables may have confounded the results. In addition, both groups of study participants had access to educational and nutritional counseling, therefore both groups may have received enhanced care. Lack of adequate power due to small sample size may have led to the statistically nonsignificant results.

Smith et al (1978) conducted a case-control study to evaluate the impact of an ongoing comprehensive, multidisciplinary, psycho-social educational program on the medical outcome of pregnant indigent adolescents. One hundred and twenty six (126) program adolescents who delivered between 1970 and 1974 were matched to 126 controls based on age, parity, race and month of delivery.

Coincident with routine obstetrical examinations, program adolescents attended weekly classes on nutrition, contraception, child development, labour preparation, and psychosocial aspects of pregnancy, presented by a multidisciplinary team. Adolescents who attended at least two sessions were included in the analysis. Controls received standard prenatal care.

Although program adolescents obtained statistically significantly more prenatal care visits (6.3) than controls (5.1), this difference was not clinically significant. Program adolescents had significantly fewer prenatal and intrapartum complications, and were more likely to return for postpartum exams than were controls. Infants of program mothers were significantly heavier than control infants, on average 164 grams. Low birth weight and preterm birth rates were not provided. Differential program effects were also found, program adolescents less than 16 years had infants of significantly higher birth weights and better apgar scores than young adolescent controls. The number of young adolescents (less than 16 years) was not reported.

Elster et al (1987) compared maternal, infant and parenting results for 125 adolescents who received care from a comprehensive pregnancy and parenthood program between January 1983 and July 1984, with 135 adolescents who received care from community health providers.

The Teen Mother and Child Program (TMCP) provided routine medical care, pregnancy education, psychosocial, nutritional and financial counseling, infant health education and parenting skills. TMCP participants and controls were eligible for the study if they were less than 19 years of age, English speaking, and free from major chronic diseases. Both groups were also eligible for supplemental food coupons through the local WIC program.

Prenatal, labour and delivery, and infant data were obtained from hospital record abstraction. Subjects were interviewed at home during scheduled intervals for 26 months post delivery to ascertain child health and parenting data.

The two groups were similar with regard to most demographic, behavioral, medical variables and psychosocial adjustment scores. TMCP adolescents differed from controls by coming from families with somewhat higher socioeconomic status, and they were more likely to currently be attending school, have completed school or be employed at the time of conception. Although significantly less TMCP adolescents began prenatal care in the first trimester, 33% compared to 46% of controls, a significantly greater proportion of TMCP adolescents obtained the expected number of prenatal visits, 87% versus 70%. The rates of maternal complications were similar between the two groups with one exception, TMCP adolescents had a significantly increased rate of treated pregnancy induced hypertension. This may however, been due to closer monitoring of TMCP adolescents.

There were no statistically significant differences between the two groups with regard to infant outcomes. However, 7% of TMCP infants were born preterm compared to 10% of controls. This 30% reduction was clinically significant. Using log-linear analysis to account for differences in socioeconomic status and vocational educational status, the data was reevaluated. All maternal outcomes excluding the rate of pregnancy induced hypertension remained significant.

The authors suggest that although the comprehensive program did not impact birth outcomes, it had a significant effect on events that occurred during the first two postpartum years. At 12 and 26 months postpartum, TPCP adolescents scored significantly better on composite measures encompassing medical, psychosocial and parenting events than did the control group, even after accounting for possible confounding factors.

This study was both well designed and analyzed. The authors chose a novel way of attempting to reduce selection bias by examining the psychological (and motivational) status of study participants. A thorough examination of maternal and infant outcomes were conducted, and differences between the study groups were controlled in the analysis. Perhaps most importantly, the authors documented the longterm impacts of the program. Lack of statistically significant infant results may have been due to lack of power versus lack of program effects.

Kay et al (1991) conducted an effectiveness evaluation for adolescents who attended the Young Adults' Health Center (YAHC) between January 1981-June 1988. One hundred and eighty (180) YAHC clients were matched to 180 control adolescents based on age and year of delivery. Both study groups obtained at least three prenatal care visits and delivered at the same hospital. With a sample size of 180 per group the authors concluded that study had 90% power to detect a 125 gram difference in birth weight.

The study groups were similar with regard to medical and sociodemographic backgrounds. YAHC clients obtained significantly more prenatal care visits (12.8) compared with their matched controls (9.8). Significantly more YAHC clients reduced or stopped smoking during their pregnancy (27.6%) than did controls (9.5%). There was no difference in the rate of maternal complications between the two groups.

Analysis of variance and covariance was used to compare the pregnancy outcomes of the two study groups. Maternal age, race, insurance coverage, and

smoking status were adjusted for each dependant variable. After adjustment, there were no statistically significant differences in birth weight, gestational age, neonatal intensive care admission, infant morbidity, Apgar scores or rates of low birth weight and preterm birth between the study groups. However, the rate of low birth weight was 15.5% for YAHC clients compared to 10.8% for controls. This 30% difference was clinically significant. Postpartum, program adolescents were more likely to use contraceptives and less likely to become pregnant again after delivery.

This case control study also employed a good design and analysis. Although the authors stated the sample size had adequate power to detect a 125 gram difference in birth weight, it is doubtful that it had adequate power to detect small differences in rates of low birth weight. Again, nonsignificant results may have been due to power issues rather than lack of program effects.

In summary, all four small comprehensive care studies were consistent in finding that women who participated in comprehensive care obtained both clinically and statistically significantly more prenatal care. They were able to show that participants in comprehensive programs smoked less and gained more weight than did controls. The impact of these changes on infant outcomes were mixed. Two studies found significant birth weight differences favoring comprehensive program participants, especially young adolescents, but none found the rate of low birth weight to be significantly reduced for program infants. However, it was doubtful that any of the studies had sufficient sample sizes, thus power to detect differences in adverse pregnancy outcomes including low birth weight, preterm birth and intrauterine growth retardation. Perhaps more importantly, both studies examining maternal

behaviors postpartum found program effects for medical, psychosocial and parenting outcomes.

Case Management

In programs that employed case management, one caregiver, generally a Nurse-Midwife was responsible for planning and reviewing care plans after every client appointment. Case managers either worked in conjunction with multidisciplinary teams or referred clients to ancillary service providers when need arose. Two randomized trials evaluated the effects of case managed care for low income women. Seven case-control studies evaluated the effects of case managed care for adolescents. The results of four case-control studies are detailed here as the remainder had small sample sizes, less than 60 per group.

In a multicenter trial Heins et al (1990) randomized 1458 women at high risk for low birth weight or preterm birth between July 1983 and October 1987. Women were eligible for randomization if they had a score of 10 points or more on their first visit using the risk screening tool developed by Papiernik-Berkhauer (1980) and modified by Creasy et al (1980). In addition, women with a previous history of low birth weight were eligible. Women were excluded from the trial if they had a history of medical or pregnancy complications or multiple pregnancy. The authors determined that the trial had a 90% chance of detecting a statistically significant decrease in the rate of low birth weight from 13% to 8%.

Women randomized into the intervention group received case-managed care from nurse-midwives. Controls received standard care for high-risk pregnancies from obstetricians. Women in the intervention group were seen

every 1-2 weeks throughout their pregnancy and were assessed with regard to lifestyle modification, nutritional attainment, social support, activity level and if required they were taught preterm labour signs and symptoms, uterine palpation and activity restrictions. Care plan modification and referral as required occurred at each meeting. Women in the control group received standard prenatal care from obstetricians, with less emphasis on personal life style issues and individualized social support. They were seen less frequently for prenatal visits and received cervical examinations only if symptoms of preterm labour appeared. Both groups of women had access to the WIC.program, nutritionists, and public health nurses.

Comparability was achieved between the two groups in terms of sociodemographic variables risk scores, smoking and clinic site. There was no statistical or clinical difference in smoking cessation rates between intervention and control groups. There was no statistical difference in initiation of prenatal care. Very few study participants began care in the first trimester, almost half of each group initiated care after 20 weeks gestation. Information on the number of prenatal visits obtained was not provided.

Infants of intervention mothers had slightly lower rates of low birth weight, very low birth weight, preterm birth and very preterm birth. None of the results were statistically or clinically significant. The rates of adverse pregnancy outcomes remained extremely high in both groups. Subgroup analyses were performed to assess whether the overall non-significant results were obscuring subgroup differences. Program effects were shown for infants of black women with high risk scores. The rate of very low birth weight was 2.6% for black intervention infants compared with 6.7% for black controls.

In spite of the excellent design format, the trial fell short in several areas. Both study groups tended to initiate prenatal care late in their pregnancies. Therefore, the lack of program results may have been confounded by this factor. Lack of program results may also have occurred because the two study groups may have received very similar care. Both groups of women had access to WIC, nutritional counseling and public health nursing services. Although the intervention group was seen at regular intervals, there was no way to ascertain that frequent contact did not occur for controls. Thus, the results could have been contaminated by increased intervention among the control group. Limited infant outcome information was another issue. By failing to provide information on intrauterine growth retardation, it was impossible to determine what proportion of low birth weight was attributed to this outcome. Given that smoking cessation and enhanced nutrition generally effect infant weight gain during each week of gestation, this outcome measure would have assisted in determining true program impacts.

McLaughlin et al (1992) randomized 428 low income women into a comprehensive prenatal care program. Women qualified for the program by being less than 28 weeks gestation and having a high risk score for child maltreatment. The program was designed to test the effects of comprehensive care on birth weight, child development and child maltreatment.

The comprehensive care group received prenatal care provided by a multidisciplinary team of nurse-midwives, social workers, nutritionists, paraprofessional home visitors, and a psychologist. The team focussed on psychosocial support for mothers, education about self-care and promotion of

healthy behaviors during pregnancy. Comprehensive care mothers were offered individual meetings with the psychologist until they reached 28 weeks gestation, then they attended prenatal support groups led by the psychologist. The comparison group received standard prenatal care by obstetrical residents. Both study groups delivered in the same hospital.

The randomization process succeeded in producing similar sociodemographic groups. Birth results were available for 308 women. Infants of comprehensive care mothers weighed on average 84 grams heavier than infants in the comparison group. This difference was not clinically or statistically significant. When stratified by parity, significant program effects on birth weight were seen for primiparous women. Intervention infants of primiparous mothers averaged 144 grams heavier than infants of primiparous controls, a modest difference. Comprehensive prenatal care did not result in significant differences in the rate of low birth weight for intervention infants as a whole, or for primiparas and multiparas separately.

Multiple regression analysis using treatment group, race and age groupings showed no effect of intervention for the overall sample. A similar analysis of variance was performed based on parity. For primiparous mothers, standard care and maternal age were strong predictors of low birth weight. There were no predictor variables for multiparous mothers.

Once again, although the analytical design was excellent, the analysis was scanty. The authors failed to include maternal outcomes that would have enhanced the results. As the cutoff for entry into the trial was late (up to 28 weeks), and no information was provided on initiation of care, nonsignificant

results could have been due to late entry effects rather than lack of program effects. No information was provided on maternal behavioral change, or prenatal care as a proxy for this. Therefore it is feasible to question if the intervention did not succeed because women did not attend. By only providing infant outcomes, the analysis was severely limited.

La Guardia et al (1989) examined the impact of intensive social services, behavior modification and pregnancy education provided in a sheltered environment, on the incidence of low birth weight among indigent urban adolescents between 1984 and 1986. One hundred and twelve (112) adolescents who lived in, and received care from a maternity shelter were compared with 113 adolescents who lived at home. Both groups of adolescents received medical care services from the same provider. Inclusion criteria other than maternal age less than 19 years at conception, were not stated.

The two study groups had dissimilar backgrounds. Controls were slightly older and more likely to smoke. A significantly greater proportion of intervention adolescents were of minority status, primiparous, single and poor. Intervention adolescents registered on average a month later for prenatal care. There were no differences in weight gain, prenatal complications or intrapartum courses between the two groups. Information on adequacy of prenatal care or number of prenatal visits was not provided. Intervention infants were only slightly heavier than controls, the average difference being 40 grams. There were no group differences in the rates of low birth weight infants. However, intervention infants were significantly less likely to be preterm and low birth weight (2.6%) than were controls (9.7%). This difference was clinically significant.The validity of the findings has been confounded by failure to

account for differences in maternal risk factors, especially smoking, in either the design or analysis.

Using a case-control format, Hardy et al (1987) assessed the impact of the Johns Hopkins Adolescent Pregnancy Program (JHAPP) over a six year period from 1876 to 1981. Adolescents in the JHAPP participated in a case managed, comprehensive program of care. Controls were chosen from adolescent women who participated in other Hopkins programs and received standard prenatal care. The program was limited to adolescents less than 18 years of age at the time of conception.

The JHAPP consisted of a defined program of medical care, prenatal and infant care education, behavioral lifestyle assessment, psychosocial support services, and community referral. A multidisciplinary team approach coordinated by an individual case management system was employed by the program. Weekly team meetings and chart review after each visit enabled the JHAPP to monitor appropriateness of care and plan for future needs.

Due to difficulties in ensuring an appropriate control group for the first years of the study, the results were divided into two 3 year blocks from 1976-1978 and 1979-1981. In the first block, results were provided for 930 JHAPP participants and 2028 controls. Program participants were predominantly black, single and on social assistance. Controls differed somewhat by being older, less likely to be black and twice as likely to be multiparas. Results showed that JHAPP experienced significantly less maternal complications. However, the rates of low birth weight, preterm birth and perinatal death were similar for both groups. Stratified analysis based on maternal age showed a program effect for

adolescents less than 15 years at delivery. Program adolescents experienced significantly less maternal complications, low birth weight infants and preterm births.

For the block 1979-1981 controls were matched to program participants according to: age at delivery; educational attainment; obstetrical history; prepregnancy weight and length of gestation at first prenatal visit. Maternal and infant outcomes for the entire group, stratified by age and length of time in the program were reported for 744 program participants and 744 controls. The matching strategy produced groups that had very similar sociodemographic backgrounds. The proportion of smokers was similar in both groups. Program participants had significantly better pregnancies, they gained on average five more pounds than controls; attended on average 0.5 more prenatal visits, and experienced a 30% reduction in anemia and a 40% reduction in preeclampsia. With the exception of number of prenatal visits, these differences were also clinically significant.

JHAPP infants were only slightly larger than control infants, on average 45 grams heavier. They had significantly better rates of low birth weight and very low birth weight than controls at 9.9% versus 16.4% and 1.9% versus 3.9% respectively. The rate of preterm birth was lower among program participants, but was not statistically or clinically significant. Differential program effects based on maternal age were reported. Both nulliparous and multiparous adolescents less than 16 years of age had, on average, the largest infants and the lowest frequency of low birth weight. Differential program effects based on length of contact with the program were also reported. Adolescents who entered the program during their first trimester gained on average six (6)

pounds more prior than controls. However, this additional weight gain was not transferred to their infants who averaged only 64 grams heavier.

This was an excellent case-control study that appropriately controlled differences in study groups through the design, and conducted a thorough analysis of available data. By matching on five maternal variables, the study groups were perhaps overmatched, diminishing the observed impact of the intervention.

Piechnik and Corbett (1985) analyzed infant results for the Adolescent Obstetric Clinic (AOC) over a five year period 1974-1978, using a case-control analysis. Adolescents who participated in the AOC were cared for by a multidisciplinary team featuring nurse-midwife managed care. Adolescents less than 18 years of age without serious medical or obstetrical complications were eligible for the program. Adolescents, subject to the same inclusion criteria, who received standard prenatal care.comprised the control group. Comprehensive care included prenatal screening and management, patient education, psychosocial evaluation and counseling, nutritional assessment and counselling, intrapartum care and postpartum followup.

Results were reported on 738 AOC participants and 2018 controls. Program participants were predominantly black, single, and on social assistance. More controls were older, caucasian and married. Age and race were controlled in the analysis. The authors state that marital status was not controlled because it was not identified as a factor affecting pregnancy outcome among adolescents. There was both a statistically and clinically significant difference in the overall rate of low birth weight between infants of AOC participants (9.2%) and infants

of controls (12.7%). When stratified by age this difference remained significant. When stratified by race, the low birth weight remained significant for blacks of all ages. The greatest program impact was found in young black adolescents. For young black AOC participants (<15 years) the rate of low birth weight was 10.9% compared with 22.3% for control infants. For the older age group (15-17 years) the rate of low birth weight was 10.2% and 13.6% respectively.

The measured level of significance varied throughout the analyses from 0.1 to 0.15. When this author reanalyzed the results using the more common level of significance of 0.05, program impacts were only significant for blacks less than 15 years of age.

Once again, the impact of case-managed comprehensive prenatal care on infant outcomes was somewhat mixed. Results from the two randomized trials suggested that comprehensive care did not have a significant impact on improved infant outcomes overall. However, these findings should be viewed with caution, in one trial the study groups received similar interventions, in the other trial, serious omissions clouded the results. Results of the two large case-control studies found significant differences in the rates of low birth weight favoring comprehensive care infants. All studies that examined subgroups at risk found significant differences in infant outcomes favoring women at greatest risk. Generally, significant program effects were documented for young adolescents (less than 16 years), black women and primiparous women. Only one of the randomized trials and two of the case-control studies had adequate power to detect differences in rates of low birth weight. Again, the case-control studies were subject to selection bias and in some studies lack of control over confounding variables

Home Visitation

The results of 7 randomized trials and 1 retrospective case-control study of prenatal interventions, which included home visits supplemental to prenatal care, were reviewed. Four randomized trials focussed primarily on enhancing social support through home visitation, while other components of comprehensive care were not actively reinforced[4] . In three randomized trials[5] and the case-control study[6] , home visitors actively intervened and reinforced all aspects of comprehensive prenatal care.

The South Manchester Family Worker Project (SMFWP) randomized 1227 women at risk for low birth weight between 1982 and 1985 (Spencer et al, 1989). The authors stated that "The project aimed to provide additional social support to pregnant women at above average risk of giving birth to a low birth weight infant. It was intended that this support would reduce the level of stress, thereby improving the well-being of the pregnant women and ultimately the health of their babies" (Spencer, et al., 1989, pg. 281). Women presenting for routine prenatal care who were less than 20 weeks gestation and identified at risk for having a low birth weight infant, via a sociodemographic and obstetrical screening tool[7], were included in the trial. The authors estimated that the study had a 76% chance of detecting a difference in birth weight of 77 grams.

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[4] Spenser et al, Oakley et al, Bryce et al, Dawson et al.
[5] Olds et al, Graham et al and Villar et al.
[6] Polland et al.
[7] Screening tool documented on page 283.

The family workers, were lay women with no formal qualifications in health care or social services. They visited each client once or twice a week and assisted with a variety of tasks including child care, shopping, promotion of health/social services and assisted with housing and state benefit obtainments. Of the women randomized into the intervention group, only 41.4% utilized the services of a family worker. The analysis was based on an intention to treat principle, therefore all women randomized into the intervention group were included in the study results.

The two study groups were almost identical in terms of infant outcomes. There was very small difference in birth weight between the groups, intervention infants were on average 35 grams lighter than controls. The differences in rates of low birth weight, small for gestational age and preterm birth were neither clinically not statistically different. When results were reanalyzed using only women who accepted a family worker as the intervention group the results remained nonsignificant. A subgroup analysis of primigravid adolescents showed differences in the rate of low birth weight and preterm birth, favoring program infants, but the differences were not statistically or clinically significant. The size of this subgroup was not large enough to constitute a powerful test of these outcomes.

Study design likely contributed to nonsignificant results. Although the aim of the project was to enhance social support, there was no measure of psychological support in the entry criteria. Given the fact that only 41% of the intervention group received the intervention, it is likely that the study did not adequately target those most likely to benefit. The study may also have been hampered by a very limited interpretation of social support. The study design

appears to have interpreted assistance with household maintenance as some form of psychological support. The rationale for this has not been identified. As home visitors were actively discouraged from reinforcing any aspect of prenatal care, it is doubtful that this intervention could be called social support.

Oakley et al (1990) randomized 509 women with a history of low birth weight infants to receive either, a social support intervention from midwives in addition to standard antenatal care or standard antenatal care. Social support intervention consisted of a "minimum package" of three home visits plus two telephone contacts. Midwives provided a listening service for the women to discuss any topic of concern to them, gave practical information and advice when asked, and carried out referrals to other health professionals and agencies.

Virtually all the intervention mothers obtained at least one home visit, 92% of them received at least three visits. Both groups obtained a similar number of prenatal care visits. Control mothers experienced significantly more hospitalizations during pregnancy than intervention mothers. They also received more interventions during labour and delivery. Postnatally, intervention mothers reported less anxiety regarding parenting and infant health.

There was virtually no clinical or statistical differences between the two study groups in any measure of infant outcome. Intervention infants on average weighed 38 grams more than control infants. The rates of low birth weight and preterm birth were extremely high in both groups. Slightly fewer intervention infants required additional postnatal care.

This trial appears to have been prone to design problems that may have limited the impact of the intervention. Firstly, the level of psychological support was not addressed in the entry criteria. Therefore the psychological risk status and the need for social support remains unknown. Secondly, there does not appear to be very much difference between the two groups with regard to prenatal care. The only difference being social support. Even though 90% of the intervention group received 3 or more home visits, they would have been seen on average every two months. It is doubtful that this level of servicing would significantly affect social support, maternal health or infant outcomes. Thirdly, the study was constrained by a very narrow definition of social support. Midwives acted as confidants but were quite restricted in their ability to reinforce prenatal care. Finally, it was doubtful that the trial had adequate power to detect differences in the rate of preterm birth or low birth weight.

Bryce et al (1991) randomized 1970 women between October 1984 and December 1987. Women were eligible for the program if they had previously experienced one or more poor obstetrical outcomes[8]. Women were excluded if they were non-English speaking; previously had been enrolled in the trial; were more than 25 weeks gestation or were carrying a dead fetus. The program group was offered additional social support by a trained midwife and routine prenatal care, the control group was offered routine prenatal care. The authors conclude that the trial had a 60% chance of detecting a true reduction in preterm birth by 25%.

Home visits were scheduled every 4-6 weeks by the midwife, who acted as confidant and listener. Antenatal care, advice and information were provided

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[8] Poor obstetrical outcome included: previous LBW infant or PD; one or more perinatal deaths; three or more first trimester miscarriages; one or more second trimester miscarriages; or antepartum haemorrhage in a previous pregnancy.

to program participants only on request. Ninety percent (90%) of the women in the program group accepted the intervention, and 80% obtained at least one home visit. Program infants experienced a nonsignificant overall reduction in preterm birth, 12.8% compared with 14.9%. However, significantly more extremely preterm infants (20-27 weeks gestation) were born in the program group (2.8%) compared with the control group (1.4%). Given the small number of infant born extremely preterm, this result could have occurred due to chance. The rate of low birth weight was virtually the same between the groups. Subgroup analysis showed a program effect only for women in the highest socioeconomic class. No program effect was apparent for women with limited existing social support. Post hoc stratification indicated a positive program effect for women with a history of previous preterm singleton births.

This trial was also prone to design errors. Like the previous two trials, psychosocial risk status was not an entry criterion for an intervention that focussed on providing psychosocial support. Therefore the intervention could have targeted the wrong group. Once again, there did not appear to be tangible differences between the prenatal care received by the two groups, as midwives were restricted from reinforcing prenatal care. It remains unclear what proportion of the intervention group received more than one home visits, therefore the level/intensity of servicing could not be assessed. Although the program appeared to be more effective for women of high socioeconomic status, it is not known if other variables not controlled in the analysis could hgave been responsible for this.

In a small trial, Dawson et al (1991) randomized 170 low income women between July 1977 and March 1978. Women were eligible for the trial if they

were expecting their first or second child, 20-26 weeks pregnant, at least 16 years of age, and could speak English. Women were not selected for psychosocial risk. Women were stratified by race and parity and randomized according to race-parity subgroups.

Women in the intervention group were offered the services of a paraprofessional home visitor in addition to routine prenatal care. The home visitors provided emotional support, transport, household assistance, emotional guidance and responded to questions regarding pregnancy, nutrition and health behaviors. Health and health services were a minor component of home visits. Control mothers received prenatal care that including social and nutritional services and occasional home visits by public health nurses. Thus, the difference between.the two study groups was the mainly the provision of paraprofessional home visitors.

Ninety-two percent (92%) of intervention mothers accepted the intervention, and 90% of the intervention group had at least two months of home visits prenatally. There was no difference between the intervention and control groups in obstetrical or intrapartum complications. Infant data were analyzed with Kruskal-Wallis and Mann-Whitney tests because they were not normally distributed. There was no statistical difference between the two groups of infants with regard to gestational age, birth weight, or preterm birth. However, 4% of intervention infants experienced preterm birth compared with 12.5% of controls. This 3 fold difference was clinically significant. The proportion of infants with low birth weights was not reported.

The non significant results may alternatively be explained by issues of study design and power. Again, psychosocial risk was not a criterion for entry in the study, increasing the speculation about the appropriateness of the intervention. Although 90% of the intervention group received two months of home visits, it is not clear how often these visits occurred. The intensity of servicing, as a result of study design, may not have been sufficient to effect maternal health and infant outcomes. Although the study results indicated a nonsignificant preterm birth rate, 4% of intervention infants and 12.5% of control infants experienced preterm birth. This nonsignificant result may have been due to inadequate power rather than lack of program effect.

Olds et al (1988) randomized 400 women into a comprehensive program of prenatal and postnatal nurse home visits between April 1978 and September 1980. Primiparous women less than 25 weeks gestation were eligible for the program if they were 18 years old or younger, single, or of low socioeconomic status. The program aimed at improving the outcomes of pregnancy, early childrearing, and life-course development. Intervention women received home visits every 1-2 weeks during pregnancy and care focused on pregnancy and parent education, behavior modification, enhancement of informal support systems and linkage with community services. All women randomized into the intervention group participated in the program. The control group received traditional medical prenatal care and well child visits.

Participation in the program was significantly associated with a wide range of positive maternal effects. By the end of the pregnancy intervention women were significantly different from control women: they had utilized more community services; attended more prenatal care classes; made greater lifestyle

modifications; increased their reliance on social supports; and experienced less kidney infections

However, these improvements were not transferred to their infants. There were no clinical or statistical differences in birth weight or rates of low birth weight or preterm birth between intervention and controls overall. However, subgroup analyses showed positive program effects for young adolescents (14-16 years) and smokers. In contrast to the control group, infants born to young adolescents were significantly heavier, weighing on average 395 grams more. There were no low birth weight or preterm birth infants among the intervention young adolescents[9], compared with 11.8% of the infants of young control adolescents. Program smokers experienced a significantly lower percentage of preterm birth at 2.1% compared with 9.8% for controls. Postpartum followup showed program participants were less anxious about parenting, used less restrictive and punishing behaviors and provided more educative and stimulating toys for their infants. Infants of program participants had significantly better mental development at 12 and 24 months postpartum. This excellent trial was able to clearly show both short term and longterm outcomes for mothers and infants.

The Latin American Network for Perinatal and Reproductive Research conducted a randomized trial of home visitations at four centers in Argentina, Brazil, Cuba and Mexico between January 1989 and March 1991 (Villar et al, 1992). Women were included in the trial if they had one or more

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[9] Had the authors chosen to evoke the 'Rule of Three's" by substituting 3 (the upper 95th confidence limit for a null value) for the null value, 10.7% of the intervention infants would have been born preterm and low birth weights. Therefore, there would have been no clinical or statistical difference between the intervention and control infants for these outcome measures.

sociodemograhic or physical risk factors[10] for delivering a low birth weight infant. Women who met the criteria, were less than 23 weeks gestation and had no history of major mental illness, cervical celclage or Rh isoimmunization were recruited.

A total of 2235 women participated in the study. Women in the intervention group received four to six home visits, about one a month, from a social worker or nurse. In addition to the provision of direct emotional support, the home visitor was actively involved in education and counselling regarding medical recommendations, nutrition and health behaviors. The control group received standard prenatal care.

Eighty three percent (83%) of the women assigned to the intervention group received at least four home visits, and 90% were visited at least once. Study results were recorded according to intention to treat principle, therefore results were reported on all women randomized to the intervention group. Intervention women had significantly greater prenatal care knowledge and reduced their smoking consumption more than did controls. Both groups experienced a similar number of prenatal care visits. No clinical or statistical differences were observed between the groups overall in rates of maternal and neonatal morbidity, low birth weight, preterm birth and intrauterine growth retardation, length of stay and postnatal hospitalization. Stratified analysis based on demographic risk factors, psychological distress and study site were conducted. Program effects were seen for women with pshychological risks. Infants of women with high base line levels of psychological distress and low

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[10] Risk factors included: previous LBW infant or PD; previous fetal or infant death; age <19 years; body weight <51kg; low family income; less than 3 years of school; cigarette or alcohol consumption; or single parenthood.

levels of social support had consistently lower rates of low birth weight, preterm birth and intrauterine growth retardation, though not significantly so. The remaining stratified analyses revealed no trends and were not clinically or statistically significant.

Several limitations on the methods Villar et al., may have precluded a fair test of the hypothesis that social support was not beneficial during high risk pregnancies. First, the selection criteria may not have been adequate to determine a high risk group, as the rate of low birth weight in controls (9.4%) was similar to the unselected population rate of 10.6% for Mexico city (Barros, 1992). Second, it would appear that the providers of social support had no previous close relationship with the recipients. To be effective, social support may have to be provided by persons with whom the recipients have had time to develop a relationship. Third, the providers saw the women roughly once a month during the intervention, which may have been insufficient to provide meaningful social support.

In a small trial, Graham et al (1992) randomized 154 high risk, low income women between March 1987 and September 1989. Women who were between 17 and 28 weeks gestation, who had a low family function score, and had experienced at least one stressful life event prior to registration were eligible for the intervention. Other risk factors included smoking, low maternal weight-height ratio, maternal age over 27 or previous preterm birth. The goal of the program was to strengthen intrafamilial and interpersonal support systems of the women. Prenatal care utilization and low birth weight were the outcomes of interest.

Both the experimental and the control group received routine prenatal care. The experimental group also received home intervention from trained peers, that provided psychosocial support, nutritional education, prenatal care and childbirth education, lifestyle health risk education and community service referral. Sixty three percent (63%) of the experimental group obtained four home visits, 74% obtained at least one home visit.

Rates of prenatal care utilization indicated that women in the experimental group, regardless of the number of home visits, had significantly more prenatal visits than those in the control group. Women who obtained at least four home visits had a lower rate of low birth weight than those who obtained only one visit. However, the difference was not clinically or statistically significant.

Study design may have contributed to the nonsignificant infant results. Although women could enter the trial between 17 and 28 weeks gestation, information on when they entered was not provided. With such a late cutoff, sufficient time may not have been available for social support to affect maternal behavior. In addition, as the number of home visits were limited to 4, the program may have lacked intensity to effect change. One of the weaknesses of the program was the limited involvement of family support persons, therefore the home visitor could do very little to influence familial support. Although the authors contend they had adequate power to detect a 15% absolute reduction in low birth weight, their estimates may have been overly liberal, and the sample size too small.

Polland et al (1992) reported the results of The Maternal Child Health Advocate (MCHA) case-control study to assess the effectiveness of paraprofessional

advocate services on participation in prenatal care and infant birthweight. One hundred and eleven (111) low income black women who received three or more advocate contacts and delivered singleton births were matched to 111 women from the same prenatal clinic who received traditional prenatal care. Advocates were peers of similar educational background and ethnicity who counselled and assisted pregnant women with health and social service referrals, housing, shopping, transportation and other basic necessities.

Matching criteria included trimester of prenatal care initiation; parity and race. Results of the match indicate that the comparison group was slightly more advantaged sociodemographically than were program participants. Results of the analysis indicated program effects for both prenatal care participation and birth weight. Program participants obtained more prenatal visits than did their comparison group with an average of 8.0 visits versus 6.5 visits. The difference was both clinically and statistically significant. Although the authors found a statistically significant difference in birth weight favoring program infants, the 148 grams average difference was modest. The rates of low birth weight and preterm birth were not included. The effects of the intensity of advocate contact on amount of prenatal care and birthweight were examined by stepwise linear multiple regression within the program group. Intensity of advocate contact was the only predictor variable significantly associated with prenatal care participation. No predictor variable contributed significantly to birthweight.

Self selection may bias limits the findings, as the study did not use a randomized design. Although program participants were more likely to be socially disadvantaged, by virtue of participating in an intervention program, they may have been motivationally advantaged. This confounder among

many others may have complicated the results. Power calculations were not included in the results, but with the small sample size, the power was likely not sufficient to rule out chance as an alternate explanation of the results.

The results of comprehensive programs that included home visits, once again found that women who participated in comprehensive prenatal care improved their health habits by reducing their smoking consumption and increasing their weight gain compared to nonparticipants. In general, significantly more women in comprehensive care obtained the expected number of prenatal visits for length of gestation when compared to nonparticipants. In general, the improvement in maternal health habits, as measured by increased prenatal visits, did not however lead to overall improvements in infant outcomes. A few studies found that comprehensive care participants had significantly heavier infants than non participants, however, the difference from a clinical perspective was modest. All seven randomized trials of home visitation failed to demonstrate significant effects on low birth weight, preterm birth or other infant outcomes. Of the five randomized trials with sufficient power, three detected program effects for high risk subgroups; primigravid adolescents, young adolescents, smokers and women with high baseline psychological distress or low levels of social support.

In summary, the lack of significant differences in overall rates of adverse outcomes for comprehensive care participants who received home visitation interventions could possibly be explained by design issues. In general the aim of home visitation programs was to provide additional social, educational, and home support to women and their families. The hypothesis being that women who feel supported would engage in healthy behaviors, and this would lead to

healthy infant outcomes. With the exception of one or two trials, the study designs were seriously flawed. They failed to utilize measures of psychological risk in their entry criteria, leading to speculation about the appropriateness of the target group. Lack of acceptance of the intervention, infrequent contact and lack of involvement of family supports characterized all but two trials. Four trials defined enhanced care so narrowly that there was virtually no difference between the intervention and control group. The one trial that provided an excellent design did find subgroup program effects.

CONCLUSION

When compared to standard prenatal care, comprehensive care for socially disadvantaged women has been shown to be effective in assisting women to make lifestyle behavioral changes. There was some evidence to show that comprehensive care participants were more successful in reducing or quitting smoking, improving their nutritional status and in gaining adequate weight. Comprehensive care also facilitated participants ability to make appropriate use of community resources, especially WIC.

When initiation of prenatal care, number of prenatal visits and/or adequacy of prenatal care[11] were analyzed as a proxy for maternal behavior, mixed results were found in the literature. In general, both comprehensive care participants and nonparticipants initiated prenatal care during their second trimester of pregnancy. As many measures of prenatal care adequacy depend on first trimester initiation of prenatal care, very few comprehensive care participants or nonparticipants obtained adequate care. The effectiveness of comprehensive

[11] As measured most commonly by Kessner's Prenatal Care Index.

prenatal programs tended to be shown in differences in the number of prenatal visits between participants and nonparticipants. Published studies tended to find that women in comprehensive care obtained significantly more prenatal visits, even when they came later in their pregnancies.

Conclusions were harder to draw with respect to the effects of comprehensive care on birth outcomes. Randomized trials that examined program efficacy found no overall program effects for low birth weight or preterm delivery. The reason for the nonsignificant infant results in many of the trials could quite possibly be accounted for by poor study designs. Only two trials utilized appropriate design, however, they tended to have small sample sizes. In spite of the overall nonsignificant results, many trials found favorable program effects for subgroups of women at increased risk of adverse pregnancy outcomes. Primiparous women, young adolescents (less than 19 years), and blacks were the most commonly reported groups for whom program effects were seen.

In case-control studies with adequate power, the majority found program effects for low birth weight, preterm birth and neonatal mortality. As with randomized trials, similar subgroups were found to benefit from comprehensive care. There were several studies that evaluated programs targeting adolescents and found program participants had infants with significantly higher birth weights and lower rates of low birth weight, particularly young adolescents. This was supported by several smaller studies not detailed in this review[12]. Case-controlled studies, essentially provide information on a highly selected group of participants and, therefore, provide

[12] Daniels & Manning, 1983; Felice et al, 1981; Smoke & Grace, 1988

weaker evidence than randomized trials, and their results were not generalizable.

In both randomized trials and case-control studies the literature found that longer participation in prenatal care was an important factor in achieving positive maternal and infant outcomes. Women who participated longer gained more weight, obtained more prenatal care, and had infants that were heavier and at decreased risk for low birth weight. Older adolescents and caucasian primips were the subgroups most likely to obtain longer participation in comprehensive care.

Comprehensive care also appeared to have an impact after the program was complete. Participation in comprehensive care was associated with longterm maternal and infant changes. Improved postpartum psychosocial adjustment, better parenting skills, lengthened pregnancy intervals were found in women who participated in comprehensive care. Improved cognitive ability was found for comprehensive care infants and children up two years of age.

Several methodological problems with both randomized trials and case-control studies were found in this literature review. The majority of the randomized trials failed to include in their selection criteria information that was crucial to determining the appropriate target group for their intervention. Lack of participation in the intervention, unknown or infrequent contact with the intervention and very restrictive interventions were methodological problems common to the majority of the trials.

Selection bias is by far the biggest methodological problem in case-control studies. The self-selection of some women into comprehensive care and others to avoid it confounded the causal relationship between comprehensive care and outcomes. Attempts to diminish the bias of self selection were rarely reported in the literature. Two studies addressed this issue, one by choosing controls from a time period prior to initiation of the intervention, the other, more creatively, by attempting to obtain controls that were motivationally similar. Lack of control for confounding variables, (especially behavioral variables) characterized every large study that utilized vital statistics data. The quality and type of the data available in secondary data bases, especially vital statistics data bases, severely restricted these analyses. Many studies that utilized vital statistics data were unable to utilize gestational age data due to missing and outlying data. This was reflected in lack of intrauterine growth retardation information for infants.

Several methodological problems were common to both randomized trials and case-control studies. Socially disadvantaged women, for whom most of these interventions were targeting, tended to enter care during their second or even third trimester. By virtue of entering late, they were unable to obtain full benefits of comprehensive care. Nonsignificant differences may well have occurred due to late entry effects and not lack of program effects.

Another methodological problem commonly encountered was lack of adequate power to determine true program effects. Thireteen studies simply had sample sizes too small to detect differences in rates of adverse infant outcomes. Equally as common were studies that calculated the power of their study based on very

modest differences in birth weight or, conversely extreme differences in adverse outcomes.

The final methodological concern was the adequate measurement of prenatal care. Popular measures of prenatal care, such as trimester of entry and the number of prenatal visits, were limited by the fact that women at either end of these continuums did not compose homogeneous groups. Women who enter care early in pregnancy and who obtain many prenatal visits may have (or have had) problematic pregnancies or medical risks which required additional care, or they may have been healthy women who simply wanted to obtain good prenatal care. Conversely, women who entered care late in pregnancy may have had very healthy previous pregnancies and, consequently, did not perceive a need for early care, or they may have been women who did not know they were pregnant or did not understand the need for prenatal care. Because of this lack of homogeneity within categories of prenatal care use, the relationships between traditional measures of prenatal care and birth outcomes remain unclear.

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CHAPTER 3

PREGNANCY OUTREACH PROJECTS

Background

In 1988, the British Columbia Ministry of Health piloted Pregnancy Outreach Projects (POP) in eight B.C. communities[13]. These prenatal programs were developed to address adverse pregnancy outcomes, especially low birth weight among high risk populations, and were initiated in response to concerns from both the public health and medical communities. While health and social service authorities recognized that low birth weight was associated with demographic, medical, obstetrical, behavioral and environmental factors, traditional prenatal care only addressed medical and obstetrical concerns (Institute of Medicine, 1985). In addition, most women who participated in community based prenatal services were not at risk for having low birth weight infants. High risk women frequently delayed access to traditional prenatal care and did not access community based prenatal services. With these factors in mind, the POP was developed to enhance the prenatal care of high risk pregnant women through community directed services.

Pregnancy Outreach Projects are community based programs aimed at identifying high risk women in the community, engaging them in prenatal care services, and supporting them in making behavioral changes to reduce their risk of having low birth weigh infants or other adverse pregnancy outcomes (Pregnancy Outreach Projects: Project Handbook,1993). The focus of the

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[13] Pregnancy Outreach Programs were piloted in Cranbrook, Terrace, Prince George, Williams Lake, Surrey, Port Alberni, Duncan and Nanaimo. Currently there are 22 communities participating in the POPs.

programs is on behavioral modification. Particular attention is paid to nutrition, emotional support, smoking, alcohol and drug use.

Funding for POP is provided by contract to community agencies which have well established links to high risk women. These sponsoring agencies are typically not health care agencies. Support and direction is provided to the agencies through mandatory advisory committees composed of health professionals and community leaders. Local health units maintain close ties through representation on advisory committees.

The programs are staffed by nurses, nutritionists, outreach workers and volunteers. A health professional coordinates the program, while the outreach workers are the primary service providers. Volunteers provide support services to both clients and staff. Peer support through the use of outreach workers is an integral component of the programs.

Objectives

The goal of the POP is to promote positive health practices that contribute to the health of infants and mothers. This goal is achieved through lifestyle oriented interventions. Individual health goals are developed and clients are assisted in achieving these by modifying their behavior. Six broad objectives are used to measure program success, these are presented in Table 3.1.

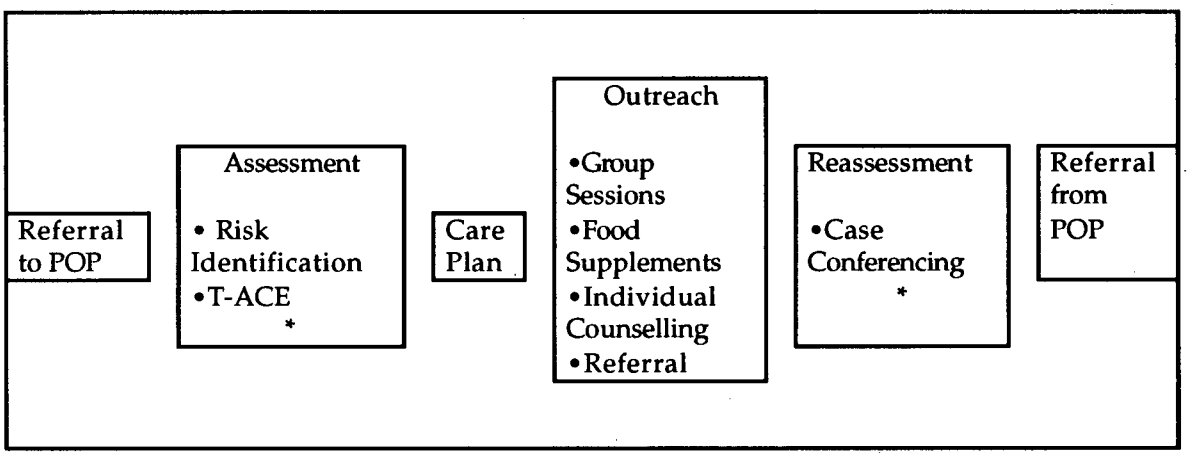
Table 3.1
Pregnancy Outreach Projects Objectives

Objective 1	To increase food intake to meet the minimum recommended servings in the "B.C. Guide for Pregnancy".
Objective 2	To decrease the number of cigarettes smoked per day in those pregnant women who smoke.
Objective 3	To decrease the use of alcohol with a view to abstinence.
Objective 4	To reduce drug use to only those approved by a physician.
Objective 5	To ensure that there is at least one consistent source of emotional support for the client
Objective 6	To encourage breast feeding so that 70% of clients are breast feeding on discharge from hospital.

Service Model

The POP utilize a multidimensional service model to achieve program objectives. This model is shown in Figure 3.1.

Figure 3.1
Pregnancy Outreach Projects Service Model



* Acknowledgements and outcomes of referral are provided to referral source.

Pregnancy Outreach Project service begins with referral; most commonly through self referral, health unit, community agency or physician[14]. During the first few client contacts, the program staff determine specific risks through the use of the Individual Prenatal Risk Identification Tool and T-ACE (alcohol screening) questionnaire. In order to be eligible for the program a client must be less than 28 weeks gestation[15] and have at least one major risk or three minor risk factors.

Client screening and assessment for program eligibility are conducted by all program staff. In consultation with the client, the program staff develop a client specific care plan. One staff member, usually the outreach worker, is chosen as the key worker for each client; however the team approach to service remains strong.

Program Components

There are four essential components to program service. These components were selected based on supporting evidence in the literature and experience with high risk counselling programs. The four components that comprise the program: group sessions, food supplements, individual counselling and health care referrals are detailed in Table 3.2.

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[14] Referrals to the program come from many sources including: family physicians, public health professionals, social services, alcohol and drug programs, community agencies, prenatal instuctors, native friendship centers, and self via: friends; newspaper articles; pamphlets and bulletins.

[15] Pregnancy Outreach Programs are limited to women less than 28 weeks gestation as lifestyle interventions are unlikely to alter the course of pregnancy thereafter.

Table 3.2
Program Components

Group Sessions	Drop-in sessions are required to be held at least once every two weeks. Bi-weekly or weekly sessions are the standard. Each session a client selected topic on pregnancy or infant care is presented. Group discussion follows the presentation. Low cost nutritional snacks and recipes are provided at each drop in session. The sessions provide clients with the opportunity to gain knowledge and take control of their lives.
Food Supplements	Food supplements are provided to clients based on financial need and nutritional assessment. Milk, juice, eggs and cheese are the most commonly offered supplements. Food vouchers may serve as a "hook" for clients who might not otherwise become involved with the program.
Individual Counselling	Nursing, nutrition and lay counsellors are available for each client. Clients are encouraged to see a counsellor as often as needed. Based on experience of high-risk counselling programs, a minimum of 5 counselling sessions are used to define adequate program participation. Sessions take place at the program site, client's home or other site.
Referral	Referrals are made to both community and government agencies during pregnancy and after birth, depending on individual client needs. Young single clients are commonly referred to "Nobody's Perfect" parenting programs, and the Health Units contact each client following delivery, for post-natal assessment and followup.

At three points during the program the client's progress is monitored: at program intake, two months after intake, and the last visit prior to due date[16]. During these assessments the client and counsellor discuss and evaluate the client's goal achievements and alter the care plan as required. Post delivery, clients often visit and attend drop in sessions, at which time infant outcomes

[16] The last prenatal visit generally occurs between 36 and 38 weeks of gestation.

are obtained. In some sites, infant outcomes are also obtained from health unit personnel. Client focussed quantitative evaluations are conducted yearly. These formative evaluations document changes in client behavior related to the six program objectives. Information from all program sites is then compiled into annual evaluation reports (Pregnancy Outreach Projects: Quantitative Evaluation Report, 1990 & 1991). Gestational age and birth weight for POP client infants are presented and compared to provincial statistics.

Assessment Tools

Pregnancy Outreach Projects utilize two tools to determine eligibility for the programs and client specific risks. These are the Individual Prenatal Risk Identification Tool and the T-ACE questionnaire.

Individual Prenatal Risk Identification Tool

In 1988 the Burnaby Health Department undertook the task of developing the Individual Prenatal Risk Identification Tool (IPRIT). The goal to produce an assessment tool that would assist community health service providers in early identification and care of high risk pregnant women. At completion of the process, the B.C. Ministry of Health piloted the tool in the newly formed POP. Since April 1989, the IPRIT has been utilized by all programs.

The IPRIT is both a screening and assessment tool (Appendix A). It is a multidimensional tool that assesses physical, socio-economic, substance abuse and emotional risk factors. The tool provides simple decision rules for

inclusion of a risk factor in the pregnant woman's profile, and further quantifies the risk factors as being either major or minor in nature.

The IPRIT not only determines if the client qualifies for intervention by the program, but also provides the direction for subsequent counselling. Once a client is enrolled in the program, lifestyle interventions are determined by the assessed risk factor profile.

The reliability, validity, sensitivity, specificity and predictive values of the IPRIT have not been determined. Therefore, it is difficult to know how accurate this tool is in selecting only those women who are at increased risk of adverse pregnancy outcomes.

T-ACE Questionnaire

The T-ACE questionnaire is an alcohol screening questionnaire that was developed in 1987 by Dr. Robert Sokol, Chairman, Department of Obstetrics-Gynecology at Wayne State University School of Medicine (Sokol, et al., 1989). The purpose of the instrument is to develop a brief questionnaire that provides physicians with a simple, quick tool to assist them in identifying risk drinkers in their practice. The T-ACE questionnaire is a screening tool composed of four simple questions (Appendix B). One of the questions addresses alcohol tolerance, while the other three focus on drinking behavior and perceptions.

The T-ACE questionnaire is administered to all women who admitted to ever having had alcohol. The questionnaire determines a woman's risk score based on preconception drinking practices. For each of the questions in the T-ACE, a

score is assigned. The T-ACE score has a range of 0-5. The first question is assigned a maximum score of 2 and the remaining three questions have maximum scores of 1. At the end of the questionnaire the client's score is totaled and a score 2 or more is considered to be indicative of risk drinking. Any woman with a score of 2 or more is eligible for the program. For a T-ACE score of 2 or more the sensitivity[17] of the tool is 69%, specificity [18] 89% and positive predictive value[19] 23% (Sokol, et al., 1989).

Vancouver Island Pregnancy Outreach Projects

There are three programs on Vancouver Island, located in Duncan, Port Alberni and Nanaimo. These were among the eight pilot sites for the POP and all commenced operation during the fall of 1988. In Duncan, the POP serves Cowichan Valley, Kuper Island, Chemanius, Shawnigan Lake and Cobble Hill. It is sponsored by the Cowichan Valley Native Friendship Centre. The Port Alberni POP serves the town of Port Alberni and surrounding areas, it is sponsored by the Alberni Health Outreach for Parents and Infants. The Nanaimo POP serves Nanaimo, Nanoose and the reserves in the area. It is sponsored by the Tillicum Haus Friendship Centre.

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[17] Sensitivity refers to the ability of a test to correctly identify those who have the disease or health problem in question. When sensitivity is high, the number of false negatives (those who have the disease but have a negative test result) is low.

[18] Specificity refers to the ability of a test to correctly identify those who do not have the disease or health problem in question. When specificity is high, the number of false positives (those who do not have the disease but have a positive test result) is low.

[19] Positive predictive value refers to the probability that the individual has the disease or health problem given a positive test result.

Although the POP do not select or target any high risk populations, aboriginal and adolescent women are frequently referred to the program.. All three Vancouver Island POP are affiliated with aboriginal communities and service a large number of aboriginal women. Many social service and community agencies also refer adolescent women for POP services.

All three sites provides serves for a similar high risk pregnant population. Previous formative evaluations (Pregnancy Outreach Projects, Site Reports,1991) have demonstrated that POP clients are significantly different from the general population of women giving birth in Central Vancouver Island. POP clients are predominantly young, single, poorly educated and on social assistance. About half of the clients have at least one child, and more than half are aboriginal. The most common major risk factors are: inadequate nutrition, smoking and inadequate pre-pregnancy weight. The most common minor risk factors are: financial problems, inadequate housing, low self-esteem, unstable relationship, family history of abuse or neglect, limited learning ability and isolation.

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CHAPTER 4

RATIONALE AND METHODS

RATIONALE

The Pregnancy Outreach Projects have undergone three overall provincial evaluations since their inception. These evaluations were concerned with four areas: implementation, effectiveness, acceptance and satisfaction. The quantitative reports focused on implementation issues as well as impact of intervention on the clients (Pregnancy Outreach Projects: Quantitative Evaluation Report, 1990 & 1991). The qualitative reports focussed on client acceptance and satisfaction (Pregnancy Outreach Projects: Qualitative Evaluation Report, 1990 & 1991). The POP evaluations to date have been very favorable. Each year the programs were enrolling more high risk pregnant women, many who had never participated in any prenatal care. Clients were entering the programs earlier in their gestation, and were increasingly being integrated into existing prenatal and postnatal community services. The clients were consistently modifying their behavior in relation to the six objectives, and satisfaction with the programs among clients was great. Community and sponsoring agency support for the programs has remained very high.

Although both quantitative and qualitative evaluations had shown that the programs were very sucessful in meeting their stated objectives, program managers were interested in measuring the impact of maternal behavior change on maternal and infant outcomes. In addition, interest was expressed in determining the subgroups that received the most benefit from the programs. Although these questions were beyond the mandate of the programs, they were

of interest to managers and staff. In order to document these results, a case-control study, comparing POP clients to a high risk comparison group was required.

Questions

The primary questions of interest in this study were:

1. What were the characteristics of the women who attended a POP during 1990-1991?
2. Were there any statistically significant differences in maternal outcomes between POP clients and controls?
3. Were there any statistically significant differences in infant outcomes between infants of POP clients and infants of controls?

The secondary questions of interest in this study were:

4. Were there any differences in maternal and infant outcomes between women who entered the POP prior to mid pregnancy and their matched controls?
5. Were there any differences in maternal and infant outcomes between women who enter the POP after mid pregnancy and their matched controls?
6. Were there any subgroups of women at risk, for who measurable program effects were shown?

METHODS

Study Design

The questions were addressed by means of a quasi-experimental matched case-control analysis. This design was chosen in order to produce two study groups that were similar with respect to certain sociodemographic variables that were associated with adverse pregnancy outcomes. Through matching, the confounding effects of the sociodemographic variables was controlled, allowing the observed impact of the programs to be determined. Maternal and infant outcomes for POP clients and controls were then compared.

Sample Size and Power

At the design stage, it was anticipated that approximately 125 POP clients would be included in the case group. As newborn outcomes were of primary interest in this study, a dichotomous definition of low birth weight was used to determine the power of this study. With a sample size of 125 women per group (1:1 match), this study would have 56% power (two-tailed test) to detect a difference in the proportion of low birth weight from 15% (high risk rate) to 5% (population rate for B.C.). In order to achieve 90% power this study would require a sample size of 226 women per group (Cohen,1988).

Given the fixed number of cases, the only means available to increase the power of the study was to increase the number of controls. By matching each case to three controls, the sample size of 125 cases and 425 controls provided an

85% chance of detecting the specified difference in the rate of low birth weight (Schlesselman, 1982).

Data from this study were analyzed using a bi-directional (two-tailed) test of significance rather than a uni-directional test for two reasons. First, it was unclear if matching POP clients to controls on sociodemographic variables provided a comparison group that was sufficiently similar to POP clients. Although the use of sociodemograhic characteristics to obtain a control group is common among case-control studies, it has not been determined if this was the best method of obtaining a comparable comparison group. Secondly, it appeared likely that while the programs could positively impact POP infants, the extremely high risk status of clients could negate program impacts. Thus, risk status and program influence could exert their effects in opposite directions, hense no program effects could possibly be seen. Given that the risk status of POP clients may be higher that controls, and that POP impacts on infant birth weight and gestational age may have been diminished by the extremely high risk status of POP clients, bi-directional tests were chosen for the analyses.

Data Sources

Maternal, birth, and birth outcome data were obtained from the University of British Columbia (UBC) Perinatal Study. The UBC Perinatal Study retrospectively abstracted data from maternal and infant hospital medical charts. Hospital chart abstraction included, but was not limited to; prenatal record, physician orders, physician record of progress (intrapartum), nursing admission record, nursing progress notes, social work progress notes, laboratory

and radiology findings, infant birth record, infant progress notes, and discharge information.

Study Subjects

There are two groups of subjects in this study, POP clients (cases) and the comparison group (controls).

Pregnancy Outreach Project Clients

All women who participated in a Vancouver Island POP and gave birth between July 23, 1990 and July 21, 1991 constituted the client group for this study. POP clients who obtained at least one counseling visit and had known birth outcomes were included. In addition to the stated criteria, infants must have been singleton births of known birth weight, gestational age and gender.

Comparison group

A high risk comparison group was required for this study. This group was drawn from the the UBC Perinatal Study. The UBC Perinatal Study was a population based study that ocurred between July 23, 1990 and July 21, 1991 within the Central and North Vancouver Island health regions. The objective of the UBC Perinatal Study was to evaluate the introduction of a program for identifing pregnant women at risk for increased alcohol consumption, and to determine their incidence at risk drinking and the association with infant outcomes (Armstrong, et al.,1994). Detailed pregnancy, delivery and newborn information were collected on 3659 women who gave birth during this one year

period. All women who resided in the Central Vancouver Island region, the same region as POP clients, formed the pool from which controls for this study were drawn (n=2345). The same selection criteria were applied in order to determine eligibility into the control pool.

Identification of POP Clients

All POP clients in this study gave birth during the time period of the UBC Perinatal Study, and were captured among that study's results. Although it was known that POP clients were part of the larger UBC Perinatal Study, there were no easy means of identifying who the POP clients were. The UBC Perinatal Study did not collect information on additional sources of prenatal care and no unique identifier was common to both POP clients and UBC Perinatal Study participants. Therefore, a probalistic linkage method was needed to identify POP clients within the UBC Perinatal Study.

Computerized record linkage was used to identify POP clients within the UBC Perinatal Study data base. Five maternal and infant variables were utilized: maternal birth date; infant birth date; gestational age; infant weight; and infant sex. To ensure a high probability of success, the information from both the POP data base and the UBC Perinatal Study data base had to agree on all five variables. Maternal birth date, infant birth date and infant sex were absolute measurements. Infant birth weight and gestational age were softer measurements. Birth weight within 250 grams and gestational age within two weeks were deemed to be acceptable limits for the data link. In situations were there was more than one possible match, birthing hospital was used to narrow the possible link.

Independent Variable

The independent variable in this study was participation in a POP at any of the three Vancouver Island sites: Duncan, Nanaimo or Port Alberni during the time period of July 23, 1990 to July 21, 1991.

Matching Variables

Maternal age, maternal race, parity and family income were the matching variables used in this study. The four demographic variables were chosen in order to create a comparison group that would closely mirror the sociodemographic characteristics of POP clients. Many studies have investigated the association of these sociodemographic variables with birth outcomes. Although cigarette consumption is also strongly associated with adverse birth outcomes, this variable was not utilized in this study. Smoking information was poorly documented, and it was impossible to ascertain for individual clients, if the documented cigarette consumption was the rate pre-pregnancy, mid-pregnancy or at delivery. Table 4.1 shows the categorization of the sociodemographic matching variables

Table 4.1
Maternal Matching Variables

Age	≤19 years	20 - 34 years	≥ 35 years
Race	Aboriginal	Non-Aboriginal	
Parity	zero	one to four	≥ five
Family Income	low	adequate	

Using a simultaneous distribution matching strategy, each POP client was matched to three controls based on the four sociodemographic variables. The result of this simultaneous matching procedure was the creation of the two study groups: POP clients and comparison group.

Age at Delivery: In this study clients were matched in three age categories: 14-19 years, 20-34 years, and 35 or more years. Within the youngest age group (13-19 years) the values were dichotomized into 14-16 years and 17-19 years. Many studies supported the hypothesis that young maternal age itself was a risk factor for both preterm birth and low birth weight infants (Blondel et al., 1987; Kramer, 1987; McCormick et al., 1984; Institute of Medicine, 1985) Furthermore, adolescents with low gynecological age (conception within 2 years of menarche) were at greater risk than older adolescents for preterm birth and low birth weight (Kitzes, 1986; Scholl et al., 1989). Advanced maternal age (over 34 years) has also been shown to adversely affect infant outcome, increasing mortality, low birth weight and preterm birth (Cnattingius et al., 1992; Friede et al., 1988).

Maternal birth date was obtained from either the prenatal record or the hospital admission record. Maternal age at delivery was calculated by subtracting infant date of birth from maternal date of birth.

Race: In this study, clients were matched according to aboriginal status. Aboriginal status was important for reasons related to birth weight, gestation and birth defects. Aboriginal status is associated with heavier birth weights at each week of gestation and with a higher incidence of preterm birth (Buck et al., 1992; Kierans et al., 1993; Thomson, 1990). Also, the incidences of alcohol related birth defects and infant mortality are higher among aboriginal infants in

British Columbia (Bray et al., 1989; Fetal Alcohol Syndrome in British Columbia, 1983; Kierans et al, 1993; Robinson et al., 1987).

Aboriginal status was determined through either documentation on the study participants prenatal record, or through personal health number (PHN). A PHN ending with an R2 was used to identify people.of aboriginal descent. This includes status, non-status and metis people, both on and off reserves (British Columbia Ministry of Health, 1988).

Parity: Many studies have shown that parity was risk factor for adverse pregnancy income independent of maternal age. Infants born to both primiparous and grand multiparous (≥5) women were at higher risk for low birth weight (Kramer, 1987; Preventing Low Birthweight, 1985). Grand multiparous women also have a higher risk for perinatal deaths due to placental complications (Brunner et al., 1992).

Parity was determined through either documentation on the prenatal record or hospital admission record, if no prenatal record was available.

Family Income: Socioeconomic status is commonly measured by variables such as occupation, education, income, or a composite generated from the weighted sum of a number of variables. In this study, family income was chosen to represent socioeconomic status. The choice of family income was supported by studies that suggest that income, rather than education or occupation correlates best with the socioeconomic differences in adverse pregnancy outcomes.(Binsacca et al., 1987; Egbuonu et al., 1982; Starfield et al., 1982; Stein et al., 1987; Wigle et al., 1980).

Measures of family income are related to the definition of a family. According to the 1986 Census Dictionary (Statistics Canada, 1987), a household refers to a person or group of persons who occupy a private dwelling and do not have a usual place or residence elsewhere in Canada. A census family includes a husband or wife with children who have never married, or a lone parent with one or more children who have never married, living in the same dwelling. Groups of two or more persons who live in the same dwelling and are related to each other by blood, marriage, common-law relationships, or adoption are referred to as an economic family. The choice of either census family or economic family would have been appropriate given that both are more likely than household to be based on the notion of economic dependency. Economic family was the definition selected because it was utilized in previous canadian studies (Thomson, 1990; Wilkins et al., 1989; Wilkins et al., 1991).

Size of economic family unit was calculated by adding the number of adults in the family to the mother's parity and current pregnancy, to determine the total number of individuals within the family unit. Family income was determined by first coding maternal and paternal occupations, and then determining income by occupation for 1985, the latest year available (Standard Occupational Classification,1981; Population and Dwelling Characteristics: Employment Income by Occupation, 1989). For families where one or both adult members were unemployed, social assistance rates were utilized.

The family's socioeconomic status was deemed adequate if family income was above the Statistics Canada low income cut-off, and inadequate if it was below the Statistics Canada low income cut-off (Income Distributions by Size in

Canada: Low Income Cut-offs, 1991). The Statistics Canada income calculations were based on individual family size and population size of 30,000 - 99,999 residents. The latter is intended to adjust for differences in the cost of living that are a consequence of the size of the city.

An attempt was made to match each control to POP client on all four variables. When this was not possible, controls were matched on a minimum of three variables. Maternal age at delivery was the best matched variable and with each subset (1 case: 3 controls) matched according to age categories. Maternal race was inconsistently recorded in the UBC Perinatal Study. For 1022 (45.8%) women in the UBC Perinatal Study, information on maternal race was not documented. Information from B.C. Division of Vital Statistics[20] in addition to UBC Perinatal Study home interviews [21] indicated that women of unknown racial origin were likely to be non-aboriginal.

Data Analysis

Although the study design employed matching, the necessity of maintaining matching in the analysis is a statistical grey area. Several authors strongly support maintaining matching in the analysis, because if matching is dropped the results may be biased towards the null hypothesis (Feinstein, 1985; Schlesselman, 1982). In order to maximize the strength of the analysis, given the small sample size, matching was maintained in the analysis.

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[20] Jennifer Gait, Vital Statistics, B.C. Ministry of Health, personal communication.

[21] UBC Perinatal Study home interviews assessed 82.1% of women with unknown racial origin to be caucaian.

The analyses were performed for the total study sample, then two subanalyses were performed. The first subanalysis determined if there were any differences in maternal and infant outcomes based on intensity of service, the second subanalysis determined if there were any subgroups for who measurable program effects were shown.

Although previous studies have shown that the impact of intensity of service on infant outcomes was mixed, intensity of program service was measured in this study. Intensity of service is commonly measured either by number of program contacts or length of time in the program. Although the POP have defined intensity of service by number of visits, this measure was not used in the study for two reasons. First, the POP have determined that five counselling visits constitutes "program success", this figure is based on information from the Montreal Diet Dispensary[22], whose program is quite different from the POP[23] therefore not necessarily applicable. Secondly, the three POP sites differed in their definition of what constituted a counseling visit.

For this study intensity of program service was measured by length of contact with the program. Women who entered a POP prior to midpregnancy (20 completed weeks) formed one subgroup, and those who entered past midpregnancy (21-28 weeks)[24] formed the other subgroup. This analysis was done because it provided a means for separately evaluating the impact of differences in program contact on maternal behavior modification and infant outcomes. Several evaluations of comprehensive prenatal care programs have

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22 Lisa Forster-Coull, Nutrition Branch, B.C. Ministry of Health, personal communication.
23 Sheila Dubois, acting Executive Director,Montreal Diet Dispensory, personal communication.
24 Women over 28 weeks of gestation are not eligible for the projects.

shown that women who enter prior to midpregnancy had better infant outcomes (Leveno, et al. 1985;. Scholl, et al. 1987; Alexander, et al. 1987).

Maternal Outcomes of Interest

Initiation of prenatal care, number of prenatal visits, adequacy of prenatal care and maternal morbidity were the maternal outcomes of interest in this study. For the continuous variables, initiation of prenatal care and number of prenatal visits, values were pooled across each control subset. Then matched 1:3 T-tests were performed between the case (POP client) and pooled control values within each subset to determine if there were any differences between the two study groups (Miettinen, 1969).

The Cochran-Mantel-Haenszel (CMH) procedure for obtaining a point estimate of the odds ratio and a CMH chi-square test of significance were utilized to analyze the dichotomous variables. With this procedure, outcome measures for the controls within each subset were also pooled. Each case and its corresponding set of matched controls were regarded as a separate subset within a 2 x 2 table. CMH odds ratios were used to measure differences in adequacy of prenatal care and maternal morbidity. The CMH chi-square test and confidence intervals were then calculated to determine whether the odds ratios were significant.

Initiation of Prenatal Care: The time interval between last menstural period and initial contact with physician in weeks, was used to determine the initiation of prenatal care.

Number of Prenatal Visits: Total number of prenatal visits was obtained from the prenatal record. The hospital portion of the prenatal record may not show the total number of prenatal visits, as these records were often forwarded to the admitting hospital at 37 completed weeks of gestation. Therefore the actual number of prenatal visits may have been higher than recorded.

Adequacy of Prenatal Care: The time interval between the expectant mother's initial contact with her physician and her infant's birth was used to determine adequacy of prenatal care. A dichotomous variable for prenatal care was created using Peoples et al, (1984) adaptation of Kessner's Adequacy of Care Index Levels (Appendix C). The Kesnner Index is an algorithm that includes trimester of pregnancy prenatal care began, number of prenatal visits and length of gestation, compared to the expected norm for visits. Using the adapted method, prenatal care was determined to be either adequate or inadequate.

Maternal Morbidity: Maternal morbidity refers to diseases or conditions that developed during pregnancy, as well as obstetrical complications resulting from labour and delivery. Variables utilized to determine maternal morbidity were obtained from both the prenatal record and the physician's record of progress (intrapartum). Maternal morbidity included any one of the following: anemia, placenta previa, placenta abruptio, polyhydramnios, oligohydramnios, pregnancy induced hypertension, gestational diabetes, preeclampsia, toxemia, threatened premature labour and post partum hemorrhage.

Infant Outcomes of Interest

Mean birth weigh, gestational age, head circumference and length as well as rates of preterm birth, low birth weight, small for gestational age, large for gestational age, infant morbidity and congenital anomalies were the infant outcomes of interest in this study. Once again, the continuous variables were analyzed using matched 1:3 T-tests. The Cochran-Mantel-Haenszel (CMH) procedure was again utilized to analyze dichotomous variables. Odds ratios were used to measure differences in the rates of low birth weight, preterm birth, small for gestational age, large for gestational age, congenital anomalies, as well as perinatal morbidity for study groups. The CMH chi-square test and confidence intervals were then calculated to determine whether the odds ratios were significant.

Gestational Age: Gestational age was abstracted from infant birth record according to: last menstrual period date (date of delivery minus patient reported last menstrual period).or ultrasound date (date of delivery minus date of ultrasound plus number of weeks gestation at ultrasound). Priority was placed on determining gestational age by last menstrual period date.

Birth Weight: Birth weight was abstracted from two different sources: infant birth record or physicians record of progress (intrapartum report). Priority was placed on obtaining birth weight from the infant birth record.

Head Circumference: Head circumference was abstracted from infant birth record.

Length: Infant length was abstracted from infant birth record.

Preterm Delivery: Infants born prior to 37 completed weeks (less than 259 days) of gestation were determined to be preterm (British Columbia Ministry of Health, 1990).

Low Birth Weight: Infants with birth weights less than 2500 grams were categorized as low birth weight (British Columbia Ministry of Health, 1990).

Small for Gestational Age: Small for gestational age (also known as intrauterine growth retardation) was determined using Canadian comparisons for singleton births (Arbuckle et al.,1989 &1993). Infants with birth weights below the 10th percentile for gestational age were considered to be small for gestational age.

Large for Gestational Age: Large for gestational age was determined using Canadian comparisons for singleton births (Arbuckle et al., 1989 &1993). Infants with birth weights above the 90th percentile for gestational age were considered to be large for gestational age.

Perinatal Conditions: Perinatal conditions refered to diseases or conditions that developed during pregnancy or were preexisting and aggravated by labour and delivery. They included one or more of the following: birth infections, birth trauma, seizures, respiratory distress, hemorrhage, narcotic abstinence syndrome, fetal alcohol syndrome, and neonatal intensive care admission.

Information was obtained from either infant birth record or infant progress notes.

Congenital Anomalies: Congenital anomalies describe any important structural defects (both internal and external) present in an infant at birth that were not caused by birth injury. Congenital anomalies were determined using International Classification of Diseases codes 740-759 (ICD 9 CM, 1989). Information was obtained from either infant birth record or infant progress notes.

Data for this study were analyzed using the statistical software package, SPSS-PC version 4.0.

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CHAPTER 5

RESULTS

POP DATA BASE DEVELOPMENT

Pregnancy Outreach Projects Intake

There were 212 women with due dates between July 1, 1990 and July 31, 1991 referred to the three Vancouver Island POP. As shown in Table 5.1, source of referral was known for 147 (69.3%) of these women. Of the known referrals, almost half (44.9%) of the women referred themselves to a POP, having become aware of the program from friends, family, other clients, community groups, or through various media sources. Many of the remaining referrals (51%) arose from contact with community based health professionals and agencies. Very few referrals came from physicians.

Table 5.1
Sources of Referral

Source of Referral	N=147	%
Self	66	44.9
Health Unit	26	17.7
Other Health Professionals	22	15.1
Community Agencies	17	11.6
Physician	8	5.4
Alcohol and Drug Programs	4	2.7
Social Services and Housing	3	2.0
Self via Physician	1	0.7

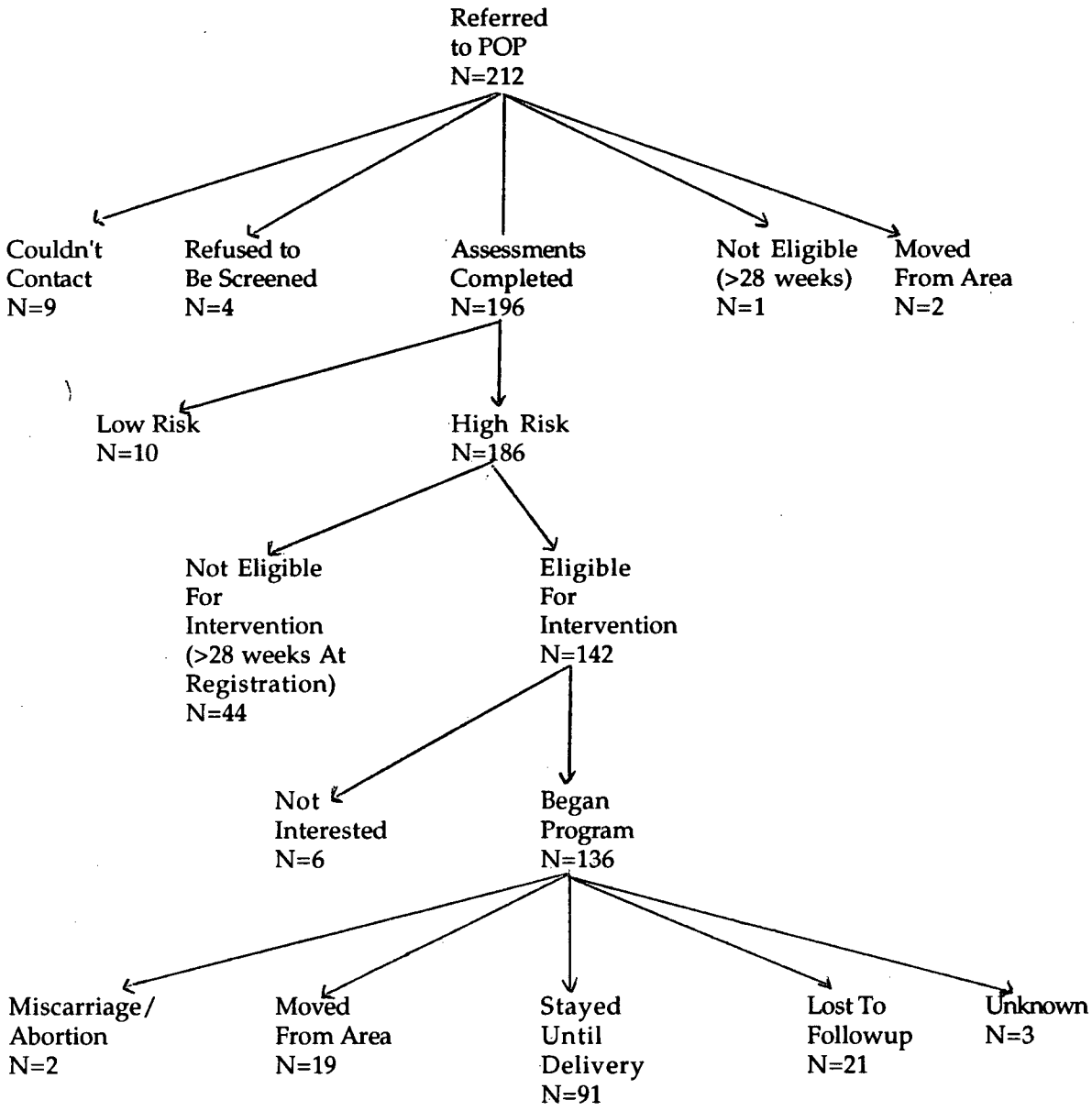
Client Retention

Figure 5.1 provides an overview of program retention. Of the 212 women referred to the program, 16 were not assessed. The main reasons for non assessment were inability to contact and disinterest in the program. Of the 196 women who were assessed, 54 did not met the eligibility criteria. The most common reason for exclusion from the program was gestation greater than 28 weeks.

One hundred and thirty six of a possible 142 eligible clients were enrolled in the program, for an overall participation rate of 95.8%. A review of the available data for the 6 nonparticipants suggests their risk profiles for adverse pregnancy outcomes did not differ in any systematic manner from clients who participated in the program.

Of the 136 clients that started the program, 91 (66.9%) stayed in the program until delivery. Nineteen clients moved from Vancouver Island and their results were lost to this study. Twenty one clients were lost to followup from the POP, however, infant information was available for these women and they were included as study participants. Therefore, a total of 112 POP women were eligible for this study.

Figure 5.1
Client Retention



Lost to Followup

Table 5.2 provides a comparison of 91 clients who stayed in a POP until delivery, and the 21 who were lost to followup. Both groups of program clients were very similar. Clients who completed the program entered half a week ahead of those that dropped and on average, had a greater number of major risks and fewer minor risks at program entry. Demographically, clients who did not complete the program were slightly younger, had fewer children and more likely to be in a relationship. They were also less likely to have completed high school or be employed, however they were less likely to rely on social assistance as their source of income. They were equally as likely to be aboriginal as nonaboriginal.

Table 5.2
POP Clients-Completed and Lost to Followup

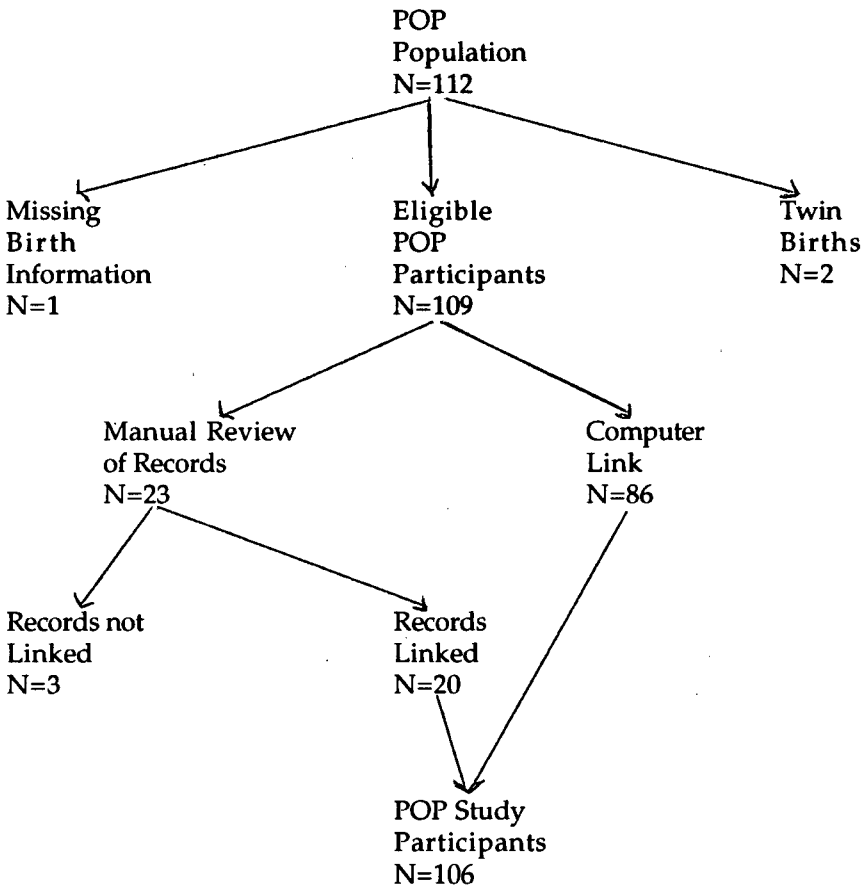
Characteristics of Pregnancy Outreach Project Clients				
	Completed Program (N=91)		Lost to Followup (N=21)	
	N	%	N	%
Average				
Major Risk	0.98		0.87	
Minor Risks	4.5		4.7	
Age	22.8		21.2	
Parity	1.4		1.1	
Gestation at Intake	17.4		17.9	
Single	49	43.8	9	37.5
Aboriginal	63	56.3	12	50.0
Not Completed High School	81	72.3	19	79.1
Employed	10	8.9	0	0
Receiving Income Assistance	92	82.1	18	75

Study Eligible POP Clients

As shown in Figure 5.2, data were available for a total of 112 POP clients who delivered between July 23, 1990 and July 21, 1991. Three clients (2.7%) were subsequently excluded from the analysis. Two women were excluded as they delivered twins. Information on 16 infants required manual review as they were either missing gender, birth weight or gestational age information or the recorded values were outside of acceptable parameters. For 1 client, infant birth information was not obtained and the client was subsequently excluded from the analysis. The remaining 15 infants were successfully assigned.

A total of 109 POP clients were eligible for this study. Computerized record linkage was then used to identify POP clients within the UBC Perinatal Study data base. Eighty six (78.9%) POP clients were initially identified using the five maternal and infant linking variables. Manual review of POP charts was then conducted for the remaining 23 (21.1%) clients. Twenty POP clients were successfully identified following the manual review. The loss of only three POP clients (2.8%) using the data link, compared favorably with previous investigations in which a similar approach was used (Peoples et al., 1983; Beuscher et al, 1991). Incomplete linking of the POP clients has led to the possibility that some POP clients may have been counted amongthe comparison group. To the extent that POP did improve birth outcomes, this incomplete linking would lead to an underestimate of the true differences between the two groups. A total of 106 (97.2%) POP clients comprised the case group for this study.

Figure 5.2
Study Eligible POP Clients



Power Calculation

At the design stage it was predicted that 125 POP clients would be available for this study. Given 1:3 matching adequate power would have been achieved to detect a decrease in the proportion of low birth weight from 15% among to 5% among POP clients. With only 106 POP clients available for this study, the power to detect this change in low birth weight has decreased to 70%.

Development of Comparison Group

Each of the 106 POP clients was matched to 3 controls based on the demographic matching variables. Eighty nine (83.9%) POP clients were matched to three controls on all four variables. For the remaining 17 POP clients (16.1%) incomplete matches occurred. The relatively small number of aboriginal women[25] in the UBC Perinatal Study necessitated incomplete aboriginal race matching. Eleven aboriginal POP clients were matched with 1 control who was nonaboriginal and 6 were matched with two controls who were nonaboriginal. Twelve POP clients with between 1 and 4 children were matched with one control who was primiparous. Thirteen low income POP clients were matched with one control who had adequate income.

Missing Data

Generally information on maternal matching variables was less well documented than were maternal and infant outcome variables. Information on maternal age and parity were available for each study participant. For 97 (22.9

[25] Aboriginal women accounted for 8.1% of the UBC Perinatal Study population.

%) participants, information of maternal race was not documented on the prenatal record. Based on information from Vital Statistics[26], women who lacked race information were assumed to be nonaboriginal. Sixty seven (15.8%) study participants were either missing or had incomplete information on occupation.

Prenatal records were missing for 24 (5.7%) study participants. Hospital chart documentation indicated that these women did not visit physicians during their pregnancy. For an additional 4 (1%) participants, prenatal records were incomplete. For 38 (8.9%) participants, information on last menstrual period was either missing (n=5) or grossly out of range (n=33). For these women, gestational age was calculated by using ultrasound date.

For three (0.7%) infants gestational age, birth weight or gender were not documented, these three variables were required for calculating both large and small for gestational age. For ninety six (22.6%) infants, head circumference was not documented, and 124 (29.2%) were missing information on length. Seven (1.7%) infants had no documentation regarding congenital anomalies and perinatal conditions.

ANALYSIS OF MATERNAL AND INFANT OUTCOMES

Maternal Characteristics

Descriptive data on maternal characteristics of the study groups is presented in Table 5.3. The mean age at delivery was 22.8 years for POP clients and 23.2 years for controls. Both study groups were proportionately represented among the

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[26] Jennifer Gait, Vital Statistics, B.C. Ministry of Health, personal communication.

three age categories, with 33% of the study sample aged 13-19 years, 63.2% aged 20-34 years and 3.8% were 35 years or older. Compared to the 1990 provincial data (British Columbia Ministry of Health, 1990), the study groups had a much greater proportion of adolescents (5.7% provincially) and a smaller proportion of those aged 35 or older (10.7% provincially). The large proportion of aboriginal women comprising the adolescent age group may explain some of the elevated proportion of births in this age group. From a provincial standpoint, among the aboriginal population 20% of births occurred to women aged 19 years or less (Tuk, 1995).

There were significant differences in the racial composition of the two study groups, with regard to both the numbers of aboriginal women and women of unknown race. Whereas 56.6% of POP clients were aboriginal, they accounted for only 43.1% of the controls. This occurred because although a large proportion of the UBC Perinatal Study aboriginal women were selected as controls[27], the overall total proportion of aboriginals in the UBC Perinatal Study was small. The proportion of aboriginal women in the study greatly exceeded provincial numbers. According to recent studies (Kierans et al., 1993; Thomson, 1990; Tuk, 1995) aboriginal women of childbearing age in the province accounted for between 2.5% -2.75% of the birthing population.

There were also significant differences between the two study groups with regard to marital status, 51.9% of the POP clients were single compared with 59.1% of the controls. Provincially 24.3% of all live births occurred to unmarried women (British Columbia Ministry of Health, 1990).

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[27] 137 or a possible 181 (75.7%) of the documented aboriginal population were selected as controls using the matching criteria.

The vast majority of study participants had low incomes. A slightly greater proportion of POP clients (74.5%) had low family incomes than did controls (70.8%). The proportion for which income information was unknown was similar for both groups.

POP clients and controls had the same average parity at 1.40 births. Primiparas comprised 34.9% of the POP clients and 39.3% of the controls. The proportion of grand multiparous women (5 or more children) was similar between the two groups at 6.6% for POP clients and 5.3% for controls. Compared to provincial data, the proportion of primiparous women was lower (43.6% provincially), while the proportion of grand multiparas were similar (6.5% provincially).

Twenty nine percent of the multiparous POP clients had experienced adverse obstetrical outcomes, mainly preterm births, in previous pregnancies compared with 21.6% of multiparous controls. The proportion of underweight and overweight women was small in both groups with slightly more controls at pregravid weight extremes. Similar proportions of POP clients and controls had existing medical conditions, 15.1% and 18.2% respectively.

Both groups were similar with regard to modifiable behaviors although the proportion of smokers was slightly higher among the controls (48.1%) than the POP clients (44.2%). POP clients were at greater risk for alcohol and illicit drug use, though not significantly so.

Table 5.3
Study Clients-Maternal Profile

	POP Clients (N=106)		Comparison Group (N=318)	
	N	%	N	%
Maternal Age				
Average *	22.8 ± 5.6		23.2 ± 5.8	
≤ 19 years	35	33.0	105	33.0
20-34 years	67	63.2	201	63.2
≥ 35 years	4	3.8	12	3.8
Race				
Aboriginal	60	56.6	137	43.1†
Caucasian	29	27.4	95	29.9
Unknown	16	15.0	82	25.8†
Marital Status				
Single	55	51.9	188	59.1†
Married	51	48.1	130	40.9†
Family Income				
Low income	79	74.5	225	70.8
Adequate	21	19.8	73	23.0
Unknown	6	5.7	20	6.3
Parity				
Average*	1.4 ± 1.7		1.4 ± 1.6	
Primipara	37	34.9	125	39.3
Multipara	62	58.5	176	55.3
Parity ≥ 5	7	6.6	17	5.3
Previous Poor OB Outcome^	18	29.0	38	21.6
Physical				
Underweight(<50kg)	2	1.9	10	3.1
Overweight (>80kg)	1	.09	4	1.3
Existing Medical Condition	16	15.1	58	18.2
Behavioral				
Smoker	49	44.2	153	48.1
T-ACE > 2	18	17.0	47	14.8
Drug	5	5.0	9	2.8

* Mean ± Standard Deviation
^ Denominator is Multiparous Women
† Statistically Significant ($p \leq 0.05$)

Primary Analyses

Maternal Outcomes

Maternal outcomes for the overall analysis are shown in Tables 5.4 and 5.5. It can be seen that POP clients experienced slightly better results in all measured maternal outcomes when compared with their matched controls. POP clients initiated prenatal care on average 1.2 weeks ahead of controls. The matched T-test value of 1.36 (df=96, C.L.=-2.9; 0.54) showed that there was no statistically significant association between POP participation and early initiation of prenatal care. It is also highly unlikely that a 1.2 week mean difference in initiation of prenatal care was clinically significant.

POP clients obtained on average 7.9 prenatal visits, compared with 7.2 visits for controls. This difference of 0.5 prenatal visits produced a significant T-value of 2.05 (df=96, C.L.=0.21; 1.3) indicating as association between POP participation and an increased number of prenatal visits obtained.

Only a small proportion of both POP clients and controls obtained adequate prenatal care, 28.3% and 21.1% respectively. The difference in the proportion who received adequate care resulted in an odds ratio of 1.11 (df=96, C.L.=0.66; 1.9).

The proportion of women who experienced morbidity was nearly identical in the two study groups with 20.7% of POP clients and 19.5% of controls having experienced one or more pregnancy/delivery complications.

For three of the four measures of maternal outcomes, initiation of prenatal care, adequacy of prenatal care and maternal morbidity, the overall analysis showed no program effects for POP clients. However, POP clients achieved slightly more prenatal visits than their matched controls, indicating modest program effects for this maternal outcome.

Table 5.4
Maternal Outcomes-Initiation and Visits

	POP Clients (N=106)	Controls (N=318)	Mean Difference	T-Test & 95% C.L.∞
Initiation of Prenatal Care (weeks)*	14.4 ± 6.8	15.6 ± 4.9	-1.2	1.36 (-2.9; 0.54)
Number of Prenatal Visits*	7.9 ± 2.8	7.2 ± 1.8	0.64	2.05† (0.21; 1.3)

* Mean ± Standard Deviation
∞ Confidence Limits
† Statistically Significant.($P \leq 0.05$)

Table 5.5
Maternal Outcomes-Adequacy and Morbidity

	POP Clients (n=106)	Controls (n=318)	Odds Ratio & 95% C.L.∞
Adequacy of Prenatal Care § (%)	30 (28.3)	67 (21.1)	1.11 (0.66; 1.9)
Maternal Morbidity ¡(%)	22 (20.7)	62 (19.5)	0.81 (0.48; 1.4)

∞ Confidence Limits
§ As measured by modified Kessner Index (Appendix C)
¡ Maternal Morbidity included any one of the following: anemia, placenta previa, placenta abruptio, polyhydramnios, oligohydramnios, pregnancy induced hypertension, gestational diabetes, preeclampsia, toxemia, threatened premature labour and post partum hemorrhage.

Infant Outcomes

Results of infant outcomes are presented in Tables 5.6 and 5.7. It can be seen (Table 5.6) that there were virtually no differences in measures of growth between the two groups of infants. POP infants had slightly shorter gestations than control infants, with a mean difference of 0.46 weeks. The matched T-test value of 1.67 (df=105, C.L.=-1.0; 0.08) showed lack of a statistically significant association between POP participation and gestational age. POP infants were on average 11 grams lighter that control infants. They had slightly smaller mean head circumferences (0.33 centimeters) and slightly shorter length (0.55 centimeters). None of these differences were statistically significant.

Analysis of infant growth and development indicated that there were no significant statistical differences between infants born to POP clients and controls. A closer look at the data showed that there was much greater variability among all measures of growth for infants of POP clients than for control infants, likely due to smaller numbers of POP clients.

Table 5.6
Infant Growth

	POP Clients (N=106)	Controls (N=318)	Mean Difference	T-Test & 95% C.L.∞
Gestational Age (weeks)*	38.6 ± 2.5	39.0 ± 1.4	-0.46	1.67 (-1.0; 0.08)
Birth Weight (grams)*	3,349 ± 693	3,361± 372	-11.5	0.16 (-155.9; 132.8)
Head Circumference (centimeters)*	34.4 ± 2.0	34.7 ± 1.5	-0.33	1.21 (-0.87; 0.22)
Length (centimeters)*	50.7 ± 3.4	51.3 ± 3.0	-0.55	0.97 (-1.7; 0.60)

* Mean ± Standard Deviation
∞ Confidence Limits

Table 5.7 describes and evaluates the impact of POP on infant morbidity. Infant morbidity was defined in terms of preterm birth, low birth weight, small for gestational age, large for gestational age, perinatal complications and congenital anomalies. In contrast to measures of infant growth there were differences between the two groups. With the exception of small for gestational age, POP infants experienced more morbidity than control infants.

The rate of preterm birth was 15.1 per 100 births for POP infants compared with 8.8 for control infants. The odds ratio of 2.39 (C.L.=1.2; 4.7) indicated a statistically significant association between a higher rate of preterm birth and POP participation. POP infants also experienced a higher rate of low birth weight at 11.4 per 100 births compared with 6.6 for control infants. The difference resulted in an odds ratio of 1.48 (C.I.=0.74; 3.0) and was not statistically significant.

Results of the small for gestational age measure are the reverse of those shown previously, and indicated favorable program effects for POP infants. The rate of small for gestational age was 8.5 per 100 births for POP infants and 12.3 for control infants. The difference produced an odds ratio of 0.53 (C.L.=0.26; 0.99), indicating a statistically significant association between POP participation and lower rate of small for gestational age. The rate of large for gestational age was 17.0 per 100 births for POP infants compared with 10.4 for control infants. This difference resulted an odds ratio of 1.24 (C.I.=0.71; 2.2).

The number of infants experiencing one or more perinatal conditions was relatively low for both groups of infants. The rate was 10.5 per 100 births for POP infants compared with 6.5 for control infants (O.R.=1.41; C.L.=0.69; 2.9). Considerably more POP infants were born with one or more congenital anomalies than were control infants. The rates were 14.2 per 100 births and 4.7 respectively. The resulting odds ratio of 3.31 (C.L.=1.6; 6.9) was statistically significant.

Statistical results of all measures of infant morbidity for the overall sample were mixed. POP infants had significantly higher rates of preterm birth and congenital anomalies. However, they had a significantly better rate of small for gestational age. There were no statistically significant differences for rates of low birth weight and large for gestational age between the two comparison groups.

Table 5.7
Infant Morbidity

	POP Clients (N=106)	Controls (N=318)	Odds Ratio & 95% C.L. ∞
Preterm Birth ∞(%)	15.1	8.8	2.39† (1.2; 4.7)
Low Birth Weight ƒ(%)	11.4	6.6	1.48 (0.74; 3.0)
Small for Gestational Age ∂(%)	8.5	12.3	0.53† (0.26; 0.99)
Large for Gestational Age i(%)	17.0	10.4	1.24 (0.71; 2.2)
Perinatal Conditions •(%)	10.5	6.5	1.41 (0.69; 2.9)
Congenital Anomalies ¢(%)	14.2	4.7	3.31† (1.6; 6.9)

∞ Confidence Limits
∞ Less than 37 completed weeks of gestation.
ƒ Less than 2500 grams.
∂ Birth weight less than 10th percentile for gestational age.
i Birth weight greater than 90th percentile for gestational age.
• One or more of the following conditions:birth infections, birth trauma, seizures, respiratory distress, hemorrhage, narcotic abstinence syndrome, fetal alcohol syndrome, and neonatal intensive care admission.
¢ One or more condition under ICD-9 codes 740-759.
† Statistically Significant.($p \leq 0.05$)

Subanalysis-Program Entry

To determine if there were any differential program effects based on length of contact with the program (a measure of intensity of service) a subanalysis was performed. Women who entered a POP prior to 20 completed weeks of gestation (early entry) formed one group, and those who entered between 21 and 28 weeks gestation (late entry) formed the other group.

Multivariate analysis comparing early and late entry clients could theoretically have been utilized in this subanalysis. However, given the small subgroup sizes (60 early entry and 46 late entry clients) and the dramatic differences in risk profiles (Table 5.8), utilization of this measure would not have yielded accurate results. For this reason, a comparison of each subgroup of POP clients with their matched controls was performed. By comparing the POP subgroups to their matched controls, sociodemographic similarities were maintained in the analysis, allowing contact with the POP to be the main difference between the comparison groups.

Descriptive information on POP clients based upon entry to the programs is presented in Table 5.8. Although both early and late entry clients were similar with regard to mean risk scores upon entry to the programs, they were significantly different in every other respect. Women who entered the programs later were at greater sociodemographic risk for having a low birth weight infant. They were more likely to be adolescent, unmarried, caucasian, and experiencing their first child.

Table 5.8
POP Clients-Early and Late Entry

	Early Entry[e] N=60	Late Entry[l] N=46
Maternal Age *	24.0 ± 5.3	21.2 ± 5.9†
< 20 Years(%)	25.0	43.5†
Single(%)	45.0	58.7†
Aboriginal(%)	55.0	43.5†
Parity *	1.8 ± 1.9	1.0 ± 1.2†
Primiparity(%)	28.3	44.5†
Major Risk *	1.0 ± 0.98	1.0 ± 1.2
Minor Risk *	4.5 ± 1.7	4.48 ± 2.4

[e] Early Entry was defined as program entry prior to 20 completed weeks of gestation.
[l] Late Entry was defined as program entry between 21 and 28 weeks of gestation.
* Mean ± Standard Deviation
† Statistically Significant ($p \leq 0.05$)

Early Entry Maternal Outcomes

Maternal outcomes for women who entered the programs prior to mid pregnancy (early entry) and their matched controls are shown in Tables 5.9 and 5.10. For every measure of maternal outcome, early entry POP clients obtained better results than their controls. On average, early entry POP clients initiated prenatal care during their first trimester of pregnancy while their controls initiated care during their second trimester. Early entry POP clients initiated prenatal care on average 3.5 weeks ahead of their controls (C.L.=-5.7; -1.1). This difference indicated a significant association between POP participation and early initiation of prenatal care. Early entry POP clients obtained on average 1.2 more prenatal visits than their controls (C.L.=0.3; 1.9). Again, this difference was statistically significant.

Once again, a far greater proportion of early entry POP clients (36.7%) obtained adequate prenatal care[28], compared to their controls (22.5%). This 14.2% difference resulted in a statistically significant odds ratio of 2.47 (C.L.=1.2; 5.0).

The proportion of early entry POP clients who experienced one or more pregnancy/delivery complications was slightly lower than for their controls. Approximately sixteen percent (16.6%) of POP clients and 19.0% of controls experienced morbidity.

For three of the four measures of maternal outcomes, initiation of prenatal care, number of prenatal visits and adequacy of prenatal care, early entry POP clients obtained statistically better results that their controls indicating positive program effects. For the remaining measure, maternal morbidity, there was no significant difference between the two groups.

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[28] Based on an adaptation of the Kessner Index of Prenatal care. This index is an algorithm that includes trimester of pregnancy prenatal care began, number of prenatal visits and length of gestation, compared to the expected norm for visits (Appendix E).

Table 5.9
Early Entry[e] Maternal Outcomes-Initiation and Visits

	POP Clients (N=60)	Controls (N=180)	Mean Difference	95% Confidence Limits
Initiation of Prenatal Care (weeks)*	12.6 ± 5.9	16.1 ± 4.8	-3.6	(-5.7; -1.1)†
Number of Prenatal Visits*	8.5 ± 2.6	7.3 ± 1.7	1.1	(0.3; 1.9)†

[e] Early Entry was defined as program entry prior to 20 completed weeks of gestation.
* Mean ± Standard Deviation
† Statistically Significant ($p \leq 0.05$)

Table 5.10
Early Entry[e] Maternal Outcomes-Adequacy and Morbidity

	POP Clients (N=60)	Controls (N=180)	Odds Ratio	95% Confidence Limits
Adequacy of Prenatal Care § (%)	22 (36.7%)	40 (22.2%)	2.47†	(1.2; 5.0)
Maternal Morbidity ¡(%)	10 (16.6%)	34 (19.0%)	0.92	(0.61; 1.4)

[e] Early Entry was defined as program entry prior to 20 completed weeks of gestation.
§ As measured by modified Kessner Index (Appendix C)
¡ Maternal Morbidity included any one of the following: anemia, placenta previa, placenta abruptio, polyhydramnios, oligohydramnios, pregnancy induced hypertension, gestational diabetes, preeclampsia, toxemia, threatened premature labour and post partum hemorrhage.
† Statistically Significant ($p \leq 0.05$)

Early Entry Infant Outcomes

Results of the early entry infant subanalysis are presented in Tables 5.11 and 5.12. Although early entry POP clients had significantly better maternal outcomes than their controls, the improvements were not transferred to POP infants. Table 5.11 shows there were virtually no differences in any measure of infant growth between early entry POP infants and their control infants. Early entry POP infants had slightly shorter gestations than control infants, with a mean difference of 0.3 weeks. Although early entry POP infants were slightly younger, they were slightly heavier. Early entry POP infants were on average 11 grams heavier that their control infants. Both groups of infants were identical in head circumference (34.5 cm) and length (51.0 cm).

The subanalysis for measures of infant growth showed no significant statistical differences between early entry POP infants control infants. Again, POP infants experienced much greater variability among all measures of growth than control infants.

Table 5.11
Early Entry[e] Analysis-Infant Growth

	POP Clients (N=60)§	Controls (N=180)§	Mean Difference	95% Confidence Limits
Gestational Age (weeks)*	38.8 ± 2.2	39.1 ± 1.3	-0.3	(-0.97; 0.38)
Birth Weight (grams)*	3,408 ± 632	3,396 ± 352	11.4	(-183.4; 206.2)
Head Circumference (centimeters)*	34.5 ± 1.8	34.5 ± 1.2	-0.21	(-0.68; 0.68)
Length (centimeters)*	51.0 ± 3.7	51.0 ± 3.3	-0.35	(-2.1; 1.4)

[e] Early Entry was defined as program entry prior to 20 completed weeks of gestation.
* Mean ± Standard Deviation
§ For gestational age and birth weight only

Similar to the overall infant analysis, although the two groups of infants looked similar with regard to growth measurements, they were very different with regard to measures of morbidity (Table 5.12). Once again, with the exception of small for gestational age, early entry POP infants experienced more morbidity than their control infants. The differences, when compared with the overall analysis were not as pronounced.

The rate of preterm birth was 10.0 per 100 births for early entry POP infants compared with 8.3 for their control infants. The odds ratio of 1.23 (C.L.=0.45; 3.4) was not statistically significant. Early entry POP infants also had a higher rate of low birth weight at 8.3 per 100 births compared with 5.6 for their control infants. The corresponding odds ratio of 1.50 (C.L.=0.53; 4.3),was nonsignificant.

Again, the results of small for gestational age were the reverse of those previous, and showed early entry POP infants had a lower rate of small for gestational age than did their control infants. The rate of small for gestational age was 6.7 per 100 births for POP infants and 10.6 for control infants (O.R.=0.63, C.L.=0.22; 1.8). The rate of large for gestational age was 16.6 per 100 births for early entry POP infants compared with 11.7 for their control infants (O.R.=1.33, C.L.=0.79; 2.1).

The number of infants experiencing one or more perinatal conditions was again relatively low for both groups of infants. The rate was 8.3 per 100 births for early entry POP infants compared with 6.2 for their control infants. Considerably more early entry POP infants were born with one or more congenital anomalies than were their control infants. The rates were 13.3 per 100 births and 4.0 respectively. The resulting odds ratio of 3.8 (C.L.=1.4; 10.5) was statistically significant.

The morbidity results for early entry POP infants were mixed. Early entry POP infants had considerably higher rates of large for gestational age and congenital anomalies than their control infants. Early entry POP infants, however, had a considerably lower rate of small for gestational age. For the remaining measures of morbidity, the two groups of infants were not very different.

Table 5.12
Early Entry[e] Analysis-Infant Morbidity

	POP Clients (N=60)	Controls (N=180)	Odds Ratio	95% Confidence Limits
Preterm Birth [∞](%)	10.0	8.3	1.23	(0.45; 3.4)
Low Birth Weight [ƒ](%)	8.3	5.6	1.50	(0.53; 4.3)
Small for Gestational Age [∂](%)	6.7	10.6	0.63	(0.22; 1.8)
Large for Gestational Age [i](%)	16.6	11.7	1.33	(0.79; 2.1)
Perinatal Conditions [•](%)	8.3	6.2	1.40	(0.47; 4.2)
Congenital Anomalies [¢](%)	13.3	4.0	3.8†	(1.4; 10.5)

[e] Early Entry was defined as program entry prior to 20 completed weeks of gestation.
[∞] Less than 37 completed weeks of gestation.
[ƒ] Less than 2500 grams.
[∂] Birth weight less than 10th percentile for gestational age.
[i] Birth weight greater than 90th percentile for gestational age.
[•] One or more of the following conditions:birth infections, birth trauma, seizures, respiratory distress, hemorrhage, narcotic abstinence syndrome, fetal alcohol syndrome, and neonatal intensive care admission.
[¢] One or more condition under ICD-9 codes 740-759.
† Statistically Significant.($p \leq 0.05$)

Late Entry Maternal Outcomes

Maternal outcomes for women who entered the programs after mid pregnancy (late entry) and their matched controls are shown in Tables 5.13 and 5.14. For three of the four measures of maternal outcome, late entry POP clients were slightly disadvantaged when compared to their controls.

Both late entry POP clients and their controls tended to initiate prenatal care during their second trimester. Late entry POP clients initiated prenatal care on average 2.2 weeks (C.L.=-0.59; 4.9) behind their controls. Although POP clients initiated care later, they obtained on average the same number of prenatal visits (7.1) as their controls.

Only 17.4% of late entry POP clients received adequate prenatal care compared to 21.8% of their controls. The proportion of late entry POP clients who experienced one or more pregnancy/delivery complications was slightly higher than for their controls. Approximately twenty six percent (26.1%) of POP clients and 22.6% of controls experienced morbidity. None of these differences were statistically significant.

Table 5.13
Late Entry[1] Maternal Outcomes-Initiation and Visits

	POP Clients (N=46)	Controls (N=138)	Mean Difference	95% Confidence Limits
Initiation of Prenatal Care (weeks)*	17.1 ± 7.1	14.9 ± 5.0	2.2	(-0.59; 4.9)
Number of Prenatal Visits*	7.1 ± 2.9	7.1 ± 1.9	-0.004	(-0.08; 0.79)

[1] Late Entry was defined as program entry between 21 and 28 weeks of gestation.
* Mean ± Standard Deviation

Table 5.14
Late Entry[1] Maternal Outcomes-Adequacy and Morbidity

	POP Clients (n=46)	Controls (n=138)	Odds Ratio	95% Confidence Limits
Adequacy of Prenatal Care § (%)	8 (17.4%)	30 (21.8%)	0.78	(0.54; 1.1)
Maternal Morbidity ¡(%)	12 (26.1%)	31 (22.6%)	1.27	(0.58; 2.8)

[1] Late Entry was defined as program entry between 21 and 28 weeks of gestation.
§ As measured by modified Kessner Index (Appendix C)
¡ Maternal Morbidity included any one of the following: anemia, placenta previa, placenta abruptio, polyhydramnios, oligohydramnios, pregnancy induced hypertension, gestational diabetes, preeclampsia, toxemia, threatened premature labour and post partum hemorrhage.

Late Entry Infant Outcomes

Results of the late entry subanalysis are presented in Tables 5.15 and 5.16. Table 5.15 showed both groups of infants were very similar with regard to measures of growth. Late entry POP infants had slightly shorter gestations than their control infants, with a mean difference of 0.6 weeks. In addition to being slightly younger, late entry infants were on average 42 grams lighter (C.L.=-273.6; 190.7). Late entry POP infants had slightly smaller mean head circumferences (0.63 centimeters) and were slightly shorter (0.75 centimeters) than their control infants.

There were no statistically significant differences in any measure of infant growth between late entry POP infants and their control infants. Once again, late entry POP infants experienced greater variability in their outcomes.

Table 5.15
Late Entry[1] Analysis-Infant Growth

	POP Clients (N=46)§	Controls (N=138)§	Mean Difference	95% Confidence Limits
Gestational Age (weeks)*	38.3 ± 2.8	39.0 ± 1.5	-0.67	(-1.6; 0.26)
Birth Weight (grams)*	3,273 ± 765	3,315 ± 395	-41.5	(-273.6; 190.7)
Head Circumference (centimeters)*	34.3 ± 2.3	34.9 ± 1.7	-0.63	(-1.5; 0.24)
Length (centimeters)*	50.5 ± 3.1	51.3 ± 2.8	-0.75	(-2.3; 0.80)

[1] Late Entry was defined as program entry between 21 and 28 completed weeks of gestation.
* Mean ± Standard Deviation
§ For gestational age and birth weight only

Similar to both previous infant analyses, although the two groups of infants look similar with regard to growth measurements, they were very different with regard to measures of morbidity (Table 5.16). Once again, with the exception of small for gestational age, late entry POP infants experienced more morbidity than their control infants. The differences, when compared with the overall analysis were more extreme.

The rate of preterm birth was 21.7 per 100 births for late entry POP infants compared with 9.4 for their control infants. The difference (O.R.=2.7, C.L.=0.98; 6.6) was borderline significant. Late entry POP infants born also had a higher rate of low birth weight at 15.2 per 100 births compared with 8.0 for their control infants. The difference resulted in an odds ratio of 2.11 (C.L.=0.76; 5.8).

Again, the results of small for gestational age were the reverse of those previous, and showed late entry POP infants had a lower rate of small for gestational age than their control infants. The rate of small for gestational age was 10.9 per 100 births for late entry POP infants and 14.5 for control infants (O.R.=0.72, C.L.=0.26; 2.0). The rate of large for gestational age was 17.4 per 100 births for late entry POP infants compared with 8.7 for their control infants (O.R.=2.88, C.L.=0.87; 7.2).

The number of infants experiencing one or more perinatal conditions was 13.0 per 100 births for late entry POP infants compared with 6.7 for control infants. This difference resulted in an corresponding odds ratio of 2.13 (C.L.=0.75; 5.0). Again, considerably more late entry POP infants were born with one or more congenital anomalies than their control infants. The rates were 15.2 per 100 births and 5.9 respectively. The resulting difference was borderline significant with an odds ratio of 2.86 (C.L.=0.99; 8.1).

Statistical results of infant morbidity showed that late entry POP infants were not statistically different from their control infants with regard to measures of infant morbidity. However, for two measures, preterm birth and congenital anomalies the differences bordered on significant.

Table 5.16
Late Entry[l] Analysis-Infant Morbidity

	POP Clients (N=46)	Controls (N=138)	Odds Ratios	95% Confidence Limits
Preterm Birth ∞(%)	21.7	9.4	2.7	(0.98; 6.6)
Low Birth Weight ƒ(%)	15.2	8.0	2.11	(0.76; 5.8)
Small for Gestational Age ∂(%)	10.9	14.5	0.72	(0.26; 2.0)
Large for Gestational Age i(%)	17.4	8.7	2.5	(0.87; 7.2)
Perinatal Conditions •(%)	13.0	6.7	2.13	(0.75; 5.0)
Congenital Anomalies ¢(%)	15.2	5.9	2.86	(0.99; 8.1)

[l] Late Entry was defined as program entry between 21 and 28 completed weeks of gestation.
∞ Less than 37 completed weeks of gestation.
ƒ Less than 2500 grams.
∂ Birth weight less than 10th percentile for gestational age.
i Birth weight greater than 90th percentile for gestational age.
• One or more of the following conditions:birth infections, birth trauma, seizures, respiratory distress, hemorrhage, narcotic abstinence syndrome, fetal alcohol syndrome, and neonatal intensive care admission.
¢ One or more condition under ICD-9 codes 740-759.

Subanalysis-Groups at Risk

To determine if there were any differential program effects based on risk status, a second subanalysis was performed. This subanalysis examined program impacts for women with risk characteristics for low birth weight: adolescence; primiparous women; single women and smokers. As it was questionable whether aboriginal race, in and of itself, is a risk factor for preterm birth and large for gestational age, women were stratified by race. Select infant outcomes were measured, these were: low birth weight, preterm birth and small for

gestational age. As women were not matched on two of these risk factors, smoking and single marital status, the matching technique was eliminated for this subanalysis. The results of the subgroup analysis is presented in Tables 5.17 and 5.18.

The results of the subanalysis for aboriginal women are presented in Table 5.17. Across all risk categories infants of aboriginal POP clients had lower birth weights than infants of aboriginal controls. For both POP clients and controls, infants born to adolescents had the heaviest average birth weights. The difference in birth weight ranged from 122 grams for smokers to 187 grams for primiparous women. For three of the four risk groups (adolescents, primiparous, single) in the subanalysis, infants of aboriginal POP clients experienced higher rates of adverse outcomes than did infants of aboriginal controls.

More aboriginal adolescent POP clients (15.0%) had infants born with low birth weight than did aboriginal adolescent controls (2.4%). This difference produced an odds ratio of 7.41 and statistically significant confidence limits of 1.1 and 38.1. Just over twenty one percent (21.4%) of aboriginal primiparous POP infants were small for gestational age compared with 4.4% of aboriginal primiparous control infants. This difference was statistically significant (O.R.=6.14; C.L.=1.2; 32.6).

The results are somewhat mixed, but generally reversed for aboriginal smokers. Although confidence limits were not statistically significant, program effects were seen for aboriginal POP smokers. There was a 2.1 fold difference in the

rate of small for gestational age for infants born to aboriginal POP smokers (7.1%) and aboriginal smoking controls (15.4%).

Table 5.17
Subanalysis-Aboriginals

Risk Characteristic	N	Birth Wt. (grams)	LBW^{f} (%)	PB$^{\infty}$ (%)	SGA$^{\partial}$ (%)
Adolescent					
POP Clients	20	3348	15.0†	20.0	10.0
Controls	42	3495	2.4	4.8	2.4
Primiparous					
POP Clients	14	3191	14.3	21.4†	14.3
Controls	45	3380	4.4	4.4	6.7
Single					
POP Clients	29	3307	6.9	10.3	6.9
Controls	61	3434	3.3	4.9	3.3
Smoker					
POP Clients	14	3234	7.1	14.3	7.1
Controls	39	3356	10.3	10.3	15.4

$^{\infty}$ Preterm Birth, less than 37 completed weeks of gestation
^{f} Low Birth Weight, less than 2500 grams
$^{\partial}$ Small for Gestational Age,birth weight less than 10th percentile for gestational age
† Statistically Significant ($p \leq 0.05$)

The results of the subanalysis for caucasian women are presented in Table 5.18. In all risk categories infants of caucasian POP clients had higher mean birth weights than infants of controls. Once again, for both POP clients and controls, infants born to adolescents had the heaviest average birth weights. The difference in birth weight ranged from 58 grams for primiparous women to 181 grams for smokers. In contrast to aboriginal women, across all four risk groups, infants of caucasian POP clients experienced lower rates of adverse outcomes than infants of caucasian controls.

None of the infant outcome measures had statistically significant confidence limits. However, there were two infant outcomes for which differences between the comparison groups were large. There was a 3.07 fold difference in the proportion of small for gestational age infants born to caucasian adolescents. Just over six percent (6.7%) of caucasian adolescent POP infants were small for gestational age compared with 20.6% of caucasian adolescent control infants. There was a 3.22 fold difference in the proportion of preterm births to single women. Four percent of caucasian single POP clients gave birth prematurely compared with 12.9 % of caucasian single controls.

Table 5.18
Subanalysis-Caucasians

Risk Characteristic	N	Birth Wt. (grams)	LBW^{f} (%)	PB$^{\infty}$ (%)	SGA$^{\partial}$ (%)
Adolescent					
POP Clients	15	3438	6.7	6.7	6.7
Controls	68	3292	10.3	8.8	20.6
Primiparous					
POP Clients	21	3320	13.6	9.1	13.6
Controls	87	3262	11.5	11.5	19.5
Single					
POP Clients	25	3373	8.0	4.0	16.0
Controls	93	3245	10.8	12.9	24.7
Smoker					
POP Clients	29	3347	6.9	6.9	17.3
Controls	88	3166	11.4	12.5	23.8

$^{\infty}$ Preterm Birth, less than 37 completed weeks of gestation
^{f} Low Birth Weight, less than 2500 grams
$^{\partial}$ Small for Gestational Age, birth weight less than 10th percentile for gestational age

SUMMARY

The stated aim of the Pregnancy Outreach Projects is to identify women at risk in the community, engage them in prenatal care services and support them in making behavioral changes to reduce their risk of having low birth weight infants or other adverse pregnancy outcomes (Pregnancy Outreach Projects: Project Handbook, 1993). The focus of care is on behavior modification. Appropriate nutritional intake, enhanced emotional support, smoking, alcohol and drug reduction are the primary behaviors of interest in the programs.

With the focus of care on behavior modification, it was expected that maternal program effects could be realized in three areas, attainment of prenatal care services, monitoring of prenatal condition and attainment of appropriate weight gain. Given the nature of long term participation, it was also expected that women who entered the programs early would have more opportunity to modify their behavior and therefore obtain better outcomes.

Infant program effects were more problematic to determine for two reasons; the late cutoff point for entry into the programs (28 weeks) and the time lag between knowledge attainment, and attitudinal and behavioral change. As the programs focused on maternal behaviors known to effect primarily infant weight gain, infant program effects could be expected in gestational age appropriate weight gain, particularly for infants of women who entered the programs early (prior to 20 weeks gestation). Given the present program structure, maternal behavioral change may have occurred too late in pregnancy for women who entered the programs late (after 20 weeks gestation), to transfer

benefits of the intervention to their infants. Therefore it was unclear if infants of women who entered late would have significantly different outcomes than controls.

Results of the analysis for the two study groups overall showed that POP clients, on average, initiated prenatal care slightly earlier and obtained significantly more prenatal visits than their matched controls. A slightly greater proportion of POP clients received adequate prenatal care and a slightly smaller proportion experienced morbidity. (Due to limitations of the data base, maternal weight gain could not be measured.) It was expected that the programs might not be able to influence initiation and adequacy of prenatal care given that POP clients entered the programs at any time during their first 28 weeks of pregnancy. The programs may have influenced the number of prenatal visits attained, though the difference between the two study groups was modest.

In measures of growth (gestational age, birth weight, head circumference and length) the two groups of infants were similar. However, for measures of infant morbidity the results were mixed. A greater proportion of POP infants experienced preterm births, low birth weight, large for gestational age, perinatal conditions and congenital anomalies. The differences were significant for rates of preterm birth and congenital anomalies. However, POP infants had a significantly lower rate of small for gestational age. Given the strong nutritional component of the programs, and emphasis on smoking cessation, it is likely that program effects were shown in the differential rate of small for gestational age between the two groups of infants.

In the early entry subanalysis, results indicated that women who entered the programs early may have had more time to modify their behavior, as their maternal outcomes were better than those of their controls. With the exception of maternal morbidity, where their was no difference, early entry POP clients had statistically better maternal outcomes than their controls.

For POP clients who entered after mid pregnancy, the programs likely did not have the opportunity to influence maternal behavior change. POP clients had slightly worse maternal outcomes than their controls. By virtue of coming late, the programs could not influence initiation or adequacy of prenatal care. The programs may have been able to influence the number of prenatal visits. Although POP clients initiated care on average 2 weeks later than their controls, they obtained the same average number of visits. None of the differences for the late entry subanalysis were statistically significant.

The infant subanalysis based on entry into the programs followed similar patterns as the overall analysis. In the early entry analysis, although the two groups of infants looked similar with regard to measures of infant growth, they were very different with regard to measures of morbidity. Once again, with the exception of small for gestational age, early entry POP infants experienced more morbidity than their control infants. Once again it was possible that program effects were being shown for POP infants, who obtained a lower rate of small for gestational age than control infants. The pattern of infant results was again similar for late entry POP subanalysis. POP infants again, had a lower rate of small for gestational age, but higher rates of other adverse outcomes, compared to their control infants. For two morbidity outcomes, preterm birth and

congenital anomalies, POP infants had outcomes that were borderline significant.

It was interesting to note that although POP clients who entered early looked very different than those who entered late (Table 5.9), the analyses based on time of entry showed little difference from the overall analysis. Early versus late entry into prenatal care had little effect on actual outcomes, the effect of time of entry was instead shown in augmented or diminished differences in outcome measures between the two subgroups of POP clients and controls.

Results of the subanalysis based on subgroups at risk show that both aboriginal and caucasian adolescent women (both POP clients and controls) had infants with the heaviest average birth weights. Although some researchers have found that socioeconomically advantaged adolescents have heavy infants, poor socioeconomic circumstances in addition to young maternal age has not been associated with heavy infants.

Measures of infant morbidity were very different for aboriginals and caucasians. With one exception, aboriginal POP clients had infants that were at greater risk of low birth weight, preterm birth and small for gestational age than were infants of aboriginal controls. Program effects may have been seen for aboriginal smokers whose infants had lower rates of low birth weight and small for gestational age. Caucasian POP clients experienced the opposite results. Their infants were at decreased risk of adverse outcomes, across all risk categories, than were caucasian control infants. Although none of the differences were statistically significant, large differences favoring POP clients

were seen in the rate of small for gestational age for infants of adolescents, and the rate of preterm birth for single women.

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CHAPTER 6

DISCUSSION OF RESULTS AND IMPLICATION OF STUDY

DISCUSSION

The association between socially disadvantaged pregnant women and adverse infant outcomes, has been consistently documented in studies over the past five decades. In an attempt to prevent low birth weight and other adverse outcomes, comprehensive prenatal care programs that identify and provide specialized services to socially disadvantaged women have evolved since the 1970's. Comprehensive prenatal care programs that provide lifestyle, nutritional and psychosocial interventions have been developed to improve maternal health and therefore, infant outcomes. Although several studies have described programs that attempt to reduce low birth weight and/or preterm birth, the results of the available studies have been inconsistent. The findings of the present study will be compared to previous reported studies to examine the impact of POP on maternal and infant outcomes.

Maternal Outcomes

The ability of comprehensive prenatal care programs to improve maternal compliance with prenatal visits, has been well documented in the literature. This study found an association between participation in comprehensive care (POP) and improvement in measures of prenatal care outcomes relative to the matched comparison group. Although POP clients initiated care earlier and a greater proportion obtained adequate care than controls, neither result is statistically or clinically significant. No clear trends regarding the impact of

comprehensive prenatal care on these measures were shown in the literature. This could be expected, as comprehensive programs have little control over when women enter prenatal care (other than setting a maximum length of gestation limit), therefore, their ability to influence initiation and adequacy of prenatal care is severely limited.

On the other hand, comprehensive prenatal care programs have consistently been shown to increase the number of prenatal care visits participants obtain. This study found a statistically significant difference in the number of prenatal visits obtained by POP clients. Although the size of the difference (0.5 visits) was the same as that found by Hardy et al. (1987), it was markedly smaller than the 3 visit difference found by Elster et al. (1987), and somewhat smaller than the 1.5 visit difference found by Polland et al (1992) and the 1.1 visit difference found by Smith et al (1978). Opinions of prenatal care experts cast doubt on the clinical significance of this 0.5 visit difference[29].

Examining the number of prenatal care visits, in and of itself, as a measure of maternal health is somewhat risky. Women who obtain several visits may have more pregnancy problems that require closer monitoring or may simply be responding to recommended number of visits. Conversely, women who obtain few visits may have uncomplicated pregnancies and not require close monitoring or simply not know the need to obtain early and regular care. However, even with these divergent views, investigators still consider the number of prenatal visits to be an important indicator of prenatal care management.

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[29] Drs. M.Cox & B. Ridyard, Obstetrician & Gynecologist, personal communication.

Very few studies examined pregnancy and/or labour and delivery complications for measures of maternal morbidity, and for those that did, no clear trend emerged. Both Olds et al (1986) and Hardy et al (1987) found that comprehensive care participants suffered less maternal morbidity (using composite measures) and had better managed pregnancies than did their comparison groups. Smith et al. (1978) found that comprehensive care participants experienced more morbidity. Although a finding of more morbidity seems counterintuitive, this could occur if intervention women were more closely monitored than controls. The rate of maternal morbidity was very similar between POP clients and controls in this study. Like measures of prenatal care, this measure can be somewhat misleading as increased rates of reported maternal morbidity may result from either better monitoring or increased risk, the reverse is also true.

Infant Outcomes

With the exception of diminished infant mortality, no clear trends have emerged from the literature with regard to the impact of comprehensive prenatal care on infant outcomes. None of the randomized trials reviewed found intervention impacts, while approximately half of the case-control studies found comprehensive care participation improved infant outcomes. Some studies found improvements in the rate of low birth weight but not in preterm birth, while others found the reverse.

This study found that the impact of comprehensive prenatal care on infant outcomes was mixed. The true impact of the programs may have been shown in the statistically and clinically lower rate of small for gestational age infants

between POP clients and control. Given the emphasis placed on improving nutritional status and decreasing risky lifestyle behaviors, (especially smoking) in the program, this result is likely. Unfortunately, comparisons of this outcome measure with the literature are hard to make. With one exception, none of the reported studies documented rates of intrauterine growth retardation or term low birth weight. Comparisons between small for gestational age and low birth weight are not appropriate because both term and preterm births are included.

Although a significantly (both statistically and clinically) greater proportion of POP infants were born preterm and with congenital anomalies (correlated outcomes), these outcomes are likely not a reflection of a lack of program effects. There are two plausible explanations for these results: First, because preterm labour education and management were not included in the program, program participation would not be expected to influence the rate of preterm birth. Second, a greater proportion of POP multips (17%) had experienced at least one previous preterm infant compared with 11.9% of control multips. Many of these POP clients had experienced three or more preterm births. Therefore, the programs did not address measures to combat preterm birth and POP clients as a whole, were at greater risk for this outcomes.

POP infants also experienced higher rates of low birth weight, large for gestational age and perinatal conditions. Although, none of the differences were statistically significant, the 1.6 to 1.7 fold differences in these rates of adverse outcomes makes them all clinically significant.

Impact of Program Entry on Maternal and Infant Outcomes

In the literature, two measures were utilized to determine if there were differences in maternal and infant outcomes as a result of intensity of service; (1) the number of comprehensive visits or, (2) the length of gestation covered by comprehensive care. Due to lack of consistency in measuring comprehensive care visits for POP clients, the latter measure was chosen in an attempt to measure differential impacts of the program. As a measure of length of gestation covered by comprehensive care, the utilization of number of months of prenatal coverage is controversial, particularly when evaluating infant outcomes. Women who deliver preterm infants bias the results to indicate that less gestational coverage leads to poorer infant outcomes. The present study avoided that methodological pitfall by measuring gestational age at enrollment categorized as before or after midgestation.

Similar to the trend found in the literature, this study found that women who entered care early obtained significantly (both statistically and clinically) better prenatal care coverage and experienced less morbidity than their controls. As both groups of women had very similar sociodemographic characteristics, the reasons for this difference was not clearly apparent. Some sort of motivational bias that favors POP clients to enter care early and comply with the recommended number of visits is a plausible explanation. Alternately, some unmatched variable, more common among POP clients than controls, could have influenced early program participation.

The impact of the programs for women who entered prenatal care late is harder to measure. Looking for program effects by measuring initiation of prenatal care and adequacy of care would be misleading, as the programs have no influence over these outcomes for late entering clients. Only by examining the number of prenatal visits obtained in conjunction with initiation of prenatal care can the influence of the program be shown. It is doubtful that the programs had any impact on maternal outcomes for late entering clients as they obtained the same number of visits as their controls and started care only two weeks later.

In contrast to trends in the literature, the present study found that infants of women who initiated prenatal care early did not have significantly lower rates of adverse outcomes compared to their controls. In fact, with for most of the morbidity outcome measures, POP infants had higher rates of adverse outcomes. For one measure, congenital anomalies, did the 3 fold difference reach both statistical and clinical significance.

Reversing the trend was the outcome measure small for gestational age. Although the difference was not statistically significant, the 1.6 fold difference is clinically significant. Published reports found greater intensity of service to be associated with better infant outcomes. Both Olds et al (1986) and Hardy et al (1987) found that women who registered early for prenatal care had infants that were significantly heavier than those of the comparison group. Although, the birth weight results in this study follow the same general pattern, the impact of POP participation on birth weight differences was minimal. The reasons for lack of statistically significant program effects for women with greater prenatal care contact is unknown. Perhaps variables not controlled in the design

confounded the results. Alternatively, the study might not have had enough power to detect true differences.

Similar to the trend in the literature, infants of POP clients who initiated comprehensive care late were not statistically different from infants of their controls. From a clinical perspective, POP infants had significantly higher rates of most adverse outcomes, again with the exception of small for gestational age. However, the differences between the two groups in this subanalysis may have nothing to do with program impact and everything to do with late entry effects. By virtue of entering the programs between 21 and 28 weeks of gestation, clients may not have had adequate time to transfer benefits of behavior modification onto their infants. Once again, the sample size of this subanalysis was to small to rule out chance as an alternative explanation for the statistically nonsignificant results.

Impact of Program on Subgroups at Risk

The present study found differential program effects on infant outcomes when stratified by maternal race and risk characteristics. Although in general, aboriginal POP clients had higher rates of adverse infant outcomes than aboriginal controls, clinically significant program effects were clearly shown in the rate of small for gestational age for infants of POP smokers. While many studies found infants of minority women who received comprehensive care, mainly blacks, to have better infant outcomes, no studies examined program impacts for women of aboriginal race. Therefore comparisons to the literature are impossible.

Caucasian POP clients regardless of risk category had much lower rates of adverse infant outcomes than caucasian controls. Clinically significant program effects were shown for infants of both adolescents and single women. This finding is in general agreement with trends in the literature that found infants of adolescents, particularly young adolescents obtained significant benefits from comprehensive care. In this study, infants of POP adolescents were on average 148 grams heavier than control infants and experienced a 3.07 fold decrease in their rate of small for gestational age. Olds et al (1986) found that young adolescents had infants that were on average 395 grams heavier than infants of the comparison group. Infants of program adolescents also had significantly lower rates of preterm birth and low birth weight. Peoples et al (1983) found that program adolescents had significantly fewer infants born with low birth weight. Hardy et al. (1987) found that adolescents had the heaviest infants and the lowest rate of small for gestational age infants. As the size of the adolescent population in this study was very small, there is no way of knowing if the results were due purely to chance, however, they are consistent with the findings of other studies.

One interesting finding was that regardless of race or intervention group, infants of adolescents had the highest mean birth weight. The trend in the literature has been that infants of adolescents have had lower mean birth weight than non-adolescent mothers. While some studies have found age to be an independent risk factor, others have found increased socioeconomic risk status to be an independent risk factor. Given that all the adolescents in this study were socioeconomically disadvantaged, the finding of heavier birth weights is contrary to current trends.

Other Issues

Two other issues deserve comment. First is the finding that, in every outcome measure, the standard deviations for POP clients showed more variability than those of controls. There are two possible explanations for this difference. First, this difference in variability may be due to differences in the degree of risk between the two groups. POP clients were at risk for adverse pregnancy outcome based on a broad range of social, demographic, economic, medical or obstetrical risks. Risk characteristics for controls were limited to sociodemograhic variables. As controls were more homogeneous than POP clients, they may have been at less risk. Second, the variability in standard deviations for outcomes measures may simply have reflected the small size of the POP client group compared to the comparison group.

The second issue relates to the use of the screening/assessment tools. The ability of the T-ACE and IPRIT screening tools to accurately determine a high risk population are questionable. The IPRIT tool has not been tested or evaluated against any measure, therefore its predictive values are unknown. Although the T-ACE tool is used by some physicians in clinical practice, it has mediocre sensitivity and a poor predictive value. Therefore it's ability to appropriately select a "high risk" group is questionable.

LIMITATIONS

Despite careful planning, this study was not immune to problems that limit the validity, reliability and generalizability of the statistical anlayses. The most critical threats are discussed below.

The most serious limitation in this study is selection bias. Referrals to the programs were almost equally split between self referral and community health agency referral. It is not known if health attitude and behavior or motivational levels differed between those that self selected and those that were agency referrals. It may be that individuals who self selected had higher levels of motivation than other potential clients which could have impacted the likelihood of entry and retention in the program. Individuals could have been referred to POP either because they also were highly motivated, or, conversely, had lifestyles and circumstances that put them at risk for adverse pregnancy outcomes. Thus as a group the POP clients may have had differences in susceptibility.

It is also likely that the POP clients as a group could have differed from controls. It may be that individuals at extreme risk for adverse pregnancy outcomes were referred to the programs, either through self or agency referral while those with modest risks were not. As there were no means available to evaluate differences in health beliefs and behaviors between the two study groups, it is possible that selection bias could have resulted in differences in susceptibility between these groups. Selection bias would have acted to diminish the impact of the programs. The impact of selection bias could have been reduced if it had

been possible to select controls from a time period prior to the start of the programs.

The power of this study to detect a 10% absolute difference in the rate of low birth weight (from 15% to 5%) was lower than predicted. In the design stage it was estimated that 125 POP clients would be available for this study. Matched 1:3 the study would have had an 85% chance of detecting a true difference. With the POP group limited to 106 clients, the power decreased to 70%. Although not optimal, this level of power was comparable (if not better) than many of the studies reviewed in the literature.

This study was also subject to misclassification bias. Computerized record linkage was used to identify POP clients within the UBC Perinatal Study data base. Following this and a manual review, three POP clients were not identified. It is possible that the missing women could have been selected as part of the control group. The impact of misclassifying these three POP clients as controls would be small, as the missing women accounted for only 0.7% of the study sample.

It is not known if the matching strategy employed in this study adequately selected a control group of comparable risk to POP clients. Stratification and matching are the design techniques commonly used to counter selection bias and ensure that desired similarities occur between the compared groups. In this study the matching technique was employed and three controls were matched to each POP client based on four demographic risk factors. Although, a demographic matching process has historically been used in public health

epidemiological studies, demographic variables may not be the best predictors of risk in this group.

The study would have been enhanced if controls could have been matched to each POP client, based on the client's particular risks. Matching on client specific risks would have ensured that each subset had similar risks. Social and physical variables including reproductive risk, maternal height, pregravid weight, weight gain and smoking status have higher attributable risks for adverse pregnancy outcomes than the variables used. However, information on the former variables was either not collected or poorly recorded. As a result the statistical process of demographic matching may have omitted the crucial variables needed to predict or identify program impacts.

Although several experts have stated that in a retrospective matched case-control analysis, study groups should be matched on a maximum of four variables, there remains the possibility that the study groups were overmatched (Feinstein, 1985; Schlesselman,1982; Miettinen, 1970). The result of overmatching is the creation of two groups that are too similar, diminishing the ability of the study to isolate the effects of the programs and thereby reducing validity and statistical efficacy of results.

As mentioned previously, the necessity of maintaining matching in the data analysis is controversial. Although matched analyses are intuitively harder to understand, a matched analysis was completed because it was more likely to produce a statistically significant value than an unmatched analysis. Given the small sample size, this appeared to be the most appropriate action. In addition,

matching controlled for many of the variables that would likely confound the results.

Although control for certain known risk factors was conducted through the matching process, there remained several uncontrolled variables that were possible confounders. Preexisting health status was a potential confounder as information pertaining to participants physical and psychological health was not available. A greater proportion of multiparous POP clients than controls experienced a previous poor pregnancy outcome, this is also a potentially serious confounder. Many other uncontrolled variables including health care practices, reproductive risk, environmental influences, lifestyle habits and nutritional status could have affected birth outcomes. Therefore, the study results are confounded to the extent by which differences in uncontrolled variables between the two study groups existed.

Prenatal care was another confounder in this study. There was no way to ascertain if controls received any additional prenatal care. Although the POP was the only comprehensive intervention in the area, controls could have received interventions from other social service agencies. The possibility of this occurring is highly unlikely, never the less, any additional prenatal care received by controls would diminish the differences between the study groups and could minimize the impact of the programs.

POP content and servicing also pose limitations. For the purposes of this study the three Vancouver Island programs are treated as being homogeneous in their service provision. This is not likely to be true, as there may be systematic differences in program delivery between the sites. However, it is impossible to

identify program differences that may have influenced maternal and infant outcomes.

This study was unable to quantify or qualify the amount and type of intervention provided to individual clients in the POP. Therefore, it is impossible to ascertain the most effective aspects of the intervention efforts, nor which clients were the most or least responsive to intervention efforts.

Finally, as only the Vancouver Island POP have been evaluated in this study, and the target groups and services differ among all the programs, the conclusions reached are limited to the Vancouver Island POP and may not be applicable to all programs.

The use of secondary data from the UBC Perinatal Study limited both the study design, scope of research questions and conclusions reached. Despite these limitations the study did provide a confirmation of the relationship between POP and maternal and infant outcomes. Given these relationships there are a number of policy and research recommendations that can be made.

IMPLICATIONS

Pregnancy Outreach Project Implications

In this study POP participation was found to be associated overall with slightly improved maternal outcomes. However, neither the role of POP participation per se, not the impact of any comprehensive care program in improving infant outcomes has been clearly delineated. Given this, there are some areas in

which changes in program content would assist in the clarification of program impacts.

A careful examination of the screening tools should be undertaken. An effort should be made to determine the sensitivity and specificity of the IPRIT if it is to remain as a screening tool. In addition, an examination of the content of the IPRIT should be undertaken as there are some variables for which the association with adverse pregnancy outcome has not been proven, or has in fact been disproved. Although the author of the T-ACE questionnaire found it to rate highly against the gold standard, the Michigan Alcohol Scrrening Test[30] this view is biased. Given the dismal predictive positive value (23%) and the mediocre sensitivity (69%), consideration should be given to it's replacement.

As program effects were seen for subgroups of women with increased risk, aboriginal smokers, adolescent and single caucasian women in particular, consideration should be given to targeting these subpopulations. By targeting specific subpopulations, referral agencies could more easily identify potential high risk women and refer them to the programs earlier. Clearly defining target subpopulations may increase the likelihood that POP services are reaching more women in need. The subpopulations traditionally targeted for comprehensive care programs are adolescents, minority women and those living in poverty. At this time it is unclear if the subpopulations most likely to benefit from POP services are specifically targeted.

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[30] Selzer, M.L. (1971). The Michigan Alcohol Screening Test: the quest for a new diagnostic instrument. American Hournal of Psychiatry, 127, 1653-1658.

In conjunction with targeting specific subpopulations, every effort should be made to encourage early entry into the programs. As behavior modification is a large component of the programs, and behavior change is a slow process, early entry maximizes program benefits. There were, for example, significant differences in maternal outcomes and the rate of small for gestational age for women who entered the programs early, compared to their controls. No significant differences were found for women who entered late. The time lag from program entry to delivery likely was too short for women who entered late (and their infants) to gain the benefit of behavior changes. Therefore it would be prudent to encourage early entry in order to maximize maternal behavior change and improve infant outcomes.

A broader range of endpoints should be considered when determining program objectives. As the POP include interventions that go beyond the pregnancy period, these should be reflected in the objectives. Program objectives should be expanded to include improvements in obstetrical and perinatal outcomes, improvements in appropriate parental behaviors, and improvements in social and emotional adjustment to the parental role.

It may also be important to consider expanding the scope of interventions to include the first postnatal year. Many studies (Elster et al., 1987; Heins et al., 1990; Spencer et al., 1989; Peoples et al., 1984; Kay et al., 1991) have found that comprehensive prenatal services did not impact pregnancy outcomes when compared with traditional prenatal care. In contrast, comprehensive care's major impact was on events that occurred during the first two postnatal years. Parental psychosocial health and parenting behaviors were found to be the major gains of comprehensive programs. This underscores the need to include

both pregnancy and parenthood intervention services in comprehensive programs. Expanding the scope of POP services could be achieved either through additional postnatal programming or affiliation with existing infant programs.

Research Implications

Although this study did find an overall improvement in one infant outcome, and program impacts for women based on initiation of care and risk categorization, it is important to clarify that this study was not exhaustive. Therefore, a number of areas in which further research could be explored have been presented.

As one of the major limitations of this study was the small sample size, an analysis covering a longer period of time with a larger sample size might produce more conclusive findings. Using a similar design but increasing the number of POP clients would provide a large enough case pool to ensure adequate power. This could be accomplished through pooling the birth results of all the programs over a 12 -18 month period. The availability of a comparable control group remains an issue. Controls would need to be selected based on predetermined medical, behavioral or psychosocial risks. Although increasing the sample size would increase power, the tradeoff may be in limited outcomes measures. Outcomes of interest would be limited to those available on hospital or vital statistics records.

Given the difficulty in determining a similar comparison group, a within-mother (before-after) study design could be utilized to determine program

impacts. Infants of women who participated in a POP during their second (or subsequent) pregnancy would be compared to the first (or previous) infant. By comparing sibling pairs, infants born to the same mothers, each woman becomes her own control. Thus selection bias and other confounders are eliminated, allowing true program impacts to be shown.

It may also be prudent, given limited financial resources, to determine if there are specific risk factors within the POP population that contribute greatly to adverse pregnancy outcomes. A multivariate analysis of women with adverse pregnancy outcomes could be conducted to determine which risk factors in this population contributed to adverse outcomes. This would again require pooling all POP sites, or collecting several years of data from a few sites. If certain risk factors could be identified, it may be possible to target potential clients most likely to benefit from comprehensive prenatal services.

There are also research issues related to the longterm impacts of the programs. An analysis that looks beyond the scope of traditional maternal and infant outcomes would assist in determining other program impacts. An evaluation that focused on family and infant outcomes during the first year of life would determine if there are any longterm impacts of the programs. Family outcomes could include social support during pregnancy, social and emotional adjustment to parenting, parent-infant interaction, and understanding of infant growth and development. Infant outcomes could include social adjustment and attatchment, growth and development measures, emergency room visits, hospitalizations and immunizations.

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APPENDIX A

Province of British Columbia

Ministry of Health and Ministry Responsible for Seniors

Individual Prenatal Risk Identification

Date: _____ Location: _____ Client ID: _____

SEE GUIDE FOR DEFINITIONS AND EXPLANATION.

Code	Description	Yes	Explanation
Physical Factors			
PF1	Previous pregnancy loss	☐	
PF2	Illness/condition with impact on pregnancy	☐	
PF3	Pre-pregnancy weight - body mass index (BMI)	☐	
PF4	Rate of weight gain	☐	
PF5	Inadequate nutrition	☐	
PF6	Previous child with anomaly	☐	
PF7	Previous child requiring neonatal intensive care	☐	
PF8	Multiple pregnancy	☐	
PF9	Birth interval	☐	
PF10	Grand multipara - 5 or more pregnancies	☐	
PF11	Established genetic risk	☐	
PF12	Age 17 and younger/ 36 and older	☐	
Substance Abuse/Misuse			
SA1	Cigarette smoking	☐	
SA2	Alcohol use	☐	
SA3	Inappropriate use of over the counter and prescription drugs	☐	
SA4	Other drug use	☐	
Psychosocial & Economic Factors			
PE1	Single parenthood	☐	
PE2	Delayed access to prenatal care	☐	
PE3	Refusal of/resistance to appropriate services	☐	
PE4	Isolation - ethnic, language and social	☐	
PE5	Limited learning ability/illiterate	☐	
PE6	Marital problems/unstable relationship/family violence	☐	
PE7	Mental health problems	☐	
PE8	Low self-esteem	☐	
PE9	Inability to cope/anxiety regarding pregnancy and baby	☐	
PE10	Unrealistic expectations	☐	
PE11	Unwanted pregnancies/denial of pregnancy	☐	
PE12	Financial problems	☐	
PE13	Inadequate housing	☐	

A GUIDE FOR THE USE OF INDIVIDUAL PRENATAL RISK IDENTIFICATION TOOL

PURPOSE

The purpose of this form is to provide a tool which will identify some of the major factors that can influence the outcome of the pregnancy and at a quick glance provide the risk factors specific to the individual client. Program staff can use it as a checklist when determining the care plan for the client. It is intended to complement the prenatal assessment of the physician by highlighting lifestyle factors in particular.

The guide is not meant to be an all inclusive source of information of risks in families and pregnancies. It compiles in a single document basic information to assist professionals in the early identification of risks with the ultimate goal of reducing perinatal morbidity and mortality.

Personal experience, knowledge and intuition on the part of the professionals are as important, if not more, than whatever guide or form is used. The guide should be used with the knowledge and understanding of risks, situations and their effect on health to arrive at a decision for appropriate intervention.

The comprehensive multidisciplinary approach to care should be a sound principle to adopt. It will ensure that all points of intervention are covered and appropriate preventive measures are taken through community outreach and other family health programs of the health agency.

The lists of risk factors noted on the forms are not meant to be all inclusive. They are intended to cover the most frequent problems producing risk.

DEFINITIONS

In general, the risk factors that will increase the chances of morbidity and mortality are of a physical, nutritional, mental/emotional, socio-economic or occupational nature. For the purpose of this guide, the following definitions have been adopted:

risk: an increased probability of adverse outcomes

high risk groups: groups with increased probability of adverse outcomes

high risk families: families whose circumstances indicate high risk factors which may interfere with optimum family life and functioning

high risk pregnancy: a pregnancy in which the mother and/or the fetus has an increased probability of maternal and fetal morbidity or mortality prenatally and intranatally

high risk infant: newborn or infant with familial, maternal and perinatal factors that may lead to an increased probability of morbidity and subsequent disabilities

The risks are provided as a check list for coordinators to ensure they are discovering the risks that may be encountered with the perinatal client. A brief description of each risk is provided to help understand the risk factors.

PHYSICAL FACTORS

		YES	NO
PF1	Previous pregnancy loss	☐	☐
PF2	Illness/condition with impact on pregnancy	☐	☐
PF3	Pre-pregnancy weight - body mass index (BMI)	☐	☐
PF4	Rate of weight gain	☐	☐
PF5	Inadequate nutrition	☐	☐
PF6	Previous child with anomaly	☐	☐
PF7	Previous child requiring neonatal intensive care	☐	☐
PF8	Multiple pregnancy	☐	☐
PF9	Birth interval	☐	☐
PF10	Grand multipara - 5 or more pregnancies	☐	☐
PF11	Established genetic risk	☐	☐
PF12	Age 17 and younger/ 36 and older at time of delivery	☐	☐

PF1: Previous pregnancy loss

Previous pregnancy loss - abortion (both spontaneous and elective), stillbirth, neonatal and infant death (up to 365 days old), such as SIDS are significant factors. Depending on the cause of such loss the same conditions may be either present or occur again for another reproductive loss. The level of risk depends on the causative factor.

PF2: Illness/condition with impact on pregnancy

The following conditions would lead to unfavourable outcome of pregnancy if close medical surveillance is not provided: poorly controlled diabetes or hypertension, chronic renal failure, congenital or rheumatic heart disease, and very rapid weight gain. Other conditions may have an impact on pregnancy if not controlled by routine medical care, eg. mild hypertension, gestational diabetes, and urinary tract infections.

Many conditions may lead to premature labour, congenital anomalies, intrauterine growth retardation, and other associated morbidities. These include infections (rubella, STD, toxoplasmosis, genital herpes), abnormal presentation, surgical procedure during pregnancy, uterine and associated malformations, toxemia, anemia, bleeding, diabetes, hypertension, obesity, renal disease, isoimmunization, etc. The risk and its effects are related to the severity of the condition.

Other conditions such as blindness, deafness and physical handicaps can affect the mother in pregnancy. The level of risk will depend on the individual's abilities, compensating mechanisms, and support structure.

PF3: Pre-pregnancy weight

Body Mass Index (BMI) = $\frac{\text{wt (kg)}}{\text{ht}^2\ (\text{m}^2)}$

The underweight woman has a BMI under 19.8. A BMI of over 29 indicates obesity.

A woman's nutritional status prior to and during pregnancy are important factors that influence the health of the fetus and the baby. The mother's pre-pregnancy weight and weight gain during pregnancy are two factors which affect the infant's birth weight and thus the infant's health.

"No widely accepted standards of weight for height exist for adolescents. Except for very young girls or those who conceive within 2 years of menarche, adult BMI recommendations may be used provisionally to classify girls as underweight, moderate weight, overweight and obese." Nutrition During Pregnancy. National Academy of Sciences. 1990.

Note: 1 pound = 0.45 kilograms
1 inch = 2.54 centimetres
1 foot = .3048 meters

PF4: Rate of weight gain

Inadequate weight gain: 2nd and 3rd trimester

- if weight gain less than 1 kg/month for women beginning pregnancy with an acceptable BMI (BMI = 19.8 - 26)
- if weight gain is less than 0.5kg/month for obese women (BMI > 29)

Rapid weight gain: 2nd and 3rd trimester

- if weight gain is greater than 3 kg/month

Measurement should be carefully evaluated to avoid measurement or recording errors, or differences due to clothing, boots, shoes, etc. Inappropriate rate of weight gain may lead to low birthweight infants and related problems.

Underweight women (BMI < 19.8) are certainly at risk if their weight gain is less than 1 kg/month and overweight women (BMI > 26-29) if their weight gain is less than 0.5 kg/month. The literature does not identify specific guidelines for these populations.

Rapid weight gain may indicate fluid retention, multiple gestations, or excessive food intake. For the underweight woman (BMI < 19.8) with a weight gain > 3 kg/month, clinical judgement is required to determine whether this represents a health risk or is a result of 'catch-up' weight gain.

PF5: Inadequate Nutrition

Consistently less than the minimum recommended servings in 1 or more food groups, as outlined in the "B.C. Food Guide for Pregnancy":

less than 8 servings of Grain Products
less than 6 servings of Vegetables and Fruit
less than 3 servings of Milk Products
less than 2 servings of Meat and Alternatives

The *Baby's Best Chance: Parents' Handbook of Pregnancy and Baby Care* provides essential information with regards to nutrition requirements for the pregnant woman. The "B.C. Food Guide for Pregnancy" outlines the appropriate numbers of food group servings for adequate calories and nutrients. A deficiency can represent a serious risk to the development of the fetus and to the mother's health.

The assessment of the four food groups should be based on the client's reporting of her typical daily intake. It is recommended that the consulting nutritionist be involved in the nutrition screening aspect of the initial interview.

PF6: Previous child with anomaly or disorder

This includes conditions with impact on development of the child; eg. chronic heart disease, neural tube defects (i.e. spina bifida), cleft palate, fetal alcohol syndrome, fetal alcohol effects; and conditions which are more readily corrected or have only minor functional impairment, eg.

ventral-septal defects with spontaneous closure, minor orthopaedic abnormalities, uncomplicated pyloric stenosis, etc.

Cerebral palsy, mental retardation, congenital anomalies ... if the same perinatal conditions still exist, they may lead to the same risk in the present pregnancy.

Established genetic risk - either from previous pregnancies or from a familial history i.e., muscular dystrophy, cystic fibrosis, etc. is significant.

PF7: Previous high risk infant
High risk infants that were premature (<37 weeks), postmature (>42 weeks), or had a low birthweight (<2500 grams).

PF8: Multiple pregnancy
Prenatal mortality resulting from twin births is as high as 14%, the greatest mortality resulting from premature birth. Special emphasis should be placed on nutritional counselling for multiple pregnancy.

PF9: Birth interval
Although the optimum birth interval has not been defined, the incidence of fetal growth retardation and prematurity is consistently high when the birth interval is less than two years. Spacing allows time for the mother's body to recover and to be in optimal health before becoming pregnant again.

PF10: Grand multipara
Parity alone or combined with maternal age is significant. Higher risk of morbidity occurs at the first pregnancy and at the fifth pregnancy or more.

PF11: Age 17 and under/age 36 and over at time of delivery
Pregnant women 17 years of age and younger risk low birth weight infants. Pregnant women 36 years of age and over risk infants with chromosomal abnormalities.

SUBSTANCE ABUSE/MISUSE

		YES	NO
SA1	Cigarette smoking	☐	☐
SA2	Alcohol use	☐	☐
SA3	Inappropriate use of over the counter and prescription drugs	☐	☐
SA4	Other drug use	☐	☐

SA1: Smoking
Cigarette smoking has been shown to decrease infant birth weight in direct proportion to the amount smoked. Cigarette smoking increases the risks of perinatal morbidity and mortality. The growth-retarding effect of cigarette smoking and higher incidence of spontaneous abortions, stillbirths or placental complications among women who smoke during pregnancy may be due to several factors including direct toxicity of carbon monoxide, nicotine and/or other constituents of tobacco, reducing blood flow to the uterus affecting transfer of nutrients to the fetus, or suboptimal maternal food intake. Passive smoking (secondhand smoke) may also be a cause of concern during pregnancy due to the oxygen depleting effect of carbon monoxide.

SA2: Alcohol use
There is no known safe level of alcohol consumption for pregnant women. It is not possible at this time to say what is the minimum level of alcohol consumption that may endanger the fetus. Heavier alcohol misuse (such as maternal dependency) may lead to the fetal alcohol syndrome: low birth weight, failure to thrive, mental handicap, facial congenital anomalies, developmental delays, hyperactivity, etc. Alcohol (2 or more drinks per day or binge drinking) and other drug use (including tobacco and cocaine), may independently increase the risk of spontaneous abortion and low birth weight infants. When combined, fetal risk is greatly increased.

Use of the T-ACE questions is recommended to determine the risk of alcohol misuse.

Note: 1 Drink = 12 oz beer
= 5 oz wine
= 1 mixed drink (1.5 oz. or 'hard' liquor)
Binge = consuming 5 or more alcoholic drinks on any one occasion

SA3: Inappropriate use of over the counter and treatment drugs
Drugs may affect the intake, absorption, metabolism and/or utilization of nutrients in the body, thereby influencing maternal nutrition status. The effect that a drug has on the fetus depends on many factors including the type of drug, the amount taken by the mother, the stage of pregnancy at which it is taken, and the frequency and duration of its use. Some drugs are known to have or strongly suspected of having any teratogenic effect in humans. Women should discuss with their family physician before taking any medications.

Determine the pregnant woman's use of any drugs, including the use of herbs.

SA4: Other drug use (including cocaine, opiates, solvents, and poly-drug use)

Any needle drug use, any use of cocaine or crack, poly drug use, daily use of other drugs, for example tylenol #3 (codeine), hash, marijuana is to be considered a significant risk to the infant.

PSYCHOSOCIAL & ECONOMIC FACTORS

Social Environment: The effects of maternal social environment on the outcome of pregnancy are recognized to be both multiple and profound. 'Social environment' is described as the summation of numerous factors, including the family's standards of health and hygiene, housing and financial status, emotional and social support and so on. The effects may be direct or indirect and may be difficult to separate within the context of socio-economic status. It is the inter-relationship of these factors, rather than any single factor, that works to affect the outcome of the pregnancy.

		YES	NO
PE1	Single parenthood	☐	☐
PE2	Delayed access to prenatal care	☐	☐
PE3	Refusal of/resistance to appropriate services	☐	☐
PE4	Isolation - ethnic, language and social	☐	☐
PE5	Limited learning ability/illiterate	☐	☐
PE6	Marital problems/unstable relationship/family violence	☐	☐
PE7	Mental health problems	☐	☐
PE8	Low self-esteem	☐	☐
PE9	Inability to cope/anxiety regarding pregnancy and baby	☐	☐
PE10	Unrealistic expectations	☐	☐
PE11	Unwanted pregnancies/denial of pregnancy	☐	☐
PE12	Financial problems	☐	☐
PE13	Inadequate housing	☐	☐

PE1: Single parenthood

The frequency of cases of low birth weight infants and the perinatal mortality rates of infants born to unmarried mothers is higher than those of children of married women. Marital status alone is not necessarily an indicator of potential risk for mother and fetus so much as it is an indicator of an unwanted/unplanned pregnancy. These pregnant women, especially if unwed or teenagers, tend to neglect antenatal care and leave advice unheeded. Statistically, pregnancy complications occur more frequently in unmarried than in married women. The increased amount of risk can be associated with multiple social problems. Single parenthood still has an influence, but to a decreased amount, if financial and emotional support is present.

PE2: Delayed access to prenatal care

Early access to medical care and return follow-up visits are essential for risk identification and monitoring. Some of the factors to consider are no medical care by 20 weeks, frequent missed appointments, no follow-up on medical advice and no attendance at prenatal classes in a primipara.

PE3: Refusal of/resistance to appropriate services

Refusal of or resistance to appropriate services, such as Ministry of Social Services, poses obvious threats to the client's receiving appropriate medical care and support for the mother and the fetus. This refusal or resistance can be due to a lack of trust on the part of the pregnant woman due to past experiences within her family or community or previous requests for help may have been unmet in the past.

PE4: Isolation—Ethnic, language, social, and/or geographical

Ethnic or language isolation can tend to deprive mothers of available information and resources. This can apply to immigrant and refugee status women as well as Aboriginal women.

Social isolation i.e., lack of supports, possibly new to area, can create a void in resources, either classes or physicians, which can put a mother at risk of not being assessed early and receiving adequate care and attention. Social isolation in itself is a stress and must be dealt with in conjunction with the stress of pregnancy.

Geographic isolation can be an issue in remote areas as well as for mothers with limited transportation options and the location of facilities and programs.

PE5: Limited learning ability/illiterate

Limited learning ability/illiteracy especially if associated with other risks is significant. Problems can range from severe communicative disability to a limited ability to understand. These people may not have access to information nor an understanding of the importance of education regarding pregnancy, childbirth and child care.

PE6: Marital problems/unstable relationship/family violence

Marital problems/unstable relationship: Marital discord, lack of partner support, lack of extended family support may lead to a higher incidence of reproductive loss, low birth weight (preterm, small for dates) nutritional problems, absence of maternal child bonding, neglect and abuse resulting in developmental delays and other associated morbidities.

Family violence/abuse: Determine if the woman is currently in an abusive relationship, if there are affects on the emotional or physical health of the woman, or if there is a possibility of repetition during pregnancy or shortly thereafter.

Evidence of neglect - history of abuse/neglect, for example lack of positive parenting in the past, history of negative foster home placements.

A family history of abuse/neglect (emotional or physical) tends to repeat itself from generation to generation and where there is abuse present in the home, the new baby is in high risk of being abused and neglected.

PE7: Mental health problems

Mental health problems, current and previous occurrence(s), may shed light on one's family background, coping mechanisms, self-esteem and reactions to stress or crisis. As the pregnant woman strives to develop a degree of comfort with the many changes in social context and psychologic equilibrium, there often occurs a surfacing of old conflicts that were never adequately resolved in earlier developmental periods. For example, pregnant clients may experience conflicts of autonomy with their mothers, renewed rivalry with siblings, or active uncertainty about sexuality and disturbing fantasies about past relationships, each of which had been adequately dealt with prior to pregnancy but which now result in troubling family interactions or marital discord. Manifest problems in adjustment prior to pregnancy, such as marital discord, economic difficulties, poor self-concept, and neuroticism may be exacerbated by pregnancy. Anxiety allowed to go unallayed may lead to maladaptive mother-child interaction.

PE8: Low self-esteem

Low self-esteem can manifest itself in a pregnant woman having no confidence in herself, her body, her decision-making choices. Exhibition of depression, lack of self-worth or motivation, and uncaring of self and other people. She may even choose to be in an abusive relationship or refuse to avail herself of advice and information.

PE9: Inability to cope/anxiety regarding pregnancy and baby

Coping potential is the ability of the individual and family to adapt to stress. When individuals experience stress, they may use a variety of methods to cope. With an intense perception of threat, defense mechanisms such as denial, projection, rationalization, displacement and intellectualization may occur. The prolonged denial of the high-risk status of the pregnancy may result in failure to comply with therapeutic regimes. Anxiety regarding the pregnancy and baby may manifest itself in many expressed irrational fears and distortions. Women who are having difficulty accepting pregnancy and developing a relationship with the growing fetus may present with extreme anxiety about the condition of the baby and will be hypervigilant in looking for signs that 'something is wrong' with the pregnancy.

PE10: Unrealistic expectations

Unrealistic expectations of roles of mother and or father, baby and significant others can lead to frustration, stress, neglect and abuse. Another psychosocial maladaptation of pregnancy is failure to make adequate, concrete plans for postnatal care of the baby. The absence of family members or friends to assist in the care of the baby or, at the other extreme, passivity and over reliance on family members are signs of difficulty in adapting to pregnancy, as is unrealistic planning or inadequate preparation for managing the baby at home.

PE11: Unwanted pregnancy/denial of pregnancy

Pregnant women who have an unwanted pregnancy or unplanned pregnancy and/or who deny the pregnancy, can tend to neglect antenatal care and leave advice unheeded. The stresses in these women are very high.

PE12: Financial problems

Unemployment, very low income, and/or receiving social assistance may lead to a higher incidence of reproductive loss, low birth weight, nutritional problems, neglect and abuse resulting in developmental delays and other associated morbidities.

PE13: Inadequate housing

While this can be a difficult risk to assess, some of the features to be considered may be: lack of facilities (bathroom, cooking, bedroom, etc.), space/overcrowding, hazardous living conditions, pest infestation, etc.

For 'street people', this is a significant risk, as well as for others with an unstable functional household unit - where there is significant moving of the family and/or many people coming and going out of the house. This can be a high stress factor for the pregnant woman and her family.

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APPENDIX B

T-ACE Measurement

T-ACE is a measurement tool of four questions that are significant identifiers of risk drinking (i.e., alcohol intake sufficient to potentially dame the embryo/fetus).

For the Pregnancy Outreach Program the T-ACE is completed at intake. The T-ACE score has a range of 0-5. The value of each answer to the four questions is totalled to determine the final T-ACE score.

1. How many drinks does it take to make you feel high? 0 less than or equal to 2 drinks 2 more than 2 drinks	**T** olerance
2. Have people annoyed you by criticizing your drinking? 0 no 1 yes	**A** nnoyance
3. Have you felt you ought to cut down on your drinking? 0 no 1 yes	**C** ut Down
4. Have you ever had a drink first thing in the morning to steady your nerves or to get rid of a hangover? 0 no 1 yes	**E** ye Opener

Source: Sokol, Robert J., "Finding the Risk Drinker in Your Clinical Practice" in *Alcohol and Child/Family Health: Proceedings of a Conference with Particular Reference to the Prevention of Alcohol-Related Birth Defects*, edited by Robinson, G. and Armstrong R., Vancouver, B.C., December 1988.

Note: For the purposes of the Pregnancy Outreach Program Evaluation - a client is at risk for alcohol use if she has a positive T-ACE (a score of 2 or greater).

Rev93/06/24

APPENDIX C

Criteria for Adequacy of Care Index Levels*

Adequacy of Care	Trimester of First Prenatal Visit	Gestation (Weeks)	Number of Prenatal Visits
Adequate	First (1–3 Months)	13 or less	1 or more or not stated
		14–17	2 or more
		18–21	3 or more
		22–25	4 or more
		26–29	5 or more
		30–31	6 or more
		32–33	7 or more
		34–35	8 or more
		36 or more	9 or more
Less-than-Adequate	All Other Combinations		

* Source: Peoples et al, (1984). Evaluation of the Effects of the North Carolina Improved Pregnancy Outcome Project: Implications for State-Level Decision-Making. AJPH, 74(6), 549-554.