RISK FACTORS FOR SPONTANEOUS PRETERM BIRTH AMONG ABORIGINAL AND NON-ABORIGINAL WOMEN IN MANITOBA

by

MAUREEN ISABELLA HEAMAN, R.N., B.N., M.N.

A Thesis

Submitted to the Faculty of Graduate Studies

in Partial Fulfilment of the Requirements

for the Degree of

DOCTOR OF PHILOSOPHY

Faculty of Graduate Studies

Individual Interdisciplinary Program

University of Manitoba

Winnipeg, Manitoba, Canada

August 27, 2001

0-612-62639-3

THE UNIVERSITY OF MANITOBA

FACULTY OF GRADUATE STUDIES
*****
COPYRIGHT PERMISSION

RISK FACTORS FOR SPONTANEOUS PRETERM BIRTH AMONG ABORIGINAL AND NON-ABORIGINAL WOMEN IN MANITOBA

BY

MAUREEN ISABELLA HEAMAN

A Thesis/Practicum submitted to the Faculty of Graduate Studies of The University of Manitoba in partial fulfillment of the requirement of the degree

of

DOCTOR OF PHILOSOPHY

ABSTRACT

In the province of Manitoba, the incidence of preterm birth (PTB) has been increasing and is about 17% higher among Aboriginal than non-Aboriginal women. The purpose of this study was to identify risk factors for spontaneous PTB in Manitoba women, and to compare risk factors among Aboriginal and non-Aboriginal women. A case-control study was conducted at two tertiary care hospitals in Winnipeg, Manitoba. Cases were women who delivered a live singleton infant at less than 37 weeks gestation following spontaneous labor, while controls delivered between 37 and 42 weeks gestation. A ratio of two controls per every case was used, and stratified sampling by race was employed. An interview was conducted with each subject on the postpartum unit, and information was collected from the health record. Data were analyzed using SPSS and SAS. There were 226 cases (36% Aboriginal) and 458 controls (38% Aboriginal). Using stratified analyses, adjusted odds ratios (AOR) and 95% confidence intervals were calculated. Significant risk factors for PTB across both strata, after controlling for race, included: previous PTB, two or more previous spontaneous abortions, hospitalization during pregnancy, gestational hypertension, vaginal bleeding after 12 weeks gestation, smoking in the month prior to pregnancy, short stature, low total weight gain during pregnancy (less than 20 pounds), and inadequate prenatal care. Risk factors for non-Aboriginal women included abuse during pregnancy, low support from others, low self-esteem, rupture of membranes (ROM) before labor, and moving two or more times in the last year. Risk factors for Aboriginal women included ROM before labor, high perceived stress, and anemia, while age less than 19 years and single marital status were protective factors. After adjusting for other factors in a multiple logistic regression model, significant modifiable risk factors included smoking prior to pregnancy (AOR 1.69), low weight gain (AOR 3.41), and inadequate prenatal care (AOR 3.36). The population attributable risk was 24.5% for smoking prior to pregnancy, 22.3% for low weight gain, and 15.9% for inadequate prenatal care. This study identified some modifiable risk factors for PTB which can be targeted for public health interventions, and contributed to our understanding of differences in risk factors among Aboriginal and non-Aboriginal women.

ACKNOWLEDGMENTS

I would like to gratefully acknowledge all those who assisted and supported me in the process of conducting my dissertation research.

To my Advisor, Dr. Annette Gupton, for so capably chairing my PhD committee, for permitting me to be self-directed while at the same time providing guidance and encouragement, for generously sharing her expertise in nursing research, and for being a valued mentor and colleague throughout the years.

To Dr. James Blanchard, for serving on my PhD committee, for teaching me about epidemiology, for providing valuable assistance with study design and statistical analysis, and for contributing greatly to the quality of my dissertation.

To Dr. Raymond Currie, for serving on my PhD committee, for teaching me about survey research and questionnaire design, for assisting me with sociological concepts, and for his wise counsel and ongoing support during this project.

To Dr. Michael Moffatt, for serving on my PhD committee, for sharing his expertise in study design and methodology, and for suggesting the comparison of risk factors among Aboriginal and non-Aboriginal women.

To The Children's Hospital Foundation of Manitoba, Inc., for providing funding in the form of an operating grant and a small grant for this project.

To my research assistants, Kathy Feader, Ceceile Porter, Karen Daeninck, Karen Taylor, Valerie Cook, and Grace McDougall, for contributing their excellent interviewing skills and obstetrical nursing knowledge to data collection, and for their interest and enthusiasm throughout the project.

To Mary Cheang, Biostatistical Consulting Unit, Department of Community Health Sciences, for providing valuable statistical consultation.

To the participants in the focus group, for generously sharing their expertise related to Aboriginal people and health care of Aboriginal women, and providing assistance with interpreting results.

To the Manitoba Nursing Research Institute, for providing assistance with data entry (Shelley Turner) and grant administration (Marni Laurencelle).

To St. Boniface General Hospital and Health Sciences Centre for providing access to patients for data collection, and to the nursing staff who helped with recruitment of subjects.

To the women who participated in the study and gave so generously of their time during the busy postpartum period.

To my family, friends, and colleagues, whose support and interest during my doctoral studies was very much appreciated.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

Preterm birth is the most significant problem facing providers of maternal and infant care today (Creasy & Merkatz, 1990). Despite the progress made in perinatal medicine over the past two decades, including the introduction of new diagnostic and therapeutic technologies, there has been no improvement in the preterm birth rate (American College of Obstetricians and Gynecologists, 1995). In fact, the rate has been steadily increasing. In the United States, the incidence of preterm birth increased from 9.4% in 1981 to 11.8% in 1999, a rise of more than 20% (Ventura, Martin, Curtin, Menacker, & Hamilton, 2001). In Canada, the proportion of live births before 37 completed weeks gestation increased from 6.4% in 1981 to 7.1% in 1996, mainly due to an increase in the proportion of live births between 32 and 36 weeks gestation (Canadian Perinatal Surveillance System, 1999; Joseph & Kramer, 1997). In Manitoba, the preterm birth rate increased from 6.2% in 1989-1993 to 6.9% in 1994-1998 (Manitoba Health, 2000). In addition, Aboriginal women in Manitoba have about a 17% higher incidence of preterm birth than non-Aboriginal women . Based on data from the Manitoba Health Epidemiology Unit perinatal database, preterm births accounted for 7.66% of live births to Aboriginal women, compared to 6.39% of non-Aboriginal women during a three-year period from 1994 to 1996 (Personal communication, J. Blanchard, July 1998). Refer to Table 1.

Table 1.
Preterm Births in Manitoba, Comparing Aboriginal and Non-Aboriginal Women, for a three-year period 1994-1996

Race	20-27 weeks gestation	28-33 weeks gestation	34-36 weeks gestation	Total preterm births	% of total live births
Aboriginal*	26	89	351	466	7.66%
Non-Aboriginal	208	574	1853	2635	6.39%
Total	234	663	2204	3101	6.55%

* Aboriginal women were identified by treaty status.

These recent increases in preterm birth rates are concerning to health care professionals and policy makers alike, since more than 90% of all neonatal deaths occur among infants born preterm, and more than three-fourths of these deaths occur among infants born at less than 32 weeks of gestation (Ventura et al., 2001). Preterm infants are 40 times more likely to die in the neonatal period than are those with normal birth weights, and neurodevelopmental handicaps, such as cerebral palsy, seizure disorders, and mental retardation, are 22 times more common in less than 1500 gram infants versus 2500 gram infants (Morrison, 1990). In addition to the medical impact, the economic consequences of preterm birth also are significant. These consequences include the high cost of neonatal intensive care, frequent rehospitalizations in the first years of life, and special education and long-term care for infants with severe physical and neurological disabilities (Morrison, 1990). For each preterm low birthweight infant born in Canada, the neonatal intensive care and postneonatal care cost up to one year of age have been conservatively estimated at $48,183 in 1995, with a lifetime cost of $676,800 per surviving infant (Montquin & Lalonde, 1998). In the United States, there is a 50 fold differential in initial hospital costs and a 24 fold differential in first year medical costs between very low birth weight infants and all other infants (Petrou & Davidson, 2000). The burden on the family and society of caring for these premature babies is immense.

The etiology of preterm birth is multifactorial; risk factors include demographic, biomedical, behavioral and psychosocial characteristics. In Kramer's (1987) review and meta-analysis of 895 studies, he concluded that low pre-pregnancy weight, prior history of prematurity or spontaneous abortion, in utero exposure to diethylstilbestrol (DES), and cigarette smoking have well established causal effects for preterm birth, and the majority of prematurity remains unexplained. Berkowitz and Papiernik (1993), in a comprehensive review of the epidemiology of preterm birth in the United States, concluded that reasonably well established risk factors for preterm birth included black race, single marital status, low socioeconomic status, previous low birth weight or preterm delivery, multiple second trimester spontaneous abortions, cervical and uterine anomalies (including those associated with in utero DES exposure), multiple gestations and cigarette smoking. Probable risk factors included cocaine use, urogenital infections, and inadequate prenatal care. In one of the few Canadian studies on this topic, significant determinants of preterm birth included maternal short stature, noncompletion of high school, unmarried status, smoking, diabetes, urinary tract infection within two weeks of delivery, prepregnancy hypertension, and previous history of preterm delivery, low birth weight or neonatal death (Kramer, McLean, Eason, & Usher, 1992). Factors requiring further study related to preterm birth in developed countries include genital tract infection, maternal employment and physical activity, stress and anxiety, general morbidity, and quality of antenatal care (Kramer, 1987).

Many studies on the epidemiology of preterm birth have focused on only one or two sets of factors, such as biomedical risk factors or sociodemographic characteristics. There is a need to understand how the various sets of factors, including psychosocial and behavioral factors, interact to produce preterm birth. In addition, most biomedical risk factors, such as a history of preterm birth, and sociodemographic characteristics, such as age or education, are not amenable to change during pregnancy. In contrast, lifestyle behaviors such as diet, smoking, and utilization of prenatal care, and psychosocial risk factors such as stress, are potentially modifiable during pregnancy. Greater knowledge of modifiable risk factors will facilitate interventions to reduce these risk factors in pregnant women, with the ultimate goal of reducing the incidence of preterm birth in a particular population.

No study has provided a comprehensive examination of risk factors for preterm birth in Manitoba women, nor has any study compared risk factors for preterm birth in Aboriginal and non-Aboriginal women. Research needs to be undertaken to obtain a better understanding of the risk factors for prematurity in this population, and what factors are responsible for the excess 25% of risk among Aboriginal women in the province. The population attributable risk percent (PAR%) can be calculated to represent the proportion of disease that is due to certain modifiable risk factors, and the fraction by which the incidence of disease might be reduced after removal of a specific risk factor can be estimated (Berkowitz & Lapinski, 1998). This understanding will contribute to the development of more effective prevention of preterm birth by targeting potentially modifiable risk factors for public health intervention, with the goal of decreasing the overall rate of preterm birth in Manitoba, especially among Aboriginal women.

Purpose of the Study and Research Questions

The purpose of this case-control study was to identify the risk factors for spontaneous preterm birth in Manitoba women, and to compare risk factors among Aboriginal and non-Aboriginal women in Manitoba. The focus was on potentially modifiable risk factors for spontaneous preterm birth.

Specific research questions were as follows:

1. Do women who smoke during pregnancy have a higher relative risk of spontaneous preterm birth than women who do not smoke during their pregnancy? Does the association between smoking and preterm birth differ between Aboriginal and non-Aboriginal women?
2. Do women with poor nutritional status (as reflected by low pregravid body mass index, inadequate rate of weight gain during pregnancy, and/or anemia) have a higher relative risk of spontaneous preterm birth than women with adequate nutritional status? Does the association between nutritional status and preterm birth differ between Aboriginal and non-Aboriginal women?
3. Do women receiving inadequate prenatal care (as determined using the Kessner Adequacy of Prenatal Care Index) have a higher relative risk of spontaneous preterm birth than women receiving adequate prenatal care? Does the association between prenatal care and preterm birth differ between Aboriginal and non-Aboriginal women?
4. Do women who report physical abuse during their pregnancy have a higher relative risk of spontaneous preterm birth than women who do not report abuse?

Does the association between abuse during pregnancy and preterm birth differ between Aboriginal and non-Aboriginal women?

5. Do women whose work involves prolonged standing, long working hours, and/or shift work have a higher relative risk of spontaneous preterm birth than women whose work is less strenuous? Does the association between strenuous work and preterm birth differ between Aboriginal and non-Aboriginal women?

6. Do women with a history of urogenital infections during their pregnancy, such as gonorrhea, chlamydia, syphilis, or bacterial vaginosis, have a higher relative risk of spontaneous preterm birth than women without urogenital infections? Does the association between urogenital infections and preterm birth differ between Aboriginal and non-Aboriginal women?

7. Do women with higher levels of stress and low levels of social support or self esteem during their pregnancy have a higher relative risk of spontaneous preterm birth than women with low levels of stress and adequate social support and self esteem? Does the association between stress, social support, self esteem, and preterm birth differ between Aboriginal and non-Aboriginal women?

CHAPTER II: LITERATURE REVIEW

Conceptual Framework

This research project was built upon a population health approach. A population health approach is described as follows:

> There is strong evidence indicating that factors outside the health care system significantly impact on health. These factors, called "determinants of health," include: income and social status, social support networks, education, employment and working conditions, physical environments, social environments, biology and genetic endowment, personal health practices and coping skills, healthy child development, health services, gender and culture. The overall goal of a population health approach is maintaining and improving the health status of the entire population and reducing inequalities in health status between groups and/or sub-groups. In a population health approach, the entire range of individual and collective factors and conditions, that the evidence shows determine population health status, and the interactions among them, are considered. (Health Promotions and Programs Branch, 1998, p. 1)

Strategies to address population health must address a broad range of health determinants in a comprehensive and interrelated way. Refer to Appendix A for a description of these determinants. The Federal/Provincial/Territorial Advisory Committee on Population Health (1994) proposes a framework that groups the determinants of health into five categories:

1. *Social and Economic Environment*: income, employment, social status, social support networks, education, and social factors in the workplace.

2. *Physical Environment:* physical factors in the workplace, as well as other aspects of the natural and human-built physical environment.

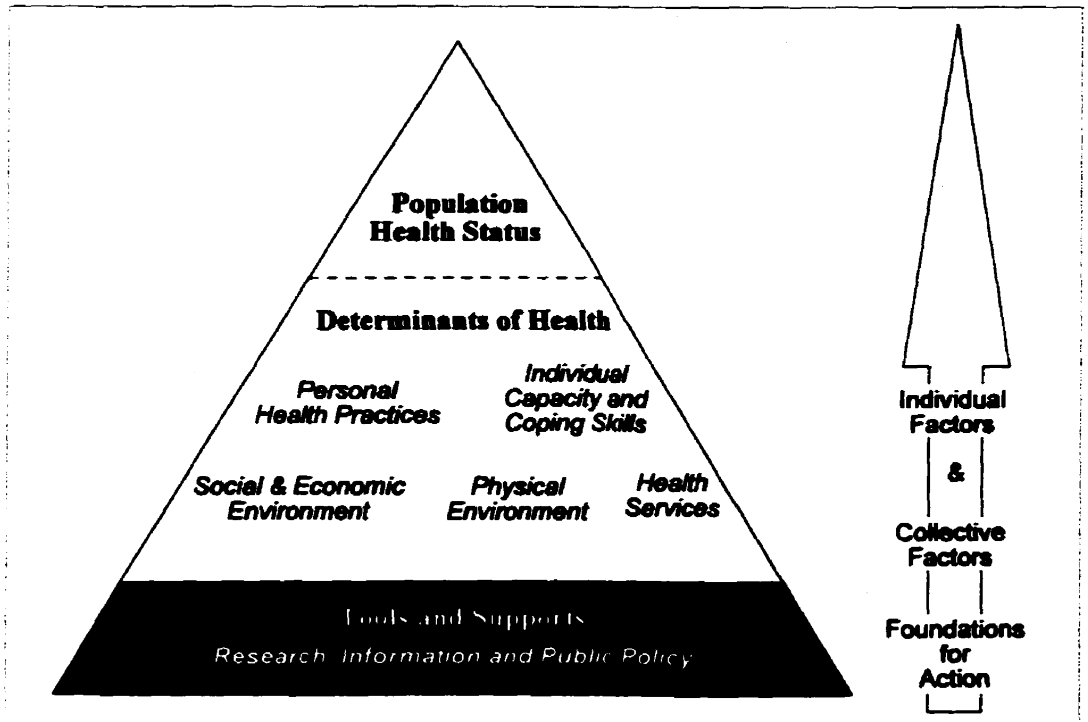
3. *Personal health practices:* behaviors that enhance or create risks to health.

4. *Individual Capacity and Coping Skills:* psychological characteristics of the person such as personal competence, coping skills, and sense of control and mastery; and genetic and biological characteristics.

5. *Health Services:* services to promote, maintain and restore health. (pp. 28-29)

The diagram in Figure 1 illustrates a framework for population health. Research, information and public policy form the foundation of the pyramid and are key tools for addressing the determinants of health. At the top of the pyramid is population health status, underpinned by the five categories of health determinants. Determinants related to the individual and those related to collective conditions are shown on two different levels, to convey the idea that the collective factors enable or provide the basis for the individual factors (Federal/Provincial/Territorial Advisory Committee on Population Health, 1994, p. 30).

Figure 1. Framework for Population Health



In applying this conceptual framework to preterm birth, the framework helps us identify the factors that influence health among women of childbearing age, analyze those factors, and assess their relative importance in determining risk of preterm birth. By learning more about the relationship of various determinants of health to preterm birth, and differences between Aboriginal and non-Aboriginal women, actions can be taken to reduce health inequalities and improve the health of women of childbearing age. Decisions about policy changes and program priorities to reduce preterm birth will be guided by consideration of the evidence about the relative contribution of multiple health determinants and their interactions.

Risk Factors for Preterm Birth

The etiology of preterm birth and the keys to its prevention remain poorly understood. Although many risk factors are known to be associated with preterm birth, the cause of most preterm births is unknown. Further research is required to clarify determinants of preterm birth and understand the etiological pathways that lead to preterm delivery (Alexander, 1998a; Health Canada, 1999). This review of the literature on risk factors for preterm birth will be organized according to the five categories of health determinants contained in the framework for population health: social and economic environment, physical environment, health services, personal health practices, and individual capacity and coping skills. In addition, differences in these health determinants among Aboriginal and non-Aboriginal women will be reviewed.

Several comprehensive reviews of the epidemiology of preterm birth have been conducted (Berkowitz & Papiernik, 1993; Bragonier, Cushner, & Hobel, 1984; Culpepper & Jack, 1993; Goldenberg & Gottlieb, 1991; Kramer, 1987; Lumley, 1993) and their conclusions will be incorporated in this review. Since Kramer (1987) conducted a comprehensive review of risk factors for low birth weight and preterm delivery based on the literature up to 1984, this review will focus on the more recent literature. Appendix B summarizes the factors Kramer (1987) assessed for their causal effect on gestational duration and whether the effect is unlikely, uncertain, or well established. This literature review will be largely restricted to studies examining risk factors for spontaneous preterm birth as opposed to low birth weight or medically indicated preterm birth, since these outcomes have different etiologies and risk factors

(Pickett, Abrams, & Selvin, 2000). The results of recent studies on risk factors for spontaneous preterm birth are summarized in Appendix C.

Social and Economic Environment

Maternal Age. Adolescents and women over the age of 35 years have an increased risk of preterm birth compared to women between the ages of 20 and 35 (Berkowitz & Papiernik, 1993; Goldenberg & Gotlieb, 1991). However, the increased risk likely reflects characteristics related to the extremes of maternal age. Pregnant adolescents are more likely to be nonwhite, of low socioeconomic status, and receive inadequate prenatal care. Older women are more likely to have chronic diseases such as hypertension or diabetes, may be more susceptible to the effects of cigarette smoking, and may be of higher parity. Goldenberg and Gotlieb (1991) conclude that when these other factors are controlled, maternal age by itself does not affect the rate of preterm delivery.

Race and Ethnicity. "Virtually all studies have shown that black women have higher preterm rates than white women" (Berkowitz & Papiernik, 1993, p. 419). However, when confounding factors are controlled, the independent effect of race on timing of delivery is less certain. Differences in age, parity, socioeconomic status, smoking, alcohol and drug use, and maternal size may explain much of the differences among races (Goldenberg & Gotlieb, 1991). However, Goldenberg and colleagues conducted a study which controlled for as many factors as possible, and concluded that there is a 4- or 5- day difference in the gestational age at delivery between blacks and whites (Wen, Goldenberg, Cutter, Hoffman, & Cliver, 1990). Collins and Hammond (1996) also found black race to be an independent risk factor for preterm birth, after controlling for maternal sociodemographic and prenatal care variables (adjusted odds ratio of 1.6). Savitz and colleagues, in their review of the literature, also concluded that black women have a markedly higher risk of preterm delivery (Savitz, Blackmore, & Thorp, 1991). Conversely, in Lang, Lieberman, and Cohen's (1996) study, black maternal race was not a risk factor for prematurity when confounding factors were controlled. In racial groups other than black, in the United States, differences in birthweight are attributable solely to social factors; "country of origin, acculturation, family factors, and racial status all contribute to differing outcomes among various groups of Hispanic and Southeast Asian women" (Culpepper & Jack, 1993, p. 603). No Canadian or American studies were found which compared differences in preterm birth between Aboriginal women and non-Aboriginal women. Studies comparing births to Aboriginal and Caucasian women in Australia have been reported, but their focus was on low birth weight, not preterm birth (Humphrey & Holzheimer, 2000; Seward & Stanley, 1981).

Socioeconomic Status. Low socioeconomic status is associated with both preterm birth and low birth weight. In a recent review, Kramer and colleagues note that preterm birth is consistently more frequent among the socially disadvantaged, even within developed countries, with increased rates of preterm birth associated with low income, low maternal education, and lower occupational group or manual occupation (Kramer, Seguin, Lydon, & Goulet, 2000). In Canada, low birth weight rates are approximately twice as high for families in the lowest quintile of income compared with families in the highest quintile (Hanvey, Avard, Graham, Underwood, Compbell, & Kelly, 1994). According to *Healthy Parents, Healthy Babies*, the rate of preterm birth is 7.4% in the poorest Canadian neighbourhoods and 5.7% in the richest (Minister of Public Works and Government Services Canada, 1997), based on data from a study by Wilkins, Sherman, and Best (1991). "Whether measured by income levels, educational level or type of job, there are conflicting opinions in the literature related to the effect of socioeconomic status on pregnancy outcome. ...when other factors are controlled, the apparent independent effect of socioeconomic status is significantly reduced" (Goldenberg & Gotlieb, 1991, pp. 85-86).

Having less than a high school education has been associated with preterm birth in some studies (Kramer et al., 1992; Lang et al., 1996; Peacock, Bland, & Anderson, 1995), but not in others. Harlow's (1996) univariate analyses showed that women with less than a high school education were at increased risk for preterm delivery, but after multivariate adjustment, education was no longer associated with prematurity because of its correlation with parity. Researchers of fetal and infant mortality in Quebec demonstrated that maternal education was inversely related to preterm births and that 15% of preterm births could have been avoided if the rates for mothers with the highest level of education had prevailed among all mothers (Chen, Fair, Wilkins, Cyr, & Fetal and Infant Mortality Study Group, 1998). A large case-control European study also found that low educational level was associated with a doubled risk of very preterm birth (Ancel, Saurel-Cubizolles, Di Renzo, Papiernik, Breart, & the Europop Group, 1999).

Marital Status. Berkowitz and Papiernik (1993), in their review, concluded that unmarried women generally have a higher rate of preterm delivery than married women, even after controlling for other related factors such as age, race, and socioeconomic status. Goldenberg and Gotlieb (1991) also concluded that women who are single or who live alone have an increased risk of preterm birth, based on studies that evaluate marital status as a univariate risk factor, but felt marital status alone was unlikely to have an independent effect on preterm delivery. In Kramer's (1987) meta-analysis, none of the studies reviewed detected a significant independent effect of marital status on prematurity or mean birthweight.

Social Support. Evidence is growing for a relationship between social support and pregnancy outcomes such as preterm birth. In a classic study of the relationships between stress, psychosocial assets, and outcomes of pregnancy, Nuckolls, Cassell, & Kaplan (1972) found that pregnant women with high life change scores had fewer complications when psychosocial assets were present. These results were supported by Norbeck & Tilden (1983), who found stress predicted maternal complications but was buffered by the effect of social support. Since then, several studies have examined interactions between life stress and social support, the direct relationship between social support and pregnancy outcome, and the effectiveness of interventions to enhance social support in improving pregnancy outcomes for pregnant women. Goldenberg and Gotlieb (1991) conclude, "At this time the evidence is sparse but indicates that emotional support impacts primarily on emotional well-being, while tangible support may have a more direct effect on birth outcomes. There is evidence that low social support adds to the stress of pregnancy and affects birth outcomes" (p. 88). Other reviewers indicate that social support has been found to have a positive effect on psychological well-being during pregnancy and has been linked to better pregnancy outcomes in several studies (McLean, Wingo, Hatfield-Timajchy, & Floyd, 1993). Intimate social support from a partner or family member appears to improve fetal growth, even for women with little life stress (Hoffman & Hatch, 1996). In a small study of 129 low-income pregnant women, women with more social network resources delivered babies of higher birth weight, and among women with high prenatal life events, those with better support delivered babies of higher birth weight (Collins, Dunkel-Schetter, Lobel, & Scrimshaw, 1993). In a prospective study of 1,513 pregnant women in London, England, having little contact with neighbors was associated with increased risk of spontaneous preterm birth (Peacock et al., 1995). Unfortunately, conflicting results have arisen from studies of the effect of providing psychosocial support during pregnancy on enhancing birth weight or gestational age at birth (Blondel, 1998; McLean et al., 1993).

Abuse. Physical abuse or violence can affect pregnancy through direct or indirect mechanisms. "A blow to a pregnant woman's abdomen can cause adverse outcomes directly (ie, fetal injury and death, or complications such as preterm labor). The indirect mechanisms relates to a woman's victimization experience from intimate-partner violence and how it can induce intermediary risks (ie, psychologic stress or insufficient access to medical care) that could cause poor outcomes" (Cokkinides, Coker, Sanderson, Addy, & Bethea, 1999, p. 661).

Physical violence during pregnancy is relatively common. Gazmarian, Lazorick, Spitz, Ballard, Saltzman, and Marks (1996) reviewed 11 studies and found that the prevalance of women experiencing violence during pregnancy ranged from 0.9% to 20.0%, with the majority (8 out of the 11 studies) reporting the prevalence to be between 3.9% and 8.3%. Several studies have found an association between physical violence during pregnancy and maternal attributes of young maternal age, education less than 12 years, single marital status, and low income (Bell & Eaglin, 2000; Goodwin, Gazmararian, Johnson, Gilbert, Saltzman, & the PRAMS Working Group, 2000; Weinbaum, Adams, Motylewski-Link, & Chavez, 2000). Physical violence also has been linked to receiving inadequate prenatal care; unintended pregnancies; smoking, alcohol or illicit drug use during pregnancy; and divorce or separation (Bell & Eaglin, 2000; Berenson, Wiemann, Wilkinson, Jones, & Anderson, 1994; Goodwin et al., 2000; McFarlane, Parker, & Soeken, 1996b; Parker, McFarlane, & Soeken, 1994). In a study by Curry and Harvey (1998), abused women reported more stress, less support from partner and others, and lower self esteem, based on data from the Prenatal Psychosocial Profile (Curry, Campbell, & Christian, 1994). Racial differences in the incidence of abuse also occur. Bell and Eaglin (2000), using data from a postpartum survey of 5,016 mothers in Washington state, found that 10.8% of Native American respondents reported physical violence within 12 months of delivery compared to 4.4% of white respondents.

Several studies have shown an association between physical abuse and low birth weight or preterm births. In one study that determined the effect of abuse on birth weight, 1,203 women were screened for abuse (Parker et al., 1994). Abuse during pregnancy was reported by 20.6% of teens and 14.2% of adult women. Abuse during pregnancy was a significant risk factor for low birth weight (relative risk of 1.5), and also was related to late entry into prenatal care. A second report on this same study indicated that women abused during pregnancy delivered infants weighing an average of 133 grams less than women not abused, and more severe abuse was significantly correlated with lower infant birth weights for all three ethnic groups studied: White, African American, and Hispanic (McFarlane, Parker, & Soeken, 1996a).

Weinbaum et al. (2000) surveyed 3,483 postpartum women in California; 6.4% reported they were physically or sexually abused in the past 2 years and the victims were more likely to have a preterm delivery (OR 1.7, 95% CI 1.1-2.5). Factors associated with abuse included young maternal age, single marital status, low income, smoking, and alcohol consumption during pregnancy. Fernandez and Krueger (1999) studied 489 predominantly white indigent women and found that women who were victims of domestic violence during pregnancy were 2.5 times more likely to have a preterm birth than their nonvictim counterparts (OR 2.5, 95% CI 1.4, 4.1). In a prospective cohort study, adolescents who reported severe prenatal violence were more likely to deliver preterm (OR 3.5, 95% CI 1.1-10.8) than those who did not report severe violence, after adjusting for race, adequacy of prenatal care, prior preterm delivery, and alcohol use. For adults, the relationship between prenatal violence and preterm delivery was not statistically significant (Covington, Justason, & Wright, 2001).

Other studies have failed to demonstrate an association between abuse and preterm birth, but linked abuse to preterm labor. Cokkinides et al. (1999), using population based data from 6,143 women in South Carolina, found that physical violence was associated with an increased risk of premature labor requiring hospitalization (OR 1.8), but after adjustments for maternal age, poverty, involvement in prenatal care, and smoking during pregnancy, they found no association between physical violence during pregnancy and low birth weight or preterm birth. Berenson et al. (1994) found that women abused during pregnancy were more likely to enter prenatal care during the third trimester and were twice as likely to experience preterm labor as those who had not experienced abuse (AOR 2.3, 95% CI 0.9-5.8), but no difference was noted between abused and nonabused women in the prevalence of preterm delivery. Campbell et al. (1999), in a case-control design with 1,004 women, discovered that abuse was a significant risk factor for full term low birth weight infants but not for preterm infants, and the risk for low birth weight became nonsignificant when adjusted for other abuse-related maternal health problems. Further research is needed to determine how violence affects birth outcomes, and the role of confounders or mediators in explaining the relationship.

Physical Environment

Maternal Work. "Work in general during pregnancy is not associated with adverse outcomes; however, strenuous work, extended work beyond 40 hours per week, and shift work may be associated with modest increases" in low birth weight and prematurity (Culpepper & Jack, 1993, p. 604). In their review of the literature on the role of employment-related physical activity, Berkowitz & Papiernik (1995) concluded that prolonged standing and long working hours may increase the risk of preterm delivery. A recent meta-analysis based on 160,988 women in 29 studies showed that physically demanding work, prolonged standing, shift and night work, and high cumulative work fatigue score were significantly associated with preterm birth, whereas there was no significant association between long work hours and preterm birth (Mozurkewich, Luke, Avni, & Wolf, 2000).

In a Canadian study, Fortier, Marcoux, and Brisson (1995) studied 4,390 women in Quebec City, and showed a modest association between regular evening or night work and preterm birth. However, prolonged standing, lifting objects, physical effort, or shiftwork did not increase the risk of preterm delivery in their study. Parker, Schoendorf, and Kiely (1994), in a study of U.S. births in 1988, found that both black and white women in the operator, fabricator, and laborer occupations were at higher risk of preterm birth than women reporting professional or managerial occupations. In a Danish study, women who reported more than five hours of both standing and walking at work per day during the second trimester had an increased risk of preterm birth (adjusted OR of 3.3) (Henriksen, Hedegaard, Secher, & Wilcox, 1995). A national sample of U.S. nurses also was used to study the association between occupational factors and preterm birth (Luke et al., 1995). Factors significantly associated with preterm birth included hours worked per week, per shift, and while standing; physical exertion; noise; and an occupational fatigue score (ranging from 0 to 4). In the final logistic regression model, working more than 36 hours per week (OR 1.6, 95% CI 1.1-2.2) and an occupational fatigue score of 3 or more (OR 1.4, 95% CI 1.1-1.9) were associated with increased risk of preterm birth. In summary, a number of studies have supported an association between strenuous work and preterm birth.

Personal Health Practices

Smoking. Berkowitz and Papiernik (1993), based on their extensive review of the literature, conclude that there is convincing evidence that maternal smoking is associated with a moderately increased risk of preterm birth, and that the risk of preterm delivery increases with increasing number of cigarettes smoked per day. Relative risks for smokers range from 1.2 to close to 2.0. Results from a number of recently published large epidemiologic studies have shown smoking to be associated with an increased risk of spontaneous preterm birth (Harlow et al., 1996; Kyrklund-Blomberg & Cnattinguis, 1998; Kolas, Nakling, & Salvesen, 2000; Kramer et al., 1992; Meis et al.,1995), and several studies found that the risk is dose-dependent (Kyrklund-Blomberg & Cnattingius, 1998; Kolas et al., 2000; Moore & Zaccaro, 2000; Wisborg, Henriksen, Hedegaard, & Secher, 1996). For example, a study of 4,111 women in Denmark showed that smokers had a 40% higher risk of preterm birth than nonsmokers, and there was a dose-response relation between the number of cigarettes smoked per day and preterm delivery, with a relative risk of 1.0, 1.5, and 1.8 for women smoking 1 to 5, 6 to 10, and more than 10 cigarettes per day respectively (Wisborg, Henriksen, Hedegaard, & Secher, 1996). A large study of 311,977 births in Sweden found that smoking was associated more with an increased risk of very preterm birth (<32 weeks gestation) than moderate preterm birth (34-36 weeks gestation) and that smoking was associated more with spontaneous than induced birth. Risk of preterm birth also increased with amount smoked. The odds ratios of mothers who smoked heavily (>10 cigarettes/day) were 1.7 for spontaneous very preterm birth and 1.4 for spontaneous moderately preterm birth. In addition, the risks remained essentially unchanged after excluding pregnancies with complications that could be related to smoking (Kyrklund-Blomberg & Cnattingius, 1998). Other studies found a stronger association between smoking and preterm birth among multiparous women than among nulliparous women (Cnattingius, Forman, Berendes, Graubard, & Isotalo, 1993; Kolas et al., 2000). In a study by Stewart et al. (1994) of population attributable risk (PAR) for prematurity in Ottawa, Canada, smoking after the fourth gestational month had a PAR of 9%. However, not all studies support an effect of smoking. Lang et al. (1996) found that smoking during all or part of pregnancy had no effect on the risk of preterm labor, although it did increase the risk of term small-for-gestational age birth. In Peacock's (1995) prospective study of 1,513 pregnant women in

London, England, smoking was associated only with an increased risk of very early delivery; there was no excess risk after 32 weeks gestation.

Shah and Bracken (2000) recently published a systematic review and meta-analysis of prospective studies on the association between maternal smoking and preterm birth. Twenty studies were included in the meta-analysis, and the pooled point estimate for maternal smoking versus no smoking and preterm delivery was 1.27 (95% CI 1.21-1.33). When stratified into light and heavy smoking, the pooled estimate was 1.22 (95% CI 1.13-1.32) for light to moderate smoking and 1.31 (95% CI 1.20-1.42) for heavy smoking. They also identified eight case-control studies on the relationship between preterm delivery and maternal smoking, with most studies reporting odds ratios in the 2.0 to 3.0 ranges. However, these studies were noted as varying widely in their quality and procedures. Based on the results of their meta-analysis, the authors concluded, "Cigarette smoking is a preventable risk factor associated with preterm delivery. Consistent results across many study populations and research designs and evidence of a dose-response relationship support its causal role in preterm delivery" (p. 465).

Alcohol and Drug Use. "Inconsistent findings have been given for the effect of alcohol consumption on both pregnancy duration and risk of preterm birth... Available evidence suggests that an association between alcohol consumption and preterm birth is unlikely" (Berkowitz & Papiernik, 1993, p. 428). However, an association between alcohol use and low birth weight has been supported. A study in England examined the association of maternal drinking before and during early pregnancy on infant birthweight in 10,539 women. Infants born to women who reported drinking three or more drinks daily or one to two drinks daily with at least one binge, had an adjusted mean birthweight about 150 grams less than that of infants whose mothers abstained during pregnancy (Passaro, Little, Savitz, & Noss, 1996). Neither prepregnancy nor early pregnancy drinking level affected the risk of preterm delivery in this study. In a U.S. national sample of pregnant women having live births, race, age, mother's education, prenatal care, smoking and alcohol consumption during pregnancy were significantly related to having a low birth weight baby, but the alcohol effect on mean birthweight was small relative to that of the other risk factors (Faden, Graubard, & Dufour, 1997). In Wen's (1990) study of 17,000 indigent women in Alabama, alcohol intake and illicit drug use were significantly related to intrauterine growth restriction (IUGR), but neither alcohol nor drug consumption had a significant effect on preterm delivery, based on univariate analysis.

There is evidence that cocaine use increases the risk of preterm birth, but the evidence with respect to other illicit drugs such as heroin or marijuana is either limited or inconsistent (Berkowitz & Papiernik, 1993, p. 428). A meta-analysis of five studies of prenatal cocaine exposure suggests that maternal cocaine exposure is associated with increased risk of low birth weight newborns (pooled relative risk estimate 2.15, 95% CI 1.75-2.64) and that the effect is greater with heavier cocaine use (pooled relative risk estimate 4.42, 95% CI 2.24-8.71) (Hulse, English, Milne, Holman, & Bower, 1997). A meta-analysis to estimate the effect of maternal cannabis use on birth weight concluded there is inadequate evidence that cannabis, at the amount typically consumed by pregnant women, causes low birth weight (English, Hulse, Milne, Holman, & Bower, 1997). Unfortunately, these meta-analyses did not study the relationship between cocaine or cannabis and preterm birth.

Maternal Nutrition. Several studies have examined the association between maternal nutritional status and the risk of preterm birth, examining anthropometric, dietary, and nutritional factors. These studies suggest that short stature, low prepregnancy weight, low body mass index (BMI), low maternal weight gain, and iron deficiency anemia increase the risk of preterm delivery, although the results are sometimes conflicting (Berkowitz & Papiernik, 1993). Carmichael and Abrams (1997) conducted a critical review of 13 studies examining the relationship between gestational weight gain and preterm delivery. They concluded that an inadequate rate of maternal weight gain was associated with an increased risk (approximately 50-100%) of preterm birth, and that a slow rate of gain during the latter part of pregnancy was particularly important. Lang et al. (1996) found that a low prepregnancy weight (<100 pounds) and low rates of weekly weight gain (<0.40 pounds per week) doubled the risk of preterm labor. Kramer et al. (1992) studied a cohort of 13,102 women who delivered at the Royal Victoria Hospital in Montreal. Total weight gain was significantly associated with spontaneous preterm birth, averaging 14.6, 12.5, 9.9, and 9.1 kg in women delivering at 37 or more, less than 37, less than 34, and less than 32 completed weeks, respectively. However, this relationship disappeared when the analysis was based on net rate of weight gain (total weight gain minus infant birth weight/gestational age) per week. Mean net rates of gain were 0.28, 0.29, 0.27, and 0.27 kg/week, respectively. The authors concluded that prepregnancy weight-for-height and pregnancy weight gain were not important determinants of spontaneous preterm birth, and that some previous studies may have mistaken an effect of shortened gestation for its cause. Short stature, however, did have an association with preterm birth. A recent prospective study of 7,589 pregnant women in Los Angeles used multivariate logistic regression techniques to isolate the role of each nutritional variable from other factors that may influence birth outcome (Siega-Riz, Adair, & Hobel, 1996). Women who delivered preterm had patterns of weight gain similar to women delivering term infants, but underweight status (body mass index <19.8 kg/m^2) before pregnancy and inadequate weight gain in the third trimester nearly doubled the likelihood of delivering preterm. Hickey and colleagues also found that a low third-trimester rate of weight gain (<.38 kg/week) was associated with an increased risk of spontaneous preterm delivery (Hickey, Cliver, McNeal, Hoffman, & Goldenberg, 1995) and that very low and low pregravid body mass indices were associated with increased adjusted odds ratios for late (33-36 weeks' gestation) preterm delivery among black and white women (Hickey, Cliver, McNeal, & Goldenberg, 1997). Wen et al. (1990) reported that weight gains of less than 0.24 kg/week after 20 weeks' gestation were associated with an increased risk of preterm birth among indigent women (adjusted odds ratio 1.52).

Magnitude of risk for low pregnancy weight gain has been shown to vary according to a woman's prepregnancy BMI. Schieve and colleagues reported that the association between low rate of maternal weight gain and an increased risk of preterm birth is most pronounced in women of low BMI (Schieve, Cogswell, & Scanlon, 1999; Schieve et al, 2000). For example, based on a sample of 2,229 women, the adjusted odds ratio for a low rate of pregnancy weight gain was 6.7 for underweight women, 3.6 for average-weight women, and 1.6 for overweight women, compared with average-weight women with average pregnancy weight gain (Schieve et al.).

In a review article, Luke (1998) concluded that low dietary zinc and iron deficiency anemia are associated with an increased risk of preterm birth. Siega-Riz, Adair, and Hobel (1998) found that anemia was significantly associated with preterm birth, even after adjusting for several confounders (AOR 1.83). Other investigators found that hemoglobin concentrations exhibited a U-shaped relationship, with high and low values associated with a greater risk for preterm birth. In univariable analysis, a hemoglobin level of less than 10.4 gm/dl and greater than 13.3 gm/dl increased the odds of preterm birth (OR 1.50 and 1.22 respectively), although hemoglobin was not significantly associated with preterm birth in the final multivariable analysis (Meis et al., 1995).

Sexually Transmitted Diseases and Urogenital Infection. The relationship between common reproductive tract infections and spontaneous preterm birth has recently become better understood. "Up to 40% of women in spontaneous labor will have bacteria in both the amniotic fluid and the membranes, and an additional 20% will have organisms in the membranes but not in the amniotic fluid" (Goldenberg & Andrews, 1996, p. 782). In their review of sexually transmitted diseases and outcomes of pregnancy, Goldenberg and colleagues conclude that gonorrhea is associated with a threefold increase in the preterm birth rate and that syphilis and bacterial vaginosis infections are associated with a twofold increase in preterm birth. Chlamydia and Group B streptococcus have been associated with prematurity in some studies, but the majority of the evidence shows no association. They cite more than 15 studies showing an association between bacterial vaginosis and preterm birth (Goldenberg, Andrews, Yuan, MacKay, & St. Louis, 1997). "Bacterial vaginosis is a condition in which the normal, lactobacillus-predominant vaginal flora is replaced with anaerobic bacteria, Gardnerella vaginalis, and Mycoplasma hominis" (Hillier et al., 1995, p. 1737). Fiscella (1996) reviewed the role of urogenital infections in racial disparities in preterm birth in the United States. His findings suggest that both bacterial vaginosis and bacteriuria are associated with at least a twofold risk of preterm delivery, and untreated syphilis and gonorrhea are associated with a three- to five-fold risk of preterm delivery. He concluded that bacterial vaginosis makes a significant contribution to the racial disparity in rates of preterm birth, based on a higher prevalence of bacterial vaginosis among black women.

Individual Capacity and Coping Skills

> Stress. Research on stress and birth outcomes originated approximately 25 years ago with the earliest published empirical studies on the role of stress in preterm delivery appearing in the 1970s. Over time, nearly three dozen studies have been published and approximately one dozen reviews summarize the results of research on the role of stress in preterm delivery. Prospective studies with larger samples, appropriate controls and standardized measures of stress are now available, providing a basis upon which to conclude that stress is a significant risk factor for preterm delivery. ... Results of this research suggest that the stress-preterm association appears to apply to women of many different nationalities, cultures and social classes with few exceptions. (Dunkel-Schetter, 1998, p. 39).

In a review of the literature from 1963 to 1992, McLean et al. (1993) examined the life stress model and its application to pregnancy outcome. They viewed the life stress model as encompassing stressors (e.g. the occurrence of stressful life events) and potential effect modifiers, such as personal dispositions, psychologic state, and social networks/social support. They concluded that the cumulative evidence from studies of different populations, using varied design and measures, is that psychosocial factors are associated with increased risk of preterm delivery, low birth weight, and other pregnancy outcomes. Lobel's (1994) review of stress and birth outcomes found that life event numbers, state anxiety, and subjectively weighted life event stress had some limited effects on birth outcomes, while studies employing a multidimensional measure of prenatal stress had a significant association with preterm birth.

Recent studies continue to support an association between stress and preterm birth. Copper and colleagues conducted an extensive study to determine whether various measures of poor psychosocial status in pregnancy were associated with spontaneous preterm birth (Copper et al., 1996). Anxiety, stress, self-esteem, mastery, and depression were assessed at 25 to 29 weeks gestation in 2,593 pregnant women by use of a 28-item Likert scale. After controlling for maternal demographic and behavioral characteristics, stress was the only psychosocial characteristic that was significantly associated with spontaneous preterm birth; for each point on the stress scale, the odds ratio of preterm birth was 1.16. Wadhwa, Sandman, Porto, Dunkel-Schetter, and Garite (1993) conducted a small prospective study of 90 women, and found that, independent of biomedical risk, each unit increase of prenatal life event stress was associated with a 55.03 gram decrease in infant birth weight, and each unit increase of prenatal pregnancy anxiety was associated with a 3-day decrease in gestational age at birth. A larger prospective study of 8,719 women in Denmark showed that psychological distress in the 30th week of pregnancy was associated with an increased risk of preterm delivery (relative risk 1.22

for moderate distress and 1.75 for high distress), whereas distress measured in the 16th week was not related to preterm delivery (Hedegaard, Henriksen, Sabroe, & Secher, 1993). Another report by these investigators clarifies that stressful life events evaluated independently of the individual's appraisal were not associated with risk of preterm delivery, but life events assessed by the subjects as highly stressful were associated with shorter mean duration of gestation and increased risk of preterm delivery (Hedegaard, Henriksen, Scher, Hatch, & Sabroe, 1996).

The importance of studying chronic role strain and daily hassles also has been emphasized in the stress literature. Pritchard and Teo Mfphm (1994) studied the association of preterm birth with the psychosocial stresses of the household role among women in Glasgow, Scotland. Women experiencing high levels of perceived difficulty with the household role had an increased odds of preterm birth (OR 2.86, 95% CI 1.05, 7.76).

Multiple mediating and interactive processes are likely to be involved in the pathways by which stress contributes to preterm labor and delivery, including endocrine, immune, and behavioral responses (Gennaro & Fehder, 1996; Dunkel-Schetter, 1998).

> Mechanisms for the association of psychosocial characteristics with poor pregnancy outcome can be theorized to occur by both direct and indirect causal pathways. For example, periods of stress can precipitate the release of catecholamines, resulting in vasoconstriction and subsequently oxygen and calorie reduction to the fetus. Indirectly, psychosocial factors such as depression, anxiety, and low self-esteem have been shown to be associated with higher incidences of maladaptive health behaviors. (Copper et al., 1996, p. 1289)

Newer work suggests a key role for stress hormones, especially corticotropin-releasing hormone (CRH). Investigators have related stress in pregnancy to increased levels of CRH and shown an association between elevated maternal CRH levels and preterm labor (Hobel, Dunkel-Schetter, Roesch, Castro, & Arora, 1999; Wadhwa, Porto, Garite, Chicz-DeMet, & Sandman, 1998). "Abnormal corticotropin-releasing hormone elevation may be a hormonal response to inflammatory stress from decidua, fetal membrane, or placental infection, or it may be a response to episodic or chronic stressors of a physiologic or psychosocial nature" (Majzoub, McGregor, Lockwood, Smith, Taggart, & Schulkin, 1999, p. S239). Dudley (1999) suggests that abnormalities in the regulation of CRH and the production of inflammatory cytokines forms the pathophysiologic basis for the association between maternal stress and preterm birth, while Lockwood (1999) proposes that maternal and fetal stress activates cells in the placenta and fetal membranes to produce CRH; CRH then enhances prostaglandin production in these tissues to promote parturition. Further investigation is needed to fully understand the association between maternal stress, the hypothalamic-pituitary-adrenal (HPA) axis, and premature delivery (Austin & Leader, 2000).

Personal competence, coping skills, self esteem, and sense of control and mastery have not been researched extensively in relation to preterm birth, although these characteristics have been proposed as possible mediators of stress during pregnancy. One study found personal resources (mastery, optimism, and self esteem) to be directly associated with birth weight and indirectly associated with gestational age through stress reduction. In addition, high self esteem was associated with lower pregnancy-related anxiety and lower state anxiety among this sample of White and Hispanic low-income women (Rini, Dunkel-Schetter, Wadhwa, & Sandman, 1999). However, the large prospective study by Copper et al. (1996), cited previously, did not find self-esteem to be a significant risk factor for preterm birth. In a study of 191 inner-city women, higher self-esteem was related to lower prenatal depressed mood, fewer life events, and greater social support during pregnancy, but its association with birth outcome was not studied (Ritter, Hobfoll, Lavin, Cameron, & Hulsizer, 2000). Further research is needed about the influence of these psychologic characteristics on preterm birth and their role in mediating stress.

Biological Characteristics. Obstetric risk factors for preterm birth include having a previous low birth weight or premature newborn, a history of two or more second trimester spontaneous abortions, cervical and uterine anomalies, and multiple gestation (Berkowitz & Papiernik, 1993; Morrison, 1990). A previous history of preterm birth is one of the most important factors for a subsequent preterm birth, with a relative risk of approximately 3.0 (Berkowitz & Papiernik, 1993). The increasing incidence of multiple gestation pregnancies and their contribution to the increase in preterm birth rates may be associated with more widespread use of fertility-enhancing therapies (Ventura et al., 1999).

Health Services

Prenatal Care. Prenatal care has the potential for reducing the incidence of low birthweight, preterm birth, and other less than optimal pregnancy outcomes. The Institute of Medicine (1985) report, Preventing Low Birthweight, estimated that for every dollar spent on prenatal care for women at high risk, $3.38 would be saved in the total cost of caring for low birth weight infants requiring expensive medical care. However, prenatal care has not been demonstrated to improve birth outcomes conclusively. While some reviews concluded that prenatal care plays a role in reductions in preterm birth and low birth weight infants (Klein & Goldenberg, 1990), others have not (Fiscella, 1995). Fiscella reviewed studies of prenatal care published between 1966 and 1994. Although many of the 14 observational studies showed a positive effect of prenatal care on birth outcome, none of the 11 randomized controlled trials of types of enhanced prenatal care demonstrated a significant effect. "These different conclusions highlight the enormous difficulties involved in evaluating prenatal care. Potential selection bias and the absence of direct, randomized controlled trials precludes a straightforward evaluation of the impact of prenatal care on birth outcomes" (Fiscella, 1995, p. 475). Other issues include the lack of a standard definition of inadequate prenatal care, although usually some combination of the number and timing of prenatal visits has been used (Goldenberg, Patterson, & Freese, 1992). In addition, attendance figures for prenatal care do not take into account the content and quality of prenatal care.

The relationship between preterm birth and the reduced opportunity for prenatal care visits produces a preterm delivery bias, or a spurious relationship between a reduced number of prenatal care visits and prematurity (Fiscella, 1995). To adjust for the number of visits relative to gestational age at delivery, two measures of prenatal care utilization have been developed: the Kessner Adequacy of Prenatal Care Index (Kessner, Singer, Kalk, & Schlesinger, 1973) and the Adequacy of Prenatal Care Utilization Index (Kotelchuck, 1994). Both of these measures can be calculated if data are collected on the month prenatal care began, and the total number of visits from the time prenatal care begins until delivery.

One study of the relationship of prenatal care to birth weight was conducted in Winnipeg, Manitoba (Mustard & Roos, 1994). Results indicated that women had an average of 11.2 prenatal visits during their pregnancies, and 90% of women initiated care by the 13th week of gestation. Using the Kessner Adequacy of Prenatal Care Index, 74.3% of women received adequate prenatal care and 8.9% received inadequate care. Women in the lowest income quintile had consistently poorer utilization of prenatal care than those in the median and high income groups. After adjustment for maternal characteristics and early complications of pregnancy, infants born to women receiving less than adequate care were 58 grams lighter than those born to women with adequate care. Unfortunately, the relationship between prenatal care and preterm birth was not examined in this study.

Krueger and Scholl (2000) conducted a prospective study of 1,771 young pregnant women in New Jersey to determine whether a relationship exists between adequacy of prenatal care and preterm birth, using the indices of both Kessner and Kotelchuck. Based on the Kessner index, 16.4% of the women received inadequate care, compared to 36.8% using the Kotelchuck index. Women who received inadequate prenatal care were more likely to be multiparous and black. After controlling for potentially confounding variables, the risk of preterm birth for women receiving inadequate care was increased two-to-threefold (inadequate care as per Kessner index, OR 2.80, 95% CI 2.07-3.78; as per Kotelchuck index, OR 2.10, 95% CI 1.58-2.81). In addition, women receiving adequate-plus care as per Kotelchuck index also had an increased risk of preterm birth (OR 1.93, 95% CI 1.37 to 2.72). Women with additional pregnancy risks or complications would likely have additional prenatal visits, resulting in the "adequate plus" rating, and these complications may have predisposed them to increased risk of preterm birth.

Summary

The etiology of preterm birth is multifactorial, involving interactions between a variety of risk factors. Most biomedical and sociodemographic risk factors are not amenable to change during pregnancy. In contrast, lifestyle behaviors such as diet, smoking, drug and alcohol use, and utilization of prenatal care, are amenable to change during pregnancy. These behaviors appear to be influenced by psychosocial factors such as stress and social support, and various psychological and social factors have been related to pregnancy outcome. However, Goldenberg and Gottlieb (1991) point out that "small numbers, inadequate controls, poor definition and specificity of both psychosocial factors and outcome measures, and retrospective designs have made this literature difficult to interpret" (p. 84). They also emphasize that future studies need to control for potential confounding factors such as smoking, alcohol and drug use, race, parity, age, socioeconomic status, and maternal anthropometric measurements.

Aboriginal People

The term Aboriginal peoples does not refer to one homogeneous group. The Aboriginal population is divided into four categories: North American (First Nations) Indians registered under the *Indian* Act ; North American Indians not registered under the *Indian* Act; Métis people, and Inuit (National Forum on Health, 1997). The population of Aboriginal peoples in Canada has been growing at a more rapid rate than that of the non-Aboriginal Canadian population, as a result of the combination of decreasing infant mortality rates and the higher fertility rates of Aboriginal peoples (National Forum on

Health, 1997). Manitoba has a large Aboriginal population. In 1991, 116,200 Aboriginal people lived in Manitoba, and accounted for 10.6% of Manitoba's total population. Manitoba has the greatest proportion of Aboriginal people of all ten Canadian provinces, and Winnipeg has the largest number of Aboriginal people of all Canadian cities (Native Affairs Secretariat, 1995). A growing number of Aboriginal people are moving to urban centres. "Between 1991 and 1996, Winnipeg's Aboriginal population grew by one third to become the largest in Canada. Census figures for 1996 show 45,750 Aboriginal people living in Winnipeg. . . . The Social Planning Council of Winnipeg predicts there will be 73,840 Aboriginal people in Winnipeg by the year 2001" (Manitoba Round Table on Environment & Economy, 1999, p. 13).

Aboriginal Women's Health

The term "Aboriginal women" includes women of First Nations (Indian), Inuit, and Métis descent in Canada (Stout, 1996). Aboriginal women experience poorer health than other Canadian women based on several measures of health status. For example, Aboriginal women have a lower life expectancy than non-Aboriginal women in Canada. "A woman born into a First Nations community in 1991 can expect to live to 74 years of age relative to 81 years for any other Canadian women born in that year" (Kaufert, 1996, p. 7). Aboriginal women also experience higher rates of several risk factors for preterm birth, including low socioeconomic status, noncompletion of high school, smoking, urogenital infections, abuse, poor nutritional status, and inadequate prenatal care.

In terms of socioeconomic status, women from Canada's First Nations communities are at high risk of poverty, with 33% compared to 17% of other Canadian women having incomes below the Statistics Canada low income cut off (Kaufert, 1996).

In Manitoba, almost one-quarter of Aboriginal women earned an annual income less than $3,000 in 1991, compared with 12.4% of all Manitoba women (Native Affairs Secretariat, 1995). Aboriginal women are also less likely to be employed, and less likely to have completed high school (Kaufert, 1996). However, "there are signs that education levels are slowly improving, with more positive indicators for women, for the south and for Winnipeg outside the core area" (Native Affairs Secretariat, 1995, p. 5). Lone parent families are more common in the Aboriginal community, especially among off-reserve where lone parent families make up 34% of all Aboriginal families compared to 13% of all Manitoba families (Native Affairs Secretariat, 1995). Many Aboriginal women have relocated to urban areas, where they live in poor socioeconomic conditions characterized by sub-standard, unsafe or crowded housing (Federal/Provincial/Territorial Working Group on Women's Health 1990; National Forum on Health, 1997; Stout, 1996). "The relationship between health and socioeconomic status is well recognized. Studies in many populations have demonstrated the impact of socioeconomic status on mortality, morbidity, and the prevalence of behavioral risk factors. . . . in terms of income, the proportion of the population on social assistance, labour force participation, education level, and housing quality, the gap between Aboriginal and non-Aboriginal Canadians remains to be closed" (Young, 1994b, p. vi).

The teen pregnancy rate presents an area of concern, with a fertility rate for Aboriginal adolescents in Manitoba (age 15 to 19) of 71.2 per 1000 females in 1990 compared to 31.3 per 1000 females in the non-Aboriginal community (Native Affairs Secretariat, 1995). Rates of sexually transmitted diseases are higher among Aboriginal women than in the female population in general. In addition, Aboriginal women also have an increased experience of violence in their lives; the incidence of physical and sexual abuse and suicide is higher in Aboriginal communities (National Forum on Health, 1997; Stout, 1996). Domestic violence is one of the primary reasons for Aboriginal women relocating to an urban setting (Allard, Lithman, O'Neil, & Sinclaire, 1993). Obesity, poor eating habits and physical inactivity are prevalent in the Aboriginal population; the diets of many Aboriginal peoples consist of processed foods with high levels of sugar and fat (National Forum on Health, 1997). "Of the 'lifestyle' factors, smoking is particularly serious among Aboriginal peoples. Whereas less than a third of Canadians now smoke regularly, this proportion is 43% among Indians, 49% among Métis, and 64% among Inuit" (Young, 1994b, p. v). A survey of the on-reserve First Nation population in Manitoba revealed that 64% of the people interviewed indicated they were currently smoking cigarettes, and 67% began smoking before the age of 18. Nearly half of the people interviewed (47%) indicated that alcohol consumption was a problem in their household, and 25% felt they had a drinking problem themselves. Eighty-one percent of the women interviewed reported that they did not drink during their last pregnancy, but only 29% reported that they did not smoke (Manitoba First Nations Regional Health Survey, 1998).

Understanding how the health system works, and how and where to access services presents a problem for urban Aboriginal peoples (Canadian Nurses Association, 1995). Aboriginal women often find health systems alien and confusing, and care is often insensitive to Aboriginal cultural values (Stout, 1996). Research indicates that First Nations women do not regularly attend prenatal care. A small qualitative study of First Nations women revealed these women were often dissatisfied with health-care providers in prenatal clinics. "Their expectations of freely offered explanations and a friendly non-authoritarian approach were often not realized and their beliefs about pregnancy were in conflict with those of health-care providers" (Sokoloski, 1995, p. 89). A study of the perspectives of urban Aboriginal people found a general distrust of social institutions, including health institutions, by women of all ages. Participants felt that racism and discrimination were all too common (Canadian Nurses Association, 1995).

Given the higher rates of several risk factors for preterm birth among Aboriginal women, it is not surprising that the incidence of preterm birth is 17% higher among Aboriginal women in Manitoba. In order to reduce inequalities in health status between Aboriginal and non-Aboriginal women in Manitoba, a better understanding of the differences in determinants of health is needed.

Definition of Terms

Preterm Labor: The onset of regular uterine contractions resulting in cervical change occurring between 20 and 36 completed weeks gestation.

Preterm Birth : A live birth that occurs at a gestational age of less than 37 completed weeks (<259 days).

Spontaneous Preterm Birth: Delivery preceded by spontaneous labor or rupture of membranes without induction or elective cesarean section for maternal or fetal reasons.

Indicated Preterm Birth: Medically induced or operative early delivery because of either a maternal or fetal complication; also referred to as iatrogenic preterm birth.

Low Birth Weight (LBW): An infant who weighs less than 2,500 grams (5 pounds and 8 ounces) at birth, irrespective of gestational age.

Small for Gestational Age (SGA): An infant whose birth weight is less than the 10th percentile for his or her gestational age when plotted on a growth chart.

Spontaneous Preterm Premature Rupture of Membranes (SPPROM): Spontaneous rupture of the amniotic membranes prior to 37 completed weeks gestation and prior to onset of labor.

Aboriginal:

> In Canada, the term *Native* continues to be used by some native organizations and their leaders, although *Aboriginal* seems to be preferred. . . three Aboriginal groups are recognized in Canada: Indians, Inuit, and Métis. The term *Indian*, while still used widely by many Indians themselves, is being replaced by *First Nation*. . . In Canada, a further distinction is made between 'status' ('Treaty', 'registered'), and 'nonstatus' Indians, which is defined legally by the Indian Act. . . . All registered Indians are members of a 'band', a political and administrative unit created by the federal government. The term *Eskimo* is almost never used today in Canada, where it is perceived to be a derogatory term. Instead, *Inuit* is preferred by the people. . . *Métis* is used only in Canada, and refers to a distinct cultural group that originated from mixed Indian-white marriages in the early settlement of the Canadian West. (Young, 1994a, p. 6)

CHAPTER III: DESIGN AND METHODS

Study Design

A case-control study was conducted. A case-control study is a type of observational analytic epidemiologic investigation in which subjects are selected on the basis of whether they do (cases) or do not (controls) have a particular disease under study. The groups are then compared with respect to the proportion having a history of an exposure or characteristic of interest (Hennekens & Buring, 1987, p. 132). The past few decades have seen increasingly extensive use of case-control methodology, to the point where case-control studies have become the most common epidemiologic study design in health care literature today (Armenian & Lilienfeld, 1994; Hennekens & Buring, 1987). The main advantages of the method relate to its efficiency and informativeness in being able to evaluate exposures in a timely and cost-effective manner, especially among rare outcomes, and in testing the effect and interactions of a large number of etiologic factors (Armenian & Lilienfeld, 1994; Hennekens & Buring, 1987). Because the occurrence of preterm birth is relatively infrequent, occurring in about 7% of the population, and of multifactorial etiology, a case-control design is more appropriate than a prospective cohort design. A cohort study would require the participation of several thousand pregnant women for the duration of their pregnancy, making such a study design less feasible.

A hospital-based case-control study was conducted, in which all cases of spontaneous preterm birth delivered at St. Boniface General Hospital and Health Sciences Centre in Winnipeg, Manitoba, were studied during a specific period of time. The majority of preterm births in the province occur at these two tertiary care hospitals

(72% in 1996) (Personal communication, J. Blanchard, December 1997). The controls consisted of women with full term births selected from the same hospitals from which the cases arose. The focus was on spontaneous preterm births, because "spontaneous and indicated preterm births have different overall profiles of association with pregnancy risk factors" (Meis et al., 1995b, p. 597).

Subject Selection

Cases were defined as women who were delivered of a live singleton infant at less than 37 completed weeks gestation and in whom the delivery was preceded by spontaneous labor or rupture of the membranes without induction or elective cesarean birth for maternal or fetal indications. Controls were defined as women who were delivered of a live singleton infant between 37 and 41 completed weeks gestation in whom the delivery was preceded by spontaneous labor or rupture of membranes without induction or elective cesarean birth for maternal or fetal indications (adapted from Haas, Harlow, Cramer, & Frigoletto, 1991).

Inclusion criteria for cases included women who had a spontaneous preterm birth at less than 37 completed weeks gestation at St. Boniface General Hospital or Health Sciences Centre, singleton pregnancy, live birth, and ability to read, write and speak English. Exclusion criteria for cases included women who had an indicated preterm birth (medically induced or elective cesarean delivery), multiple pregnancy, stillbirth, early neonatal death, newborn with congenital anomalies, or known maternal psychiatric disorder.

Inclusion criteria for controls included women who had a full term birth between 37 and 41 completed weeks gestation at St. Boniface General Hospital or Health Sciences

Centre, live birth, singleton pregnancy, and ability to read, write and speak English. Exclusion criteria for controls included women who had an induction of labor, elective cesarean birth, multiple pregnancy, stillbirth, early neonatal death, newborn with congenital anomalies, or known maternal psychiatric disorder.

Sample Size

Sample size was estimated using Epi Info, Version 6.04, based on the following parameters: one-sided alpha of 5%, power of 80%, minimum detectable odds ratio of 1.6, exposure among controls of 25%, and a ratio of controls per case of 2:1. The estimated sample size consisted of 220 cases and 440 controls. Refer to Appendix D for a detailed description of the sampling plan for the study and how sample size was estimated.

Stratified sampling by race was employed to obtain predetermined numbers in subgroups of Aboriginal and non-Aboriginal women among both cases and controls, aiming for a 2:1 ratio of controls to cases in each subgroup. The targeted distribution of subjects across racial strata is depicted in Table 2, while the actual number of subjects recruited in every subgroup is depicted in Table 3. There were 226 cases and 458 controls enrolled in the study, for a total of 684 subjects. This number was slightly higher than the targeted sample size of 220 cases and 440 controls. However, the number of Aboriginal subjects recruited was slightly below the desired number of 90 cases and 180 controls, with 82 (36.3%) of the cases and 176 (38.4%) of the controls being Aboriginal.

Table 2.
Targeted Number of Cases and Controls in Each Subgroup

Subgroup	Number of Cases	Number of Controls
Aboriginal Subjects	90	180
Non-Aboriginal Subjects	130	260
Total	220	440

Table 3.
Actual Number of Cases and Controls Recruited in Each Subgroup

Subgroup	Number of Cases	Number of Controls
Aboriginal Subjects	82	176
Non-Aboriginal Subjects	144	282
Total	226	458

Procedure

Data were collected after ethical approval was received from the Faculty of Nursing Ethical Review Committee (Appendix E), and approval for access had been obtained from participating agencies (Appendix F). Women identified as eligible cases or controls were approached during their postpartum stay in hospital to participate in the study. All potential participants were provided with a written and verbal explanation about the study, and had the opportunity to ask questions about their participation. Subjects then signed a consent form indicating that they agreed to participate in an interview, and granting permission to access their health record to collect additional data related to risk factors for preterm birth (Appendix G). A mutually convenient time and place to complete the survey was arranged if the participant did not want to complete it when first approached. Efforts were made to collect data within two weeks of delivery to reduce recall bias regarding events during the pregnancy. The majority of interviews took place on the postpartum unit within the first few days following delivery (99.4%), while only four interviews took place in the woman's home (0.6%) at her request. Participation in the study took approximately 30 minutes (Mean length of interview 29 minutes, SD 6 minutes, range 17-70 minutes).

Research assistants were Registered Nurses with obstetrical experience and excellent interpersonal skills. Six research assistants were hired, three for each hospital, to provide 7 day a week recruitment of potential subjects. Attempts were made to hire one or two nurses of Aboriginal descent to facilitate communication with and participation by Aboriginal subjects. One Aboriginal nurse was hired initially, but was unable to continue working on the project due to a job change. Training was provided to the research assistants in interview techniques, administration of the survey questionnaire, collection of data from the health record, and administrative procedures. A pilot test was conducted, in which each research assistant conducted two interviews and reviewed the health records, then met as a group with the investigator to discuss any problems encountered and make decisions on a consistent approach to be used. Minor revisions were made to the survey questionnaire following the pilot test. Pilot test results were not included in the final sample.

<u>Subject recruitment and time frame</u>

Data collection commenced on October 12, 1999 and ended on December 31, 2000. All eligible cases delivering at either St. Boniface General Hospital or Health Sciences Center during the data collection time frame were approached to participate in the study. Once the target number of non-Aboriginal cases subjects was reached, all cases of preterm birth continued to be screened but data were only collected from eligible Aboriginal subjects until the decision was made to discontinue data collection. Systematic sampling was used to obtain the controls; of all eligible controls, every 3rd woman at each hospital was approached to participate in the study. Once the target number of non-Aboriginal control subjects was reached, every 3rd eligible woman continued to be screened but data were only collected from eligible Aboriginal subjects until that target was reached. Refer to Appendix H for a description of the rate of subject recruitment in each category.

The Labor and Delivery unit logbooks (in which each delivery is recorded chronologically) were used to identify eligible cases and controls, and served as a sampling frame for controls. Fink (1995) notes that "systematic sampling should not be used if repetition is a natural component of the sampling frame" (p. 14). Although there are repetitions in term births associated with inductions (women tend to deliver in the evening since inductions are started in the mornings) and elective cesarean births (only scheduled on weekdays), these are exclusion criteria for the control group and therefore should not have affected the control group. No other inherently recurring order was anticipated for potential subjects who met the inclusion criteria for the control group; controls therefore should have had an equal chance of selection. A random start was needed to systematically sample from the sampling frame (Fink, 1995), and a die was tossed to determine what name on the list would be selected first, based on deliveries recorded in the logbook on the first day of data collection.

Refusals to participate

Eight hundred and seventy-eight women were approached to participate in the study, and 194 women refused to participate (22%), yielding an overall response rate of 78%. The majority of refusals came from women who had delivered a term infant (n=163; 84%) and who therefore may have been less motivated to participate in the study. Only 31 women who had delivered a preterm infant refused to participate in the study. Racial status was known for only 142 (73%) of the women who refused to participate; approximately half were Aboriginal (n=65, 46%) and half were non-Aboriginal (n=77, 54%). The age of women who refused to participate ranged from 14 to 42 years (M 25.3; SD 6.3). Sixty-eight percent of the refusals (n=132) came from Health Sciences Centre, which is consistent with the overall lower recruitment rate of women from that hospital.

Instruments

Most case-control studies rely on a questionnaire as the primary source of exposure data (Correa, Stewart, Yeh, & Santos-Burgoa, 1994). An in-person survey interview was conducted with each participant, using a standardized questionnaire to reduce error that could be attributed to the interviewer. "This is accomplished by scripting the question format and question order, defining in detail how the interviewer is to move through the questionnaire, and defining how the interviewer is to respond to questions or comments from the respondent" (Frey & Oishi, 1995, p. 2). An in-person interview was selected over self-administered questionnaires "because of the role the interviewer can play in enhancing respondent participation, guiding the questioning, answering the respondent's questions, and clarifying the meaning of responses" (Frey &

Oishi, 1995, p. 3). In-person interviewing was selected over telephone interviewing because clarifications and probing are easier in person, nonverbal cues indicating hesitation or confusion on the part of the respondent can be observed, visual aids can be used to help respondents keep track of the response options for complex questions, and in-person interviews get fewer omissions and incomplete responses to sensitive questions (Frey & Oishi, 1995). Interviewing also reduces the overall cognitive burden on the respondent, since the questions are read to the respondent, and may be useful within subpopulations where literacy problems are common (Tourangeau & Smith, 1996), such as immigrant and Aboriginal women. However, two disadvantages should be noted. The potential for socially desirable responses is greater in the in-person interview than the telephone interview (Frey & Oishi, 1995). Both types of interviews result in decreased levels of reporting in response to sensitive questions relative to self-administration of the same questions. Respondents may be reluctant to admit to an interviewer that they have engaged in illegal or embarrassing activities, and are more likely to admit to activities such as alcohol consumption, frequent sexual partners and illicit drug use on self-administered questionnaires (Tourangeau & Smith, 1996).

Survey questionnaire

A survey questionnaire was developed to collect information from women regarding risk factors for preterm birth, including sociodemographic, behavioral and biomedical characteristics (e.g., age, race, education, income, marital status, maternal employment, smoking, alcohol use, obstetric history, medical condition). Refer to Appendix I. Several of the questions were adapted from widely used surveys such as the Winnipeg Area Survey (1984-1998), the General Social Survey (Statistics Canada,1991), and the National Population Health Survey (Statistics Canada, 1994). This enhanced the quality of the questionnaire, since these questions had been devised by survey experts and had been pretested prior to use. Content validation of the survey questionnaire was performed by having the questionnaire reviewed by several experts, and through pilot testing the questionnaire with potential respondents.

Health Record Data Collection Form

A data collection form was used to collect pertinent information from each woman's health record regarding medical, biologic, and other characteristics (e.g. obstetric history, number of prenatal visits, genital and urinary tract infections, prepregnancy weight and height, hemoglobin, weight gain during pregnancy). Refer to Appendix J.

Measurement of Key Study Variables

This section provides an overview of how the risk factors for each of the seven research questions were measured.

Smoking

Data on maternal smoking were collected using the following interview questions, adapted from the Ottawa Carleton Health Department and Regional Perinatal Program Questionnaire (Ottawa-Carleton Preterm Birth Prevention Initiative, 1992):

- Did you smoke cigarettes during the month before you became pregnant?
- How many cigarettes did you smoke each day in the month before you became pregnant (on average)?
- Did you smoke cigarettes after you knew you were pregnant?

- How many cigarettes did you smoke each day, on average, during the first three months of your pregnancy? During the second three months of your pregnancy? During the third three months of your pregnancy?

Nutritional Status

Data were collected on the following variables: pre-pregnancy weight and height, and total weight gain during pregnancy (both self-reported and from health record), and weight gain in each trimester of pregnancy and hemoglobin at 28-32 weeks gestation (from health record). A weight of less than 111 pounds (50.5 kg) was designated as being underweight prior to pregnancy; and a height of less than 62 inches (155 cm) reflected short stature. Overall rate of weight gain per week was calculated as total weight gain divided by gestational age in weeks. Body mass index (BMI) was calculated as kilogram of pre-pregnant body weight divided by height in meters squared, and categorized as per the Institute of Medicine (1990): underweight or low <19.8; average 19.8-26.0; overweight or high >26.0. The rate of weight gain in the second and third trimester was calculated by taking total weight gain, subtracting 2.5 kg for an approximation of weight gain in first trimester, and then dividing by gestational age minus 13 weeks (adapted from Hickey et al., 1995). Then a bivariate variable was created, with low rates of weight gain being defined as less than 0.38 kg/week (as used by Hickey et al., 1995; Spinillo, Capuzzo, Piazzi, Ferrari, Morales, & Di Mario, 1998). Anemia was defined using the Centers for Disease Control and Prevention criteria as a hemoglobin less than 10.5 gm/dl in the second trimester (Schieve et al., 2000).

Prenatal Care

The Kessner Adequacy of Prenatal Care Index (Kessner, Singer, Kalk, &

Schlesinger, 1973) is the most widely used index to assess the adequacy of prenatal care in epidemiologic studies (Delgado-Rodriguez, Gomez-Olmedo, Bueno-Cavanillas, & Galvez-Vargas, 1996; Fiscella, 1995). This index combines the timing of the first prenatal visit and the total number of visits, adjusting for length of gestation, to create an index with three levels of adequacy: adequate, intermediate, and inadequate. Refer to Table 4. For care to be considered adequate, it has to be initiated prior to 14 weeks gestation. Any woman who begins prenatal care at 28 weeks gestation or later is considered to have inadequate care. In order to calculate the index, women in this study were asked "How many weeks or months pregnant were you when you had your first visit for prenatal care?" and "About how many visits for prenatal care did you have during your pregnancy?" Data on these variables were also collected from the prenatal record which is completed by the physician and sent to the hospital prior to birth for inclusion with the health record.

Table 4.
Kessner Adequacy of Prenatal Care Index

Prenatal Care Index	Gestation (weeks)		Number of prenatal visits
Adequate*	13 or less	and	1 or more or not stated
	14-17	and	2 or more
	18-21	and	3 or more
	22-25	and	4 or more
	26-29	and	5 or more
	30-31	and	6 or more
	32-33	and	7 or more
	34-35	and	8 or more
	36 or more	and	9 or more
Inadequate**	14-21	and	0 or not stated
	22-29	and	1 or less or not stated
	30-31	and	2 or less or not stated
	32-33	and	3 or less or not stated
	34 or more	and	4 or less or not stated
Intermediate	All combinations other than specified above		

* In addition to the specific number of visits indicated, the interval to the first prenatal visit has to be 13 weeks or less (first trimester).
** In addition to the specific number of visits indicated, all women who start their prenatal care in the third trimester (at 28 weeks or later) are considered to have inadequate care.

Adapted from: Infant death: An analysis by maternal risk and health care (Table 2-3, p. 59). Washington, DC: Institute of Medicine, National Academy of Sciences, 1973.

An advantage of using the Kessner index is that it adjusts the expected number of prenatal care visits for gestation at delivery. In other words, a woman who delivers preterm is not expected to have as many prenatal care visits as a woman who delivers at term. A limitation of the Kessner index it that it indicates nothing about the content or clinical adequacy of prenatal care; it is strictly a utilization index (Kotelchuck, 1994). Other criticisms of the index are that it is heavily weighted toward timing of prenatal care initiation and does not distinguish timing of initiation from poor subsequent utilization (Kotelchuck, 1994). An alternative measure, the Kotelchuck Adequacy of Prenatal Care Utilization (APNCU) Index, was developed to overcome some of these weaknesses, and adds an "adequate-plus" category for women who begin prenatal care by the fourth month and have 110% or more of the number of visits recommended by the American College of Obstetricians and Gynecologists (Kotelchuck, 1994). However, a comparison of these two indices of prenatal care utilization based on a case-control study in Spain suggests the Kessner index is better for discriminating low birth weight than the APNCU index. "In logistic regression analyses, the residuals of the Kessner index added meaningful information to the APNCU index, whereas the opposite did not occur" (Delgado-Rodriguez et al., 1996, p. 648). In the study by Krueger and Scholl (2000), inadequate care using the Kessner index was associated with a higher odds of preterm delivery than the Kotechuck index.

Abuse

The Abuse Assessment Screen (AAS) has been widely used to determine abuse during pregnancy in health settings, and consists of several questions to determine the level and type of abuse and the identity of the abuser within a defined period. Refer to Appendix K. The screen was developed by the Nursing Research Consortium on Violence and Abuse (McFarlane, Parker, Soeken, Silva, & Reel, 1998, p. 65). The five major questions from the AAS were incorporated as part of the Survey Questionnaire: "1) Have you ever been emotionally or physically abused by your partner or someone important to you? 2) Within the last year, have you been hit, slapped, kicked, or otherwise physically hurt by someone? 3) While you were pregnant, were you hit, slapped, kicked, or otherwise physically hurt by someone? 4) Within the last year, has anyone forced you to have sexual activities? and 5) Are you afraid of your partner or anyone listed above?" (Parker, McFarlane, & Soeken, 1994, p. 324). This screen has been found to detect abuse as effectively as longer instruments developed specifically for research, and has been used with ethnically heterogeneous samples. Content and criterion validity and test-retest reliability have been established (McFarlane, et al., 1998; Parker et al, 1994; Soeken, McFarlane, Parker, & Lominack, 1998).

Strenuous Work

Women were asked if they were employed during pregnancy, and if so, how many hours they worked for pay each week during their pregnancy. They also were asked, "For what type of business, industry or service did you work for the longest time during your pregnancy?" and "What kind of work were you doing?". The responses to these questions were then used to classify the women's occupations according to the National Occupational Classification (Employment and Immigration Canada, 1993), which is a systematic taxonomy of occupations in the Canadian labour market into 26 major groups based on skill level and skill type. For this study, these 26 groups were subsequently recoded into 6 broader groups using the technique of the Winnipeg Area Study (2000). In order to determine strenuous work, questions were adapted from the General Social Survey (Statistics Canada, 1991), using the following introductory statement, "I'm now going to ask you questions about the amount of time you spend on physical activity at work or while doing your daily chores, but not leisure time activity." Women were asked how many hours per day during their pregnancy they usually spent standing or walking, lifting or carrying light loads, and doing heavy work or carrying very heavy loads.

Urogenital Infections

During the interview, women were asked if they had any of the following health problems during their pregnancy: kidney infection (pyelonephritis), bladder infection, or a sexually transmitted disease. The health record was reviewed to determine if the woman had any of the following urogenital infections during her pregnancy (yes/no): gonorrhea, syphilis, chlamydia, bacterial vaginosis, urinary tract infection, pyelonephritis, and other (specify).

Stress, Social Support, and Self Esteem

Stress was assessed using two methods: life event stress and perceived stress. The Prenatal Psychosocial Profile (PPP) (Curry, Campbell, & Christian, 1994; Curry, Burton, & Fields, 1998) was used to assess psychosocial risk in the areas of life event stress, self-esteem, support of partner, and support of others (Appendix L) and was incorporated as part of the survey questionnaire. The PPP is a composite of the Support Behaviors Inventory (Brown, 1986), the Rosenberg (1965) self esteem scale, and a newly developed measure of stress. Because the PPP was being administered during the postpartum period rather than during pregnancy, the stem statements for the subscales were modified to read as follows: for assessment of stress, *To what extent was (READ CHOICE) a stressor/hassle for you during your pregnancy?,* for assessment of support, *I want you to tell me how satisfied you were with the support you received from (your partner/other people) during your pregnancy,* for assessment of self esteem, *I would like you to tell me how much you agree or disagree that this statement described yourself during your pregnancy.* High scores on the PPP subscales indicate higher social support, self-esteem, and stress. The tool was designed to be read to women, and is easy to administer and score. Response cards were used to facilitate responses (Appendix M). The PPP has been administered to over 3,444 culturally diverse rural and urban pregnant women, including Native American women (Curry et al., 1998). Normative data have been reported. The scale means, standard deviations, and alphas for each of the five studies in which the instrument has been used are shown in Appendix N (Curry et al., 1998). Internal consistency is acceptable, with alphas for the support scales ranging from .92 to .98, and alphas for the stress scale ranging from .67 to .78. Test-retest correlations for the support and stress subscales range from .52 to .68, indicating moderate stability over time (Curry et al, 1998). Factor analysis supported independence of subscales as all items loaded on the appropriate scales and minimally on others. Convergent validity for the stress scale was evidenced by a correlation of .71 with the Difficult Life Circumstances Scale (Curry et al., 1994). The PPP takes about 5 minutes to complete.

In addition, the 4-item version of the Perceived Stress Scale (PSS) was used to measure women's perception of stress (Cohen, Kamarck, & Mermelstein, 1983; Cohen & Williamson, 1988). The PSS has been applied successfully as a measure of perceived stress in a wide variety of populations, including new mothers (Walker, 1989). The PSS measures the degree to which persons find "their lives unpredictable, uncontrollable, and overloading" (Cohen et al., 1983, p. 387). For example, one of the questions was worded "In the last month of your pregnancy, how often did you feel difficulties were piling up so high that you could not overcome them?" Items are rated on a 5-point scale, ranging from "never" (0) to "very often" (4). The PSS is scored by reversing responses to the two positively worded items and then summing responses to all items. Higher scores represent higher levels of perceived stress. Coefficient alpha reliability for the PSS ranges from .84 to .86 and short-term test-retest reliability is .85. Evidence for concurrent and predictive validity is derived from correlations with life-event scores and mental and physical health outcomes. The PSS exceeds life events as an effective predictor of a wide variety of outcomes. Norms have been established using 940 male and 1,427 female residents of the United States (Cohen & Williamson, 1988).

Data Analysis

Data were coded and transferred to a computer file. Data analysis was performed using the following statistical software programs: SPSS for Windows Version 10.0, SAS Version 8.1 (SAS Institute Inc., Cary, NC), and Epi Info Version 6.0 (CDC Atlanta and WHO Geneva). A statistician from the Biostatistical Consulting service of the Department of Community Health Services at the University of Manitoba was consulted regarding data analysis and interpretation. Initially, data were summarized using descriptive statistics; frequencies were calculated for categorical variables, and means and distribution were calculated for continuous variables. The distribution of continuous variables was examined to determine how to group subjects (for example, at median, quartiles) for subsequent categorical analyses.

To test for statistically significant differences in distribution of categorical variables among cases and controls, the Chi-square test was used. Where a cell's expected frequency was less than 5, the Fisher's exact test was used. The t test for independent samples was used to compare case-control differences for continuous variables.

The comparison of exposure to risk factors among cases and controls and the calculation of the odds ratio (OR) are the unique features in analyzing data from case-control studies (Lilienfeld & Stolley, 1994). Data were tabulated in the form of a four-fold table (refer to Figure 2), which allows for comparison of the prevalence of exposure among the cases, a/(a+c), with that for controls, b/(b+d). The odds ratio, an estimate of the relative risk, was calculated as the cross-product of the entries in the table, ad/bc (Lilienfeld & Stolley, 1994). Where appropriate, odds ratios were calculated for different amounts of exposure (for example, number of cigarettes smoked per day, rate of weight gain during pregnancy).

Figure 2.
Framework of a Case-Control Study

	Number of Individuals		
Characteristic	With disease (cases)	Without disease (controls)	Total
With	a	b	a+b
Without	c	d	c+d
Total	a+c	b+d	a+b+c+d=N

(from Lilienfeld & Stolley, 1994, p. 227)

The 95% confidence interval and significance test for each odds ratio also were computed. If the underlying statistical model is correct and there is no bias, the confidence interval will include the true parameter value in at least 95% of replications of the process of obtaining the data. The 95% confidence interval provides both an idea of the likely magnitude of the effect and the random variability of the point estimate, whereas the p value indicates only the degree of consistency between the data and a single hypothesis. If the null value (a rate ratio of 1) is within the 95% confidence interval, then the estimate of effect will not be statistically significant at the 1 - 0.95 = 0.05 alpha level (Rothman & Greenland, 1998).

Stratification is a mainstay of epidemiologic analyses, and provides a direct method for eliminating biased comparisons that result from confounding (Rothman &

Greenland, 1998; Schlesselman, 1982). Since a major purpose of this study was to determine whether the association between various risk factors and preterm birth differed between Aboriginal and non-Aboriginal women, stratified analysis was the technique used to evaluate and describe effect-measure modification between these two groups or strata. Subjects were stratified into an Aboriginal group and a non-Aboriginal group. The subgroup-specific odds ratio represents the effect of a selected risk factor, adjusted for race, on the risk of preterm birth. If the odds ratios are relatively constant across subgroups, being consistently elevated or reduced, they can be combined to form a summary estimate, adjusted for the effects of race (Schlesselman, 1982).

> Most stratified analysis methods are based on the fact that, if the effect measure is uniform (that is, homogeneous or constant) across strata, each stratum provides an estimate of the same quantity. .. .investigators will desire a more formal statistical evaluation of the extent to which variation in the stratum-specific estimates of effect is consistent with purely random behavior . . . . Statistical tests of the null hypothesis that the effect measure is uniform are also known as tests of homogeneity (i.e., the hypothesis that the measure has a "common" or constant value across the strata). Such tests are based on comparisons of stratum-specific estimates against a uniform effect estimate, or of observed cell counts against cell counts expected under the homogeneity hypothesis. Thus, to test homogeneity we first conduct an analysis in which we assume homogeneity and derive an estimate of the uniform effect measure. (Rothman & Greenland, 1998, pp. 265-266)

The Mantel-Haenszel summary odds ratio was calculated to provide a weighted average of the subgroup specific odds ratios. The Breslow-Day test of homogeneity was used to test the null hypothesis that an effect measure was uniform across strata. A p value greater than .10 indicated that heterogeneity (nonuniformity) was not detected by the test, and the measure was considered uniform. If the p value was deemed significant, then heterogeneity (nonuniformity) was considered to be detected, and the stratum-specific rather than summary estimates of risk were presented. Because the standard tests of homogeneity have very low power in typical epidemiologic studies (i.e., there is little chance they will reject homogeneity), a p value of $\leq .10$ was chosen as the level of significance for the Breslow-Day test (Rothman & Greenland, 1998).

Multivariate analyses were performed to study the effects of several factors simultaneously and to identify variables which may be confounded with each other. Multivariate logistic regression models were used "to determine which of the variables has an independent association with the outcome, to determine which variables interact among themselves, and to quantify the relative contribution of each variable or combination of variables to the risk of the disease" (Lilienfeld & Stolley, 1994, p. 245). An adjusted odds ratio and 95% confidence limits were calculated for each main-effect term in the models. Models were constructed for the total sample and for the subgroups of Aboriginal and non-Aboriginal women. The models included the variables for which there was some evidence from the stratified analyses of an independent association with preterm birth.

The population attributable risk percent (PAR%) was calculated for selected modifiable risk factors, for the sample as a whole and for the two subgroups of Aboriginal and non-Aboriginal women, using the adjusted odds ratio from the final models. PAR% also is referred to as the etiologic fraction or attributable risk, and is the proportion of all cases in the target population attributable to exposure (Schlesselman, 1982). PAR% can be estimated from a case-control study, provided the exposure rate in the control group is approximately representative of the target population. The formula for calculating PAR% is presented in Appendix O.

The vision of the Aboriginal community includes empowering individuals and families to increase their control and influence over issues, programs, and decisions that affect their lives and their ability to determine their own destinies (Manitoba Round Table on Environment and Economy, 1999). In keeping with this vision, a focus group of Aboriginal health care providers was convened to discuss and assist with interpretation of the results of this study as they relate to Aboriginal women, and to provide recommendations to the investigator on policy and program directions appropriate to the needs of Aboriginal women. Five Aboriginal women with a health care professional background participated in a focus group on April 30, 2001, facilitated by the investigator. Feedback obtained from this group is incorporated throughout the discussion chapter.

Ethical Implications

Informed consent was obtained from all subjects voluntarily participating in the study. Refer to Appendix G for the Invitation to Participate and the Consent Form. At no time were respondents' names associated with the questionnaires, thereby assuring confidentiality. Respondents were informed they could withdraw from the study at any point without affecting their care. Only the investigator, members of her dissertation committee, the data entry clerk, and the statistical consultant had access to the data.

Questionnaires are being stored in a locked filing cabinet and will be destroyed after seven years.

No experimental conditions were imposed on subjects. There were no perceived harmful effects of the study, although it may have been distressing for some women who delivered a premature infant to think about possible risk factors for preterm birth. The proposal was approved by the Faculty of Nursing Ethical Review Committee at the University of Manitoba (Appendix E), and agency approval was obtained before data were collected (Appendix F). The proposal for the focus group was approved by the Nursing/Education Research Ethics Board of the University of Manitoba (Appendix E).

CHAPTER IV: RESULTS

The results of the study will be presented in several sections. First, demographic characteristics of the study subjects will be summarized and the results of stratified analyses of the association between demographic characteristics and preterm birth will be presented. This will be followed by an examination of examine risk factors related to pregnancy characteristics and medical and obstetric history. Then results related to descriptive analyses and stratified analyses of relative risk for the variables that comprise the seven research questions will be presented: smoking, nutritional status, prenatal care, abuse, strenuous work, urogenital infections, and stress and social support. In each section, tables will be used to compare differences in cases and controls among three groups: all subjects, non-Aboriginal subjects, and Aboriginal subjects. A comparison of differences between non-Aboriginal and Aboriginal subjects on the various factors will be addressed in the narrative. This chapter will conclude with a presentation of the results of multiple logistic regression analyses, and a discussion of population attributable risk for various risk factors.

Demographic Characteristics

Descriptive Analyses of Demographic Characteristics

The demographic characteristics of study subjects are shown in Table 5. There were 226 cases and 458 controls enrolled in the study, for a total of 684 subjects. Eighty-two (36.3%) of the cases and 176 (38.4%) of the controls were Aboriginal. There were no significant sociodemographic differences between cases and controls in age, marital status, education, or place of residence. There were significant differences between the

Aboriginal and non-Aboriginal subjects in that the Aboriginal subjects were, on average, younger, of lower income, and less educated.

Subjects ranged in age from 14 to 45 years (M 27.2, SD 6.1). There was no significant difference in mean age between cases and controls (M 27.7 vs 27.0 years; $t = 1.32$, $p = 0.186$); however Aboriginal subjects were significantly younger than non-Aboriginal subjects (M 24.3 vs 29.0 years, $t = -10.36$, $p < .001$). There also was no significant difference in total years of education between cases and controls (M 12.8 vs 12.9 years; $t = -0.35$, $p = 0.725$), although Aboriginal subjects had significantly less years of schooling than non-Aboriginal subjects (M 11.1 vs 13.9 years, $t = -13.16$, $p < .001$). Overall, 55.7% of the subjects were married and 24.4% were living in a common-law relationship, while 16.8% were single. There was no significant difference between cases and controls in current living arrangement ($X^2 = 3.05$, $p=0.692$). However, there was a significant difference in current living arrangement between the Aboriginal and non-Aboriginal groups, with a lower proportion of the Aboriginal women being married (34.1% vs 68.8%) and more living common-law (33.3% vs 19.0%) or single (27.9% vs 10.1%) than the non-Aboriginal women ($X^2 = 85.89$, $p<.001$).

Average family income varied widely. The modal response was a family income of under $10,000.00 (18.6% of responses), but less than 7% of the non-Aboriginal group reported this income level compared to more than 40% of the Aboriginal group. When income was categorized into low, moderate, and high, there was no significant difference in family income between cases and controls ($X^2 =0.84$, $p = 0.656$), while a higher proportion of Aboriginal subjects reported a low family income than non-Aboriginal subjects (X^2=176.12, p< .001). Ninety-three subjects (13.6%) did not know their income or did not respond to the question regarding income.

The majority of non-Aboriginal subjects were white (83.1%), with the remainder being Asian (11.3%), Latino (2.6%), black (2.3%), or other (0.7%). There was no significant difference between non-Aboriginal cases and controls in racial background (X^2 = 4.59, p = 0.332). Of the Aboriginal subjects, 207 (80.2%) reported their ethnic background as First Nations, 45 (17.4%) as Métis, and 6 (2.3%) as Inuit. There was no significant differences between cases and controls in ethnic background (X^2=6.75, p=.080); however, there was a tendency for more cases than controls to be from Métis or Inuit background.

The majority of the subjects resided in the province of Manitoba (98.1%), while 13 subjects (1.9%) resided in either Ontario, Nunavut, or Saskatchewan but delivered their baby in Manitoba. There was no significant difference between cases and controls in place of residence (X^2 = 6.44, p = 0.092). Most of the non-Aboriginal subjects resided in an urban area (Winnipeg or Brandon) (78.8%), while another 19.1% were from south rural Manitoba. The residence of Aboriginal subjects was primarily divided between north rural Manitoba (47.9%) and the urban area (40.1%), with only 7.8% residing in south rural Manitoba. Refer to Appendix P for maps of Manitoba depicting subjects' region of residence.

Table 5.
Demographic characteristics of cases and controls, by group

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)
No. of subjects	226 (33.0)	458 (67.0)	144 (33.8)	282 (66.2)	82 (31.8)	176 (68.2)
Age Group						
<20 years	19 (8.4)	56 (12.2)	8 (5.6)	13 (4.6)	11 (13.4)	43 (24.4)
20-34 years	170 (75.2)	335 (73.1)	104 (72.2)	213 (75.5)	66 (80.5)	122 (69.3)
>34 years	37 (16.4)	67 (14.6)	32 (22.2)	56 (19.9)	5 (6.1)	11 (6.3)
Education						
<12 years	69 (30.7)	137 (30.1)	24 (16.7)	36 (12.8)	45 (56.6)	101 (58.4)
12 years	54 (24.0)	85 (18.7)	37 (25.7)	55 (19.5)	17 (21.0)	30 (17.3)
>12 years	103 (45.3)	233 (51.2)	83 (57.6)	191 (67.7)	19 (23.5)	42 (24.3)
Race/Ethnicity						
White	122 (54.0)	232 (50.7)	122 (84.7)	232 (82.3)	-	-
Black	3 (1.3)	7 (1.5)	3 (2.1)	7 (2.5)	-	-
Asian	16 (7.1)	32 (7.0)	16 (11.1)	32 (11.3)	-	-
Latino	1 (0.4)	10 (2.2)	1 (0.7)	10 (3.5)	-	-
Other	2 (0.9)	1 (0.2)	2 (1.4)	1 (0.4)	-	-
Aboriginal	82 (36.3)	176 (38.4)	-	-	-	-
First Nations	-	-	-	-	58 (70.7)	149 (84.7)
Metis	-	-	-	-	21 (25.6)	24 (13.6)
Inuit	-	-	-	-	3 (3.7)	3 (1.7)
Family Income						
<$10,000	38 (18.8)	72 (18.5)	9 (6.8)	16 (6.2)	29 (42.0)	56 (42.7)
10-19,999	34 (16.8)	59 (15.2)	16 (12.0)	22 (8.5)	18 (26.1)	37 (28.2)
20-29,999	25 (12.4)	43 (11.1)	17 (12.8)	30 (11.6)	8 (11.6)	13 (9.9)
30-39,999	17 (8.4)	55 (14.1)	14 (10.5)	47 (18.2)	3 (4.3)	8 (6.1)
40-49,999	19 (9.4)	34 (8.7)	16 (12.0)	28 (10.9)	3 (4.3)	6 (4.6)
50-59,999	14 (6.9)	38 (9.8)	12 (9.0)	34 (13.2)	2 (2.9)	4 (3.1)
60-69,999	12 (5.9)	28 (7.2)	12 (9.0)	26 (10.1)	0	2 (1.5)
70-79,999	11 (5.4)	20 (5.1)	9 (6.8)	17 (6.6)	2 (2.9)	3 (2.3)
80-89,999	10 (5.0)	16 (4.1)	9 (6.8)	15 (5.8)	1 (1.4)	1 (0.8)
90-99,999	9 (4.5)	5 (1.3)	6 (4.5)	5 (1.9)	3 (4.3)	0
100,000 +	13 (6.4)	19 (4.9)	13 (9.8)	18 (7.0)	0	1 (0.8)
Marital Status						
	124 (54.9)	257 (56.1)	92 (63.9)	201 (71.3)	32 (39.0)	56 (31.8)
Married	59 (26.1)	108 (23.6)	29 (20.1)	52 (18.4)	30 (36.6)	56 (31.8)
Common-law	35 (15.5)	80 (17.5)	19 (13.2)	24 (8.5)	16 (19.5)	56 (31.8)
Single	2 (0.9)	5 (1.1)	2 (1.4)	3 (1.1)	0	2 (1.1)
Divorced	5 (2.2)	8 (1.7)	2 (1.4)	2 (0.7)	3 (3.7)	6 (3.4)
Separated	1 (0.4)	0	0	0	1 (1.2)	0
Widowed						
Place of Residence						
Urban	138 (61.6)	295 (65.3)	108 (75.5)	222 (80.4)	30 (37.0)	73 (41.5)
South rural MB	38 (17.0)	62 (13.7)	31 (21.7)	48 (17.8)	7 (8.6)	13 (7.4)
North rural MB	40 (17.9)	90 (19.9)	2 (1.4)	5 (1.8)	38 (46.9)	84 (48.3)
Outside MB	8 (3.6)	5 (1.1)	2 (1.4)	0	6 (7.4)	5(2.8)

Stratified Analyses of Association between Demographic Characteristics and Preterm Birth

Stratified analyses were used to determine whether the association between risk factors and preterm birth differed between Aboriginal and non-Aboriginal women. Refer to Table 6, which presents the odds ratios and 95% confidence intervals for both strata (Aboriginal and non-Aboriginal groups), the Mantel-Haenszel common odds ratio, and the Breslow-Day test of homogeneity. The Breslow-Day test of homogeneity was used to test the null hypothesis that an effect measure was uniform across strata. If the p value was not significant, then homogeneity (uniformity) was assumed, and the Mantel-Haenszel odds ratio was reported. The Mantel-Haenszel common odds ratio provides a weighted average of the within stratum odds ratios, and, if significant, confirms the reality of an association between the risk factor and preterm birth, after controlling for race. If the p value was significant ($p \leq .10$), then heterogeneity (nonuniformity) was considered to be detected, and the stratum-specific rather than summary estimates of risk are discussed.

Young maternal age and marital status exhibited heterogeneity across strata. Young maternal age was a significant factor for the Aboriginal group only, with an age of less than 19 years being protective; i.e., women less than 19 years had a reduced risk of preterm birth compared to those 19 years of age or greater ($p = .027$). In the non-Aboriginal group, there was a tendency for women aged less than 19 years to be at increased risk of preterm birth, although the odds ratio was not significant. Having single marital status reduced the odds of preterm birth for the Aboriginal group by about one-half ($p = .052$). Conversely, there was a trend toward single marital status being a risk factor for non-Aboriginal women, although the odds ratio of 1.66 did not achieve statistical significance (p = .090). When examined as bivariate variables, non-completion of high school, maternal age greater than 35 years, low family income less than $20,000 per year, and rural place of residence were not associated with an increased risk of preterm birth in either the non-Aboriginal or Aboriginal group, after controlling for race.

Table 6.
Odds ratios (95% confidence intervals) for the relationship of demographic characteristics and preterm birth, stratified by race

Characteristic	Non-Aboriginal O.R. (95% C.I.)	Aboriginal O.R. (95% C.I.)	Mantel-Haenszel O.R. (95% C.I.)	Breslow-Day Test (p)
Age < 19 years	1.99 (0.57, 7.00)	0.37 (0.15, 0.92)*	0.61 (0.30, 1.24)	5.0 (.025)
Age > 35 years	1.27 (0.74, 2.19)	1.07 (0.31, 3.66)	1.24 (0.75, 2.03)	.06 (.802)
Single marital status	1.66 (0.92, 2.99)	0.56 (0.31, 1.01)	0.94 (0.63, 1.42)	6.64(.010)
Family Income <$20,000	1.34 (0.77, 2.33)	0.87 (0.46, 1.64)	1.11 (0.73, 1.69)	1.00 (.317)
Non-completion of high school	1.39 (0.80, 2.42)	0.88 (0.51, 1.50)	1.09 (0.74, 1.61)	1.39(.238)
Rural place of residence	1.33 (0.82, 2.16)	1.19 (0.69, 2.04)	1.27 (0.88, 1.82)	.10 (.758)

Chi square *p<.05

Pregnancy Characteristics, Medical and Obstetric History

Descriptive Analyses of Pregnancy Characteristics, Medical, and Obstetric History

The pregnancy characteristics of subjects are shown in Table 7. Four hundred eighty-two subjects (70.5%) delivered at St. Boniface General Hospital, 200 subjects (29.2%) at Health Sciences Centre, and 2 subjects (0.3%) in other locations, with the newborn subsequently being transferred to either St. Boniface General Hospital or Health Sciences Centre. There was no significant difference between cases and controls in place of delivery ($X^2 = 3.74$, p = .154). As expected, fewer of the cases had planned to deliver at either of these two hospitals (n=159, 70.4%) than the controls (n=419, 91.9%). This is consistent with current practice, in that women who experience preterm labor or other complications of pregnancy in rural or northern areas are often transferred to one of the two tertiary care hospitals in Winnipeg for delivery.

Similar proportions of cases (42.2%) and controls (38.9%) were primiparous, that is, had delivered their first baby (X^2 =0.69, p=.406). However, significantly more non-Aboriginal women were primiparous than Aboriginal women (46.8% vs 28.6%, X^2 =21.99, p<.001). Gestational age at delivery of cases ranged from 23 to 36 weeks (M 34.2, SD 2.5), with the majority of women (74.8%) giving birth between 34 and 36 weeks gestation. Birth weight of the cases' newborns ranged from 575 to 4,283 grams (M 2,543.9 grams, SD 651.7). Gestational age at delivery of controls ranged from 37 to 42 weeks (mean 39.1, S.D. 1.1), with birth weight of their newborns ranging from 2,263 to 5,267 grams (M 3,502.6 grams, SD 457.6).

Cases had a significantly greater history than controls of previous premature delivery (25.2% vs 7.9%, X^2 = 38.83, p < .001) and two or more spontaneous abortions (miscarriages) (10.6% vs 5.3%, X^2 = 6.58, p=.010). Significantly more Aboriginal women had a history of previous premature delivery than non-Aboriginal women (18.6% vs 10.6%, X^2 =8.84, p=.003). This may arise from the fact that more of the Aboriginal women were multiparous. Similar proportions of cases and controls had a past pregnancy history of therapeutic abortion. Only a small number of women reported a history of stillbirth, ectopic pregnancy, or multiple birth.

Few of the women reported chronic health problems, with asthma being the most common condition. Conversely, several women experienced health problems during their pregnancy, and cases often had a higher incidence of complications than controls. For example, cases had a significantly higher incidence of vaginal bleeding after 12 weeks of pregnancy (25.0% vs 11.6%, $X^2 = 19.14$, $p < .001$), gestational hypertension (12.0% vs 5.3%, $X^2 = 9.54$, $p = .002$), and rupture of membranes prior to onset of labor (57.0% vs 30.0%, $X^2 = 45.87$, $p<.001$) than controls. Cases and controls had a similar proportion of bladder infections during pregnancy (24.1% vs 21.8%, $X^2 =0.61$, $p = 0.44$). A greater proportion of Aboriginal women reported gestational diabetes (5.8% vs 2.3%, $X^2 =5.53$, $p=.019$), bladder infections (32.2% vs 16.8%, $X^2 =21.51$, $p<.001$), vaginal bleeding (21.7% vs 12.7%, $X^2 =9.45$, $p=.002$), and gestational hypertension (10.5% vs 5.6%, $X^2 =5.54$, $p=.019$) during their pregnancy than non-Aboriginal women. Seventy-one (31.4%) of the cases compared to only 48 (10.5%) of the controls had been hospitalized during their pregnancy ($X^2=50.69$, $p<.001$). There was no significant difference between Aboriginal and non-Aboriginal subjects in the proportion of women who were hospitalized one or more times during their pregnancy (19.0% vs 16.4%, $X^2 =0.73$, $p=.392$) or who reported having rupture of membranes prior to onset of labor (36.5% vs 40.3%, $X^2 = 0.97$, $p=.324$).

Table 7.

<u>Pregnancy characteristics, and medical and obstetric history of cases and controls, by group</u>

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)
Place of Delivery						
St. Boniface Gen.Hosp.	169 (74.8)	313 (68.3)	109(75.7)	193 (68.4)	60 (73.2)	120 (68.2)
Health Sciences Centre	57 (25.0)	143 (31.2)	35 (24.3)	89 (31.6)	22 (26.8)	54 (30.7)
Other	0	2 (0.4)	0	0	0	2 (1.1)
Parity						
Primipara	95 (34.9)	177 (38.9)	73 (51.0)	126 (44.7)	22 (26.8)	51 (29.5)
Multipara	130 (57.8)	278 (61.1)	70 (49.0)	156 (55.3)	60 (73.2)	122 (70.5)
Past Pregnancy History						
Spontaneous Abortion ≥2	24 (10.6)	24 (5.3)*	15 (10.4)	16 (5.7)	9 (11.0)	8 (4.6)
Therapeutic Abortion ≥2	8 (3.5)	14 (3.1)	5 (3.5)	6 (2.1)	3 (3.7)	8 (4.5)
Ectopic pregnancy	5 (2.2)	6 (1.3)	3 (2.1)	3 (1.1)	2 (2.5)	3 (1.7)
Stillbirth	5 (2.2)	2 (0.4)	1 (0.7)	1 (0.4)	4 (4.9)	1 (0.6)*
Preterm birth	57 (25.2)	36 (7.9)**	27 (18.8)	18 (6.4)**	30(36.6)	18(10)**
Multiple birth	4 (1.8)	1 (0.2)	4 (2.8)	1 (0.4)	0	0
Chronic health problem						
Diabetes	1 (0.4)	3 (0.7)	0	1 (0.4)	1 (1.2)	2 (1.1)
Hypertension	10 (4.4)	10 (2.2)	6 (4.2)	5 (1.8)	4 (4.9)	5 (2.8)
Heart disease	2 (0.9)	9 (2.0)	1 (0.7)	5 (1.8)	1 (1.2)	4 (2.3)
Kidney disease	6 (2.7)	5 (1.1)	5 (3.5)	3 (1.1)	1 (1.2)	2 (1.1)
Asthma	21 (9.3)	48 (10.5)	12 (8.4)	31 (11.0)	9 (11.0)	17 (9.7)
Health problem during pregnancy:						
Gestational diabetes	10 (4.4)	15 (3.3)	5 (3.5)	5 (1.8)	5 (6.1)	10 (5.7)
Pyelonephritis	5 (2.2)	9 (2.0)	3 (2.1)	6 (2.1)	2 (2.4)	3 (1.7)
Bladder infection	54 (24.1)	99 (21.8)	29 (20.4)	42 (14.9)	25 (30.5)	57 (32.9)
Vaginal bleeding	56 (25.0)	53(11.6)**	32 (22.2)	22 (7.8)**	24 (30.0)	31 (17.8)*
Polyhydramnios	8 (3.5)	9 (2.0)	4 (2.8)	5 (1.8)	4 (4.9)	4 (2.3)
Gestational hypertension	27 (12.0)	24 (5.3)*	14 (9.7)	10 (3.6)*	13 (16.0)	14 (8.0)
Abdominal surgery	5 (2.2)	2 (0.4)	4 (2.8)	1 (0.4)	1 (1.2)	1 (0.6)
Rupture of membranes prior to onset of labor	127 (57.0)	136(30)**	74 (51.7)	96 (34.4)*	53 (66.3)	40(23)**
Hospitalizations during						
preg	155 (68.6)	410 (89.5)	100(69.4)	256 (90.8)	55 (67.1)	154 (87.5)
None	71 (31.4)	48(10.5)**	44 (30.6)	26 (9.2)**	27 (32.9)	22(13)**
1 or more						

*Chi square p <.05 **Chi square p<.001

<u>Stratified Analyses of Association between Pregnancy Characteristics and Preterm Birth</u>

The results of stratified analyses for the association between various pregnancy characteristics and preterm birth are shown in Table 8. The risk of preterm birth increased substantially for several pregnancy characteristics. The majority of these risk factors demonstrated homogeneity of effect. Based on the Mantel-Haenszel common odds ratio, a previous history of one or more preterm births (OR 4.41, $p < .001$), a history of two or more spontaneous abortions or miscarriages (OR 2.07, $p = .019$), vaginal bleeding after 12 weeks gestation in the current pregnancy (OR 2.61, $p < .001$), high blood pressure during pregnancy (gestational hypertension) (OR 2.52, $p = .002$), and hospitalization during pregnancy (OR 3.93, $p < .001$) were significant risk factors for preterm birth, after controlling for race. Rupture of membranes prior to onset of labor was a significant risk factor for both the Aboriginal (OR 6.58, $p < .001$) and non-Aboriginal groups (OR 2.04, $p = .001$), but demonstrated heterogeneity of effect, having a higher odds ratio in the Aboriginal group.

Table 8.
Odds ratios (95% confidence intervals) for the relationship of various pregnancy characteristics with preterm birth, stratified by race

Characteristic	Non-Aborig. OR (95%C.I.)	Aboriginal OR (95% C.I.)	Mantel-Haenszel OR (95% C.I.)	Breslow-Day test (p value)
Primiparous status	1.29 (0.86, 1.93)	0.87 (0.48, 1.57)	1.14 (0.82, 1.58)	1.18 (.277)
2 or more previous spontaneous abortions	1.99 (0.94, 4.20)	2.23 (0.82, 6.06)	2.07(1.14,3.77)*	0.03 (.856)
2 or more previous therapeutic abortions	1.62 (0.48,5.43)	0.68 (0.17, 2.64)	1.07 (0.44, 2.61)	0.89 (.346)
Ectopic pregnancy	1.98 (0.39, 9.99)	1.25 (0.20, 7.69)	1.61 (0.49, 5.36)	0.14 (.712)
Previous preterm birth	3.89 (2.02, 7.48)	5.04 (2.56, 9.93)	4.41(2.75, 7.1)**	0.29 (.591)
Asthma	0.74 (0.37, 1.49)	1.15 (0.49, 2.69)	0.88 (0.51, 1.50)	0.60 (.439)
Bladder infection	1.46 (0.87, 2.47)	0.89 (0.50, 1.56)	1.15 (0.79, 1.69)	1.62 (.203)
Vaginal bleeding after 12 weeks of pregnancy	3.36 (1.87, 6.05)	1.96 (1.06, 3.64)	2.61(1.71,3.97)*	1.55 (.214)
Polyhydramnios	1.58 (0.42, 5.99)	2.15 (0.52, 8.84)	1.83 (0.70, 4.80)	0.10 (.755)
Gestational hypertension	2.92 (1.26, 6.57)	2.19 (0.98, 4.89)	2.52 (1.41, 4.49)*	0.24 (0.625)
Rupture of membranes prior to onset of labour	2.04 (1.4, 3.1)*	6.58(3.7, 11.8)**	3.01 (2.17, 4.19)	10.44 (.001)
Antenatal hospitalization	4.33 (2.53, 7.41)	3.41 (1.80, 6.49)	3.93(2.6, 5.9)**	0.31 (.577)

Chi square * $p<.05$ ** $p<.001$

Research Question 1: Cigarette Smoking and Other Substance Abuse

Descriptive Analyses of Cigarette Smoking and Other Substance Abuse

Overall, 49.5% of the women reported smoking during the month before they became pregnant, while 39.4% of the women reported smoking during their pregnancy. Women tended to quit smoking as the pregnancy progressed, with only 14.7% reporting smoking during the third trimester. Smoking during pregnancy was considerably more prevalent among Aboriginal women (61.2%) than non-Aboriginal women (26.2%) (X^2=82.55, p<.001). There was no significant difference between the proportion of cases and controls who reported smoking during their pregnancy (42.9% vs 37.7%, X^2 = 1.71, p = .191). Refer to Table 9. The proportion of cases who smoked prior to pregnancy (54.4%) was higher than the proportion of controls who smoked (47.0%) and approached statistical significance (X^2 = 3.29, p = .070). Among non-Aboriginal subjects, the proportion of cases who smoked prior to pregnancy was higher than controls (40.3% vs 31.7%) and approached statistical significance (X^2 = 3.12, p = .078).

A total of 57 women (8.4%) reported drinking alcohol once a month or more frequently, and 25 of these women reported drinking alcohol once a week or more frequently. There was no significant difference between cases and controls in alcohol use (9.3% vs 7.9%, X^2 = .41, p=.524). Alcohol use during pregnancy (once a month or more frequently) was more prevalent among Aboriginal women (12.9%) than non-Aboriginal women (5.6%) (X^2=11.11, p=.001). Less than 10% of the sample reported taking recreational drugs during their pregnancy. A total of 58 women (8.5%) reported using marijuana, while six women (0.9%) reported using cocaine. There was no significant difference between the proportion of cases and controls who reported drug use during pregnancy (10.7% vs 9.2%, X^2 = 0.39, p =.534). However, 17.9% of Aboriginal women reported drug use compared to 4.7% of non-Aboriginal women (X^2=32.01, p<.001).

Table 9.
Smoking, alcohol, and drug use of cases and controls, by group

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)
Smoked prior to pregnancy						
Yes	123 (54.4)	215 (47.0)	58 (40.3)	89 (31.7)	65 (79.3)	126(71.6)
No	103 (45.6)	242 (53.0)	86 (59.7)	192 (68.3)	17 (20.7)	50 (28.4)
Smoked during pregnancy						
Yes	97 (42.9)	172 (37.7)	41 (28.5)	70 (25.0)	56 (68.3)	102(58.0)
No	129 (57.1)	284 (62.3)	103(71.5)	210 (75.0)	26 (31.7)	74 (42.0)
Smoked in third trimester						
Yes	37 (16.4)	63 (13.8)	22 (15.3)	39 (13.9)	15 (18.3)	24 (13.7)
No	189 (83.6)	393 (86.2)	122(84.7)	242 (86.1)	67 (81.7)	151(86.3)
Alcohol use during pregnancy						
None/<once a mo.	204 (90.7)	420 (92.1)	133(92.4)	269 (95.4)	71 (87.7)	151(86.8)
Once a month or more	21 (9.3)	36 (7.9)	11 (7.6)	13 (4.6)	10 (12.3)	23 (13.2)
Recreational drug use during pregnancy						
Yes	201 (89.3)	416 (90.8)	134(93.1)	272 (96.5)	67 (82.7)	144(81.8)
No	24 (10.7)	42 (9.2)	10 (6.9)	10 (3.5)	14 (17.3)	32 (18.2)

Stratified Analyses of Association Between Smoking, Other Substance Abuse, and Preterm Birth

Stratified analyses of the association between smoking, other substance abuse, and preterm birth are shown in Table 10. Smoking in the month prior to pregnancy was a significant risk factor for preterm birth (OR = 1.47, p =.030), and demonstrated homogeneity of effect across the two groups. Smoking during pregnancy was associated with a small, statistically insignificant increase in the odds ratios for spontaneous preterm birth. There were no associations between alcohol use or recreational drug use during pregnancy and preterm birth. Refer to Table 10.

Table 10.

Odds ratios (95% confidence intervals) for the relationship of smoking, alcohol, and drug use with preterm birth, stratified by race

Characteristic	Non-Aboriginal O.R. (95% C.I.)	Aboriginal O.R. (95% C.I.)	Mantel-Haenszel O.R. (95% C.I.)	Breslow-Day test (p value)
Smoking prior to preg.	1.46 (0.96, 2.21)	1.49 (0.79, 2.79)	1.47 (1.04, 2.07)*	0.00 (.955)
Smoking during preg.	1.19 (0.76, 1.88)	1.54 (0.89, 2.68)	1.33 (0.94, 1.88)	0.49 (.484)
Alcohol use during preg more than once a month	1.71 (0.75, 3.92)	0.92 (0.42, 2.03)	1.23 (0.69, 2.16)	1.14 (.286)
Illicit drug use during preg.	2.03 (0.83, 5.00)	0.93 (0.47, 1.87)	1.23 (0.72, 2.12)	1.82 (.177)

Chi square *$p<.05$

To determine if a dose-response existed, the number of cigarettes smoked per day was categorized into none, 1-9 cigarettes per day, 10-19 cigarettes per day, and 20-50 cigarettes per day. Refer to Table 11. There was a tendency for the risk to increase with number of cigarettes smoked during pregnancy, with the risk being more than doubled when 20-50 cigarettes were smoked per day in the second trimester (OR 2.27, $p =.052$) and third trimester (OR 2.17, $p=.078$), although these results did not achieve statistical significance. For Aboriginal women, smoking 1-9 cigarettes per day in the second trimester was associated with a significant increase in the odds of preterm birth (OR 1.88, $p<.05$).

Table 11.
Odds ratios and 95% confidence intervals for the association between number of cigarettes smoked per day and preterm birth

Characteristic	Non-Aboriginal O.R. (95% C.I.)	Aboriginal O.R. (95% C.I.)	All subjects O.R. (95% C.I.)
No. of cigarettes smoked per day prior to pregnancy			
None	1.00	1.00	1.00
1-9 cigarettes/day	1.83 (0.99, 3.35)‡	1.25 (0.63, 2.49)	1.26 (0.84, 1.87)
10-19 cigarettes/day	1.32 (0.71, 2.46)	1.98 (0.93, 4.22)	1.50 (0.96, 2.34)‡‡
20-50 cigarettes/day	1.23 (0.63, 2.37)	1.65 (0.59, 4.61)	1.30 (0.75, 2.26)
No of cigarettes smoked per day in 1st trimester			
None	1.00	1.00	1.00
1-9 cigarettes/day	1.31 (0.71, 2.39)	1.45 (0.80, 2.64)	1.26 (0.86, 1.85)
10-19 cigarettes/day	1.41 (0.73, 2.72)	1.66 (0.74, 3.71)	1.44 (.87, 2.36)
20-50 cigarettes/day	1.66 (0.71, 3.91)	1.02 (0.25, 4.15)	1.41 (0.68, 2.90)
No of cigarettes smoked per day in 2nd trimester			
None	1.00	1.00	1.00
1-9 cigarettes/day	1.42 (0.71, 2.84)	1.88 (1.05, 3.39)*	1.43 (0.97, 2.12)
10-19 cigarettes/day	0.99 (0.49, 1.90)	1.54 (0.68, 3.50)	1.09 (0.66, 1.82)
20-50 cigarettes/day	2.08 (0.80, 5.38)	3.08 (0.59, 16.19)	2.27 (0.99, 5.19)‡
No of cigarettes smoked per day in 3rd trimester			
None	1.00	1.00	1.00
1-9 cigarettes/day	1.04 (0.51, 2.10)	1.58 (0.88, 2.82)	1.19 (0.80, 1.77)
10-19 cigarettes/day	0.80 (0.39, 1.62)	1.80 (0.81, 3.98)	1.08 (0.65, 1.81)
20-50 cigarettes/day	2.21 (0.87, 5.60)	1.41 (0.12, 16.18)	2.17 (0.92, 5.12)‡‡

*<.05 ‡p=.051 or .052 ‡‡=.078

Relationship between smoking and other variables

Among all subjects, women who smoked in the month prior to pregnancy were more likely to be young, single, of low income, unemployed, have less than grade 12 education, drink alcohol, take recreational drugs, and receive inadequate prenatal care, compared to women who did not smoke. They also were more likely to experience higher mean levels of stress, lower levels of support from partner and others, lower self-esteem, and moved more frequently in the past year. These characteristics did not remain consistent when the non-Aboriginal and Aboriginal groups were examined separately.

The non-Aboriginal group of women who smoked in the month prior to pregnancy exhibited most of the same characteristics as the total sample. However, for Aboriginal women who smoked in the month prior to pregnancy, there was no significant difference in age, marital status, income, education, employment status, or mean levels of stress or social support, compared to women who did not smoke. The only difference was that a greater proportion of Aboriginal women who smoked in the month prior pregnancy also consumed alcohol during their pregnancy. However, when the relationship between smoking during pregnancy (as opposed to prior to pregnancy) and these characteristics were examined, some of the relationships changed. Aboriginal women who continued to smoke after they knew they were pregnant were more likely to have less than a high school education (67.1% vs. 51.0%, X^2=6.65, p=.010) and take recreational drugs during their pregnancy (21.7% vs 12.0%, X^2=3.88, p=.049), compared to women who did not smoke. In other words, Aboriginal women who had completed high school were more likely to quit smoking once they knew they were pregnant. Refer to Tables 12 and 13.

Table 12.
Relationship between smoking in month prior to pregnancy and other variables

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Smoker n (%)	Non-smoker n (%)	Smoker n (%)	Non-smoker n (%)	Smoker n (%)	Non-smoker n (%)
Single marital status	103 (30.5)	33 (9.6)**	37 (25.2)	15 (5.4)**	66 (34.6)	18 (26.9)
Age <19 years	38 (11.2)	9 (2.6)**	8 (5.4)	2 (0.7)*	30 (15.7)	7 (10.4)
Income <$20,000 per year	139 (48.3)	64 (21.2)**	35 (25.7)	28(11.0)**	104 (68.4)	36 (75.0)
Education < high school	161 (47.6)	58 (16.8)**	41 (27.9)	21 (7.6)**	120 (62.8)	37 (55.2)
Education < grade 11	109 (32.5)	34 (9.9)**	19 (12.9)	11 (4.0)*	90 (47.9)	23 (34.8)
Multiparous	208 (61.9)	200 (58.3)	69 (46.9)	129 (46.6)	130 (68.8)	52 (78.8)
Paid job during pregnancy	170 (50.4)	254 (74)**	106 (72.1)	226 (81.3)	64 (33.7)	28 (41.8)
Inadequate prenatal care	46 (14.1)	25 (7.3)*	10 (6.8)	13 (4.7)	36 (20.0)	12 (18.2)
Alcohol use during preg.	44 (13.1)	13 (3.8)**	14 (9.5)	10 (3.6)*	30 (16.0)	3 (4.5)*
Recreational drug use	55 (16.3)	11 (3.2)**	16 (10.9)	4 (1.4)**	39 (20.5)	7 (10.4)
Moved ≥ 2 times in past year	73 (21.7)	30 (8.7)**	30 (20.4)	18 (6.5)**	43 (22.6)	12 (17.9)

*Chi square or Fisher's exact test p<.05 ** Chi square or Fisher's exact test p<.001

Table 13.
Relationship between smoking in the month prior to pregnancy and other variables continued

Characteristic	All subjects		Non-Aboriginal group		Aboriginal group	
	Smoker M (SD)	Non-smoker M (SD)	Smoker M (SD)	Non-smoker M (SD)	Smoker M (SD)	Non-smoker M (SD)
Age in years	25.3 (5.7)	29.1 (5.9)**	26.9 (5.9)	30.1(5.4)**	24.0 (5.3)	25.1 (6.3)
Education in years	11.8 (2.6)	13.9 (3.1)**	12.9 (2.3)	14.5(2.8)**	10.9 (2.6)	11.6 (2.8)
Gravidity	3.0 (2.0)	2.6 (1.8)**	2.6 (1.6)	2.3 (1.5)	3.4 (2.2)	3.8 (2.6)
Weight gain (lbs.)	32.1 (14.2)	30.5 (12.4)	32.5 (13.2)	30.3 (11.8)	31.7(15.2)	31.3 (15.4)
Hemoglobin	117.6(13)	120.5 (11)*	120.1 (12)	121.2 (11)	115.5 (14)	117.7 (12)
Perceived stress	5.7 (3.6)	4.4 (3.0)**	5.6 (3.9)	4.1 (3.0)**	5.9 (3.3)	5.6 (3.0)
Life event stress (PPP)	18.6 (4.9)	17.1 (4.2)**	19.1 (4.8)	16.6(3.8)**	18.2 (5.0)	18.9 (5.4)
Support from partner	54.1 (11.5)	57.1 (10.3)*	54.7 (10.9)	58.3 (8.7)*	53.8(12.0)	51.5 (14.9)
Support from other	54.3 (11.6)	57.0 (8.6)*	55.1 (11.2)	57.4 (8.1)*	53.7(11.8)	55.3 (10.4)
Self esteem	33.8 (5.2)	36.0 (5.0)**	34.8 (5.6)	36.7(4.7)**	33.0 (4.7)	33.1 (5.1)
No. of times moved in last year	0.9 (1.4)	0.5 (0.8)**	0.9 (1.4)	0.4 (0.7)**	0.9 (1.3)	0.8 (1.0)

* t test p<.05   ** t test p<.001

Research Question 2: Nutritional Status

Descriptive Analyses of Nutritional Status

Because prenatal records were missing from the health records of 105 women (15.4%), self-reported data were used for the majority of the height and weight variables. There was no significant difference between cases and controls in self-reported pre-pregnancy weight (M 142.19 vs.142.90 pounds, t = -.26, p=.794) or height (M 64.47 vs

64.76 inches, t= -1.27, p=.205). Body mass index (BMI) was calculated for each subject, and there was no significant difference between cases and controls in the proportion of women with underweight, average, and overweight BMI ($X^2 = .47$, p=.791). There were significant differences between Aboriginal and non-Aboriginal women, with Aboriginal women weighing significantly more prior to pregnancy than non-Aboriginal women (M 147.50 vs 140.16 pounds, t= -2.69, p= .007) and having more women in the overweight BMI category than non-Aboriginal women ($X^2 =6.65$, p=.038). When height was examined as a bivariate variable, significantly more cases than controls had short stature, defined as a height less than 62 inches (14.7% vs 8.8%, $X^2 = 5.27$, p=.022). Cases gained significantly less weight during pregnancy than controls (28.64 vs. 32.52 pounds, t= -2/96, p=.003), and more cases than controls gained less than 20 pounds during their pregnancy (22.6% vs 11.9%, $X^2 = 10.23$, p=.001). Weight gain for each trimester was calculated from the prenatal record and was missing for 178 women (26%) for the third trimester, so the results should be viewed with caution. Cases had significantly lower third trimester weight gain than controls (9.05 vs 12.40 pounds, t = -4.51, p<.001), and more cases than controls gained less than 11 pounds during the third trimester (61.5% vs 45.5%, $X^2 = 9.51$, p=.002).

The rate of weight gain in the second and third trimester was calculated by taking total weight gain, subtracting 2.5 kg for weight gain in first trimester, and then dividing by gestational age minus 13 weeks. Then a bivariate variable was created, with low weight gain being defined as less than 0.38 kg/week, based on the Institute of Medicine's (1990) cutoff for inadequate weight gain. There was no significant difference between cases and controls in rate of weight gain less than 0.38 kg per week in the second and third trimester (32.6% vs 36.3%, X^2=0.69, p=.406). If the lower quintile of weight gain per week was used as a cutoff level (less than 0.26 kg/week), there also was no significant difference between cases and controls in rate of low weight gain (18.2% vs 15.9%, X^2=0.44, p=.508).

The mean hemoglobin level at 28-32 weeks gestation was not significantly different between cases and controls (M 120.10 vs. 118.77, t=0.76, p=.446), but was significantly lower among Aboriginal women than non-Aboriginal women (M 116.34 vs 120.61, t= -4.13, p<.001). When examined as a bivariate variable, with low hemoglobin defined as less than 105 mg/dl, there was no significant difference between cases and controls in the proportion with low hemoglobin level (13.3% vs 8.8%, X^2 = 2.28, p=.131) but more Aboriginal women had a low hemoglobin compared to non-Aboriginal women (17.6% vs 6.0%, X^2= 17.58, p <.001). Hemoglobin values were obtained from the health record and were missing for 167 women (24.4%).

Table 14.
Nutritional characteristics of cases and controls, by group

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)
Prepregnancy weight						
<111 pounds	21 (10.0)	44 (10.6)	17 (12.1)	30 (11.1)	4 (5.9)	14 (9.7)
111+ pounds	188 (90.0)	371 (89.4)	124(87.9)	241 (88.9)	64 (94)	130 (90.3)
Prepregnancy height						
<62 inches (<155cm)	32 (14.7)	39 (8.8)	22 (15.4)	27 (9.6)	10(13.5)	12 (7.5)
62+ inches (155+cm)	185 (85.3)	402 (91.2)*	121(84.6)	255 (90.4)	64(86.5)	147 (92.5)
Weight gain during pregnancy						
<20 pounds	40 (22.6)	42 (11.9)	24 (19.0)	28 (12.0)	16 (31)	14 (12)
20+ pounds	137 (77.4)	310 (88.1)*	102(81.0)	206(88.0)*	35 (69)	104 (88)*
Weight gain in third trimester						
<11 pounds	75 (61.5)	175 (45.5)	51 (59.3)	122 (47.3)	24 (67)	53 (42)
11+ pounds	47 (38.5)	210 (54.5)*	35 (40.7)	136 (52.7)	12 (33)	74 (58)*
Body Mass Index						
<19.8	36 (18.3)	71 (17.6)	28 (20.4)	49 (18.4)	8 (13.3)	22 (16.1)
19.8-25.9	106 (53.8)	229 (56.7)	72 (52.6)	161 (60.3)	34 (57)	68 (49.6)
>25.9	55 (27.9)	104 (25.7)	37 (27.0)	57 (21.3)	18 (30)	47 (34.3)
Rate of weight gain per week in second and third trimester						
<0.38 kgs./wk	57 (32.6)	124 (36.3)	38 (30.4)	82 (36.4)	19 (38)	42 (35.9)
0.38+ kgs./wk	118 (67.4)	218 (63.7)	87 (69.6)	143 (63.6)	31 (62)	75 (64.1)
Rate of weight gain per week in second and third trimester						
<0.26 kgs/wk	32 (18.2)	55 (15.9)	18 (14.3)	35 (15.2)	14(28.0)	20 (17.2)
0.26+ kgs/wk	144 (81.8)	291 (84.1)	108(85.7)	195 (84.8)	36(72.0)	96 (82.8)
Hemoglobin						
<105 mg/dl	19 (13.3)	33 (8.8)	5 (5.4)	15 (6.2)	14(28.0)	18 (13.6)
105+ mg/dl	124 (86.7)	341 (91.2)	88 (94.6)	227 (93.8)	36(72.0)	114(86)*

*Chi square p<.05 **Chi square p<.001

Table 15.
Nutritional characteristics (means and standard deviations) for cases and controls, by group

Characteristic	All subjects		Non-Aboriginal group		Aboriginal group	
	Cases M (SD)	Controls M (SD)	Cases M (SD)	Controls M (SD)	Cases M (SD)	Controls M (SD)
Height in inches (self-report)	64.5 (2.7)	64.8 (2.7)	64.6 (2.8)	64.7 (2.8)	64.3 (2.3)	64.6 (2.9)
Pregravid weight in pounds (self-report)	142.2 (32)	142.9 (32)	141.1 (32)	139.7 (30)	144.4 (25)	148.9 (34)
Weight gain during preg in lbs. (self-report)	28.9 (13.6)	32.5(13.0)*	30.1 (13.1)	31.7 (11.9)	25.8(14.7)	34.0(15)*
First trimester weight gain	4.8 (4.7)	5.6 (7.0)	5.0 (4.7)	5.6 (7.0)	4.8 (1.0)	5.7 (7.0)
Second trimester weight gain	11.9 (7.4)	12.8 (7.0)	12.3 (6.6)	13.0 (6.5)	11.0 (9.0)	12.4 (8.0)
Third trimester weight gain	9.0 (6.1)	12.4 (7.5)*	9.5 (6.2)	12.1 (7.2)*	7.9 (5.6)	13.0(8.0)*
Hemoglobin	119.9(13.1)	119.0(11.6)	122.5(10.8)	120.2 (11)	114.9 (16)	116.6 (13)

*t test $p<.05$

Stratified Analyses of the Association between Nutritional Status and Preterm Birth

Stratified analyses of the association between nutritional status and preterm birth by race are shown in Table 16. Only a few of the nutritional factors were significant risk factors for preterm birth. Low pre-pregnancy weight and an underweight body mass index prior to pregnancy were not associated with an increased risk of preterm birth. Short stature (height <62 inches) (OR 1.77, p=.025), low total weight gain during pregnancy (<20 pounds) (OR 2.18, p = .001), and low weight gain in the third trimester (< 11 pounds) (OR 1.91, p = .002) were associated with an increased risk of preterm birth, after controlling for race. When total weight gain during pregnancy was examined as quartiles, the two lowest quartiles (0-22 lbs., 23-29 lbs.) were significant risk factors for preterm birth. A low rate of weight gain in the second and third trimester (using either <0.38 kgs/week or <0.26 kgs/week) was not a significant risk factor for preterm birth, after controlling for race. However, when studied as quartiles, a weight gain of 0.46-0.61 kg/week in the second and third trimester exerted a protective effect (i.e. reduced the odds of preterm birth by almost one-half) (OR 0.56, p=.030). Refer to Table 17.

Weight gain in pregnancy was also stratified by BMI, to determine if the risk of low weight gain (<20 pounds) during pregnancy was greater for women who are underweight prior to pregnancy. For women with a normal or high BMI, the odds ratio for low weight gain was 2.04 (95% CI 1.21, 3.45); for women with an underweight BMI, the odds ratio for low weight gain was 4.94 (95% CI 1.18, 20.64). However, the Breslow-Day test of homogeneity was not significant (p=.249), suggesting that weight gain does not demonstrate heterogeneity of effect when stratified by BMI.

Having anemia (a low hemoglobin of less than 105 mg/dl) was a significant risk factor for Aboriginal women (OR 2.46, p=.023) but not for non-Aboriginal women (OR 0.86, p=.776). Using the criteria of a p value $\leq .10$, this risk factor was close to demonstrating heterogeneity of effect (Breslow-Day test 2.54, p=.111). In addition, using quartiles of hemoglobin levels, having a hemoglobin between 112 and 119 mg/dl was a significant protective factor for all subjects (OR 0.46, p=.009) and for non-Aboriginal women (OR 0.39, p=.009), reducing their risk of preterm birth.

Table 16.

Odds ratios (95% confidence intervals) for the relationship of nutritional risk factors (bivariate) with preterm birth, stratified by race

Characteristic	Non-Aboriginal O.R. (95% C.I.)	Aboriginal O.R. (95% C.I.)	Mantel-Haenszel O.R. (95% C.I.)	Breslow-Day test (p value)
Height before pregnancy <62 inches (155 cm)	1.72 (0.94, 3.14)	1.90 (0.78, 4.63)	1.77 (1.08, 2.92)*	0.03 (.853)
Weight before pregnancy <111 pounds	1.10 (0.59, 2.08)	0.58 (0.18, 1.82)	0.93 (0.54, 1.62)	0.95 (.330)
Total weight gain during pregnancy < 20 pounds	1.73 (0.96, 3.14)	3.40 (1.51, 7.66)*	2.18 (1.35, 3.51)*	1.73 (.188)
Weight gain in third trimester <11 pounds	1.62 (0.99, 2.66)	2.85 (1.31, 6.20)*	1.91 (1.26, 2.90)*	1.43 (.232)
Hemoglobin < 105mg/dl	0.86 (0.30, 2.44)	2.46 (1.12, 5.44)*	1.62 (0.88, 2.99)	2.54 (.111)
Rate of weight gain in 2nd & 3rd trimester <0.38 kgs./wk	0.76 (0.47, 1.22)	1.09 (0.55, 2.17)	0.85 (0.58, 1.26)	0.74 (.391)
Rate of weight gain in 2nd & 3rd trimester <0.26 kgs/wk	0.93 (0.50, 1.72)	1.87 (0.85, 4.09)	1.20 (0.74, 1.94)	1.90 (.168)

Chi square * p<.05

Table 17.

Odds ratios and 95% confidence intervals for the association between nutritional risk factors (categories or quartiles) and preterm birth

Characteristic	Non-Aboriginal O.R. (95% C.I.)	Aboriginal O.R. (95% C.I.)	All subjects O.R. (95% C.I.)
Wt gain during pregnancy (quartiles)			
0-22 lbs	1.51 (0.80, 2.86)	3.92 (1.58, 9.73)*	2.12 (1.27, 3.55)*
23-29 lbs	1.32 (0.70, 2.49)	2.61 (0.92, 7.40)	1.72 (1.002, 1.94)*
30-39 lbs	0.69 (0.47, 1.64)	2.27 (0.81, 6.36)	1.22 (0.72, 2.07)
40-82 lbs	1.00	1.00	1.00
Rate of wt gain in 2nd & 3rd trimester (quartiles)			
0-0.32 kg/wk	0.53 (0.28, 1.00)+	1.65 (0.70, 3.90)	0.80 (0.48, 1.31)
0.33-0.45 kg/wk	0.61 (0.34, 1.11)	.95 (0.34, 2.63)	0.76 (0.46, 1.26)
0.46-0.61 kg/wk	0.38 (0.20, 0.71)*	1.20 (0.47, 3.10)	0.56 (0.33, 0.95)*
0.61-1.63 kg/wk	1.00	1.00	1.00
Hemoglobin level			
74-112 mg/dl	0.63 (0.32, 1.25)	1.02 (0.41, 2.55)	0.74 (0.44, 1.26)
113-119 mg/dl	0.39 (0.19, 0.79)*	0.67 (0.23, 1.91)	0.46 (0.26, 0.82)*
120-127 mg/dl	0.63 (0.34, 1.18)	0.38 (0.30, 2.19)	0.67 (0.40, 1.14)
128-153 mg/dl	1.00	1.00	1.00
Body Mass Index			
<19.8 kg/m2	1.24 (0.72, 2.13)	0.72 (0.28-1.85)	1.09 (0.67-1.73)
19.8-25.9 kg/m2	1.00	1.00	1.00
26+ kg/m2	1.42 (0.86-2.35)	0.96 (0.49-1.87)	1.14 (0.76-1.70)

*p<.05 +p=.05

Relationship between nutritional status and other variables

The relationship between low weight gain during pregnancy, short stature, anemia, and other variables was explored. Refer to Table 18. Short stature was not related to income, age, marital status, education, or any of the other variables studied. In the total sample, women with a low weight gain during pregnancy were more likely to be older, have less visits for prenatal care, be multiparous, and have less support from others. Aboriginal women with a low weight gain were more likely to be older and multiparous. Interestingly, all the Aboriginal cases aged less than 19 years gained at least 20 pounds during their pregnancy. Non-Aboriginal women with low weight gain were more likely to have fewer visits for prenatal care. The nutritional variable which showed the greatest relationship to other variables was anemia (hemoglobin less than 105 gm/dl) during pregnancy. Women with anemia were more likely to smoke before and during pregnancy, be multiparous, of low income, have less than a high school education, not have a paid job, and have inadequate prenatal care. Aboriginal women with anemia were more likely to smoke during pregnancy, have less than grade 11 education, and have inadequate prenatal care. Non-Aboriginal women with anemia were less likely to have a paid job and to have completed high school.

Table 18.
Relationship between anemia during pregnancy and other variables

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Anemic n (%)	Not anemic n (%)	Anemic n (%)	Not anemic n (%)	Anemic n (%)	Not anemic n (%)
Single marital status	14 (26.9)	86 (18.5)	4 (20.0)	35 (11.1)	10 (31.3)	51 (34.0)
Age <19 years	6 (11.5)	27 (5.8)	0	8 (2.5)	6 (18.8)	19 (12.7)
Income <$20,000 per year	28 (62.2)	121(29.5)**	5 (29.4)	39 (13.4)	23 (82.1)	82 (68.9)
Education < high school	27 (51.9)	126(27.1)**	6 (30.0)	41 (13.0)*	21 (65.6)	85 (56.7)
Education < grade 11	22 (43.1)	79 (17.0)**	3 (15.0)	19 (6.0)	19 (61.3)	60 (40.3)*
Multiparous	37 (71.2)	263 (56.9)*	12 (60.0)	161 (51.3)	25 (78.1)	102 (68.9)
Paid job during pregnancy	21 (40.4)	315(67.7)**	11 (55.0)	255(81.0)*	10 (31.3)	60 (40.0)
Inadequate prenatal care	11 (22.0)	29 (6.3)**	2 (10.0)	11 (3.5)	9 (30.0)	18 (12.4)*
Smoked prior to pregnancy	36 (69.2)	201(43) **	10 (50.0)	97 (30.9)	26 (81.3)	104 (69.3)
Smoked during pregnancy	34 (65.4)	153(33.0)**	8 (40.0)	71 (22.7)	26 (81.3)	82 (54.7)*

*Chi square or Fisher's exact test $p<.05$ ** Chi square or Fisher's exact test $p<.001$

Research Question 3: Utilization of Prenatal Care

<u>Descriptive Analyses of Utilization of Prenatal Care</u>

Data on prenatal care (number of prenatal visits and gestational age at first prenatal visit) were collected both from subjects' self-report and from review of the health record. Self-report data were missing for only 5 subjects overall (0.7%). Unfortunately, the prenatal record was missing from the health record of 105 subjects (15.4%). Of these, a significantly higher proportion were cases than controls [64 cases (28.3%) vs. 41 controls (9.0%), X^2=43.68, p<.001]. Since the self-report data were more complete, the narrative will focus on self-report data, although results for both health record and self-report data are presented in Tables 19 and 20 for comparison purposes.

In terms of self-reported number of visits for prenatal care, a significantly greater proportion of cases than controls had a total of less than seven visits for prenatal care (39.6% vs 9.9%, X^2 = 81.50, p<.001). Contrary to expectations, women having preterm births were not more likely to initiate prenatal care after the first trimester compared to women having term births, i.e., cases did not initiate prenatal care later than controls. The proportion of cases and controls who self-reported having their first prenatal visit in the first trimester (≤13 weeks gestation) did not differ (83.0% vs 82.5%, X^2 = 0.026, p=.871). A higher proportion of Aboriginal than non-Aboriginal women had less than seven visits for prenatal care (28.8% vs 14.4%, X^2 = 20.32, p<.001), and initiated care after the first trimester (25.2% vs 12.7%, X^2 = 17.28, p<.001).

Based on self-report data, cases had significantly fewer mean number of visits for prenatal care than controls (M 7.6 vs 10.7, t =9.63, p<.001), but there was no significant difference in the number of weeks gestation at the first visit for prenatal care between cases and controls (M 9.6 vs 10.1, t=1.27, p=.206). Aboriginal subjects had significantly fewer overall visits for prenatal care than non-Aboriginal subjects (M 9.0 vs 10.1 visits, t = 3.19, p = .002), and also had their first visit for prenatal care at a significantly higher gestational age (M 11.0 vs 9.4 weeks, t = -3.55, p < .001).

The Kessner index of prenatal care utilization was calculated. When comparing the Kessner index based on health record data versus self-reported data, the proportion of women having inadequate prenatal care was almost identical for each of the three groups (see Table 19). Because of less missing data, the Kessner index based on self-reported data will be the focus of analysis. A significantly higher proportion of cases than controls had inadequate prenatal care based on the Kessner index (15.9% vs 8.0%, X^2 = 9.82, p=.002). In addition, a higher proportion of Aboriginal women had inadequate prenatal care than non-Aboriginal women (19.5% vs 5.4%, X^2=32.74, p<.001).

Table 19.
Prenatal Care Characteristics of Cases and Controls, by Group

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)
First prenatal visit (chart)						
In first trimester	114(71.7)	259 (61.4)	81 (77.9)	181(67.8)	33 (60.0)	78 (50.3)
After first trimester	45 (28.3)	163 (38.6)*	23 (22.1)	86 (32.2)	22 (40.0)	77 (49.7)
First prenatal visit (self-report)						
In first trimester	185 (83.0)	376 (82.5)	121(85)	250 (88.7)	64 (80.0)	126 (72.4)
After first trimester	38 (17.0)	80 (17.5)	22 (15.4)	32 (11.3)	16 (20.0)	48 (27.6)
No. of prenatal visits (chart)						
< 7 visits	77 (46.4)	94 (22.1)	43 (39.4)	38 (14.1)	34 (59.6)	56 (36.1)
7+ visits	89 (53.6)	331(77.9)**	66 (60.6)	232(86)**	23 (40.4)	99 (63.9)*
No. of prenatal visits (self-reported)						
< 7 visits	86 (39.6)	44 (9.9)	48 (34.5)	12 (4.3)	38 (49)	32 (19)
7+ visits	131(60.4)	200(90.1)**	91 (65.5)	267(96)**	40 (51)	133 (81)**
Kessner Index of prenatal care (chart data)						
Adequate	53 (33.3)	175 (41.5)	37 (35.6)	132(49.4)	16 (29.1)	43 (27.7)
Intermediate	81 (50.9)	210 (49.8)	57 (54.8)	127(47.6)	24 (43.6)	83 (53.5)
Inadequate	25 (15.7)	37 (8.8)*	10 (9.6)	8 (3.0)*	15 (27.3)	29 (18.7)
Kessner Index of prenatal care (self-reported data)						
Adequate	97 (44.1)	305 (67.6)	66 (46.2)	219(77.7)	31 (40.3)	86 (50.9)
Intermediate	88 (40.0)	110 (24.4)	63 (44.1)	54 (19.1)	25 (32.5)	56 (33.1)
Inadequate	35 (15.9)	36 (8.0)**	14 (9.8)	9 (3.2)**	21 (27.3)	27 (16.0)

*p <.05 **p <.001

Stratified Analyses of Association between Prenatal Care and Preterm Birth

Stratified analyses of the association between prenatal care and preterm birth are presented in Table 20. Based on self-report data, having a first prenatal visit after the first trimester demonstrated heterogeneity of effect. In non-Aboriginal women, late entry into prenatal care had a tendency to increase the risk of preterm birth, whereas it had a tendency to reduce the risk of preterm birth among non-Aboriginal women, although neither of the odds ratios were significant. Total number of prenatal care visits also demonstrated heterogeneity of effect; although having less than 7 visits for prenatal care was a significant risk factor for both groups, the magnitude of effect differed. Non-Aboriginal women who reported having less than 7 visits for prenatal care had 11 times the odds of preterm birth (OR 11.74, $p<.001$) compared to 4 times the odds of preterm birth for Aboriginal women (OR 3.92, $p<.001$). Using the Kessner Adequacy of Prenatal Care Index, inadequate prenatal care was a significant risk factor (OR 2.37, $p=.038$), and demonstrated homogeneity of effect; i.e., women having inadequate prenatal care had more than two times the odds of preterm birth, after controlling for race. When examined as three categories using logistic regression analysis, both inadequate and intermediate care were risk factors for the total sample and the non-Aboriginal subjects, while inadequate prenatal care was a risk factor for the Aboriginal subjects. Refer to Table 21.

Table 20.
Odds ratios (95% confidence intervals) for the relationship of prenatal care with preterm birth, stratified by race

Characteristic	Non-Aboriginal O.R. (95% C.I.)	Aboriginal O.R. (95% C.I.)	Mantel-Haenszel O.R. (95% C.I.)	Breslow-Day test (p value)
First prenatal visit after first trimester >13 wks (chart)	0.60 (0.35, 1.02)	0.67 (0.36, 1.25)	0.63 (0.42, 0.94)*	0.07 (.794)
First prenatal visit after first trimester >13 wks (self-report)	1.42 (0.79, 2.55)	0.66 (0.35, 1.25)	0.99 (0.64, 1.51)	3.07 (.080)
Total number of prenatal visits <7 from chart	3.98 (2.38, 6.66)*	2.66(1.43, 4.96)*	3.35 (2.25, 4.99)*	0.95 (.329)
Total number of prenatal visits <7 self-reported	11.74 (5.97, 23.1)**	3.92(2.18, 7.1)**	6.50 (4.22, 10.03)*	5.86 (.016)
Inadequate prenatal care as per Kessner index (chart)	3.44 (1.32, 8.99)*	1.62 (0.79, 3.31)	2.11 (1.19, 3.72)*	1.55 (.213)
Inadequate prenatal care as per Kessner index (self-reported)	3.29 (1.39, 7.80)*	1.96 (1.02, 3.75)*	2.37 (1.41, 3.96)*	0.89 (.345)

Chi square *p<.05 **p<.001

Table 21.
Odds ratios and 95% confidence intervals for the association between prenatal care (categories) and preterm birth

Characteristic	Non-Aboriginal O.R. (95% C.I.)	Aboriginal O.R. (95% C.I.)	All subjects O.R. (95% C.I.)
Kessner index			
Inadequate	5.16 (2.14, 12.46)**	2.16 (1.07, 4.36)*	3.06 (1.82, 5.13)**
Intermediate	3.87 (2.45, 6.11)**	1.24 (0.66, 2.31)	2.52 (1.75, 3.60)**
Adequate	1.00	1.00	1.00

*p<.05 **p<.001

Relationship between Prenatal Care and Other Variables

Women having inadequate prenatal care were more likely to be of lower income, less educated, live in a rural or northern area of the province, smoke and drink alcohol during pregnancy, and be pregnant more times than women who received adequate prenatal care. They also experienced higher levels of perceived stress and had lower self esteem than women who received adequate prenatal care. Contrary to expectations, women with inadequate prenatal care were more likely to have a previous preterm birth. One would have expected women with a previous preterm birth to seek adequate prenatal care in the hopes of averting a subsequent preterm birth, but that was not the case. Refer to Tables 22 and 23.

Table 22.
Relationship between prenatal care and other variables

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Inadeq PNC[a] n (%)	Adeq PNC[b] n (%)	Inadeq PNC n (%)	Adeq PNC n (%)	Inadeq PNC n (%)	Adeq PNC n (%)
Single marital status	21 (29.6)	108 (18.0)*	6 (26.1)	45 (11.2)*	15 (31.3)	63 (31.8)
Age <19 years	7 (9.9)	37 (6.2)	1 (4.3)	9 (2.2)	6 (12.5)	28 (14.1)
Income <$20,000 per year	38 (69.1)	156(29.6)**	7 (35.0)	55 (14.9)*	31 (88.6)	101 (64.3)*
Education < high school	42 (59.2)	165(27.5)**	8 (34.8)	54 (13.4)*	34 (70.8)	111 (56.1)
Education < grade 11	34 (49.3)	98 (16.4)**	6 (26.1)	24 (6.0)**	28 (60.9)	74 (37.8)*
Multiparous	54 (77.1)	345 (57.8)*	16(69.6)	210 (52.4)	38 (80.9)	135 (68.9)
Previous preterm birth	19 (26.8)	70 (11.7)**	6 (26.1)	39 (9.7)*	13 (27.1)	31 (15.7)
Hospitalized during preg.	22 (31.0)	95 (15.8)*	11 (47.8)	59(14.7)**	11 (22.9)	36 (18.2)
Smoked during pregnancy	43 (60.6)	213(35.6)**	10 (43.5)	100(25.0)*	33 (68.8)	113 (57.1)
Alcohol use during preg.	13 (18.6)	39 (6.5)**	2 (8.7)	21 (5.2)	11 (23.4)	18 (9.2)*
Recreational drug use	10 (14.1)	53 (8.8)	1 (4.3)	18 (4.5)	9 (18.8)	35 (17.8)
Rural or northern residence	38 (53.5)	196 (33.1)*	4 (17.4)	85 (21.5)	34 (70.8)	111 (56.1)
Moved ≥ 2 times in past year	15 (21.1)	87 (14.5)	7 (30.4)	41 (10.2)*	8 (16.7)	45 (22.8)

*Chi square or Fisher's exact test p<.05 ** Chi square or Fisher's exact test p<.001
a = inadequate prenatal care b = adequate prenatal care

Table 23.
Relationship between prenatal care and other variables continued

Characteristic	All subjects		Non-Aboriginal group		Aboriginal group	
	Inadeq PNC M (SD)	Adeq PNC M (SD)	Inadeq PNC M (SD)	Adeq PNC M (SD)	Inadeq PNC M (SD)	Adeq PNC M (SD)
Age in years	26.0 (6.7)	27.5 (6.0)	28.9 (7.1)	29.0 (5.7)	24.7 (6.1)	24.4 (5.4)
Education in years	10.8 (2.8)	13.2 (3.0)**	12.7 (3.0)	14.0 (2.8)*	9.9 (2.3)	11.5(2.6)**
Gravidity	3.7 (2.5)	2.7 (1.8)**	3.2 (2.2)	2.3 (1.5)	3.9 (2.6)	3.4 (2.3)
Perceived stress (Cohen)	5.8 (3.7)	4.9 (3.3)*	6.1 (4.4)	4.5 (3.3)	5.7 (3.3)	5.8 (3.3)
Life event stress (PPP)	17.9 (5.0)	17.9 (4.6)	18.4 (5.1)	17.4 (4.3)	17.6 (4.9)	18.8 (5.1)
Support from partner	54.1(12.6)	56.1 (10.6)	53.7 (12.1)	7.4 (9.4)	54.3 (13.0)	53.0 (12.5)
Support from other	54.4(12.7)	55.9 (9.9)	55.1 (12.9)	56.8 (9.1)	54.1 (12.7)	54.3 (11.2)
Self esteem	32.5 (5.6)	35.3 (5.1)**	32.8 (6.9)	36.2 (4.9)*	32.4 (4.9)	33.3 (4.8)
No. of times moved in last year	.79 (1.2)	.71 (1.5)	1.00 (1.1)	.54 (1.1)*	.69 (1.2)	1.04 (2.0)

* t test p<.05 ** t test p<.001

Research Question 4: Abuse/Domestic Violence

Descriptive Analyses of Abuse

Overall, 36.7% of the sample reported having ever been emotionally or physically abused by their partner or someone important to them, 9.1% reported being abused within the last year, and 5.7% reported being abused during their pregnancy. There were no significant differences between cases and controls in the proportion reporting these forms of abuse. However, the proportion of women reporting abuse was higher among Aboriginal women than non-Aboriginal women for ever being abused (42.2% vs 33.3%,

X^2 =5.40, p=.020), abuse in the past year (17.6% vs 4.0%, X^2 =35.47, p<.001), and abuse during pregnancy (10.2% vs 3.1%, X^2 =14.91, p<.001). The non-Aboriginal group had a significant difference between cases and controls in the proportion reporting abuse in the past year (6.4% vs 2.6%, X^2 = 3.74, p = .053) and abuse during pregnancy (5.6% vs 1.5%, X^2 = 5.78, p = .016), whereas there was no significant difference between cases and controls in the Aboriginal group. Only a few women (n=13; 1.9%) reported that anyone had forced them to have sexual activities within the last year. Refer to Table 24.

Table 24.
Characteristics of abuse among cases and controls, by group

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)
Ever emotionally or physically abused	84 (37.2)	166 (36.4)	52 (36.1)	90 (31.9)	32 (39.0)	76 (43.7)
Physically abused within last year	20 (9.0)	42 (9.2)	10 (7.0)	7 (2.5)*	10 (12.3)	35 (20.0)
Physically abused during pregnancy	16 (7.1)	23 (5.0)	9 (6.3)	4 (1.4)*	7 (8.6)	19 (10.9)
Forced to have sexual activity within last year	5 (2.2)	8 (1.8)	3 (2.1)	2 (0.7)	2 (2.4)	6 (3.4)
Afraid of partner or anyone else	13 (5.8)	26 (5.7)	7 (4.9)	10 (3.5)	6 (7.3)	16 (9.1)

Chi square or Fisher's exact test *p <.05

Stratified Analyses of Association between Abuse and Preterm Birth

The results of stratified analyses of the association between abuse and preterm birth are presented in Table 25. Abuse demonstrated heterogeneity of effect among the two groups, after controlling for race. For non-Aboriginal women, abuse during pregnancy was a significant risk factor for preterm birth, increasing the risk more than four-fold (OR 4.62, p = .013). Abuse in the last year was also a significant risk factor for non-Aboriginal women, increasing the risk almost three-fold (OR 2.98, p = .025). Neither of these variables were risk factors for Aboriginal women. None of the other abuse factors were significant risk factors for either racial group.

Table 25.
Odds ratios (95% confidence intervals) for the relationship of abuse with preterm birth, stratified by race

Characteristic	Non-Aboriginal O.R. (95% C.I.)	Aboriginal O.R. (95% C.I.)	Mantel-Haenszel O.R. (95% C.I.)	Breslow-Day test (p value)
Ever abused	1.21 (0.79, 1.84)	0.83 (0.48, 1.41)	1.04 (0.75, 1.45)	1.19 (.275)
Abused in last year	2.98 (1.11, 7.99)*	0.56 (0.26, 1.20)	1.00 (0.57, 1.77)	7.40 (.007)
Abused during preg.	4.62 (1.40, 15.26)*	0.77 (0.31,1.92)	1.49 (0.77, 2.91)	5.85 (.016)
Afraid of anyone	1.39 (0.52, 3.73)	0.79 (0.30, 2.09)	1.03 (0.52, 2.05)	0.66 (.418)

Chi square *p<.05

Relationship between Abuse and other variables

A composite abuse variable was created by combining abuse in the past year and abuse during pregnancy. Of the 684 women screened for abuse, 63 (9.2%) reported physical abuse in the past year and/or physical abuse since pregnancy. Abused women were more likely to be younger, single, of lower income, less educated, pregnant more times, and moved more frequently in the past year than non-abused women. They also experienced higher levels of stress, lower levels of support from both their partner and other people, and had lower self esteem than non-abused women. Abused women were significantly more likely than non-abused women to smoke during pregnancy, drink alcohol, and take recreational drugs. Of the 63 women who reported abuse, 46 were Aboriginal and 17 were non-Aboriginal. When the relationship between abuse and other variables was studied separately for Aboriginal and non-Aboriginal women, some of the significant relationships disappeared in the Aboriginal group. Abuse showed no association with single marital status, young age, low education, or low income in the Aboriginal group. However, the association between between abuse and having high stress levels and low levels of social support and self esteem persisted for both groups. Refer to Tables 26 and 27.

Table 26.
Relationship between abuse and other variables

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Abused n (%)	Not abused n (%)	Abused n (%)	Not abused n (%)	Abused n (%)	Not abused n (%)
Single marital status	30 (47.6)	104(16.9)**	10(59)	40 (9.9)**	20 (43.5)	64 (30.5)
Age <19 years	10 (15.9)	35 (5.7%)*	2 (11.8)	6 (1.5)*	8 (17.4)	29 (13.8)
Income <$20,000 per year	33 (61.1)	168(31.5)**	6 (40.0)	56 (14.9)*	27 (69.2)	112 (70.4)
Education < high school	38 (60.3)	178(28.9)**	8 (47.1)	52(12.8)**	30 (65.2)	126 (60.0)
Smoked during pregnancy	36 (57.1)	231 (37.6)*	9 (52.9)	100(24.8)*	27 (58.7)	131 (62.4)
Alcohol use during preg.	11 (18.0)	46 (7.5)*	1 (5.9)	23 (5.7)	10 (22.7)	23 (11.0)*
Recreational drug use	20 (31.7)	45 (7.3)**	4 (23.5)	15 (3.7)*	16 (34.8)	30 (14.4)*
Moved $\geq$ 2 times in past year	29 (46.0)	73 (12.8)**	8 (47.1)	38 (9.4)**	21 (45.7)	35 (16.7)**

*Chi square or Fisher's exact test p<.05 ** Chi square or Fisher's exact test p<.001

Table 27.
Relationship between abuse and other variables, continued

Characteristic	All subjects		Non-Aboriginal group		Aboriginal group	
	Abused M (SD)	Not abused M (SD)	Abused M (SD)	Not abused M (SD)	Abused M (SD)	Not abused M (SD)
Age in years	23.4 (5.6)	27.6 (6.0)*	24.7 (6.6)	29.2 (5.6)*	22.9 (5.2)	24.6 (5.6)
Education in years	11.5 (2.4)	13.0 (3.1)*	12.7 (2.4)	14.0 (2.8)	11.0 (2.3)	11.1 (2.6)
Gravidity	3.5 (2.4)	2.7 (1.9)*	3.2 (2.3)	2.3 (2.5)	3.6 (2.5)	3.5 (2.3)
Perceived stress (Cohen)	6.7 (3.6)	4.9 (3.3)**	7.7 (4.4)	4.5 (3.3)**	6.3 (3.2)	5.7 (3.2)
Life event stress (PPP)	22.9 (5.5)	17.3 (4.2)**	22.8 (5.2)	17.3(4.1)**	22.9 (5.6)	17.4(4.4)**
Support from partner	46.0(13.1)	56.6(10.4)**	39.1 (11.2)	57.6(9.1)**	47.8 (13.2)	54.2(12.5)*
Support from other	49.9(14.7)	56.4 (9.4)**	49.9 (15.3)	57.0 (8.8)	49.9 (14.6)	55.1(10.5)*
Self esteem	31.5 (5.3)	35.3 (5.0)**	31.4 (6.0)	36.3(4.9)**	31.6 (5.1)	33.3 (4.7)*
No. of times moved in last year	1.6 (1.7)	0.6 (1.4)**	1.7 (1.6)	0.5 (1.0)*	1.6 (1.7)	0.7 (1.1)*

* t test p<.05 ** t test p<.001

Research Question 5: Strenuous Work

Descriptive Analyses of Strenuous Work

Overall, 425 women (62.2%) had a paid job during their pregnancy, and 312 of these women (73.4%) reported being employed full time. Another 29 women (4.2%) reported being unemployed, that is, out of work and looking for work. A significantly lower proportion of Aboriginal women reported having a paid job during their pregnancy than non-Aboriginal women (35.8% vs 78.2%, X^2=122.43, p<.001). As a result of fewer Aboriginal women having a paid job, more of them report their occupation as housepersons. Based on the National Occupational Classification (Employment and Immigration Canada, 1993), a significantly higher proportion of Aboriginal women were classified as "houseperson" compared to non-Aboriginal women (62.2% vs 19.8%, x^2=127.28, p<.001). However, there were no significant differences between cases and controls in categories of occupations (X^2=1.09, p=.955). Of the women who worked, the majority (n=332, 77.9%) had a regular day time or evening schedule, with the remainder working night shift or rotating shift. There were no significant differences in the proportion of cases and controls, or Aboriginal and non-Aboriginal subjects, on any of the measures of strenuous work. Refer to Table 28.

Table 28.
Work characteristics of cases and controls, by group

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)
Paid job during pregnancy	141 (62.7)	284 (62.0)	111 (77.1)	222 (78.7)	30 (37.0)	62 (35.2)
Unemployed	10 (8.8)	19 (8.0)	4 (7.3)	7 (6.3)	6 (10.3)	12 (9.6)
Occupational Classification:						
Management/Prof.	27 (12.6)	59 (13.2)	23 (16.3)	50 (18.0)	4 (5.5)	9 (5.4)
Middle management/ technical	23 (10.7)	51 (11.4)	16 (11.3)	48 (17.3)	7 (9.6)	3 (1.8)
Paraprofessional, clerical, support worker	37 (17.3)	64 (14.3)	29 (20.6)	46 (16.5)	8 (11.0)	18 (10.7)
Service	46 (21.5)	94 (21.1)	37 (26.2)	65 (23.4)	9 (12.3)	29 (17.3)
Transportation, industry, manufacturing	8 (3.7)	18 (4.0)	7 (5.0)	15 (5.4)	1 (1.4)	3 (1.8)
Houseperson	73 (34.1)	160 (35.9)	29 (20.6)	54 (19.4)	44 (60.3)	106 (63.1)
Shift work during pregnancy						
Regular daytime	93 (65.5)	191 (67.3)	70 (62.5)	151 (68.0)	23 (76.7)	40 (64.5)
Regular aft or evg shift	16 (11.3)	32 (11.3)	13 (11.6)	21 (9.5)	3 (10.0)	11 (17.7)
Regular night shift	3 (2.1)	9 (3.2)	3 (2.7)	5 (2.3)	0	4 (6.5)
Rotating shift	27 (19.0)	45 (15.8)	24 (21.4)	40 (18.0)	3 (10.0)	5 (8.1)
Other	3 (2.1)	7 (2.5)	2 (1.8)	5 (2.3)	1 (3.3)	2 (3.2)
Hours standing or walking						
<2 hours/day	32 (14.5)	67 (14.7)	23 (16.1)	45 (16.0)	9 (11.4)	22 (12.6)
2 to <4 hours/day	44 (19.8)	95 (20.8)	25 (17.5)	57 (20.2)	19 (24.1)	38 (21.8)
4 to <6 hours/day	48 (21.6)	86 (18.9)	32 (22.4)	54 (19.1)	16 (20.3)	32 (18.4)
6+ hours/day	98 (44.1)	208 (45.6)	63 (44.1)	126 (44.7)	35 (44.3)	82 (47.1)
Hours lifting, climbing						
<2 hours/day	123 (55.1)	255 (55.9)	82 (57.8)	155 (55.2)	41 (50.7)	100 (57.2)
2 to <4 hours/day	46 (20.6)	113 (24.8)	25 (17.6)	75 (26.7)	21 (25.9)	38 (21.7)
4 to <6 hours/day	29 (13.0)	36 (7.9)	17 (12.09)	19 (6.8)	12 (14.8)	17 (9.7)
6+ hours/day	25 (11.2)	52 (11.4)	18 (12.7)	32 (11.4)	7 (8.6)	20 (11.4)
Hours spent in heavy work						
<15 minutes/day	178 (79.1)	358 (78.3)	113 (78.4)	222 (79.0)	65 (80.3)	136 (77.3)
15 mins to <2 hrs/day	31 (13.8)	69 (15.1)	22 (15.3)	42 (14.9)	9 (11.1)	27 (15.3)
2 to <4 hours/day	9 (4.0)	23 (5.0)	4 (2.8)	13 (4.6)	5 (6.2)	10 (5.7)
4 to <6 hours/day	4 (1.8)	5 (1.1)	2 (1.4)	2 (0.7)	2 (2.5)	3 (1.7)
6+ hours/day	3 (1.3)	2 (0.4)	3 (2.1)	2 (0.7)	0	0

Stratified Analyses of Association between StrenuousWork and Preterm Birth

None of the variables used to measure strenuous work were significant risk factors for preterm birth: having a paid job during pregnancy; working in the transportation, industry, manufacturing or service sector; working more than 44 hours per week; working either a regular night shift or a rotating shift; spending 6 or more hours per day standing or walking; spending 6 or more hours per day lifting or carrying light loads, climbing stairs or hills; or spending 2 or more hours per day doing heavy work or carrying very heavy loads. Refer to Table 29.

Table 29.
Odds ratios (95% confidence intervals) for the relationship of strenuous work with preterm birth, stratified by race

Characteristic	Non-Aboriginal O.R. (95% C.I.)	Aboriginal O.R. (95% C.I.)	Mantel-Haenszel O.R. (95% C.I.)	Breslow-Day test (p value)
Paid job during preg.	0.91 (0.56, 1.47)	1.07 (0.62,1.85)	0.98 (0.68, 1.40)	0.20 (.657)
Industry/service occupation	1.12 (0.72, 1.75)	0.68 (0.31, 1.46)	0.98 (0.67, 1.44)	1.27 (.259)
Working >44 hours/wk	1.43 (0.73, 2.77)	1.41 (0.37, 5.43)	1.42 (0.78, 2.58)	0.00 (.989)
Night shift/Rotating shift	1.24 (0.72, 2.14)	0.65 (0.16, 2.62)	1.13 (0.69, 1.88)	0.72 (.395)
Standing ≥ 6 hours/day	0.98 (0.65, 1.46)	0.90 (0.53, 1.54)	0.95 (0.69, 1.31)	0.05 (.824)
Lifting ≥ 6 hours/day	1.13 (0.61, 2.09)	0.73 (0.30, 1.80)	0.98 (0.59, 1.62)	0.62 (.431)
Heavy work ≥2 hours/day	1.04 (0.45, 2.38)	1.18 (0.45, 3.08)	1.09 (0.58, 2.05)	0.04 (.841)

Research Question 6: Other Urogenital Infections

Descriptive Analyses of Urogenital Infections

There was no significant difference between cases and controls in the proportion of women who self-reported having a sexually transmitted disease during their pregnancy

(6.2% vs 6.0%, $X^2 = .015$, $p=.904$). More Aboriginal women reported having a sexually transmitted disease during their pregnancy than non-Aboriginal women (11.0% vs 3.1%, $X^2=17.65$, $p<.001$). Based on data collected from health records, the proportion of women with urogenital infections such as gonorrhea, bacterial vaginosis, and herpes was low. There were no cases of syphilis reported. Chlamydia (16.1% vs 2.4%, $X^2=37.74$, $p<.001$), urinary tract infections (27.1% vs 13.4%, $X^2=17.16$, $p<.001$), and bacterial vaginosis (5.8% vs 1.9%, $X^2=6.69$, $p=.010$) were significantly more common in the Aboriginal group than the non-Aboriginal group. Interestingly, bacterial vaginosis was not present in any of the Aboriginal women who had a preterm birth. Refer to Table 30. It should be noted that the total number and percentage of women reporting a sexually transmitted disease (obtained during the interview) is lower than the sum of gonorrhea, chlamydia and herpes (obtained from chart data), indicating that women under-reported having a sexually transmitted disease.

Table 30.
Urogenital infection characteristics of cases and controls, by group

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)
Any sexually transmitted disease (self-reported)	14 (6.2)	27 (5.9)	6 (4.2)	7 (2.5)	8 (9.8)	20 (11.6)
Gonorrhea	1 (0.6)	1 (0.2)	0	1 (0.4)	1 (1.7)	0
Chlamydia	9 (5.4)	34 (8.1)	2 (1.8)	7 (2.6)	7 (12.1)	27 (17.6)
Syphilis	0	0	0	0	0	0
Herpes	3 (1.8)	1 (0.2)	2 (1.9)	1 (0.4)	1 (1.8)	0
Bacterial vaginosis	3 (1.8)	16 (3.8)	3 (2.8)	4 (1.5)	0	12 (8.1)
Urinary tract infection	26 (15.2)	82 (19.5)	14 (12.4)	37 (13.8)	12 (20.7)	45 (29.6)
Kidney infection	1 (0.6)	4 (1.0)	1 (0.9)	2 (0.7)	0	2 (1.3)
Beta strep	23 (15.5)	66 (16.3)	16 (16.2)	45 (16.8)	7 (14.3)	21 (15.2)

Stratified Analyses of Association between Urogenital Infections and Preterm Birth

Stratified analyses of the association between urogenital infections and preterm birth are shown in Table 31. Self-report of having a sexually transmitted disease during pregnancy was not a significant risk factor for preterm birth, after controlling for race. Having a urinary tract infection or a positive culture for Group B streptococcus during pregnancy also were not significant risk factors for preterm birth. Because of the small number of other urogenital infections among cases, analyses were not conducted.

Table 31.
Odds ratios (95% confidence intervals) for the relationship of urogenital infections with preterm birth, stratified by race

Characteristic	Non-Aboriginal O.R. (95% C.I.)	Aboriginal O.R. (95% C.I.)	Mantel-Haenszel O.R. (95% C.I.)	Breslow-Day test (p value)
STD (self-reported)	1.70 (0.56, 5.16)	0.82 (0.35, 1.95)	1.07 (0.54, 2.10)	1.04 (.307)
Urinary tract infection	0.88 (0.46, 1.71)	0.61 (0.30, 1.27)	0.75 (0.46, 1.22)	0.53 (.468)
Beta strep positive	0.96 (0.51, 1.78)	0.92 (0.37, 2.32)	0.94 (0.56, 1.58)	0.00 (.948)

Research Question 7: Stress and Social Support

Descriptive Analyses of Stress, Social Support, and Self-esteem

Stress was assessed using two different methods. Perceived stress was assessed using the score on the four- item version of the Cohen Perceived Stress Scale, with possible scores ranging from 0 to 16. The mean score was 5.07 (range 0-16, SD 3.38). Life event stress was assessed using the stress scale on the Prenatal Psychosocial Profile (PPP) instrument; women were asked to what extent 11 factors were stressors/hassles for her during her pregnancy. Possible scores ranged from 11 to 44, with higher scores indicating higher stress. The mean score for this sample was 17.82 (range 11-36, SD 4.64).

Support from their partner and support from others were both assessed using the PPP. Women were asked, on a scale of 1 to 6, with 1 being very dissatisfied and 6 being very satisfied, how satisfied they were with the support they received from their partner and other people during the pregnancy. Possible scores ranged from 11 to 66, with higher scores indicating higher satisfaction with support. The mean score for support from partner for this sample was 55.76 (range 12-66, SD 10.98), while the mean score for support from others was 55.69 (range 11-66, SD 10.24). Eighty women (11.7%)

indicated that they did not have a partner, and therefore did not respond to the partner support scale on the PPP. Thirteen women (2%) did not respond to the support from others scale, giving reasons such as having no support from anyone except their partner, too busy with work to maintain other relationships, or having family members who live outside Canada.

Self-esteem was assessed using the PPP. Possible scores ranged from 11 to 44, with higher scores indicating higher self esteem. The mean score for this sample was 34.93 (range 16-44, SD 5.18).

There were no significant differences between cases and controls on the perceived stress score (M 5.32 vs 4.94), the life events stress score (M 17.83 vs 17.82), the support from partner score (M 55.80 vs 55.74), the support from others score (M 55.24 vs. 55.91), or the self-esteem score (M 34.81 vs 34.99). Refer to Table 33. Aboriginal women experienced significantly higher mean levels of perceived stress (M 5.81 vs 4.61, $t = -4.51$, $p < .001$) and life event stress (M 18.39 vs 17.48, $t = -2.44$, $p = .015$), and lower levels of support from partner (M 53.01 vs 57.19, $t = 4.45$, $p < .001$), support from others (M 54.15 vs 56.64, $t = 3.01$, $p = .003$), and self-esteem (M 33.02 vs 36.04, $t = 7.51$, $p < .001$) than non-Aboriginal women.

In order to study these risk factors as bivariate variables, a cutoff point of greater than or equal to two standard deviations above the mean (for stress) and below the mean (for support and self-esteem) was used. There was no significant difference between the proportion of cases and controls who had a high perceived stress score (7.6% vs 5.8%, X^2=.81, p=.369) or high life events stress score (5.0% vs 5.7%, X^2=.14, p=.707), a low self-esteem score (6.0% vs 4.3%, X^2=.92, p=.339), a low support from partner score

(7.2% vs 6.8%, X^2=.03, p=.864), or a low support from others score (7.1% vs 4.2%, X^2=2.37, p=.124). Refer to Table 32. There was, however, a significant difference between Aboriginal and non-Aboriginal women on most of these variables, with Aboriginal women having a higher proportion of high life event stress scores (9.3% vs 3.1%, X^2=11.44, p=.001), low self-esteem scores (7.9% vs 3.1%, X^2=7.35, p=.007), low support from partner scores (12.9% vs 3.9%, X^2=16.5, p<.001), and low support from other scores (7.3% vs 3.8%, X^2=3.87, p=.049).

In order to assess stability of residence, women were asked how many times they had moved in the last year and in the last five years. Four hundred and eighteen women (n=61.1%) had not moved in the last year, with the remainder moving between 1 to 7 times. Only 154 women (22.7%) had not moved in the last 5 years, with the remainder moving between 1 to 20 times. The data from one subject who worked for the carnival and moved 23 times in the past year and 50 times in the past 5 years was removed as an outlier prior to calculating means and standard deviations. There was no significant difference in the mean number of times cases had moved in the past year compared to controls (0.77 vs 0.64 times, t= -1.41, p=.160) or in the number of times moved in the past five years (2.40 vs 2.33, t= -0.20, p=.844). Aboriginal women moved significantly more times in the past year (M 0.88 vs 0.56 times, t = -3.32, p = .001), but not in the past five years (M 2.59 vs 2.24, t = -1.64, p=.101), than non-Aboriginal women. Bivariate variables also were created, to determine the proportion of women who moved two or more times in the past year and five or more times in the past five years. There was no significant difference between the proportion of cases and controls who had moved two or more times in the past year (16.4% vs 14.4%, X^2 = 0.49, p=.485) or five or more times in the past year (15.8% vs 15.9%, X^2=.001, p=.975), whereas a higher proportion of Aboriginal women than non-Aboriginal women moved two or more times more in the past year (21.4% vs 11.3%, X^2=12.85, p<.001) and five or more times in the past five years (20.9% vs 12.8%, X^2=7.75, p=.005).

Table 32.
Stress, Social Support, and Self Esteem Characteristics among cases and controls, by group

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)	Cases n (%)	Controls n (%)
Perceived stress score						
≥2 SD above M (≥11)	17 (7.6)	26 (5.8)	7 (4.9)	17 (6.1)	10 (12.3)	9 (5.2)
<2 SD above M (<11)	208 (92.4)	425 (94.2)	137(95.1)	262 (93.9)	71 (87.7)	163(94.8)*
Life events stress score						
≥2 SD above M (≥27)	11 (5.0)	25 (5.7)	7 (4.9)	6 (2.2)	4 (5.1)	19 (11.3)
<2 SD above M (<27)	210 (95.0)	415 (94.3)	135(95.1)	266 (97.8)	75 (94.9)	149 (88.7)
Support from partner score						
≤2 SD below M (≤34)	14 (7.2)	27 (6.8)	4 (3.1)	11 (4.2)	10 (15.2)	16 (11.8)
>2 SD below M (>34)	180 (92.8)	368 (93.2)	124(96.9)	248 (95.8)	56 (84.8)	120 (88.2)
Support from others score						
≤2 SD below M (≤35)	15 (7.1)	18 (4.2)	10 (7.5)	5 (1.9)	5 (6.3)	13 (7.8)
>2 SD below M (>35)	197 (92.9)	409 (95.8)	123(92.5)	256 (98)*	74 (93.7)	153 (92.2)
Self-esteem score						
≤2 SD below M (≤26)	13 (6.0)	19 (4.3)	8 (5.7)	5 (1.8)	5 (6.6)	14 (8.4)
>2 SD below M (>26)	203 (94.0)	422 (95.7)	132(94.3)	270(98)*	71 (93.4)	152 (91.6)
Number of times moved in last year						
0	132 (58.7)	286 (62.4)	82 (56.9)	198 (70.2)	50 (61.7)	88 (50.0)
1	56 (24.9)	106 (23.1)	39 (27.1)	59 (20.9)	17 (21.0)	47 (26.7)
2	12 (5.3)	34 (7.4)	8 (5.6)	14 (5.0)	4 (4.9)	20 (11.4)
>2	25 (11.1)	31 (6.7)	15 (10.4)	10 (3.6)	10 (12.2)	21 (11.9)
Number of times moved in last 5 years						
0	58 (26.0)	96 (21.2)	33 (23.2)	54 (19.3)	25 (31.3)	42 (24.1)
1	48 (21.5)	123 (27.2)	30 (21.1)	89 (31.8)	18 (22.5)	34 (19.5)
2	40 (17.9)	67 (14.8)	28 (19.7)	50 (17.9)	12 (15.0)	17 (9.8)
3	23 (10.3)	66 (14.6)	16 (11.3)	34 (12.1)	7 (8.8)	32 (18.4)
>3	53 (24.2)	101 (22.3)	35 (24.6)	63 (19.0)	18 (22.7)	49 (28.1)

* Chi square $p<.05$

Table 33.
Mean scores and standard deviations for stress, social support, and self esteem variables, for cases and controls, by group

Characteristic	All subjects		Non-Aboriginal group		Aboriginal group	
	Cases M (SD)	Controls M (SD)	Cases M (SD)	Controls M (SD)	Cases M (SD)	Controls M (SD)
Perceived stress score	5.3 (3.5)	4.9 (3.4)	5.0 (3.4)	4.4 (3.4)	5.9 (3.4)	5.8 (3.1)
Life event stress score	17.9 (4.7)	17.8 (4.6)	17.6 (4.5)	7.4 (4.2)	18.3 (5.0)	18.4 (5.2)
Support from partner score	55.8(11.4)	55.7(10.8)	57.2 (9.5)	57.2 (9.6)	53.15(14)	53.0(12.3)
Support from others score	55.3(11.0)	55.9 (9.9)	55.7(11.1)	57.1 (8.2)	54.6(10.8)	53.9(11.8)
Self esteem score	34.8 (5.5)	35.0 (5.0)	35.8 (5.7)	36.2 (4.7)	32.9 (4.6)	33.1 (4.9)
Number of times moved in last year	0.77 (1.3)	0.64 (1.1)	0.77 (1.2)	0.46(0.9)*	1.04 (2.8)	0.93 (1.2)
Number of times moved in last 5 years	2.40 (2.8)	2.36 (2.5)	2.4 (2.7)	2.1 (2.3)	2.9 (6.0)	2.7 (2.8)

* *t* test *p* value <.05

Stratified Analyses of the Association between Stress, Social Support, and Preterm Birth

Stratified analyses of the association between stress, social support, self esteem, and preterm birth are presented in Table 34. Several of these psychosocial variables demonstrated heterogeneity of effect among the two groups. Low self esteem (OR 3.28, p =.031) and a low level of support from others (OR 4.15, p=.006) were significant risk factors for non-Aboriginal women, increasing the odds of preterm birth three- to four-fold. For Aboriginal women, a high perceived stress score (OR 2.54, p=.047) was associated with a more than two-fold increased odds of preterm birth. High levels of life events stress and low levels of support from partner were not significant risk factors for preterm birth (either when coded as bivariate variables or when coded into quartiles) in either group. Among non-Aboriginal women, moving two or more times in the past year almost doubled the risk of preterm birth (OR1.95, p = .031). Moving five or more times in the last five years was not a risk factor for either group. When examined as quartiles, none of the stress, social support, or self esteem variables were significantly associated with an increased odds of preterm birth.

Table 34.
Odds ratios (95% confidence intervals) for the relationship of stress and social support with preterm birth, stratified by race

Characteristic	Non-Aboriginal O.R. (95% C.I.)	Aboriginal O.R. (95% C.I.)	Mantel-Haenszel O.R. (95% C.I.)	Breslow-Day test (p value)
Perceived stress score >10	0.79 (0.32, 1.95)	2.54 (0.99, 6.51)*	1.34 (0.71, 2.52)	3.16 (.076)
Life event stress score >26	2.30 (0.76, 6.98)	0.42 (0.14, 1.27)	0.89 (0.43, 1.85)	4.88 (.027)
Self esteem score <27	3.28 (1.05,10.20)*	0.76 (0.26, 2.19)	1.46 (0.70, 3.03)	3.54 (.060)
Support from partner score<35	0.73 (0.23, 2.33)	1.33 (0.57, 3.11)	1.06 (0.54, 2.10)	0.68 (.411)
Support from other score <36	4.16 (1.39, 12.44)*	0.79 (0.27, 2.30)	1.75 (0.86, 3.55)	4.76 (.029)
Moved ≥2 times in the last year	1.95 (1.07, 3.58)*	0.76 (0.39, 1.46)	1.24 (0.80, 1.93)	4.37 (.037)
Moved ≥ 5 times in last 5 years	1.19 (0.66, 2.15)	0.91 (0.47, 1.75)	1.05 (0.68, 1.63)	0.36 (.549)

*p<.05

Relationship between stress and other variables:

The relationship between perceived stress, support from others, self esteem, moving frequently in the past year, and sociodemographic variables was explored. Among all subjects, women who had high levels of perceived stress were more likely to be multiparous and receive inadequate prenatal care, and less likely to have a paid job. For Aboriginal women, high perceived stress was only associated with inadequate prenatal care, while for non-Aboriginal women, high perceived stress was associated with low income, non-completion of high school, not having a paid job, and receiving inadequate prenatal care. Refer to Table 35.

Among all subjects, women with low levels of self esteem were more likely to be young, single, have a low income, have less than a high school education, not have a paid job, and receive inadequate prenatal care. Low self esteem was associated with most of these same variables for non-Aboriginal women, but demonstrated no relationship with other variables for Aboriginal women. Refer to Table 36.

Among all subjects, women with low levels of support from others were more likely to be multiparous, of low income, have less than a high school education, not have a paid job, and receive inadequate prenatal care. For Aboriginal women, a low level of support was only related to having less than a high school education, while for non-Aboriginal women, a low level of support was related to being single, not having a paid job, and having less than a high school education. Refer to Table 37.

Among all subjects, women who moved two or more times in the past year were more likely to be young, single, of low income, have less than a high school education, and not have a paid job. These same relationships held true for non-Aboriginal women, with the addition of inadequate prenatal care. Among Aboriginal women, the only variable related to moving frequently was being single. Refer to Table 38.

In summary, there were significant differences in socioeconomic status, as reflected by income and education, between women with high and low perceived stress, high and low self esteem, high and low support from others, and moving two or more times versus less than two times in the past year.

Table 35.
Relationship between perceived stress and sociodemographic variables

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	High stress n (%)	Low-mod. stress n (%)	High stress n (%)	Low-mod. Stress n (%)	High stress n (%)	Low-mod. Stress n (%)
Single marital status	8 (18.6)	126 (19.9)	5 (20.8)	47 (11.8)	3 (15.8)	79 (33.8)
Age <19 years	2 (4.7)	45 (7.1)	0	10 (2.5)	2 (10.5)	35 (15.0)
Income <$20,000 per year	17 (43.6)	185 (33.7)	9 (39.1)	54 (14.8)*	8 (50.0)	131 (71.6)
Education < high school	18 (41.9)	196 (31.0)	10 (41.7)	51(12.8)**	8 (42.1)	145 (62.0)
No paid job	23 (53.5)	230 (36.4)*	12 (50.0)	80 (20.1)*	11 (57.9)	150 (64.4)
Multiparous	33 (76.7)	369 (58.7)*	17 (70.8)	207 (52.0)	16 (84.2)	162 (70.1)
Inadequate prenatal care	11 (25.6)	(57 (9.2)*	4 (16.7)	19 (4.8)*	7 (36.8)	38 (17.0)*

*Chi square or Fisher's exact test p<.05 ** Chi square or Fisher's exact test p<.001

Table 36.
Relationship between self esteem and sociodemographic variables

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Low self esteem n (%)	Mod.-high self esteem n (%)	Low self esteem n (%)	Mod.-high self esteem n (%)	Low self esteem n (%)	Mod.-high self esteem n (%)
Single marital status	11 (34.4)	118 (18.9)*	5 (38.5)	46 (11.4)*	6 (31.6)	72 (32.3)
Age <19 years	4 (12.5)	41 (6.6)	1 (7.7)	9 (2.2)	3 (15.8)	32 (14.3)
Income <$20,000 per year	20 (71.4)	169 (31.1)**	7 (58.3)	52 (14.1)**	13 (81.3)	117 (67.2)
Education < high school	19 (59.4)	185 (29.6)**	6 (46.2)	53 (13.2)*	13 (68.4)	132 (59.2)
No paid job	18 (56.3)	225 (36.1)*	7 (53.8)	84 (20.9)*	11 (57.9)	141 (63.5)
Multiparous	24 (75.0)	366 (58.8)	9 (69.2)	210 (52.4)	15 (78.9)	156 (70.6)
Inadequate prenatal care	8 (25.0)	57 (9.3)*	3 (23.1)	18 (4.5)*	5 (26.3)	39 (18.1)

*Chi square or Fisher's exact test $p<.05$ ** Chi square or Fisher's exact test $p<.001$

Table 37.
Relationship between support from others and sociodemographic variables

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Low support n (%)	Mod-high support n (%)	Low support n (%)	Mod-high support n (%)	Low support n (%)	Mod-high support n (%)
Single marital status	9 (27.3)	120 (19.8)	5 (33.3)	44 (11.6)*	4 (22.2)	76 (33.5)
Age <19 years	3 (9.1)	43 (7.1)	1 (6.7)	9 (2.4)	2 (11.1)	34 (15.0)
Income <$20,000 per year	15 (55.6)	178 (33.7)*	4 (30.8)	56 (16.0)	11 (78.6)	122 (68.9)
Education < high school	21 (63.6)	183 (30.2)**	6 (40.0)	52 (13.7)*	15 (83.3)	131 (57.7)*
No paid job	18 (54.5)	222 (36.7)*	8 (53.3)	77 (20.4)*	10 (55.6)	145 (64.2)
Multiparous	26 (78.8)	254 (42.1)*	11 (73.3)	193 (51.1)	15 (83.3)	156 (69.3)
Inadequate prenatal care	7 (21.9)	58 (9.7)*	2 (13.3)	19 (5.0)	5 (29.4)	39 (17.9)

*Chi square or Fisher's exact test $p<.05$ ** Chi square or Fisher's exact test $p<.001$

Table 38.
Relationship between number of times moved in past year and sociodemographic variables

Characteristic	All Subjects		Non-Aboriginal Group		Aboriginal Group	
	Moved ≥ 2 times n (%)	Moved < 2 times n (%)	Moved ≥ 2 times n (%)	Moved < 2 times n (%)	Moved ≥ 2 times n (%)	Moved < 2 times n (%)
Single marital status	43 (41.3)	93 (16.0)**	18 (37.5)	34 (9.0)**	25 (44.6)	59 (29.2)*
Age <19 years	13 (12.5)	34 (5.9)*	5 (10.4)	5 (1.3)*	8 (14.3)	29 (14.1)
Income <$20,000 per year	53 (55.8)	150(30.2)**	19 (43.2)	44(12.7)**	34 (66.7)	106 (71.1)
Education < high school	46 (44.2)	173 (29.8)*	18 (37.5)	44(11.6)**	28 (50.0)	129 (63.9)
No paid job	52 (50.0)	206 (35.6)*	18 (37.5)	75 (19.8)*	34 (60.7)	131 (65.2)
Multiparous	58 (55.8)	350 (60.8)	20 (41.7)	206 (54.6)	38 (67.9)	144 (72.4)
Inadequate prenatal care	15 (14.7)	56 (9.8)	7 (14.6)	16 (4.2)*	8 (14.8)	40 (20.8)

*Chi square or Fisher's exact test p<.05 ** Chi square or Fisher's exact test p<.001

Multivariate Analysis

Multiple logistic regression analyses were performed to further explore the independent and joint effects of risk factors, using the presence or absence of preterm birth as a dichotomous dependent variable. These logistic regression models were used to estimate the odds ratios for factors in relation to preterm birth after adjustment for other covariates, producing an adjusted odds ratio (AOR). In other words, each parameter estimate in the multiple logistic regression model measures the unique impact of that variable, after controlling for the influence of all the other explanatory variables in the model (Hassard, 1998).

Development of the multivariate models was largely predicated on the previous stratified analyses, with significant risk factors entered into the analyses in the same format as used previously. Therefore variables such as age, marital status, and inadequate prenatal care were entered as bivariate variables. Rate of weight gain in the second and third trimester was divided into two separate categorical variables (0-0.45 kg/week and 0.46-0.61 kg/week). In order to control for socioeconomic status, education level was entered into the models as a bivariate variable (non-completion of high school versus completion of high school or higher). Income was not included in the models because this variable had several missing values, resulting in a reduced number of subjects and decreased power. Variables were entered in one step, not in a stepwise fashion. Two different models were constructed: one including medical risk factors and one excluding medical risk factors. Shiono, Rauh, Park, Lederman, and Zuskar (1997) provide a rationale for not including medical factors in regression models for low birth weight (LBW), that can be extrapolated to models for preterm birth:

> Whether or not the mother had a previous LBW infant was not included in these regression models because this is an intermediate factor on the causal pathway between the risk factors studied and birthweight. As most of the risk factors assessed in this analysis can be considered relatively constant exposures, such as cigarette smoking, it is likely that these risk factors would have been operating in the previous pregnancy as well as the current one. If the woman smoked during her previous pregnancy and smoking was associated with the birthweight of the previous infant, then controlling for the occurrence of a previous LBW infant in subsequent births would overcontrol for the effects of smoking. The effects of overcontrolling would be to severely attenuate or remove the effects of cigarette smoking and other factors on the current pregnancy. (p. 790)

Each of the models (one including and one excluding medical factors) was sub-divided into three analyses: all subjects, non-Aboriginal subjects, and Aboriginal subjects. Refer to Tables 39 and 40. For the model based on all subjects, interaction terms for the risk factors demonstrating heterogeneity of effect in the previous stratified analyses were entered. These variables were not entered in the models for Aboriginal and non-Aboriginal subjects, as they were not applicable to these models. Only risk factors identified as significant in the previous stratified analyses were entered into the respective models for the Aboriginal and non-Aboriginal subjects (i.e., perceived stress was entered in the Aboriginal model but not the non-Aboriginal model since it was only a risk factor for Aboriginal women). Since the weight gain and anemia variables had several missing values, they were modeled separately in the presence of other factors so as not to affect the power of the majority of the model. Models were examined before and after addition of the weight gain and anemia variables to ensure that other variables did not change in significance. The protective effect of hemoglobin in the total sample and non-Aboriginal models and the risk associated with anemia in the Aboriginal model could not be studied due to the high number of missing values and instability of numbers.

The number of observations included in the logistic regression models were as follows: Models including medical factors had 570 total subjects, 377 non-Aboriginal subjects, and 215 Aboriginal subjects, and number of observations for the addition of weight gain and/or anemia variables, 352 total subjects, 318 non-Aboriginal subjects, and 150 Aboriginal subjects; models excluding medical factors had 581 total subjects, 381 non-Aboriginal subjects, and 223 Aboriginal subjects, and number of observations for the addition of weight gain and/or anemia variables, 360 total subjects, 322 non-Aboriginal subjects, and 155 Aboriginal subjects.

Table 39.

Adjusted odds ratios (AOR) and 95% confidence intervals (CI) for factors in relation to preterm birth, based on a multiple logistic regression model including medical risk factors

Factor	All subjects AOR (95% CI)	Non-Aboriginal Group AOR (95% CI)	Aboriginal Group AOR (95% CI)
2 or more spontaneous abortions	2.18 (1.01, 4.71)*	1.88 (0.77, 4.59)	2.89 (0.73, 11.55)
Previous preterm birth	4.00 (2.13, 7.51)*	3.79 (1.72, 8.37)*	4.32 (1.67, 11.22)*
Vaginal bleeding after 12 weeks	2.49 (1.41, 4.41)*	2.30 (1.14, 4.63)*	1.41 (0.58, 3.40)
Gestational hypertension	4.15 (1.73, 9.97)*	2.48 (0.86, 7.15)	7.51 (2.11, 26.76)*
Antenatal hospitalization	4.03 (2.27, 7.15)*	3.77 (1.93, 7.38)*	3.27 (1.28, 8.33)*
PROM	2.11 (1.28, 3.48)*	2.03 (1.24, 3.32)*	12.70 (5.31,30.39)*
Smoked prior to pregnancy.	1.43 (0.88, 2.32)	1.58 (0.92, 2.70)	1.04 (0.41, 2.65)
Short stature (height < 62 in.)	1.89 (0.99, 3.62)	1.67 (0.91, 3.45)	3.22 (0.84, 12.30)
Physical abuse during preg.	0.58 (0.13, 2.54)	1.46 (0.35, 6.20)	N/A
Age < 19 years	4.01 (0.86, 18.70)	N/A	0.19 (0.04, 0.89)*
Education incomplete high school or less	0.77 (0.42, 1.41)	0.73 (0.35, 1.54)	0.98 (0.43, 2.21)
Single marital status	0.94 (0.42, 2.12)	1.03 (0.46, 2.31)	0.70 (0.30, 1.66)
Moved ≥2 times in last yr	1.05 (0.36, 3.09)	1.37 (0.62, 3.04)	N/A
Inadequate prenatal care	2.44 (1.08, 5.52)*	2.84 (0.85, 9.44)	1.93 (0.72, 5.21)
High perceived stress	0.32 (0.10, 1.04)	N/A	3.30 (0.88, 12.28)
Low self esteem	1.34 (0.45, 4.03)	3.13 (0.86, 11.60)	N/A
Low support from others	0.26 (0.05, 1.48)	1.27 (0.36, 4.49)	N/A
Total wt gain < 20 lbs.	2.60 (1.08, 6.27)*	1.74 (0.75, 4.06)	8.95 (1.86, 42.94)*
Anemia (hgb < 105)	0.52 (0.12, 2.25)	N/A	undefined
Rate of wt gain 0-0.45 kg/wk	0.44 (0.20, 0.95)*	0.46 (0.23, 0.93)*	0.13 (0.03, 0.63)*
Rate of wt gain 0.46-0.61 kg/wk	0.32 (0.12, 0.77)*	0.45 (0.21, 0.96)*	0.54 (0.12, 2.50)
Non-aborig. X abuse in preg	3.45 (0.45, 26.51)	N/A	N/A
Non-aborig. X moving ≥ 2 times	1.33 (0.35, 5.04)	N/A	N/A

Factor	All subjects AOR (95% CI)	Non-Aboriginal Group AOR (95% CI)	Aboriginal Group AOR (95% CI)
Non-aborig. X low support from others	6.43 (0.76, 54.75)	N/A	N/A
Aborig. X SPROM	5.02 (1.85, 13.60)*	N/A	N/A
Aborig. X age < 19 years	0.07 (0.01, 0.61)*	N/A	N/A
Aborig. X high perceived stress	7.56 (1.12, 50.93)*	N/A	N/A
Aborig. X single marital status	0.49 (0.14, 1.67)	N/A	N/A
Aborig. X low hgb < 105	9.82 (0.73, 133.09)	N/A	N/A

* $p<.05$

Adjusted odds ratios (AOR) are based on logistic regression models. Interaction terms were included in the "All subjects" model only. Weight gain, rate of weight gain, and anemia were modeled separately in models that also included all the other variables. Majority of model based on 570 total subjects, 377 non-Aboriginal subjects, and 215 Aboriginal subjects; number of observations for the addition of weight gain and/or anemia variables based on 352 total subjects, 318 non-Aboriginal subjects, and 150 Aboriginal subjects.

Table 40.

Adjusted odds ratios (AOR) and 95% confidence intervals (CI) for factors in relation to preterm birth, based on a multiple logistic regression model excluding medical risk factors

Factor	All subjects AOR (95% CI)	Non-Aboriginal Group AOR (95% CI)	Aboriginal Group AOR (95% CI)
Smoked prior to pregnancy.	1.69 (1.15, 2.56)*	1.61 (0.98, 2.64)	1.59 (0.78, 3.24)
Short stature (height < 62 in.)	1.80 (1.03, 3.13)*	1.71 (0.89, 3.30)	1.78 (0.65, 4.87)
Physical abuse during preg.	0.93 (0.30, 2.91)	2.57 (0.67, 9.82)	N/A
Age < 19 years	1.58 (0.37, 6.79)	N/A	0.46 (0.15, 1.39)
Education incomplete high school or less	0.85 (0.51, 1.40)	0.78 (0.39, 1.53)	0.93 (0.49, 1.76)
Single marital status	0.93 (0.45, 1.92)	0.98 (0.47, 2.03)	0.50 (0.25, 0.98)*
Moved ≥2 times in last yr	0.69 (0.31, 1.56)	1.25 (0.61, 2.58)	N/A
Inadequate prenatal care	3.36 (1.75, 6.42)*	3.05 (1.10, 8.45)*	3.21 (1.49, 6.90)*
High perceived stress	0.43 (0.14, 1.30)	N/A	2.80 (0.96, 8.23)
Low self esteem	1.06 (0.43, 2.60)	1.93 (0.55, 6.79)	N/A
Low support from others	0.98 (0.26, 3.67)	2.84 (0.87, 9.29)	N/A
Total wt gain < 20 lbs.	3.41 (1.58, 7.33)*	2.22 (1.06, 4.63)*	5.31 (1.69, 16.65)*
Anemia (hgb < 105)	0.42 (0.10, 1.76)	N/A	undefined
Rate of wt gain 0-.45 kg/wk	0.44 (0.22, 0.86)*	0.46 (0.24, 0.87)*	0.37 (0.12, 1.13)
Rate of wt gain 0.46-0.61 kg/wk	0.46 (0.22, 0.96)*	0.47(0.24, 0.94)*	0.75 (0.25, 2.30)
Non-aborig. X abuse in preg	3.25 (0.55, 19.04)	N/A	N/A
Non-aborig. X moving ≥ 2 times	1.86 (0.63, 5.56)	N/A	N/A
Non-aborig. X low support from others	3.55 (0.60, 21.01)	N/A	N/A
Aborig. X age < 19 years	0.37 (0.06, 2.20)	N/A	N/A
Aborig. X high perceived stress	7.37 (1.41, 38.46)*	N/A	N/A
Aborig. X single marital status	0.46 (0.17, 1.31)	N/A	N/A
Aborig. X anemia (hgb < 105)	6.23 (0.89, 44.73)	N/A	N/A

* $p<.05$

Adjusted odds ratios (AOR) are based on logistic regression models. Interaction terms were included in the "All subjects" model only. Weight gain, rate of weight gain, and anemia were modeled separately in models that also included the all the other variables. Majority of model based on 581 total subjects, 381 non-Aboriginal subjects, and 223 Aboriginal subjects; number of observations for the addition of weight gain and/or anemia variables based on 360 total subjects, 322 non-Aboriginal subjects, and 155 Aboriginal subjects.

Testing for Interactions

The definition of interaction is logically equivalent to the definition of effect-measure modification, or heterogeneity of effect, and stratified analyses can be used to analyze statistical interactions (Rothman & Greenland, 1998). If two factors X and Z have no interaction, the risk difference for one remains constant across levels of the other (i.e., there is homogeneity of the risk differences). Interaction also may be described as departure from additivity of effects on the chosen outcome scale. If there is no interaction between X and Z on the risk scale for the outcome, then the combined effect of X and Z on risk can be computed by simply adding together the separate effects (risk differences) for X and Z (Rothman & Greenland, 1998).

Using stratified analyses, there was no association between the following factors on risk of preterm birth (i.e., the Breslow-Day test for homogeneity was not significant, and therefore homogeneity of effect was assumed):

- Inadequate prenatal care and low income (using either tertiles or a bivariate variable<$20,000)
- Inadequate prenatal care and low self esteem or high perceived stress
- Inadequate prenatal care and smoking prior to pregnancy
- Low weight gain and low BMI
- Low weight gain and short stature

- Low weight gain and smoking prior to pregnancy
- Anemia and smoking
- Anemia and inadequate prenatal care
- Smoking prior to or during pregnancy and multiparity
- Low self esteem and abuse during pregnancy
- Abuse during pregnancy and single marital status
- Abuse during pregnancy and young age < 19 years

The only interaction that was discovered was between inadequate prenatal care and place of residence. Inadequate prenatal care was a significant risk factor for preterm birth among urban residents, but not for rural/northern residents (Breslow-Day test of homogeneity = 4.92, p=.027). Similar proportions of cases and controls in the rural/northern area received inadequate prenatal care. Refer to Table 41.

Table 41.
The association between inadequate prenatal care and preterm birth, stratified by place of residence

Place of Residence	Cases with inadequate prenatal care n (%)	Controls with inadequate prenatal care n (%)	OR (95% CI)
Urban	20 (14.8)	13 (4.4)	3.77 (1.82, 7.84)
Rural/northern	15 (17.9)	23 (15.3)	1.20 (0.58, 2.45)

Population Attributable Risk

The population attributable risk percent (PAR%) is the reduction in incidence that would be achieved if the population had been entirely unexposed, compared with its actual or current exposure pattern (Rothman & Greenland, 1998). PAR% was calculated for selected potentially modifiable risk factors, using those factors achieving significance in the multiple logistic regression model that excluded medical risk factors. Refer to Table 42. The formula used was: PAR% = [proportion exposed among controls X (OR - 1)] / 1 + [proportion exposed among controls X (OR - 1)] X 100. The calculations are detailed in Appendix O.

Table 42.
Population attributable risk percent (PAR%) for selected risk factors

Risk factor	All subjects	Non-Aboriginal group	Aboriginal group
Smoking prior to pregnancy	PAR = 24.5%	PAR = 16.2%	PAR = 29.7%
Inadequate prenatal care	PAR = 15.9%	PAR = 6.2%	PAR = 26.1%
Weight gain <20 lbs.	PAR = 22.3%	PAR = 12.8%	PAR = 34.1%

The PAR% was higher for the Aboriginal group than the non-Aboriginal group for each of the risk factors examined. This occurred because either the proportion exposed among controls was higher in the Aboriginal group, or the odds ratio was higher, or both. For example, 71.6% of Aboriginal controls smoked prior to pregnancy compared to 31.7% of non-Aboriginal controls, contributing to an increased PAR% for Aboriginal women. If the incidence of smoking could be reduced among Aboriginal women of childbearing age, the potential for reduction in risk of preterm birth would be nearly 30%. This interpretation should be made with caution, since it assumes biases are absent and assumes that the absence of smoking would not expand the person-years at risk of preterm birth by removing other competing risks for preterm birth (Rothman & Greenland, 1998). "The common public-health interpretation of the attributable fraction (as potential caseload reduction) assumes that removing exposure will not affect the size of the population at risk. This assumption is not always correct" (Rothman & Greenland, 1998, p. 297). If the potential existed for absence of the risk factor to lead to more pregnancies, this would expand the source cohort and increase the number of cases. For example, if smoking was associated with infertility, the absence of smoking may lead to more pregnancies.

Summary

Based on the results of the stratified analyses, the research questions may be answered as follows:

1. Women who smoked in the month prior to their pregnancy had a higher relative risk of spontaneous preterm birth than women who did not smoke prior to pregnancy. The association between smoking and preterm birth did not differ between Aboriginal and non-Aboriginal women. Smoking during pregnancy was not associated with a significantly increased odds of preterm birth, although there was a suggestion that a dose-response effect exists.
2. Women with poor nutritional status (as reflected by short stature, inadequate weight gain during pregnancy, inadequate rate of weight gain, and anemia) had a higher relative risk of spontaneous preterm birth than women with adequate nutritional status. The association between nutritional status and preterm birth did not differ between Aboriginal and non-Aboriginal women for the risk associated with having short stature or a total weight gain in pregnancy of less than 20 pounds, or for the protective effects associated with having a rate of weight gain in the second and third trimesters of 0.46-0.61 kgs/week or a hemoglobin level of 113-119 mg/dl. There was a difference between Aboriginal and non-Aboriginal women for the risk associated with anemia, with anemia increasing the odds of preterm birth only among Aboriginal women.

3. Women receiving inadequate prenatal care, as determined using the Kessner Adequacy of Prenatal Care Index, had a higher relative risk of spontaneous preterm birth than women receiving adequate prenatal care. The association between prenatal care and preterm birth did not differ between Aboriginal and non-Aboriginal women.
4. Women who reported physical abuse during their pregnancy and in the past year had a higher relative risk of spontaneous preterm birth than women who did not report abuse, but this association only held true for non-Aboriginal women.
5. Women whose work involves prolonged standing, long working hours, and/or shift work did not have a higher relative risk of spontaneous preterm birth than women whose work was less strenuous.
6. Women with a history of urogenital infections during their pregnancy, such as sexually transmitted diseases or bacterial vaginosis, did not have a higher relative risk of spontaneous preterm birth than women without urogenital infections. However, women with premature rupture of membranes (PROM) prior to onset of labor, which may have infectious etiology, had a higher relative risk of spontaneous preterm birth than women without PROM. The association between PROM and preterm birth differed between Aboriginal and non-Aboriginal women, with Aboriginal women having significantly higher odds of preterm birth associated with SPROM (OR 6.58) compared to non-Aboriginal women (OR 2.04), although PROM acted as a risk factor for both groups.
7. Women with high levels of stress, low levels of support, and low levels of self esteem had a higher relative risk of spontaneous preterm birth than women with

low levels of stress and adequate social support and self esteem. However, the association between stress, social support, self esteem, and preterm birth differed among Aboriginal and non-Aboriginal women. A high level of perceived stress was a risk factor for Aboriginal women, while a low level of support from others and low self esteem were risk factors for non-Aboriginal women. In addition, moving two or more times in the past year (as a proxy for access to support) was a risk factor for non-Aboriginal women only.

After using multiple logistic regression to adjust for other factors associated with preterm birth, three of the above variables remained as significant independent risk factors for preterm birth: smoking in the month prior to pregnancy, inadequate prenatal care, and low weight gain during pregnancy, while rate of weight gain in the second and third trimester was a protective factor, reducing the risk of preterm birth. The population attributable risk associated with smoking prior to pregnancy, low weight gain during pregnancy, and inadequate prenatal care was 24.5%, 22.3%, and15.9% respectively. After adjusting for other variables, several medical risk factors (previous preterm birth, vaginal bleeding after 12 weeks gestation, rupture of membranes prior to labor, and antenatal hospitalization) remained strongly associated with preterm birth for both Aboriginal and non-Aboriginal women, while age less than 19 years and single marital status were protective factors for Aboriginal women, reducing their risk of preterm birth. There was no evidence that abuse during pregnancy, stress, social support, or self esteem affected risk of preterm birth once other factors associated with preterm birth were taken into account.

CHAPTER V: DISCUSSION

The purpose of this study was to identify risk factors for spontaneous preterm birth in Manitoba women, and to compare risk factors among Aboriginal and non-Aboriginal women in Manitoba. This study identified several risk factors for preterm birth that demonstrated homogeneity of effect after adjusting for race, while other factors demonstrated heterogeneity of effect among Aboriginal and non-Aboriginal women. Using stratified analysis, significant risk factors for preterm birth across both strata (i.e., having homogeneity of effect) are summarized in Table 43. The results of the stratified analyses and the logistic regression models including and excluding medical factors are presented to enable comparisons of odds ratios. Several of the medical factors demonstrated homogeneity of effect across racial groups, and the odds ratios did not change substantially after adjusting for other factors. Modifiable risk factors demonstrating homogeneity of effect included smoking prior to pregnancy, low weight gain during pregnancy, and inadequate prenatal care. The adjusted odds ratios for these factors remained similar in the model including medical risk factors, but increased in the model excluding medical risk factors.

Table 43.
Risk factors demonstrating homogeneity of effect across both strata

Risk Factor	Stratified Analysis OR (95% CI)	Logistic Regression A AOR (95% CI)	Logistic Regression B AOR (95% CI)
Previous preterm birth	4.41 (2.75, 7.05)	4.00(2.13, 7.51)	N/A
2 or more previous spontaneous abortions	2.07 (1.14, 3.77)	2.18 (1.01, 4.71)	N/A
Vaginal bleeding after 12 weeks gestation	2.61 (1.71, 3.97)	2.49 (1.41, 4.41)	N/A
Gestational hypertension	2.52 (1.41, 4.49)	4.15 (1.73, 9.97)	N/A
Antenatal hospitalization	3.93 (2.61, 5.93)	4.03 (2.27, 7.15)	N/A
Smoking prior to preg.	1.47 (1.04, 2.07)	1.43 (0.88, 2.32)	1.69 (1.15, 2.56)
Short stature (< 62 in.)	1.77 (1.08, 2.92)	1.89 (0.99, 3.62)	1.80 (1.03, 3.13)
Low weight gain < 20 lbs	2.18 (1.35, 3.51)	2.60 (1.08, 6.27)	3.41 (1.58, 7.33)
Rate of weight gain in 2nd & 3rd trimester, quartile of 0.46-0.61 kg/wk	0.56 (0.33, 0.95)	0.32 (0.12, 0.77)	0.46 (0.22, 0.96)
Inadequate prenatal care	2.37 (1.41, 3.96)	2.44 (1.08, 5.52)	3.36 (1.75, 6.42)

Note: Logistic regression A is the model including medical factors. Logistic regression B is the model excluding medical factors.

Significant risk factors for preterm birth among non-Aboriginal women (i.e., having heterogeneity of effect) are summarized in Table 44. With the exception of PROM, these factors are psychosocial in nature and are potentially modifiable. After adjusting for other factors in the regression models, these psychosocial factors were no longer significant.

Table 44.
Risk factors demonstrating heterogeneity of effect (significant for non-Aboriginal women)

Risk Factor	Stratified Analysis OR (95% CI)	Logistic Regression A AOR (95% CI)	Logistic Regression B AOR (95% CI)
Rupture of membranes prior to onset of labor	2.04 (1.36, 3.08)	2.03 (1.24, 3.32)	N/A
Abused in last year*	2.98 (1.11, 7.99)	undefined	undefined
Abused during pregnancy	4.62 (1.40, 15.26)	1.46 (0.35, 6.20)	2.57 (0.67, 9.82)
Moving ≥2 times in past year	1.95 (1.07, 3.58)	1.37 (0.62, 3.04)	1.25 (0.61, 2.58)
Low support from others	4.16 (1.39, 12.44)	1.27 (0.36, 4.49)	2.84 (0.87, 9.29)
Low self esteem	3.28 (1.05, 10.20)	3.13 (0.86, 11.60)	1.93 (0.55, 6.79)
Hemoglobin level between 113-119 mg/dl*	0.39 (0.19, 0.79)	undefined	undefined

Note: Logistic regression A is the model including medical factors. Logistic regression B is the model excluding medical factors.
*These variables were not included in the logistic regression models.

Significant risk factors for preterm birth among Aboriginal women (i.e., having heterogeneity of effect) are summarized in Table 45. PROM had a high relative risk for preterm birth among Aboriginal women, and the odds ratio increased after adjusting for other factors in the logistic regression model. High perceived stress and anemia were additional risk factors, while age less than 19 years and single marital status were protective factors.

Table 45.
Risk factors demonstrating heterogeneity of effect (significant for Aboriginal women)

Risk Factor	Stratified Analysis OR (95% CI)	Logistic Regression A AOR (95% CI)	Logistic Regression B AOR (95% CI)
Rupture of membranes prior to onset of labor	6.58 (3.67, 11.78)	12.70 (5.31, 30.39)	N/A
Age < 19 years	0.37 (0.15, 0.92)	0.19 (0.04, 0.89)	0.46 (0.15, 1.39)
Single marital status	0.56 (0.31, 1.01)	0.70 (0.30, 1.66)	0.50 (0.25, 0.98)
Anemia (hgb< 105 mg/dl)*	2.46 (1.12, 5.44)	undefined	undefined
High perceived stress	2.54 (0.99, 6.51)	3.30 (0.88, 12.28)	2.80 (0.96, 8.23)

Note: Logistic regression A is the model including medical factors. Logistic regression B is the model excluding medical factors.
*This variable was not included in the logistic regression models.

In summary, this study confirmed the importance of several medical risk factors for preterm birth that have been identified in other studies, such as having a previous preterm birth or two or more spontaneous abortions, and vaginal bleeding and high blood pressure complicating the current pregnancy. Some of the sociodemographic characteristics reported as risk factors in previous literature were not supported in this study, for example, low maternal education and low family income. Maternal age was a significant risk factor only for the Aboriginal group, with an age of less than 19 years being protective (i.e., women less than 19 years had a reduced risk of preterm birth). Marital status demonstrated opposite effects in the two groups. Having a single marital status reduced the risk of preterm birth for Aboriginal women by about one-half. Conversely, there was a trend toward single marital status being a risk factor for non-Aboriginal women, but the odds ratio (1.66) was not significant (p=.090). Modifiable risk factors for both groups included smoking in the month prior to pregnancy, poor weight gain during pregnancy, and inadequate prenatal care. None of the risk factors related to strenuous work in pregnancy or urogenital infections were significant in this analysis. For the non-Aboriginal group, modifiable risk factors include physical abuse in the past year, abuse during pregnancy, moving two or more times in the past year, having low levels of support from others, and having low self esteem. For the Aboriginal group, modifiable risk factors included anemia and high levels of perceived stress.

This chapter will discuss the results of the study related to the seven research questions, and explore implications for practice and directions for future research for those risk factors, followed by a discussion of medical and sociodemographic risk factors. The strengths and limitations of the study will be addressed. The chapter will conclude with overall implications for practice related to a population health approach, and recommendations for future research.

Smoking

This study partially confirmed results from other epidemiologic studies that smoking is significantly associated with preterm birth. Smoking during pregnancy demonstrated a small, statistically insignificant increase in the odds of preterm birth, after adjusting for race (OR 1.33, 95% CI 0.94, 1.88). Based on a sample size of 226 cases with a 2:1 ratio of controls to cases, one-sided alpha .05, and exposure rate among controls of 38% for smoking during pregnancy, this study had a power of 79.5% to detect an odds ratio of 1.5. Thus the sample size may have had insufficient power to detect a significant odds ratio for this risk factor, given that smoking during pregnancy was associated with a pooled odds ratio of 1.27 in Shah and Bracken's (2000) meta-analysis. The findings of this investigation suggest support for a dose-response association between smoking during pregnancy and an increased risk of preterm birth, which is consistent with several previous studies (Kyrklund-Blomberg & Cnattingius, 1998; Kolas et al., 2000; Wisborg et al., 1996). Smoking 20 or more cigarettes per day in the second and third trimester doubled the risk of preterm birth, although this result was not significant ($p=.078$). However, the current investigation is unique in two major respects. This is the first study reporting that smoking in the month prior to pregnancy is associated with preterm birth, after adjusting for race (OR 1.47, 95% CI 1.04, 2.07). Other studies reviewed focused on exposure to smoking during, but not prior, to pregnancy. This also is the first study reporting on the effect of smoking on risk of preterm birth in both Aboriginal and non-Aboriginal women. Smoking demonstrated homogeneity of effect across both groups.

This study used self-reports of smoking, which increases the possibility of misclassification of the exposure variable. In addition, the information on smoking was recorded retrospectively, and women who delivered preterm babies may have reported their smoking habits differently than women who delivered at full term, creating a possible differential misclassification bias. However, self-reports of prepregnancy smoking by pregnant women have been demonstrated to be a reliable source of information (Fox, Sexton, Hebel, & Thompson, 1989). The percentage of women reporting smoking during pregnancy was similar to that of other studies. The First Nations and Inuit Regional Health Survey (FNIRHS, 1997) showed that 62% of adult First Nation peoples living on-reserve and in Labrador Inuit communities were smokers and that over 70% of respondents age 20-29 were smokers. This compares closely to the 74% of Aboriginal women who reported smoking prior to pregnancy and the 61.2% who reported smoking during pregnancy in this study. It should be noted that the Aboriginal women participating in this study differed from the FNIRHS respondents, as this study included First Nations women both on- and off-reserve, and also included women of Métis ancestry. In the non-Aboriginal group, 26.2% of women reported smoking during their pregnancy. This is similar to another study conducted in Manitoba in 1995, which reported that 28.8% of women smoked during their pregnancies (Gupton & Hague, 1997). Similar relationships were found between smoking and sociodemographic characteristics in both this study and Gupton and Hague's study, in that a higher percentage of women who smoked were young, not married, had more pregnancies, and were less likely to receive prenatal care. A study of health promoting behaviors in Manitoba First Nations Communities found that individuals who quit smoking were more likely to have higher education and income status (Elias, Leader, Sanderson, O'Neil, & Tate, 2000). In this study, Aboriginal women who had completed high school were more likely to quit smoking once they were pregnant.

Implications for practice. Promoting smoking cessation among women of childbearing age should be an on-going goal for health care providers. Because smoking prior to pregnancy is associated with an increased risk of preterm birth, preconception counseling to encourage smoking cessation is important. Because smoking during pregnancy exhibited a possible dose-response relationship with preterm birth, efforts to reduce the number of cigarettes smoked may be helpful even if the woman is not able to achieve total abstinence from smoking (Meis et al., 1995a). Lumley, Oliver, and Waters (2000), in a review for the Cochrane Database, concluded that smoking cessation programs in pregnancy are effective in reducing smoking and preterm birth. Based on 34 trials of smoking cessation, there was a significant reduction in smoking in the intervention group (OR 0.53, 95% CI 0.47-0.60). The subset of trials with information on fetal outcome revealed a reduction in preterm birth in the intervention group (OR 0.83, 95% CI 0.69 -0.99). The specific content of highly effective smoking cessation programs include information about the risks of smoking to the fetus and infant, information about the benefits of quitting, recommendations to quit, feedback about fetal status, and teaching cognitive-behavioral strategies for quitting smoking (from Lumley et al, cited in Maloni, 2000). The transtheoretical model of health behavior change, also referred to as the "stages of change" model, has been used to guide effective smoking cessation programs (Prochaska & Velicer, 1997). A large-scale analysis of smoking cessation programs found that programs that were based on a theory such as the stage-matched interventions were more effective in preventing relapse than non-theory-based programs (Edwards, Aubin, & Morrison, 2000, cited in Maloni, 2000).

Gupton and Hague (1997), in their report for the Public Health Branch of Manitoba Health, put forth the following recommendations that remain relevant today:

- A public awareness campaign is needed to inform women and their families of the inherent risks of smoking during pregnancy.
- Increased efforts are required by the providers of prenatal care to identify pregnant women who smoke to increase supports for cessation and regular monitoring of cessation efforts.
- Targeted cessation programs should be implemented through collaboration with communities in locations where there are large percentages of women smokers.
- Health care providers need on-going education on successful smoking cessation programs and appropriate approaches for smoking reduction.

- A continuing system of data collection, entry and retrieval is needed for ongoing information on smoking during pregnancy to better understand the scope of the problem and to examine changes over time. (p. 47)

The high prevalence of smoking among Aboriginal women makes smoking one of the most important preventable risk factors for preterm birth in this group, with a population attributable risk percent of 30%. In keeping with the belief that Aboriginal peoples should be actively involved in the development and implementation of health care programs relevant to their people, the comments and recommendations related to the problem of smoking found in the FNIRHS (1999) are cited here:

> A comprehensive national strategy to address tobacco use in Aboriginal communities would identify prevention, cessation and protection measures. Given the profound smoking prevalence identified in this study, tobacco smoking must be seen as a high public health priority and a call to action for the community, leadership, health professionals and government. . . . Historically, tobacco is a sacred plant that has an important role in traditional ceremonies and gift giving. However, the prevalence of non-traditional smoking of tobacco is very high and appears to be increasing... Preventative action is needed in schools, communities, public spaces and workplaces. . . . Protection measures are urgently required. There is a need for basic public education within Aboriginal communities about the effects of smoking, second-hand smoke and also smokeless tobacco. . . . Community based health promotion and disease prevention research needs to examine the stages of change in an Aboriginal context to elucidate those factors most associated with success. A first and

> necessary step to help these smokers move to the next stage of change is to increase community awareness about the health effects of tobacco abuse versus traditional tobacco use. However, almost all of the smoking education and cessation programs that are currently available in Canada are not readily accessible to Aboriginal groups. Access is limited by the language used and, in some cases, by the literacy level of materials used in many of these programs. Furthermore, these programs are not culturally appropriate for First Nations and Inuit Peoples. Too few resources make smoking prevention, cessation and protection messages either personally or culturally relevant. For many Aboriginal communities, being 'culturally sensitive" also includes respecting tobacco's sacred role and clearly distinguishing between smoking and ceremonial tobacco use. As well, the vast majority of these programs and materials focus exclusively on the individual in contrast to the Aboriginal holistic approach of involving the family, the community and the environment. The NASAWIN smoking education program....provides one of the few examples of a culturally appropriate smoking intervention for Aboriginal Peoples. . . . cessation programs need to include cultural values and be designed and delivered from within the Aboriginal community. (pp. 115-116)

The Tobacco Report in the FNIRHS contains an Appendix (pp. 118-127) giving detailed information on several smoking cessation programs, some of which were developed for Aboriginal people and others directed at the population or pregnant women in general.

A focus group of Aboriginal health care professionals was convened to assist the investigator with interpreting the results of this study as they relate to Aboriginal women, and to provide recommendations on policy and program directions appropriate to the needs of Aboriginal women. The focus group participants emphasized that a smoking cessation program for Aboriginal women would need to help women develop alternative methods of coping and build self esteem and self concept, since smoking was often used as a coping mechanism to deal with stressors. A holistic approach to smoking cessation was deemed important, not just looking at the physical aspects of addiction, but incorporating the emotional, psychological, and spiritual aspects. Other authors have emphasized the importance of looking at Aboriginal health holistically, and viewing well-being as flowing from balance and harmony among all aspects of personal and collective life (Elias et al., 2000; Smylie, 2001a).

Recommendations for future research. Further study is needed to confirm the association between smoking prior to pregnancy and preterm birth, since this is one of the first studies to identify this association. Previous studies found a stronger association between smoking and preterm birth for multiparous versus primiparous women, and for very preterm versus moderate preterm births (Kolas et al., 2000; Kyrklund-Blomberg & Cnattinguis, 1998; Cnattinguis et al., 1993). Further research with a larger sample size is needed to determine if these differences in association exist in a Manitoba population.

Poor Nutritional Status

This study found various associations between nutritional status and prematurity. This study confirmed the results of previous investigations that revealed a relationship between short maternal stature and preterm birth, and this association persisted after adjusting for other factors (AOR 1.80). The results also confirmed the growing body of literature supporting an association between low maternal weight gain and preterm birth, with both a low total weight gain of less than 20 pounds and a low third trimester weight gain of less than 11 pounds increasing the odds of preterm birth (OR 2.18 and 1.91 respectively). Low total weight gain during pregnancy demonstrated homogeneity of effect among Aboriginal and non-Aboriginal women. In addition, the association between low weight gain and preterm birth remained significant after adjustment by logistic regression (AOR 2.60 in the model including medical factors, and AOR 3.41 in the model excluding medical factors). However, the significant bivariate association between gestational weight gain and preterm birth disappeared when gestational weight gain was expressed as a weekly rate of weight gain. It should be noted that total weight gain may not be an appropriate measure "because it is related to gestational duration (i.e., the longer a woman is pregnant, the more time she has to gain weight). Therefore it is preferable to use rate or pattern of weight gain" (Carmichael & Abrams, 1997, p. 866) Kramer et al. (1992) suggests that an effect of shortened gestation (lower total weight gain) may be mistaken for its cause. Because the overall rate of weight gain may be biased by the much lower rate of gain during the first trimester, a rate of weight gain was calculated for the second and third trimester only. Spinillo et al. (1998) also investigated weight gains during the second and third trimesters to avoid the confounding effect of the slower weight gain typical of the first trimester of pregnancy. Contrary to the results of Spinillo et al. (1998) who found that a second/third trimester weight gain of less than 0.37 kg per week was associated with an increased risk of preterm birth (OR 2.4), this study did not find a low second/third trimester rate of weight gain to be significant risk factor. Interestingly, a weight gain of 0.46 to 0.61 kg per week in the second and third trimester was a protective factor (OR 0.56), reducing the risk of preterm birth by about one half. In Carmichael and Abrams' (1997) review, several studies found a protective association between rate of weight gain and preterm birth, while Schieve et al (1999) found that the risk of PTB was lowest in women with intermediate weight gain (0.35-0.46 kg/wk).

Not all studies have found an association between anthropometric factors and preterm birth. The results of this study are similar to those of one other large Canadian study by Kramer et al. (1992), who also failed to demonstrate an association between low prepregnancy body mass index and an increased risk of preterm birth. However, several other studies showed an association between low pre-pregnancy BMI and preterm birth (Hickey et al., 1997; Siega-Riz et al., 1996; Spinillo et al., 1998). The reasons for these different results are unclear. Other studies found that underweight women were at increased risk of preterm birth only if they failed to gain weight at an adequate rate (Schieve et al., 2000). In this study, there was no significant difference in the risk of spontaneous preterm birth associated with a low total pregnancy weight gain among women with a low pre-pregnancy body mass index <19.8 kg/m^2 (OR 4.94) compared to those with a BMI ≥ 19.8 kg/m^2 (OR 2.04), although the difference was in the direction of higher risk for underweight women. A larger sample size may be needed to study the complex association between BMI and preterm birth. For example, Hickey et al. (1997) found that low prepregnancy BMIs were associated with increased adjusted odds ratios for late (33-36 weeks), but not early (<33 weeks), preterm birth and for spontaneous preterm labor, but not premature rupture of membranes.

Anemia (defined as a hemoglobin less than 105 mg/dl) was a significant risk factor for preterm birth among Aboriginal women in this study. The focus group participants noted several reasons for anemia in Aboriginal women: lack of income to buy nutritious foods, combined with the high cost of iron-rich foods in northern areas of the province; "doing without" to meet the needs of their children; and a general dislike of taking pills, particularly iron pills because they cause constipation. Almost one third of First Nations people in Manitoba reported running out of money for food at least once per month (Manitoba First Nations Regional Health Survey, 1998). Anemia was not a risk factor for non-Aboriginal women, but a hemoglobin level of 112 to 119 mg/dl was a protective factor. The reason for this difference between groups is not known. Meis et al. (1995a), in their study in Wales, found that a hemoglobin concentrations exhibited a U-shaped relationship, with high and low values associated with a greater risk for preterm birth. In their univariable analysis, a hemoglobin less than 10.4 gm/dl (OR 1.50) and greater than 13.3 gm/dl (OR 1.22) increased the risk of preterm birth, although these variables were not significant in the multivariate analysis.

It is unlikely that the negative findings with respect to low BMI were due to selection bias, since self-reported values for height and prepregnancy weight were missing for only 3.8% and 8.8% of the sample respectively. If health record data had been used to calculate these factors, selection bias would have been more important, as more values were missing. However, 22% of women could not recall how much weight they gained during their pregnancy. Since self-reported data were used, the possibility exists that information bias stemming from random or systematic errors in recall for these variables may affect the findings. "The validity of recalled pregnancy weight gain has not been reported; however, studies of nonpregnant women have shown that although reported weight correlates well with actual weight, overweight women tend to underestimate their weight more than other groups. If present, this bias might have reduced the associations between weight gain and preterm delivery among overweight and obese women" (Schieve et al., 1999, p. 144).

Implications for practice. Prenatal care providers should consider women with low pregnancy weight gains at increased risk for preterm delivery (Schieve et al., 2000). The population attributable risk percent for a total weight gain of less than 20 pounds was 22% in this study, indicating that an opportunity exists to reduce the preterm birth rate by up to 22% by improving weight gain during pregnancy. Although some authors have suggested that nutritional factors may have a limited influence on the occurrence of spontaneous preterm birth in well-nourished populations (Kramer, 1998), these results and those of several other studies suggest that ensuring an adequate weight gain during pregnancy may improve length of gestation. In a study to determine the effectiveness of nutritional intervention, 2,197 women in the West Los Angeles Preterm Birth Prevention Project who received nutritional counseling had a relative risk for preterm birth of 0.73 (95% CI = 0.58, 0.92) compared to 2,173 women without counseling, suggesting that nutritional counseling has a protective effect (Hobel & Siega-Riz, 1998). Preventing anemia in Aboriginal women and ensuring adequate hemoglobin levels in non-Aboriginal women also may be beneficial in preventing preterm birth. One intervention study demonstrated that prenatal use of multivitamin-mineral supplements reduced the rates of preterm birth among poverty-level women (Scholl, Hediger, Bendich, Schall, Smigh,& Krueger, 1997).

The *Guidelines for Perinatal Care* (American Academy of Pediatrics and American College of Obstetricians and Gynecologists [AAP/ACOG], 1992) state that nutrition counseling is an integral part of perinatal care for all patients. Preconception recommendations include achieving an adequate weight for height, reflected by a BMI of 19.8-26.0 kg/m^2, and optimal nutritional status. Recommendations during pregnancy include achieving an adequate pattern of weight gain, adequate nutritional status through diet and/or supplements, and monitoring of iron status (AAP/ACOG, 1992; Health Canada, 1999a). In addition, promoting optimal infant and childhood nutrition may be important in ensuring that women reach childbearing age with a normal stature and adequate weight for height (BMI).

In this study, women with anemia were more likely to be multiparous, of low income, have less than a high school education, not have a paid job, smoke, and have inadequate prenatal care. These relationships suggest a group of socioeconomically deprived women who may benefit from targeted or additional nutritional interventions during their pregnancies. One such program is the Canada Prenatal Nutrition Program (CPNP), established by Health Canada in 1994 with the primary goals of reducing the incidence of both preterm birth and low birth weight. The CPNP "is a comprehensive program designed to provide food supplementation, nutrition counseling, support, education, referral and counseling on lifestyle issues to pregnant women who are most likely to have unhealthy babies" (Health Canada, 1999a, p. 117). Target groups include pregnant women living in poverty, pregnant adolescents, pregnant women living in violent situations, Aboriginal women, and refugees. Unfortunately, Kramer (1998) suggests that it will be difficult to satisfactorily evaluate the CPNP because program participants were not randomly selected and therefore may differ from nonparticipants in ways that may confound the effect of the program itself. The CPNP was modeled in large measure on the Women, Infants, and Children (WIC) food supplement program in the United States. Evaluation of the WIC program has shown it to be cost-effective, resulting in savings of US$2.89 to 3.50 for each federal dollar spent during the first 18 years of life, based on evidence that WIC reduced low-birth-weight-births by 25% and very-low-birth-weight-births by 44% (Owen & Owen, cited in Basrur & Makarchuk, 1999). Other studies have demonstrated that women enrolled in the WIC program were less likely to deliver a low-birth-weight infant (Brown, Watkins, & Hiett, 1996).

Recommendations for future research. Studies with sample sizes adequate for stratification on different subtypes of preterm births are needed to determine whether maternal weight gain is associated with certain subtypes of preterm birth but not others (Carmichael & Abrams, 1997). Further study is also needed to confirm whether a low rate of weight gain during the latter part of pregnancy, but not during early pregnancy, is associated with an increased risk of preterm birth (Carmichael & Abrams, 1997) A large prospective study with accurate measurements of maternal height, pre-pregnancy weight, and rates of gestational weight gain would be helpful, because cross-sectional and case-control studies are subject to recall bias. Further study is needed to determine which maternal anthropometric factors interact with one another or with other sociodemographic variables to modify the risk of prematurity (Spinillo et al., 1998). More research is needed to study the effectiveness of interventions to improve maternal nutritional status on outcomes of pregnancy such as preterm birth. Evaluation results from the CPNP may provide additional support for the value of nutritional interventions during pregnancy.

Inadequate Prenatal Care

Generally inadequate prenatal care is conceptualized as consisting of two dimensions: 1) inadequate initiation of prenatal care, defined as initiation of prenatal care after the first trimester, and 2) inadequate number of prenatal care visits, once prenatal care has begun. About 83% of women in this study initiated prenatal care in the first trimester. In Mustard's (1993) study of Winnipeg women, 90% initiated care by the 13th week of pregnancy, but only 82.9% of poor women initiated care by the end of the first trimester. In the United States, 83.2% of women began prenatal care in the first trimester (Ventura et al., 2001). It is concerning that in a country with universal access to care, the percent of women initiating prenatal care in the first trimester is no better than in the United States, which has achieved a steady increase in this health care indicator in the past decade. Women who deliver before term should have fewer visits than women who do not, because guidelines call for the greatest number of visits in the third trimester (Krueger & Scholl, 2000). Indeed, the mean number of visits for women who delivered at term was 10.7 visits compared to 7.6 visits for women who delivered preterm. A strength of this study was the use of the Kessner index of prenatal care to overcome this preterm delivery bias by adjusting for the number of visits relative to gestational age at delivery (Fiscella, 1995). Using the Kessner index, 15.9% of the cases had inadequate prenatal care compared to 8.0% of the controls. This is higher than Mustard's (1993) results of 8.9% of Winnipeg women receiving inadequate prenatal care, but slightly lower than Krueger and Scholl's (2000) results of 16.4% of young inner-city minority women in New Jersey receiving inadequate prenatal care.

Inadequate prenatal care was a significant risk factor for preterm birth in this study (OR 2.37), more than doubling the odds of preterm birth after adjusting for race, and demonstrated homogeneity of effect among Aboriginal and non-Aboriginal women. Inadequate prenatal care also remained significant after adjusting for the effects of other factors (AOR 2.44 in the model including medical factors and AOR 3.36 in the model excluding medical factors). This is similar to the finding of Krueger and Scholl (2000) that women who received inadequate prenatal care had a 2.8 times greater risk of having a preterm delivery, using the Kessner index, after controlling for potential confounding variables.

Having less than 7 visits for prenatal care also was a significant risk factor, and demonstrated heterogeneity of effect among the two groups, with non-Aboriginal women having a higher risk (OR 11.74) of preterm birth than Aboriginal women (OR 3.92). "Because of difficulties in measuring qualitative differences in prenatal care, most studies of prenatal care have relied on quantitative differences in the number of prenatal visits. However, simply counting the number of visits is misleading because this number is determined by several factors, including the gestational age at which the woman enters prenatal care, the frequency of visits recommended by her provider, the presence of complications, the need for hospitalization, the woman's compliance, and the gestational age at which the woman delivers" (Fiscella, 1995, p. 469). Thus the relationship between premature delivery and a reduced number of prenatal care visits should be viewed with caution.

Late entry into prenatal care (having a first prenatal visit after the first trimester) demonstrated heterogeneity of effect, tending to increase the risk of preterm birth for non-

Aboriginal women but reduce the risk for Aboriginal women. In other words, Aboriginal women with early initiation of prenatal care were at increased risk of preterm birth. Collins and Hammond (1996) obtained a similar result in their study of the relation of race to preterm birth: the excess odds of preterm birth among African Americans compared with whites actually increased with earlier initiation of prenatal care. They speculated that the differential access to quality medical care was a possible etiologic mechanism. Another explanation may be that Aboriginal women with high-risk medical conditions or known complications of pregnancy receive early prenatal care, and these conditions may be associated with an increased risk of preterm birth.

Limitations of the data exist. As with other variables, the possibility of recall bias exists for the self-reported data. Women may have had difficulty recalling accurately the gestational age at which they first sought prenatal care or how many visits they had altogether. However, self-reported data were used because of limitations associated with data from the prenatal record. The two variables abstracted from the prenatal care record were missing for 15.4% of the study participants, and the records with missing data disproportionately represented women having preterm births. In addition, the data from the prenatal record represent a woman's history of care with one provider. "For women who receive care from more than one provider, either sequentially or simultaneously, the reported measures underestimate the amount of care" (Mustard, 1993, p. xi). When Mustard compared the agreement between physician claim records and the hospital separation abstracts (based on data from the prenatal record), the timing of initiation of care was about 4 weeks earlier and the mean number of visits was about 2.5 visits greater using the physician claims records compared to the hospital abstract. This raises serious concerns about the accuracy of determining number and timing of visits from the prenatal care record. The possibility also exists that the quality of prenatal care may have diluted or misclassified the exposure. Perhaps receiving 5 visits of high quality is better than receiving 10 visits of poor quality.

Implications for practice. Since inadequate prenatal care is a risk factor for preterm birth, ensuring early and adequate high quality prenatal care seems to be a reasonable recommendation. The population attributable risk associated with inadequate prenatal care was 15.9%. However, the question of whether increasing access to and utilization of prenatal care will reduce the likelihood of preterm birth remains unanswered. Results of studies to prevent preterm birth through increased access to prenatal care have had mixed and often disappointing results. The Patient Outcomes Research Team on low birth weight in the United States found that provision of culturally appropriate and individualized prenatal care did not reduce the number of low birth weight newborns, although it did help low-income, minority women become more knowledgeable about their pregnancies and contributed to positive maternal behavior change (Goldenberg, 1998). A study of Medicaid expansion in the United States was effective in increasing enrolment and use of prenatal care but did not reduce the likelihood of preterm birth (Ray, Mitchel, & Piper, 1997). But population based studies which incorporated increased access to prenatal care demonstrated positive results in reducing the preterm birth rate, for example, the projects of Gomez-Olmedo in Spain and Papiernik in France (Gomez-Olmedo, Delgado-Rodriguez, Bueno-Cavanilas, Molina-Font, & Galvez-Vargas, 1996; Papiernik et al., 1985; Papiernik et al., 1986).

A significantly higher proportion of Aboriginal women received inadequate prenatal care (19.5%) compared to non-Aboriginal women (5.4%). A higher proportion of Aboriginal than non-Aboriginal women had less than seven visits for prenatal care (28.8% vs 14.4%), and initiated care after the first trimester (25.2% vs 12.7%). This finding is in keeping with that of Mustard's (1993) study of Winnipeg women, in which treaty status First Nations women averaged 1.9 fewer visits than non-First Nations women. The Aboriginal community may wish to explore reasons why Aboriginal women receive inadequate prenatal care and identify strategies to increase prenatal care utilization. Are the barriers financial, cultural, social, or related to accessibility of services? What do Aboriginal women expect from their prenatal care provider? The focus group participants noted that the cost of transportation to attend prenatal care was a significant barrier for Aboriginal women, and recommended more use of outreach into the community by a multidisciplinary team (nurse, dietician, social worker) as a preferable approach to provision of prenatal care. The Manitoba First Nations Regional Health Survey noted that racism is a significant problem influencing access to care, with 30% of First Nations people reporting a discriminatory encounter with the health care system. Stout (1996) contends that health care is often insensitive to Aboriginal cultural values, contributing to Aboriginal women's reluctance to seek medical attention and leading to later diagnoses for prenatal complications. A qualitative study of First Nations women's encounters with mainstream health care services revealed that invalidating encounters were shaped by racism, discrimination and structural inequalities while affirming encounters were characterized by having one's cultural identity respected, forming a trusting relationship, being treated in a non-discriminatory manner, and sharing in decision making (Browne &

Fiske, 2001). The investigators concluded that, "Given the political and ideological context of relations between Aboriginal people and the Canadian state, power imbalances that give rise to the women's concerns regarding their health care are unlikely to be redressed without radical changes in the current sociopolitical environment. In the interim, health practitioners, planners, and policy makers would benefit from integrating perspectives from critical medical anthropology, political economic analyses, and cultural safety into health care policies, practices, and educational programs" (Browne & Fiske, 2001, pp. 143-144). Thus an urgent need exists to provide culturally sensitive care for Aboriginal women, based on a foundation of mutual respect. The Society of Obstetricians and Gynaecologists of Canada (SOGC) has published a four-part Policy Statement, *A Guide for Health Professionals Working with Aboriginal Peoples* (Smylie, 2000, 2001a, 2001b, 2001c) which contains a number of useful recommendations to improve cross cultural understanding and promote culturally appropriate care to Aboriginal peoples. These recommendations are outlined in Appendix Q.

Strategies to improve the content and quality of prenatal care in Manitoba should be considered. Changing the focus of prenatal care from a strictly medical model to a more comprehensive one that includes social, educational, and economic support has been recommended (Moutquin, 1998; Shiono & Klebanoff, 1993). Health care providers need to have time at each prenatal visit to provide effective health promotion (Moutquin, 1998). The current fee-for-service environment in Canada, however, creates a system with no financial incentive for providers to spend extra time with a woman and her partner to deal with the situations that might arise during the course of pregnancy related to lifestyle or stress (Stewart, 1998). Alternative funding options for providers of prenatal care, such as a salary fee structure, have been recommended. A solution also needs to be found for the shortage of Canadian obstetricians and family physicians who provide obstetric care (Chance, 1997). The continued growth of midwifery in Canada should be supported as another source of prenatal care.

In this study, women who received inadequate prenatal care were more likely to be younger, multiparous, of lower income, less educated, and live in a rural or northern area of the province than women who received adequate prenatal care. Mustard (1993) also found that Winnipeg women who were young, in the lowest income quintile, and multiparous had poorer use of prenatal care. Limited availability of providers and insufficient prenatal services in rural and northern regions are additional barriers to adequate care. Access to care needs to be increased for women in rural and northern areas, although availability of prenatal care clinics/health care providers does not necessarily guarantee utilization of those services. Barriers that young low income women experience in utilizing prenatal care need to be identified and eliminated. Outreach programs and multidisciplinary teams sensitive to the needs of women who are marginalized in society because of low income, low education, being a teen or single, or speaking a language other than English or French may provide more accessible care (Stewart, 1998). Culturally appropriate services are needed for minorities and recent immigrants.

Finally, if the information on the prenatal care record is deemed important for both ensuring continuity of care by intrapartum and postpartum care providers and for administrative reporting of prenatal care services in Manitoba, then strategies need to be implemented to improve the percentage of prenatal care records received in the hospital and placed on the health record prior to delivery. Because the prenatal record is often forwarded to the hospital at 36 weeks gestation, several of the later visits are not recorded on the hospital copy of the record, and the problems associated with multiple providers has already been mentioned. A woman-held prenatal record may overcome problems associated with multiple providers and ensuring up-to-date records at the time of delivery, and has been recommended for use in Canada (Lacy, Bartlett, & Ohlsson, 1998).

Recommendations for future research. Future research should investigate the content, comprehensiveness, and quality of prenatal care for its impact on preterm birth (Alexander & Howell, 1997). Although scientific evidence for the specific content of prenatal care has been reviewed by the U.S. Public Health Service expert Panel on Prenatal Care (1989) and by contributors to the book New Perspectives in Prenatal Care (Merkatz & Thompson, 1990), there are many components of prenatal care for which scientific evidence is lacking. In particular, there is a need to determine the components of prenatal care most likely to prevent preterm birth. There also is a need to determine the appropriate pattern and number of prenatal care visits. The AAP/ACOG *Guidelines for Perinatal Care* (1992) recommend "the frequency of follow-up visits should be determined by the individual needs of the woman and the assessment of her risks. Generally, a woman with an uncomplicated pregnancy should be examined approximately every 4 weeks for the first 28 weeks of pregnancy, every 2-3 weeks until 36 weeks of gestation, and weekly thereafter, although flexibility is desirable. Women with medical or obstetric problems may require closer surveillance" (pp. 51-52). SOGC (1998) recommends visits every 4 to 6 weeks in early pregnancy, every 2-3 weeks after 30 weeks gestation, and every 1-2 weeks after 36 weeks gestation. The U.S. Public Health Service

Expert Panel on the Content of Prenatal Care (1989) recommended reducing the routine number of visits to a core schedule of nine visits for the healthy nulliparous woman and seven for the healthy parous woman, plus a preconception visit for all women. One randomized controlled trial investigated the potential impact of reducing the number of prenatal visits for low-risk women in keeping with the recommendations of the Expert Panel (McDuffie, Beck, Bischoff, Cross, & Orleans, 1996). The results indicated that good perinatal outcomes and patient satisfaction were maintained with the reduction in number of prenatal visits.

So if the number of visits does not directly influence outcome, what does? The content of prenatal care may be a more important variable. Kogan and colleagues compared mothers' reports on the content of prenatal care received with recommended national guidelines, and observed that women received only 56% of the procedures and 32% of the advice recommended by the Expert Panel (Kogan, Alexander, Kotelchuck, Nagey, & Jack, 1994). They also found the content of care recommended by the Expert Panel to be related to low birthweight. After controlling for sociodemographic, behavioral, and medical factors, women who reported not receiving all types of recommended advice were more likely to have a low-birth-weight infant than women who reported receiving the optimal level of advice (Kogan, Alexander, Kotelchuck, & Nagey, 1994). Thus content of prenatal care is a topic deserving further investigation.

"The major difficulty in assessing the impact of prenatal care on pregnancy outcome is selection bias, namely the women who receive good-quality prenatal care are more likely than women not receiving adequate services to experience better pregnancy outcomes, because of their other characteristics, which may have independent influences on pregnancy outcomes. Socio-economic status is probably the most important determinant of this bias. It has been shown repeatedly that socio-economic status affects all aspects of care: access, quality, as well as utilization" (Shoham-Vardi, Levy, Belmaker, Mazor, & Goldstein, 1997, p. 282). Kramer et al. (2000) suggest that "the association between the timing or number of prenatal care visits and the risk of preterm birth may have less to do with what is gained from the visits than with confounding psychological differences between women who initiate prenatal care early and visit their obstetrician, family physician or midwife on a regular basis and women who do not" (p. 200). Further study of the characteristics of women who seek prenatal care compared to those who do not is warranted. In addition, given that 15.9% of cases and 8.0% of controls in this study received inadequate prenatal care in spite of universal access to prenatal care in Canada, other barriers to prenatal care should be explored. Campbell and colleagues have proposed a Social Pregnancy Interaction Model, which integrates Ajzen and Fishbein's Theory of Reasoned Action, to help explain cultural and personal barriers to seeking care (Campbell, Mitchell, Stanford, & Ewigman, 1995). Significant dimensions of this model include awareness of pregnancy, acceptance of pregnancy, self-care, communication with family, communication with partner, social attitudes toward prenatal care, and attitude toward the health care provider. Models such as this one have potential for predicting utilization of prenatal care.

Exploration of the effectiveness of alternative models of care (e.g., midwifery practice, physician/nurse teams) in improving birth outcomes should be undertaken. In addition, a secondary analysis of this dataset could be conducted to compare the Kessner and Kotelchuck indices of prenatal care in Manitoba women. Development of indices of prenatal care that go beyond measuring the timing or number of prenatal care visits to quantifying the quality of prenatal care would be helpful. The feasibility and acceptance of a woman- held prenatal record should also be explored.

Abuse

The prevalence of women experiencing violence during pregnancy has been estimated to be between 4% to 8% (Gazmararian et al., 2000). In this study, 5.7% of women reported being abused during pregnancy. This number may be an underestimate, because women may have been reluctant to disclose abuse. A higher proportion of Aboriginal women (10.2%) reported being abused during pregnancy than non-Aboriginal women (3.1%), which is consistent with the results of Bell & Eaglin (2000). In the Manitoba First Nations Regional Health Survey (1998), 10% of First Nations people reported problems related to domestic violence and child abuse.

Abuse demonstrated heterogeneity of effect among the two racial groups in this study. Being abused during pregnancy (OR = 4.62) and abused in the past year (OR = 2.98) were both associated with an increased risk of preterm birth for non-Aboriginal women, but not for Aboriginal women. In the non-Aboriginal group, a higher proportion of cases than controls reported abuse both within the last year (7.0% vs 2.5%) and during pregnancy (6.3% vs 1.4%), whereas in the Aboriginal group, a higher proportion of controls than cases reported abuse within the last year (20.0% vs 12.3%) and during pregnancy (10.9% vs 8.6%), although this difference was not statistically significant. The lack of association between abuse and preterm birth among Aboriginal women may have been affected by the complex interrelations of factors affecting preterm birth. This finding is similar to that of Bullock and McFarlane (1989), who found that the association between low birth weight and abuse was stronger in middle class women than in poor women, for whom there are so many other risk factors for low birth weight. Several years ago, Cornfield and colleagues proposed that the presence of other real causes for a disease can reduce the apparent relative risk: "If two uncorrelated agents, A and B, each increase the risk of a disease, and if the risk of the disease in the absence of either agent is small (in a sense to be defined), then the apparent relative risk for A, r, is less than the risk for A in the absence of B" (Cornfield, Haenszel, Hammond, Lilienfeld, Shimkin, & Wynder, 1959, p. 194).

Similar to the results of other studies, the risk estimates for abuse became nonsignificant in the adjusted models, suggesting that other abuse-related maternal health problems are confounders or mediators that help to explain the association between abuse and preterm birth (Campbell et al., 1999). Women who experienced physical abuse had characteristics associated with greater risks for adverse pregnancy outcomes, such as young age, low income, single marital status, low level of education, and inadequate prenatal care. These relationships have been found in several previous studies (Berenson et al., 1994; Curry, Perrin, & Wall, 1998; Goodwin et al., 2000). There were significant differences between the abused and non-abused women on the PPP subscales, with abused women reporting more life event stress, less support from partner, less support than others, and low self esteem. These results are essentially the same as those obtained by Curry and Harvey (1998) using the PPP to study abuse during pregnancy. In addition, abused women were more likely to smoke, drink alcohol, and take recreational drugs. These findings lend support to the hypothesis that abuse indirectly causes preterm birth through the mechanisms of stress and through the association of abuse with other behavioral risk factors such as smoking and substance abuse (Campbell et al., 1999). Another reason for the lack of significance of abuse in the logistic regression models is that the low prevalence of abuse during pregnancy in the non-Aboriginal group may have decreased the power of this study to detect an association between abuse and preterm birth, especially in the multivariate analysis. Abuse during pregnancy, with 6% exposure among controls, had a power of 78.6% to detect an odds ratio of 2.0 for the entire sample, and this diminished to 60.3% for the non-Aboriginal group alone.

One advantage of this study was the use of an abuse assessment tool tested for reliability and validity, and used in several other studies and with ethnically diverse populations, including native Americans (Curry, Perrin, & Wall, 1998; Soeken et al., 1998). However, an abbreviated form of the Abuse Assessment Screen was used, which detected whether or not abuse occurred, but not the frequency, timing, or severity of the abuse. These are important factors to consider, and use of the entire Abuse Assessment Screen (Appendix K) is recommended for future studies.

Implications for practice. Health care professional associations such as the Society of Obstetricians and Gynecologists of Canada (SOGC), the American College of Obstetricians and Gynecologists (ACOG), and the Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN) have focused on violence against women as a significant problem that needs to be addressed in clinical practice. Many of these associations have published guidelines on screening for and intervening in intimate partner violence among their patient populations. For example, the SOGC (1996) Policy Statement on Violence against Women states, "It is the physician's responsibility to provide an environment in which disclosure becomes possible and to maintain a high index of suspicion regarding actual or potential abuse" (p. 3), and lists the 5 questions from the Abuse Assessment Screen as sample questions to be asked. Use of a structured abuse screen improves detection rates of abuse both before and during pregnancy, enabling clinicians to have a greater opportunity to intervene (Norton et al., 1995). "Prenatal care can provide an important point of contact where women can be screened for violence and referred to services that can assist them" (Goodwin et al, 2000, p. 85). However, most health care professionals do not routinely screen for abuse during prenatal visits or when providing other reproductive health care services (Chamberlain & Perham-Hester, 2000; Parsons, Goodwin, & Petersen, 2000). They require training in assessing and responding to abuse. Various resources exist to help health care professionals, such as Health Canada's (1999b) *A Handbook for Health and Social Service Professionals Responding to Abuse During Pregnancy*, and providers' awareness of these resources needs to be increased.

Although abuse during pregnancy did not emerge as a significant risk factor for preterm birth among Aboriginal women in this study, the prevalence of abuse was high. Aboriginal women's groups need to work with health care professionals to devise interventions appropriate for this group. Bohn (1998) provides suggestions for clinical care of native American battered women, and recommends that the focus of the intervention should be on Aboriginal resources that are most likely to be sensitive to the woman's needs and culture. The focus group participants noted that abused women preferred referrals within the Aboriginal community, for example, to an Aboriginal social worker or nurse.

Recommendations for future research. Further study is needed to establish the relationship between abuse and pregnancy outcomes. A cohort study with prospective assessment of abuse during pregnancy is preferable to the retrospective assessment necessitated by a case-control design. Screening several times during pregnancy has been suggested to counteract the limitation of lack of disclosure (Covington et al., 2000). Campbell et al. (2000) recommend assessing abuse at three prenatal visits, which increases the woman's trust in the data collector and allows her to decide more than once about disclosure. Future research needs to examine patterns of violence during pregnancy by distinguishing among physical, sexual, and emotional violence, and the frequency, timing, and severity of violence. Research also is needed regarding how to improve screening rates by health care professionals and the components of effective intervention programs (Gazmararian et al, 2000). The impact of screening on women's lives should also be explored; for example, does screening increase or decrease their risk of victimization and what are the effects on safety of women? (Campbell et al., 2000).

The pathways through which abuse causes low birth weight and preterm birth need to be clarified. "The effect of violence on birth outcomes is still not well understood. Associations between low birth weight and abuse during pregnancy have been shown to generally diminish or even disappear when controlling for other factors in multivariate analyses. However, careful structural equation modeling and other modeling techniques may demonstrate that abuse influences birth weight through mediators such as smoking, low weight gain, and substance abuse" (Campbell, Moracco, & Saltzman, 2000, p. 150).

Strenuous Work

This study did not find evidence for an association between strenuous work and preterm birth. This finding is similar to that of one other Canadian study, in which prolonged standing, lifting objects, physical effort, or shiftwork did not increase the risk of preterm birth (Fortier et al., 1995). Previous studies of the effect of strenuous work on the risk of preterm birth have produced mixed results. Some observational studies found an association between working conditions and preterm birth, while other studies produced contradictory findings (Luke et al., 1995; Mozurkewich et al., 2000; Walker et al., 1999). "These differences may result from a variety of methodologic problems, such as small sample size, differing definition of preterm birth, or the use of a theoretical description of working conditions that is based on job title. Other problems may arise from the confounding effects of maternal race, maternal education, obstetric complications, or medical history, which are not always taken into account. Finally, the distinction between work per se and the fatigue it produces is often not considered" (Luke et al., 1995, pp. 849-850).

In this study, women were asked to recall the amount of time they spent on physical activity at work or while doing their daily chores, but not leisure time activity. The questions were adapted from the General Social Survey (Statistics Canada, 1991) and were not designed specifically to assess the amount of strenuous work experienced during pregnancy. Nonetheless, the questions covered the risk factors included in most other studies of strenuous work during pregnancy, such as hours worked per week, type of shift, hours spent standing per day, and hours spent in heavy work or carrying heavy loads per day. One limitation is that the questions did not assess psychologic stress associated with the work environment, or degree of tiredness at the end of the shift, which have been associated with preterm birth in other studies (Homer, James, & Siegel, 1990; Luke et al., 1995). Another limitation is that classifying exposure according to postnatal interview may be subject to recall bias. However, using less subjective methods of exposure assessment such as job code classifications also did not reveal an association between strenuous work and preterm birth. Due to the modest association between strenuous work and preterm birth, the sample size in this study may not have had sufficient power to detect risk factors. In the meta-analysis by Mozurkewich et al. (2000), many of the individual studies did not obtain significant odds ratios, but when the results of these studies were pooled in the meta-analysis, significant results were obtained, with odds ratios ranging between 1.20 to 1.60.

Recommendations for future research. Future studies should consider measuring the additional physical demands of leisure time activity, and differentiating physical exertion associated with occupational activity and domestic work, to obtain a complete picture of the association between maternal physical activity and preterm birth (Pivarnik, 1998; Walker et al., 1999). The use of an occupational fatigue score such as that developed by Mamelle et al. (1984) and used by other investigators (Luke et al., 1995) also is recommended. The elements of the occupational fatigue score include standing posture, physical exertion, mental stress, and work environment; a dose-response relationship has been found with an increase in the fatigue score (Luke et al., 1995).

Urogenital Infections

Despite a growing body of evidence supporting a role for intrauterine infection in preterm labor and preterm premature rupture of membranes (PROM) (Gomez, Romero, Edwin, & David, 1997), this study did not find an association between urogenital infections and preterm birth. Overall, there were very few cases of sexually transmitted diseases identified from the subjects' prenatal records: no cases of syphilis, 2 cases of gonorrhea, 4 cases of herpes, and 43 cases of chlamydia. These numbers represent an underestimate of exposure, since 105 subjects (15.4%) were missing prenatal records. Women who did not receive prenatal care may have been overrepresented among the women with missing records; these women may not have received timely treatment for urogenital infections, and therefore may be the ones at increased risk. The finding that Group B streptococcus was not associated with an increased risk of preterm birth is consistent with prior reviews of the literature (Fiscella, 1996; Goldenberg et al., 1997). Due to the negligible incidence of syphilis, gonorrhea, and herpes, the association between these infections and preterm birth was not studied. In addition, it is unlikely that detected cases of sexually transmitted diseases would remain untreated, thereby further reducing their association with preterm birth. The possibility also exists that the most responsible organisms were not studied. "In recent years, the bacteria associated with spontaneous delivery have become better characterized, with the more common being *Ureaplasma urealyticum*, *Mycoplasma hominis*, *Bacteroides*, and *Gardnerella vaginalis* species. These microorganisms are, for the most part, of low virulence and may exist asymptomatically for long durations in the vagina and the uterus" (Goldenberg & Andrews, 1996). None of these organisms are routinely screened for at prenatal visits, although they may be identified in placental cultures following birth.

Bacterial vaginosis is not screened for routinely in Manitoba, so not all cases could be detected; only 19 subjects were recorded as positive for this infection. Although recent evidence continues to support an association between bacterial vaginosis and preterm birth, the effectiveness of treating bacterial vaginosis in reducing the preterm birth rate remains controversial (Flynn, Helwig, & Meurer, 1999; Guise, Aickin, Helfand, Peipert, & Westoff, 2000). Routine screening and treatment of bacterial vaginosis in the general population is not recommended as a means to prevent preterm delivery at this time, although there may be a benefit in certain high-risk women (Guise et al., 2000).

This study did provide support for PROM as a significant risk factor for preterm birth, providing indirect evidence of a role for intrauterine infection in preterm birth. "PROM before completion of 37 weeks' gestation occurs in 2-4% of pregnancies. Preterm PROM is the direct antecedent of 30-40% of preterm births. There is substantial direct and indirect evidence that reproductive tract infections and associated inflammatory changes are responsible for many instances of preterm PROM" (McGregor, French, & Witkin, 1996, p. 430). Using stratified analysis, PROM was associated with a six fold increase in preterm birth (OR 6.58) among Aboriginal women, compared to a two-fold increase among non-Aboriginal women (OR 2.04). After adjusting for other factors in the logistic regression model, the relative risk of preterm birth associated with PROM increased substantially for Aboriginal women (AOR 12.70) but not for non-Aboriginal women (AOR 2.03). The reason for this is not clear. However, racial disparities in PROM are evident in other populations, with PROM showing a much clearer pattern of high risk for preterm birth for blacks compared to whites in several U.S. studies (Savitz, Blackmore, & Thorp, 1991).

Why is the relative risk of preterm birth associated with PROM so much higher in Aboriginal than non-Aboriginal women? Perhaps it is related to different patterns of bacterial colonization. This has been proposed as the explanation for higher prematurity rates among black women in the United States. Fiscella (1995) concludes that higher rates of bacterial vaginosis among black women contribute to the racial disparity in rates of preterm birth in the United States. Goldenberg & Andrews (1996) note that "Black women have a substantially higher prevalence of potentially pathogenic organisms than do White, Hispanic, or Asian women. Bacterial vaginosis, defined as an overgrowth of various bacteria in the vagina, is two to three times more common in Black than White women. Because bacterial vaginosis is associated with an odds ratio for spontaneous preterm birth of between 1.5 and 3.0, it is not surprising that Black prematurity rates are substantially higher" (p. 782). In this study, a higher proportion of Aboriginal women had bacterial vaginosis than non-Aboriginal women, but this finding must be regarded as preliminary due to the small numbers of women with bacterial vaginosis and the lack of routine screening. Of interest, none of the Aboriginal cases (i.e., women having preterm birth) for whom data were available had bacterial vaginosis.

Recommendations for future research. Further study is needed to confirm if any difference exists in the incidence of bacterial vaginosis among Aboriginal and non-Aboriginal women, determine whether there is any relationship between bacterial vaginosis and PROM, and investigate whether Aboriginal women fall into a high-risk group that might benefit from routine screening and treatment of bacterial vaginosis as a means to reduce preterm birth.

In general, there is agreement that preterm delivery results from diverse etiologic pathways, and that the epidemiologic characteristics of spontaneous preterm birth should be studied separately from iatrogenic preterm birth (after medically indicated induction of labor or operative delivery). What becomes more controversial is whether spontaneous preterm birth should be further divided into two subtypes: "In the first, termed idiopathic preterm labour, preterm delivery follows spontaneous onset of uterine contractions which progress, with or without rupture of the chorioamniotic membranes, to delivery of an infant before 37 completed weeks of gestation. In the second, premature rupture of the chorioamniotic membranes (PROM) leads to preterm delivery" (Pickett, Abrams, & Selvin, 2000). Savitz, Blackmore, & Thorp (1991) recommend studying idiopathic preterm labor and PROM separately to elucidate the causes and assess the preventability of specific pathways for preterm birth. Pickett et al. (2000) explored the relationship of maternal risk factors to type of preterm delivery in a cohort of over 7000 black and white women in California, and found that although the magnitude of the effect of individual risk factors differed between preterm delivery subtypes, the set of risk factors significantly associated with both categories of spontaneous preterm birth was identical, while that associated with iatrogenic preterm births was different. They concluded that distinguishing between subtypes of spontaneous preterm births lacked sufficient evidence. However, given the dramatically different relative risk associated with PROM for Aboriginal and non-Aboriginal women in this study, examining the risk factors separately for idiopathic preterm birth and PROM separately in a future study seems warranted. Unfortunately, the sample size of this study is not sufficient to permit analysis of risk factors for these two subtypes of spontaneous preterm birth, stratified by race.

High Stress, Low Social Support, and Low Self Esteem

The case-control design of this study necessitated retrospective assessment of levels of stress, social support, and self esteem during pregnancy. Retrospective assessment poses problems. Women who deliver prematurely may be more likely to report the occurrence of stressful events that they believe could have contributed to the birth outcome. The emotional state of subjects at the time of assessment may have been different for women who did and did not experience a preterm birth, and that emotional state may affect the recall and evaluation of stressful events or perceived stress levels prior to the birth (Lobel, 1994). Thus the potential for recall bias exists, and the results should be interpreted with caution.

Life event stress was not a significant risk factor for either the Aboriginal or non-Aboriginal group. The risk factors of high perceived stress, low social support, and low self esteem demonstrated heterogeneity of effect among the racial groups. High perceived stress was a significant risk factor for Aboriginal women (OR 2.54). This was the only psychosocial variable to achieve significance in the Aboriginal group. The reason for this finding is not known. Perhaps the types of questions asked to measure perceived stress, which focus on having a sense of control over one's life, are particularly pertinent for Aboriginal women. The focus group participants viewed stress as an important factor in Aboriginal women's lives. In their review of maternal stress and preterm birth, Austin and Leader (2000) concluded that the measurement of perceived stress rather than life events alone highlight the presence of significant associations.

Among the non-Aboriginal women, low self esteem (OR 3.28) and low level of support from others (OR 4.16) were associated with an increased risk of preterm birth. Self esteem and social support may act as mediators in the stress process. In models of the stress process, social support and self esteem have been identified as important components (Lowery, 1987; Pearlin, 1989). Pearlin's model of the process of social stress incorporates three major conceptual domains: sources of stress, mediators of stress, and manifestations or outcomes of stress. The sources of stress are viewed as arising out of two broad circumstances: the occurrence of discrete life events and the presence of relatively continuous problems or life strains. Life events and the role strains they generate are more likely to result in stress when they also result in a diminishment of self esteem. People typically confront stressful conditions with a variety of behaviors, perceptions, and cognitions that may alter the difficult conditions or mediate their impact. Social support is viewed as an important mediator which can be invoked by people on behalf of their own defense against stress (Pearlin, 1989). Social support has been found to have both a "buffering" effect as well as a direct effect against stress among pregnant women (Curry, 1990; Norbeck & Tilden, 1983; Nuckols et al., 1972). Using the PPP, statistically significant correlations have been found between stress, social support, and self esteem, and pregnant women with poor support from others or high stress were more likely to have a low birth weight infant (Curry, 1990). Similar correlations were found in this study. Using the Pearson r correlation coefficient, perceived stress among non-Aboriginal women was negatively correlated with support from others ($r = -.347$, $p<.001$) and self esteem ($r = -.521$, $p<.001$), while support from others and self esteem were positively correlated ($r = .357$, $p<.001$). In other words, women with low levels of self esteem or support from others had higher levels of perceived stress. Similar correlations were found for the entire sample.

Moving two or more times in the past year was a significant risk factor for non-Aboriginal women (OR 1.95) but not for Aboriginal women. The number of times a person moves may be an indicator of stability in one's life and a marker of access to support from others, particularly for non-Aboriginal women. If one moves frequently, one is less likely to know one's neighbors or feel like a part of the community. This relates to the sociological concept of "density of acquaintanceship", or the proportion of a community's residents who are acquainted with one another, which can be affected by an individual's length of residence in a community. "All other factors being equal, the longer a given individual has lived in a community, the greater will have been his or her opportunity to become acquainted with other community residents" (Freudenburg, 1986, p. 30). Shiono et al. (1997), after controlling for level of poverty and other known correlates of birth weight, found that having a stable residence (defined as living 3 or more years in current residence) was positively related to birth weight. These investigators suggest that having a stable residence may be a marker for other types of unmeasured social supports, and that the protective factors that are associated with living in a stable residence hold promise as a new factor that deserves attention. For Aboriginal women, moving more frequently may be a way of life (for example, many women move back and forth from the reservation to the city) and thus may not convey the same degree of risk that it does for non-Aboriginal women.

It has been hypothesized that stress may produce adverse birth outcomes through effects on health behaviors and self-care during pregnancy. "A highly stressed pregnant woman is unlikely to have the motivation, energy, time, and resources to observe sound diet, rest, exercise, and prenatal care practices. She may cope with stress by smoking or using alcohol and other substances" (Lobel, Dunkel-Schetter, & Scrimshaw, 1992, p.38). This hypothesis was supported by the results of this study. A greater proportion of women who smoked had high levels of both perceived stress and life events stress, low levels of support from partner and others, and low self esteem, compared to women who did not smoke, while women who received inadequate prenatal care had higher levels of perceived stress and low self esteem.

Implications for practice. Implications for practice arising from the results of this study should be cautiously proposed, since none of the psychosocial variables remained significant after adjusting for other factors in the multiple logistic regression models. However, the results of the stratified analyses suggests that psychosocial factors may play a role in preterm birth, supported by the results of other studies in the literature review. Strategies are needed to reduce women's stress levels, enhance their self esteem, and ensure access to social support during pregnancy. One potential solution is to provide women with the knowledge and skills necessary to take more control of their lives and help them to take positive steps toward a healthier lifestyle (Shiono et al., 1997). According to Culpepper and Jack (1993), "Provision of social support or psychological interventions targeting stress, anxiety, or maternal esteem, may be important for some women. Such interventions may range from increasing the frequency of visits and discussing the woman's living circumstances and plans to intensive case management and home visiting" (p. 615). Recent guidelines recommend that health care providers conduct routine psychosocial assessments of pregnant women (SOGC, 1998). The Antenatal Psychosocial Health Assessment (ALPHA) form was developed at the University of Toronto as an evidence-based tool to assist practitioners in integrating such assessments into their practice (Reid et al., 1998). If women are identified as experiencing high levels of stress or low levels of social support, referral to appropriate resources should occur. One study evaluated whether provider compliance with a psychosocial service delivery guidelines was associated with improved birth outcomes, using data on psychosocial services delivered to 3467 pregnant women from 27 sites in California (Wilkinson, Korenbrot, & Greene, 1998). They found that women who received at least one psychosocial assessment each trimester of care were half as likely as women with inadequate services to have a preterm birth outcome (OR=0.53, 95% CI 0.40, 0.72), and the effect did not depend on the credentials of the provider or the practice setting type.

If low social support is a risk factor for preterm birth, then it seems logical that interventions to enhance social support during pregnancy may be beneficial. Conflicting results have arisen from studies of the effect of psychosocial support during pregnancy on enhancing birth weight or gestational age at birth. Hoffman and Hatch (1996) concluded that observational studies of social support generally had positive findings, whereas randomized controlled trials provided little evidence of benefits. Hodnett (2000) reviewed 14 trials of programs offering additional social support for pregnant women believed to be at risk for giving birth to preterm or low birth weight babies. These programs were not associated with improvements in outcome of pregnancy, although some improvements in immediate psychosocial outcomes were found in individual trials. Conversely, one randomized trial of a social support intervention with low-income African American women was effective in reducing the rate of low-birth-weight newborns (Norbeck, DeJoseph, & Smith, 1996). The rate of low birth weight was 9.1% in the intervention group compared to 22.4% in the control group. The investigators emphasized the importance of directing a social support intervention to those women at risk due to inadequate social support, and determining the particular characteristics of social support that are most relevant for specific types of situations and populations. They criticize previous randomized trials of social support for offering the intervention universally, when it may be irrelevant to those women who already have adequate support, for selecting subjects to benefit from psychosocial interventions on the basis of medical risk factors for preterm birth, and for lacking a theoretical basis for the characteristics of the social support intervention. Other studies also have demonstrated that provision of psychologic support (Mamelle, Segueilla, Munoz, & Berland, 1997) and psychosocial services (Zimmer-Gembeck & Helfand, 1996) decrease the rate of preterm birth or low birth weight. Relaxation therapy also may have an effect on preterm labor, with women instructed in a progressive relaxation exercise having significantly longer gestations compared with a control group (Janke, 1999). However, "as long as the theoretical basis for the effect of maternal exposure to stressful situations on pregnancy complications and birth weight is unclear, psychosocial intervention programs will lack the basis needed to yield the desired results" (Paarlberg, Vingerhoets, Passchier, Dekker, & Van Geijn, 1995, p. 587).

Recommendations for future research. Prospective studies are needed to fully understand the mechanisms whereby the stress process is associated with preterm birth, using repeated measures of stressors (such as major life events and chronic strains); appraisals or perception of stress; and affective, behavioral, or biological responses to stressors or appraisals (Cohen, Kessler, & Gordon, 1995; Frost, 1993). Studying the association between stress, corticotropin-releasing hormone, and preterm birth appears to hold promise in understanding the physiological mechanism. Structural equation modeling is recommended as a statistical technique to create and test alternative conceptualizations of how stress affects preterm birth (Sheehan, 1998). It has been used effectively to untangle effects of prenatal maternal stress, personal resources, and confounding variables in modeling the mechanisms producing adverse birth outcomes (Lobel, DeVincent, Kaminer, & Meyer, 2000; Rini et al., 1999). Little evidence exists on the stress-reduction interventions most effective for Aboriginal women. This is an area requiring further research.

Medical risk factors

Several of the medical risk factors were significantly associated with preterm birth in this study, and most of them demonstrated homogeneity of effect. The results of this study are similar to those of previous investigations, in that having a previous preterm birth is a strong independent risk factor for a subsequent preterm birth. In this study, a previous preterm birth increased the risk about four-fold (OR 4.41; AOR 4.0). In addition, a history of two or more spontaneous abortions (OR 2.61; AOR 2.18), gestational hypertension (preeclampsia) (OR 2.52; AOR 4.15), and vaginal bleeding after 12 weeks of pregnancy (OR 2.61; AOR 2.49) were identified in this and several other studies as risk factors for preterm birth, including many of those listed in Appendix C. Antenatal hospitalization (OR 3.93; AOR 4.03) has not been studied as frequently, but at least one other study found hospitalization during pregnancy to be associated with an increased risk of preterm birth (OR 6.06; AOR 10.19) (Orr, Miller, James, & Babones, 2000). It is likely that antenatal hospitalization reflects the presence of conditions or complications that may be associated with an increased risk of preterm birth. Rupture of membranes prior to onset of labor was a risk factor for preterm birth for both groups, although this factor demonstrated heterogeneity of effect among non-Aboriginal (OR

2.04, AOR 2.03) and Aboriginal women (OR 6.58; AOR 12.70). Possible reasons for this finding have been discussed in the section on urogenital infections.

Thus several medical factors or conditions have strong associations with preterm birth, but many are not currently preventable or considered to be modifiable risk factors. Although women having a previous preterm birth may be monitored more closely for preterm labor in a subsequent pregnancy, many of the interventions for preterm labor such as bed rest and tocolytic drugs have not been demonstrated to be effective in preventing preterm delivery (Goldenberg, 1998; Goldenberg & Rouse, 1998). Meis et al. (1995), in their study in Wales, found late pregnancy bleeding to have one of the strongest associations (OR 5.91) with preterm birth, but noted that it was not currently preventable. There is some evidence that detection and investigation of hypertensive disorders of pregnancy (HDP) may be useful. In a review of the effectiveness of antenatal care by the World Health Organization, the authors state, "There is epidemiological evidence that improved detection and care for women with HDP has improved maternal outcomes, but there is little clear evidence of how or what specific treatments are effective" (Carroli, Rooney, & Villar, 2001, p. 13).

Sociodemographic risk factors

Although Kogan (1995) claims that the relationship between social class and adverse pregnancy outcomes has been consistently shown, some studies have failed to demonstrate an association between low socioeconomic status and preterm birth (Meis et al., 1995; Parker, Schoendorf, & Kiely, 1994; Wildschut, Nas, & Golding, 1997). The relationship between socioeconomic status (SES) and birth outcome may depend on the measure used (Parker et al., 1994). SES is usually measured by income, occupation, and/or educational attainment (Kramer et al., 2000), and all three were examined in this study. SES was not a significant risk factor for preterm birth among Manitoba women. There was no association between having an income of less than $20,000 per year, non-completion of high school, lack of a paid job during pregnancy, or industry/service occupational classification and preterm birth. A possible explanation for this finding is that low SES may be a social cause of other factors that may themselves be causal factors for preterm birth. Kramer et al. (2000) propose a conceptual model in which etiological factors for preterm birth can operate "upstream" or "downstream" relative to one another, rather than being simultaneously acting, independent determinants.

> Society-level determinants, such as poverty or income inequality, are considered as antecedent to individual-level exposures and behaviours. ...variations in risk of preterm birth or IUGR within populations are at least partly explained by ('downstream') exposures or behaviours that can be measured at the level of individuals. In other words, it is the individuals within a society who are exposed to its socio-economic conditions and whose reactions and responses to those conditions alter their risk of adverse pregnancy outcome. Thus, our primary focus is on causal pathways that explain within-population risks that vary according to ('upstream') socio-economic differences.... According to our conceptual model, having less money or education probably has no direct effect on the rate of fetal growth or the duration of gestation. In other words, socio-economic disadvantage operates 'upstream'; it leads ('downstream') to unhealthy behaviours, exposure to stress and psychological reactions to stress that increase the risk of IUGR or preterm birth. (Kramer et al., 2000, pp. 196-197).

In this study, having low income or education did not have a direct effect on the duration of gestation. However, low socioeconomic status appears to have led downstream to unhealthy behaviors and other factors that were associated with an increased risk of preterm birth, although the association between low SES and these other risk factors seems to be more evident among non-Aboriginal women than Aboriginal women. Refer to the grid presented in Table 46. For example, low income and low education were associated with smoking, inadequate prenatal care, abuse, and perceived stress among non-Aboriginal women. Among Aboriginal women, having an education less than grade 11 was associated with inadequate prenatal care and anemia, whereas other SES factors were not associated with the proximal risk factors. This indirect effect of SES has been found in other studies as well. Sheehan (1998) developed a structural equation model using data from 5,295 inner-city women, and the model showed that economic stress influenced both social support and family stress, but had no direct influence on low birth weight. Meis et al. (1995) found that the association between social class and preterm birth appeared to operate indirectly through smoking and medical problems associated with pregnancy.

Table 46.
Association between "upstream" socioeconomic factors and "downstream" risk factors for preterm birth among Aboriginal and non-Aboriginal women

Socioeconomic Indicator	Smoking		Inadequate prenatal care		Anemia		Abuse		Perceived stress	
	Non-Ab	Ab	Non-Ab	Ab	Non-Ab	Ab	Non-ab	Ab	Non-Ab	Ab
Low income	✔	✖	✔	✔	✖	✖	✔	✖	✔	✖
Educ < grade 12	✔	✖	✔	✖	✔	✖	✔	✖	✔	✖
Educ < grade 11	✔	✖	✔	✔	✖	✔	✖	✖	✔	✖
No paid job	✖	✖	✔	✖	✔	✖	✖	✖	✔	✖
Single	✔	✖	✔	✖	✖	✖	✔	✖	✖	✖
Age <19 years	✔	✖	✖	✖	✖	✖	✔	✖	✖	✖

Note: Non-Ab refers to Non-Aboriginal subjects; Ab refers to Aboriginal subjects; Educ refers to education.
✔ Chi square or Fisher's exact test significant ($p<.05$)
✖ Chi square or Fisher's exact text not significant

One possible explanation for the difference between racial groups in the association between upstream and downstream factors is that low socioeconomic status was more pervasive among Aboriginal women, and may not have served to adequately distinguish individual-level exposures and behaviors among cases and controls. In a population defined by low income and education levels, the relationship of these variables to other pregnancy risk factors seen in a more diverse population may not be apparent (Wen et al., 1990). Stout (1996) notes, "Most observers today believe that poor socio-economic conditions worsen the life chances and, by extension, the health status of Canadian Aboriginal peoples. Not only is poverty correlated with poor nutrition, smoking and other unhealthy practices..., but it also serves to undermine one's self-esteem and sense of self-worth. In this way, women may be more likely to engage in risky behaviours ....Unfortunately, poverty is a condition which affects Aboriginal women disproportionately" (p. 4). The socioeconomic characteristics of Aboriginal women in this study were generally consistent with those reported in the Manitoba First Nations Regional Health Survey (1998), the First Nations and Inuit Regional Health Survey (1999), and by Stout (1996) and Smylie (2001a). The Manitoba First Nations Regional Health Survey (1998) reported that 80% of First Nations people live in poverty (household income <$25,000), while similarly in this study 70% of the Aboriginal women who responded to the question on income reported a family income of less than $20,000 and 80.5% reported less than $30,000. This sample did better on some socioeconomic indicators. Only 19% of First Nations people reported having completed high school in the Regional Health Survey (1998), whereas 39.1% of Aboriginal women participating in this study had completed high school. However, these figures compare poorly to those of non-Aboriginal women, among whom 15% had an annual family income less than $20,000.00, and an average of 13.9 years of education compared to only 11.1 years for Aboriginal women. Thus Aboriginal race appears to be closely related to socioeconomic status. However, race should not be considered a proxy for social class. Kogan has argued against using race as a proxy for social class because members of the same racial group can have different preterm birth rates in different geographic areas; there is a great deal of heterogeneity within racial groups; and racial differences remain even after controlling for social class (Kogan, 1995; Kogan & Alexander, 1998).

Maternal education and marital status are other factors used to measure social class (Kogan & Alexander, 1998). One of the interesting findings of this study was that being of single marital status or young maternal age (less than 19 years) were protective factors for Aboriginal women, reducing the risk of preterm birth. This finding is contrary to most of the literature, which link low maternal age and single marital status to an increased risk of preterm birth (refer to Appendix C). However, at least one other study found mothers aged 12 to 17 years were at significantly lower risk of preterm birth and low birth weight compared to mothers aged 18-25 years. This protective effect for teenage mothers disappeared when Black women were excluded from the multivariate models, suggesting that the effect of age was different among varying racial categories (Cervantes, Keith, & Wyshak, 1999). The focus group participants offered some explanations for why young age and single marital status might be protective factors for Aboriginal women. When young women do not have a partner, they tend to get more support from other family members, particularly their mother and grandmother. Being young and being a single mother was viewed as more acceptable and not an issue in the Aboriginal community, and therefore not a cause of stress.

Given that single marital status and young age were protective factors for preterm birth among Aboriginal women in this study, it is not surprising that these two factors were not associated downstream with any of the other risk factors for Aboriginal women (see Table 47). In addition, all of the Aboriginal cases less than 19 years of age gained at least 20 pounds during their pregnancy, while Aboriginal women with a low weight gain were more likely to be older and multiparous. These findings suggest that early childbearing may be protective among young Aboriginal women. A similar trend has been found among Black women in the United States, where the ratio of low birth weight infants among Blacks to those among Whites is smaller in the teen years than in the older age groups. "The increasing incidence of low birth weight babies born to mature Black women has led public health educator Arline Geronimus to formulate a 'weathering hypothesis'. The hypothesis proposes that the health of adult Black women who live in poverty deteriorates dramatically after adolescence. Geronimus contends that poverty has an increasingly deleterious effect on Black women's health status as they age" (Roth, Hendrickson, Schilling, & Stowell, 1998, p. 273). This occurs through biological and sociocultural variables such as development of chronic diseases, prolonged coping with stressful circumstances, and exposure to higher levels of environmental contaminants in low SES neighbourhoods (Roth et al., 1998). Perhaps a similar deterioration in health occurs among Aboriginal women as they age. The Manitoba First Nations Regional Health Survey (1998) noted that "a surprisingly high proportion of adults in the 25-44 age group report poor health and chronic conditions" (p. 9). However, age greater than 35 years was not a risk factor for either racial group in this study. Further research is needed to explore if the "weathering hypothesis" applies in a Canadian context.

Implications for practice. Because socioeconomic status was not directly linked to preterm birth in this study, caution must be used in proposing implications for practice. However, it appears that low SES may be a social cause of other behavioral and lifestyle factors that may themselves be risk factors for preterm birth. A variety of strategies are needed to lessen the impact of poverty and ensure adequate income for women of childbearing age. Social policies on enhanced income security, child benefits, and improved maternity and parental leave have been suggested to prevent the financial insecurity faced by many Canadian families (Chance & Walker, 1998), and some of these policies have been implemented in recent years. The Manitoba Government recently introduced a prenatal benefit program targeted to women with a net family income of less than $32,000 (Manitoba Government News Release, April 17, 2001). In spite of universal health care in this country, continuing structural racism may create barriers to adequate health care. The transfer of control for health care to Aboriginal peoples may help address this problem. Health care professionals should recognize the need to support Aboriginal communities in the process of self-determination (Smylie, 2000).

Recommendations for future research. There are individual as well as societal differences among women that affect obstetric outcome (Petersen, 1999). Epidemiologists are being encouraged to move beyond the study of proximate, individual-level risk factors to application of a social-ecologic systems perspective, in order to understand health differences between populations (McMichael, 1995; McMichael, 1999). This requires using ecological or multilevel studies to look upstream for a fuller account of disease causation within a population context, in an attempt to understand the pathways that explain within-population risks for preterm birth that vary according to socioeconomic differences (Kramer et al., 2000; McMichael, 1999). A "systems-based approach envisions a causal web that extends inward, via multiple paths, from the encircling realms of the population's history, culture, and socioeconomic relations, through residential conditions and subpopulation attitudes, to the inner proximate factors of individual behaviors and exposures and their biomedical manifestations. Causal processes within this web are not necessarily linear and sequential, but may involve interactions and feedbacks" (McMichael, 1999, p. 891).

The value of ecological studies has been demonstrated by at least three Canadian studies. Wilkins et al. (1991) demonstrated that percentage of low income in the neighbourhood of residence was strongly related to measures of unfavorable birth outcomes, including preterm birth and low birth weight. An Ontario study showed significant variation in preterm birth rates among different regions, which was partially explained by socioeconomic factors (Luginaah, Lee, Abernathy, Sheehan, & Webster, 1999). Members of the Perinatal Project Team of the Manitoba Health Epidemiology Unit (Heaman, Blanchard, Beaudoin, & Green, 2001) found that geographic regions in Manitoba with the highest rates of preterm birth were those with the highest prevalence of low average family income, percent of population aged 15-64 years unemployed, percent reporting Aboriginal ethnic status, and percent of immigrants. Further studies using neighbourhood level variables related to income, education, and unemployment are needed to describe how the social environment has distinctive attributes that influence the risk of preterm birth (Rowley, 1998).

A Population Health Approach to Reduce Preterm Birth

A population health framework (refer to Figure 1) was used to guide this research. Risk factors for preterm birth from each of the five categories of determinants of health were studied: social and economic environment, physical environment, personal health practices, individual capacity and coping skills, and health services. The results of this study indicate that risk factors in the categories of personal health practices (smoking, nutritional status), individual capacity and coping skills (stress, self esteem), and health services (prenatal care) are among the most important modifiable risk factors for Manitoba women. As mentioned previously, the social and economic environment may operate "upstream" of these risk factors, although socioeconomic indicators such as income and education were not directly associated with an increased risk of preterm birth in this study. This is consistent with the framework for population health, which suggests that determinants related to collective conditions (such as the social and economic environment) enable or provide the basis for the individual factors and are therefore depicted on a lower level of the pyramid (figure 1).

Preterm birth prevention programs directed toward women at high risk have been ineffective in reducing the preterm birth rate (Alexander, Weiss, Hulsey, & Papiernik, 1991; Hueston, Knox, Eilers, Pauwels, & Lonsdorf, 1995; Moutquin, Milot-Roy, & Irion, 1996; Murphy, 1993). Various reasons have accounted for the ineffectiveness of these programs. Risk assessment systems to screen for women at risk for preterm birth have low sensitivity and poor predictive power, with up to 60% of preterm births occurring in women who were scored at low risk of preterm birth (Hobel, 1996). Therefore, even if the interventions in prevention programs were effective, they would have little impact on the rate of preterm birth in the whole population because most preterm births occur among women without identifiable risk factors (Stewart, 1998b). The underlying premise of past programs - that the rate of preterm birth could be reduced through early identification and treatment of preterm labor - was flawed because interventions to treat preterm labor have limited effectiveness (Goldenberg, 1998; Goldenberg & Rouse, 1998). Furthermore, a large percentage of women deliver prematurely because of complications of pregnancy which cannot be prevented by education programs (Hueston et al., 1995).

Past efforts to prevent preterm birth have focused on institution-specific, high-technology medical approaches instead of community-wide, population-based prevention policies and initiatives (Alexander, 1998; Alexander et al., 1991). Current thinking is that efforts to improve the health of all pregnant women will better influence pregnancy outcomes for the population as a whole (Moutquin, 1999; Steward & Nimrod, 1993). Recommendations for action arising from a Canadian Consensus Conference on Preterm Birth Prevention emphasized adopting a population health approach to prevent preterm birth (Preterm Birth Prevention Consensus Conference, 1998). According to the Federal, Provincial and Territorial Advisory Committee on Population Health (1994), "A population health strategy focuses on factors that enhance the health and well-being of the overall population....Population health concerns itself with the living and working environments that affect people's health, the conditions that enable and support people in making healthy choices, and the services that promote and maintain health" (p.9). Consideration should be given to implementing population health strategies that address the entire range of factors that influence preterm birth and are designed to affect the entire population of women of childbearing age, using the five categories of health determinants as a framework for action (Heaman, Sprague, & Stewart, 2001). These strategies will require intersectoral collaboration and involve actions targeted at the societal and community, as well as the individual, level. Stout (1996) notes that a population health approach is especially relevant to the promotion of health development among Canadian Aboriginal women, because it closely parallels Aboriginal health frameworks, provides a basis for addressing the risk factors and health determinants as experienced by Aboriginal women, and promotes the sharing of responsibilities for improvement of well-being.

Strengths and Limitations of the Study

Strengths of the Study

This study has several strengths. It is one of only a few studies to examine risk factors for preterm birth among Canadian women, and more specifically, Manitoba women. Risk factors vary among populations; in order to design programs and influence public policy, it is important to know what risk factors predominate in a particular population and the population attributable risk percent associated with those factors. This study provides evidence that smoking prior to pregnancy, inadequate prenatal care, and low weight gain during pregnancy are important risk factors for preterm birth among Manitoba women, with PAR ranging from 15.9% to 24.5% for these factors. This also is one of the first studies to compare risk factors among Aboriginal and non-Aboriginal women in Canada, and differences in risk factors have been identified. In addition, this study provides a profile of characteristics among Aboriginal and non-Aboriginal pregnant women in Manitoba, such as abuse rates, which have not previously been known. The use of in-person interviewing allowed more in-depth data to be collected on certain risk factors than could be obtained through database research (e.g., abuse, smoking, stress).

Limitations of the study

The sample size was estimated to have an 80% power of detecting an odds ratio of 1.6. However, the sample size may have had limited statistical power to detect some risk factors, particularly when stratified by race or when the risk factor had an odds ratio of less than 1.6. Therefore type II error could have accounted for the failure to observe some risk factor associations (such as smoking during pregnancy). Limited sample size also may have an impact on the ability to detect important differences or interactions between Aboriginal and non-Aboriginal women. The study was hospital-based, not population-based, and therefore caution needs to be used in generalizing the results to all women in Manitoba as the participants may not be representative of the population as a whole. In addition, case-control studies are susceptible to various forms of bias, especially selection bias and misclassification (Austin et al., 1994; Lilienfeld & Stolley, 1994). These biases can detract from the internal validity of the study (Rothman & Greenland, 1998).

Selection Bias. Selection biases are distortions that result from procedures used to select subjects and from factors that influence study participation (Rothman & Greenland, 1998, p. 119). The cases and controls consisted of pregnant women delivering at the same two hospitals during the same time frame, thus being women of reproductive age residing in the same province with universal access to prenatal care. Cases and controls should therefore have been similar with respect to factors that might affect both the development of disease and the opportunity for past exposure (Schlesselman, 1982). Establishing precisely and in advance the method and criteria by which cases and controls were identified and selected also helped reduce selection bias. However, differential referral patterns may have been a source of potential bias, because women with preterm labor were more likely to be referred from throughout the province to one of the two tertiary care hospitals for delivery, whereas women delivering at term were more likely to deliver in their originally planned location.

Low participation rates may create selection bias if participation rates vary for cases and controls and if participants and nonparticipants have a different exposure distribution (Austin et al., 1994). However, Schlesselman (1982) notes that different rates of nonresponse between cases and controls does not in itself introduce bias; bias only results if exposed cases are more or less likely to participate than exposed controls. The overall participation rate in the study was reasonably high (78%), although controls had a lower participation rate than cases, which is a common problem in many case-control studies. Unfortunately, there was no means of determining if the exposure rates of participants and non-participants differed.

Interviewer Bias. Interviewer bias was minimized by use of a highly structured questionnaire accompanied by thorough training of inteviewers who had extensive obstetrical nursing experience (Austin et al., 1994). However, the interviewers were not blinded to the classification of the respondent as a case or control, and the possibility exists that the interviewers may have probed cases more intensely for histories of exposure than controls.

Misclassification. Misclassification of either the exposure status or the presence or absence of disease can affect the estimate of relative risk (Lilienfeld & Stolley, 1994). Use of the same interview guide and health record data collection form helped ensure that procedures used to obtain information about exposures were as similar as possible for cases and controls (Hennekens & Buring, 1987). The case-control design necessitated retrospective collection of exposure data for several risk factors, which may have led to inaccuracy in reporting exposures. Case-control studies are also prone to information bias due to differential recall or differential reporting of exposure information.

Avoidance of misclassification of disease is dependent on accurate measurement of the gestational age of the pregnancy at time of delivery, with preterm birth being defined as a gestation of less than 37 completed weeks' gestation. The only pregnancies in which gestational age is truly accurate are those in which time of conception is known. When the date of conception is not known, as is usually the case, the date of the beginning of the last menstrual period and/or early ultrasound are used to date the pregnancy (Allen, Amiel-Tison, & Alcxander, 1998). The interviewers were trained to review the health record to obtain the most accurate recording of gestational age possible. Gestational age was based on menstrual dates if it differed by less than 2 weeks from that determined by an ultrasound performed before the third trimester; otherwise, it was based on the ultrasound estimate (adapted from Berkowitz & Lapinski, 1998).

Recommendations for Future Research

In addition to the specific recommendations discussed for each risk factor, the following general recommendations for future research are put forth:

- This case-control study should be replicated using a larger sample to increase the power to detect significant odds ratios. Since it took 14 months to accrue 226 cases for this study, a collaborative multi-site study using several Canadian provinces and territories would be advisable to obtain a large sample in a timely manner. This would also increase the ability to generalize the results to Canadian women, not just Manitoba women. A larger study would enhance identification of risk factors for both moderate (33-36 weeks gestation) and very ($\leq$ 32 weeks gestation) preterm births. As very preterm births are a more important contributor to neonatal morbidity and mortality, to economic burden on the health care system, and to emotional and financial burden for families, increasing our knowledge of potentially modifiable risk factors for this group would be beneficial. Because Aboriginal women are not a homogeneous group, it would be advisable to obtain a sufficient sample size to study differences in risk factors for preterm birth among First Nations, Metis, and Inuit women.
- A large prospective cohort study of pregnant women is also recommended, since prospective collection of data related to risk factors for preterm birth is preferable.

In particular, data should be collected at approximately 3 time periods during the pregnancy on psychosocial variables such as stress and physiological measures such as CRH. Although a large prospective multisite study has been conducted in the United States by the National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network (Mercer et al., 1996), there is a need to collect data specific to Canada.

- Secondary analysis of this data set should be conducted to study differences in risk factors for preterm birth and low birth weight among Manitoba women. Further study of the role of a previous preterm birth as a strong risk factor for subsequent preterm birth is warranted. For example, a comparison of cases who had a previous preterm birth with those who did not on all the other known risk factors could be conducted.
- In a secondary analysis of this data set, structural equation modeling (SEM) could be conducted to study the relationships between various risk factors and preterm birth. SEM techniques permit testing of hypotheses and making causal inferences about the effects of certain variables on other variables using correlation data rather than experimentally manipulated data. SEM consists of several causal statements that hypothesize causal relationships between several variables to explain a phenomenon. The causal statements in SEM must meet conditions of causation and be supported by adequate theory. The overall fit of the model can be tested by several alterative statistics (Munro & Page, 1993).

Summary and Conclusion

The rate of preterm birth has been increasing in Manitoba over the past decade. These increases in preterm birth rates are concerning because preterm births account for a high percentage of neonatal and infant morbidity and mortality, and the social, economic, and emotional burden of caring for these premature babies is immense. Much is still unknown with regard to the etiology of preterm birth. This case-control study has identified some modifiable risk factors which distinguish women with preterm birth from those without, and contributed to our understanding of the differences in risk factors among Aboriginal and non-Aboriginal women in Manitoba. These modifiable risk factors can now be targeted by population health strategies and public health interventions, with the goal of decreasing the overall rate of preterm birth in Manitoba and reducing the disparity in preterm birth rates among Aboriginal and non-Aboriginal women. In particular, reducing smoking and promoting good nutritional status among women of childbearing age, and increasing timely access to high quality prenatal care for pregnant women are strategies that hold promise. Several implications for practice and areas for further research have been identified.

REFERENCES

American Academy of Pediatrics and American College of Obstetricians and Gynecologists. (1992). Guidelines for Perinatal Care (3rd ed.). Elk Grove Village, IL: Author.

Adams, M., Sarno, A., Harlass, F., Rawlings, J., & Read, J. (1995). Risk factors for preterm delivery in a healthy cohort. Epidemiology, 6, 525-532.

Alexander, G. (1998a). Preterm birth: Etiology, mechanisms and prevention. Prenatal and Neonatal Medicine, 3, 3-9.

Alexander, G. (1998b). Reducing preterm and low birthweight rates in the United States: Is psychosocial assessment the answer? Maternal and Child Health Journal, 2, 195-199.

Alexander, G., & Howell, E. (1997). Preventing preterm birth and increasing access to prenatal care: Two important but distinct national goals. American Journal of Preventive Medicine, 13, 290-291.

Alexander, G., Weiss, J., Hulsey, T., & Papiernik, E. (1991). Preterm birth prevention: An evaluation of programs in the United States. Birth, 18, 160-169.

Allard, Y., Lithman, G., O'Neil, J., & Sinclaire, M. (1993). Winnipeg Case Study of Health and Social Services: Final Report. Winnipeg: University of Manitoba Northern Health Research Unit.

Allen, M., Amiel-Tyson, C., & Alexander, G . (1998). Measurement of gestational age and maturity. Prenatal & Neonatal Medicine, 3, 56-59.

American College of Obstetricians and Gynecologists. (1995). ACOG Technical Bulletin: Preterm Labor. International Journal of Gynecology & Obstetrics, 50, 303-313.

Ancel, P., Saurel-Cubizolles, M., Di Renzo, G., Papiernik, E., Breart, G., and the Europop Group. (1999). Social differences of very preterm birth in Europe: Interaction with obstetric history. American Journal of Epidemiology, 149, 908-915.

Andrews, W., Goldenberg, R., & Hauth, J. (1995). Preterm labor: Emerging role of genital tract infections. Infectious Agents Dis., 4, 196-211.

Armenian, H., & Lilienfeld, D. (1994). Overview and historical perspective. Epidemiologic Reviews, 16, 1-5.

Austin, M., & Leader, L. (2000). Maternal stress and obstetric and infant outcomes: Epidemiological findings and neurodendocrine mechanisms. Australian and New Zealand Journal of Obstetrics and Gynaeology, 40, 331-337.

Austin, H., Will, H., Flanders, D., & Greenberg, R. (1994). Limitations in the application of case-control methodology. Epidemiologic Reviews, 16, 65-76.

Basrur, S., & Makarchuk, M. (1999). More than milk, eggs and orange juice. Canadian Medical Association Journal, 160, 633.

Bell, T., & Eaglin, M. (2000, December). Domestic violence during pregnancy in Washington state January 1994-March 1996. Paper presented at the CDC Sixth Annual Maternal and Child Health Epidemiology Conference, Atlanta, GA.

Berenson, A., Wiemann, C., Wilkinson, G., Jones, W., & Anderson, G. (1994). Perinatal morbidity associated with violence experienced by pregnant women. American Journal of Obstetrics and Gynecology, 170, 1760-1769.

Berkowitz, G., & Lapinski, R. (1998). Relative and attributable risk estimates for preterm birth. Prenatal and Neonatal Medicine, 3,53-55.

Berkowitz, G., & Papiernik, E. (1993). Epidemiology of preterm birth. Epidemiologic Reviews, 15, 414-439.

Berkowitz, G., & Papiernik, E. (1995). Working conditions, maternity legislation, and preterm birth. Seminars in Perinatology, 19, 272-278.

Blondel, B. (1998). Social and medical support during pregnancy: an overview of the randomized controlled trials. Prenatal and Neonatal Medicine, 3, 141-144.

Bohn, D. (1998). Clinical interventions with Native American battered women. In J. Campbell (Ed.), Empowering survivors of abuse: Health care for battered women and their children (pp. 241-258). Thousand Oaks, CA: Sage Publications.

Bragonier, J., Cushner, I, & Hobel, C. (1984). Social and personal factors in the etiology of preterm birth. In F. Fuchs & P. Stubblefield (Eds.), Preterm birth: Causes, prevention, and management (pp. 64-85). New York: Macmillan Publishing Company.

Brown, M. (1986). Social support during pregnancy: A unidimensional or multidimensional construct? Nursing Research, 35, 4-9.

Brown, H., Watkins, K., & Hiett, A. (1996). The impact of the Women, Infants and Children Food Supplement Program on birth outcome. American Journal of Obstetrics and Gynecology, 174, 1279-1283.

Browne, A., & Fiske, J. (2001). First Nations women's encounters with mainstream health care services. Western Journal of Nursing Research, 23(2). 126-147.

Bullock, L., & McFarlane, J. (1989). The birth-weight/battering connection. American Journal of Nursing, 89, 1153-1155.

Campbell, J., Mitchell, P., Stanford, J., & Ewigman, B. (1995). Validating a model developed to predict prenatal care utilization. The Journal of Family Practice, 41, 457-464.

Campbell, J., Moracco, E., & Saltzman, L. (2000). Future directions for violence against women and reproductive health: Science, prevention, and action. Maternal and Child Health Journal, 4, 149-154.

Campbell, J., Torres, S., Ryan, J., King, C., Campbell, D., Stallings, R., & Fuchs, S. (1999). Physical and nonphysical partner abuse and other risk factors for low birth weight among full term and preterm babies. American Journal of Epidemiology, 150, 714-726.

Canadian Institute of Child Health. (1992). Prevention of low birth weight in Canada: Literature review and strategies. Ottawa: Author.

Canadian Institute of Child Health. (1994). The health of Canada's children: A CICH profile (2nd ed.). Ottawa: Author.

Canadian Nurses Association. (1995). Health in Canada: Perspectives of Urban Aboriginal People. Ottawa: Author.

Canadian Perinatal Surveillance System. (1999). Preterm Birth. Ottawa: Bureau of Reproductive and Child Health, Health Canada.

Carmichael, S., & Abrams, B. (1997). A critical review of the relationship between gestational weight gain and preterm delivery. Obstetrics and Gynecology, 89, 865-873.

Carmichael, S., Abrams, B., & Selvin, S. (1997). The association of pattern of maternal weight gain with length of gestation and risk of spontaneous preterm delivery. Paediatric and Perinatal Epidemiology, 11, 392-406.

Carroli, G., Rooney, C., & Villar, J. (2001). WHO programme to map the best reproductive health practice: How effective is antenatal care in preventing maternal mortality and serious morbidity? Paediatric and Perinatal Epidemiology, 15(Suppl.1), 1-42.

Cervantes, A., Keith, L., & Wyshak, G. (1999). Adverse birth outcomes among native-born and immigrant women: Replicating national evidence regarding Mexicans at the local level. Maternal and Child Health Journal, 3, 99-109.

Chamberlain, L., & Perham-Hester, K. (2000). Physicians' screening practices for female partner abuse during prenatal visits. Maternal and Child Health Journal, 4, 141-148.

Chance, G. (1997). A warning from the cradle? Canadian Medical Association Journal, 157, 549-551.

Chance, G., & Walker, D. (1998, April). Current prenatal environments for families and health care providers which impact on preterm birth prevention. Background paper prepared for the Preterm Birth Prevention Consensus Conference, Ottawa, Ontario, Canada.

Chen, J., Fair, M., Wilkins, R., Cyr, M., & Fetal and Infant Mortality Study Group of the Canadian Perinatal Surveillance System. (1998). Maternal education and fetal and infant mortality in Quebec. Health Reports, 10(2), 53-64.

Cnattingius, S., Forman, M., Berendes, H., Graubard, B., & Isotalo, L. (1993). Effect of age, parity, and smoking on pregnancy outcome: A population-based study. American Journal of Obstetrics and Gynecology, 168, 16-21.

Cohen, S., Kessler, R., & Gordon, L. (1995). Strategies for measuring stress in studies of psychiatric and physical disorders. In S. Cohen, R. Kessler, & L. Gordon (Eds.), Measuring stress: A guide for health and social scientists (pp. 3-25). New York: Oxford University Press.

Cokkinides, V., Coker, A., Sanderson, M., Addy, C., & Beehea, L. (1999). Physical violence during pregnancy: Maternal complications and birth outcomes. Obstetrics & Gynecology, 93, 661-666.

Collins, J., & Hammond, N. (1996). Relation of maternal race to the risk of preterm, non-low birth weight infants: A population study. American Journal of Epidmiology, 143, 333-337.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. Journal of Health & Social Behavior, 24, 385-396.

Cohen, S., & Williamson, G. (1988). Perceived stress in a probability sample in the United States. In S. Spacapan & S. Oskamp (Eds.), The social psychology of health (pp. 31.67). Newbury Park, CA: Sage.

Collins, N., Dunkel-Schetter, C., Lobel, M., & Scrimshaw, S. (1993). Social support in pregnancy: Psychosocial correlates of birth outcomes and postpartum depression. Journal of Personality and Social Psychology, 65, 1243-1258.

Collins, J., & Hammond, N. (1996). Relation of maternal race to the risk of preterm, non-lowbirth weight infants: A population study. American Journal of Epidemiology, 143, 333-337.

Copper, R., Goldenberg, R., Das, A., Elder, N., Swain, M., Norman, G., Ramsey, R., Cotroneo, P., Collins, B., Johnson, F., Jones, P., Meier, A., and the National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. (1996). The preterm prediction study: Maternal stress is associated with spontaneous preterm birth at less than thirty-five weeks gestation. American Journal of Obstetrics and Gynecology, 175, 1286-1292.

Cornfield, J., Haenszel, W., Hammond, C., Lilienfeld, A., Shimkin, M., & Wynder, E. (1959). Smoking and lung cancer: Recent evidence and a discussion of some questions. Journal of the National Cancer Institute, 22, 173-203.

Correa, A., Stewart, W., Yeh, H., & Santos-Burgoa, C. (1994). Exposure measurement in case-control studies: Reported methods and recommendations. Epidemiologic Reviews, 16, 18-32.

Covington, D., Justason, B., & Wright, L. (2001). Severity, manifestations, and consequences of violence among pregnant adolescents. Journal of Adolescent Health, 28, 55-61.

Creasy, R., & Merkatz, I. (1990). Prevention of preterm birth: Clinical opinion. Obstetrics & Gynecology, 76, 2S-4S.

Culpepper, L., & Jack, B. (1993). Psychosocial issues in pregnancy. Primary Care, 20, 599-619.

Curry, M. (1990). Stress, social support, and self-esteem during pregnancy. NAACOG's Clinical Issues in Perinatal and Women's Health Nursing, 1(3), 303-310.

Curry, M., Burton, D., & Fields, J. (1998). The Prenatal Psychosocial Profile: A research and clinical tool. Research in Nursing and Health, 21, 211-219.

Curry, M., Campbell, R., & Christian, M. (1994). Validity and reliability testing of the prenatal psychosocial profile. Research in Nursing and Health, 17, 127-135.

Curry, M., & Harvey, S. (1998). Stress related to domestic violence during pregnancy and infant birth weight. In J. Campbell (Ed.), Empowering survivors of abuse: Health care for battered women and their children (pp. 98-108). Thousand Oaks, CA: Sage Publications.

Curry, M., Perrin, N., & Wall, E. (1998). Effects of abuse on maternal complications and birth weight in adult and adolescent women. Obstetrics and Gynecology, 92, 530-534.

Delgado-Rodriguez, M., Gomez-Olmedo, M., Bueno-Cavanillas, A., & Galvez-Vargas, R. (1996). A comparison of two indices of adequacy of prenatal care utilization. Epidemiology, 7, 648-650.

Dudley, D. (1999). Immunoendocrinology of preterm labor: The link between corticotropin-releasing hormone and inflammation. American Journal of Obstetrics and Gynecology, 180, S251-S256.

Dunkel-Schetter, C. (1998). Maternal stress and preterm delivery. Prenatal and Neonatal Medicine, 3, 39-42.

Elias, B., Leader, A., Sanderson, D., O'Neil, J., & Tate, B. (2000). Living in balance: Gender, structural inequalities, and health promoting behaviors in Manitoba

First Nation Communities. Winnipeg, Manitoba: Northern Health Research Unit, University of Manitoba.

Employment and Immigration Canada. (1993). National Occupational Classification: Occupational descriptions. Ottawa: Author.

English, D., Hulse, G., Milne, E., Holman, C., & Bower, C. (1997). Maternal cannabis use and birth weight: A meta-analysis. Addiction, 92, 1553-1560.

Faden, V., Graubard, B., & Dufour, M. (1997). The relationship of drinking and birth outcome in a US national sample of expectant mothers. Paediatric and Perinatal Epidemiology, 11, 167-180.

Federal/Provincial/Territorial Working Group on Women's Health. (1990). Working together for women's health: A framework for the development of policies and programs. Ottawa: Author.

Federal, Provincial, and Territorial Advisory Committee on Population Health. (1994). Strategies for population health: Investing in the health of Canadians. Ottawa: Minister of Supply and Services Canada.

Fernandez, F., & Krueger, P. (1999). Domestic violence: Effect on pregnancy outcome. Journal of the American Osteopathic Association, 99, 254-256.

Fink, A. (1995). How to sample in surveys. Thousand Oaks, CA: Sage Publications.

First Nations and Inuit Regional Health Survey. (1999). Published by the First Nations and Inuit Regional Health Survey National Steering Committee, Canada.

Fiscella, K. (1995). Does prenatal care improve birth outcomes? A critical review. Obstetrics & Gynecology, 85, 468-479.

Fiscella, K. (1996). Racial disparities in preterm births: The role of urogenital infections. Public Health Reports, 111, 104-113.

Flynn, C., Helwig, A., & Meurer, L. (1999). Bacterial vaginosis in pregnancy and the risk of prematurity: A meta-analysis. Journal of Family Practice, 48, 885-892.

Foix-L'Helias, L, & Blondel, B. (2000). Changes in risk factors of preterm delivery in France between 1981 and 1995. Paediatric and Perinatal Epidemiology, 14, 314-323.

Fortier, I., Marcoux, S., & Brisson, J. (1995). Maternal work during pregnancy and the risks of delivering a small-for-gestational-age or preterm infant. Scandinavian Journal of Work and Environmental Health, 21, 412-418.

Fox, N., Sexton, M., & Hebel, J. (1989). The reliability of self-reports of smoking and alcohol consumption by pregnant women. Addiction Behavior, 14, 187-195.

Freudenberg, W. (1986). The density of acquaintanceship: An overlooked variable in community research? American Journal of Sociology, 92, 27-63.

Frey, J., & Oishi, S. (1995). How to conduct interviews by telephone and in person. Thousand Oaks, CA: Sage Publications.

Frost, M. (1993). Commentary on stressors and health outcomes: Implications for nursing practice, research, theory, and policy agendas. In J. Barnfather & B. Lyon (Eds.), Stress and coping: State of the science and implications for nursing theory, research and practice (pp. 43-64). Indianapolis: Center Nursing Press of Sigma Theta Tau International.

Gazmararian, J., Lazorick, S., Spitz, A., Ballard, T., Saltzman, L., & Marks, J. (1996). Prevalence of violence against pregnant women. JAMA, 275, 1915-1920.

Gazmararian, J., Petersen, R., Spitz, A., Goodwin, M., Saltzman, L., & Marks, J. (2000). Violence and reproductive health: Current knowledge and future directions. Maternal and Child Health Journal, 4, 79-84.

Gennaro, S., & Fehder, W. (1996). Stress, immune function, and relationship to pregnancy outcome. Nursing Clinics of North America, 31, 293-303.

Goldenberg, R. (1998). Low birthweight in minority and high-risk women: Patient Outcomes Research Team (PORT) final report. Washington, DC: Agency for Health Care Policy and Research.

Goldenberg, R., & Andrews, W. (1996). Editorial: Intrauterine infection and why preterm birth prevention programs have failed. American Journal of Public Health, 86, 781-783.

Goldenberg, R., Andrews, W., Yuan, A., MacKay, T., & St. Louis, M. (1997). Sexually transmitted diseases and adverse outcomes of pregnancy. Clinics in Perinatology, 24, 23-41.

Goldenberg, R., & Gotlieb, S. (1991). Social and psychological factors and pregnancy outcome. In S. Cherry & I. Merkatz (Eds.), Complications of pregnancy: Medical, surgical, gynecologic, psychosocial, and perinatal (pp. 80-96). Baltimore: Williams & Wilkins.

Goldenberg, R., Hickey, C., Cliver, S., Gotlieb, S., Woolley, T., & Hoffman, H. (1997). Abbreviated scale for the assessment of psychosocial status in pregnancy: Development and evaluation. Acta Obstet Gynecol Scand, 76, 19-29.

Goldenberg, R., Patterson, E., & Freese, M. (1992). Maternal demographic, situational and psychosocial factors and their relationship to enrollment in prenatal care: A review of the literature. Women & Health, 19, 133-151.

Goldenberg, R., & Rouse, D. (1998). Prevention of premature birth. New England Journal of Medicine, 339, 313-320.

Gomez, R., Romero, R., Edwin, S., & David, C. (1997). Pathogenesis of preterm labor and preterm premature rupture of membranes associated with intraamniotic infection. Infectious Disease Clinics of North America, 11, 135-176.

Gomez-Olmedo, M., Delgado-Rodriguea, M., Bueno-Cavanillas, A., Molina-Font, J., & Galvez-Vargas, R. (1996). Prenatal care and prevention of preterm birth: A case-control study in southern Spain. European Journal of Epidemiology, 12, 37-44.

Goodwin, M., Gazmararian, J., Johnson, C., Gilbert, B., Saltzman, and the PRAMS Working Group. (2000). Pregnancy intendedness and physical abuse around the time of pregnancy: Findings from the Pregnancy Risk Assessment Monitoring System, 1996-1997. Maternal and Child Health Journal, 4, 85-92.

Guise, J., Aickin, M., Helfand, M., Peipert, P., & Westoff, C. (2000). Screening for bacterial vaginosis in pregnancy: A meta-analysis. Obstetrics & Gynecology, 95(4 suppl):S7.

Gupton, A., & Hague, B. (1997). A report on demographic and childbirth characteristics and smoking during pregnancy within Regional Health Authorities in Manitoba. Winnipeg, MB: Manitoba Health, Public Health Branch.

Haas, I., Harlow, B., Cramer, D., & Frigoletto, F. (1991). Spontaneous preterm birth: A case-control study. American Journal of Obstetrics & Gynecology, 165, 1290-1296.

Hanvey, L., Avard, D., Graham, I., Underwood, K., Campbell, J., & Kelly, C. (1994). The Health of Canada's Children: A CICH Profile (2nd ed.). Ottawa: Canadian Institute of Child Health.

Harlow, B., Frigoletto, F., Cramer, D., Evans, J., LeFebre, M., Bain, R., McNellis, & the RADIUS Study Group. (1996). Determinants of preterm delivery in low-risk pregnancies. Journal of Clinical Epidemiology, 49, 441-448.

Hassard, T. (1998). Advanced Biostatistics. Unpublished manuscript, University of Manitoba Department of Community Health Sciences at Winnipeg.

Health Canada. (1999a). Nutrition for a healthy pregnancy: National guidelines for the childbearing years. Ottawa: Minister of Public Works and Government Services Canada.

Health Canada. (1999b). A handbook for health and social service professionals responding to abuse during pregnancy. Ottawa: Minister of Public Works and Government Services Canada.

Health Promotion and Programs Branch. (1998). A Population Health Approach: Definitions and Guiding Principles. A Document in Process. Ottawa: Health Canada.

Heaman, M., Blanchard, J., Beaudoin, C., & Green, C. (2001, June). Regional variations in preterm birth rates in Manitoba: The influence of sociodemographic factors. Poster session presented at the annual meeting of the Society for Pediatric and Perinatal Epidemiologic Research, Toronto, ON.

Heaman, M., Sprague, A., & Stewart, P. (2001). Reducing the preterm birth rate: A population health strategy. Journal of Obstetric, Gynecologic and Neonatal Nursing, 30, 20-29.

Hedegaard, M., Henriksen, T., Sabroe, S., & Secher, N. (1993). Psychological distress in pregnancy and preterm delivery. British Medical Journal, 307, 234-239.

Hedegaard, M., Henriksen, T., Secher, N., Hatch, M., & Sabroe, S. (1996). Do stressful life events affect duration of gestation and risk of preterm delivery? Epidemiology, 7, 339-345.

Hennekens, C., & Buring, J. (1987). Epidemiology in medicine. Boston: Little, Brown and Company.

Henriksen, T., Hedegaard, M., Secher, N., & Wilcox, A. (1995). Standing at work and preterm delivery. British Journal of Obstetrics and Gynecology, 102, 198-206.

Hickey, C., Cliver, S., McNeal, S., & Goldenberg, R. (1997). Low pregravid body mass index as a risk factor for preterm birth: Variation by ethnic group. Obstetrics & Gynecology, 89, 206-212.

Hickey, C., Cliver, S., McNeal, S., Hoffman, H., & Goldenberg, R. (1995). Prenatal weight gain patterns and spontaneous preterm birth among nonobese black and white women. Obstetrics & Gynecology, 85, 909-914.

Hillier, S., Nugent, R., Eschenbach, D., Krohn, M., Gibbs, R., Martin, D., Cotch, M., Edelman, R., Pastoreck, J., Rao, A., McNellis, D., Regan, J., Carey, C., & Klebanoff, M., for the Vaginal Infections and Prematurity Study Group. (1995). Association between bacterial vaginosis and preterm delivery of a low-birth weight infant. New England Journal of Medicine, 333, 1737-1742.

Hobel, C. (1996). Prevention of prematurity. Pediatric Annals, 25, 190-198.

Hobel, C., Dunkel-Schetter, C., Roesch, S., Castro, & Arora, C. (1999). Maternal plasma corticotropin-releasing hormone associated with stress at 20 weeks' gestation in pregancies ending in preterm delivery. American Journal of Obstetrics and Gynecology, 180, S257-S263.

Hobel, C., & Siega-Riz, A. (1998). The West Los Angeles Preterm Birth Prevention Project: as reassessment of interventions. Prenatal and Neonatal Medicine, 3, 161-164.

Hodnett, E. (2000). Support during pregnancy for women at increased risk. Cochrane Database of Systematic Reviews, 2, CD000198.

Hoffman, W., & Hatch, M. (1996). Stress, social support and pregnancy outcome: A reassessment based on recent research. Paediatric and Perinatal Epidemiology, 10, 380-405.

Homer, C., James, S., & Siegel, E. (1990). Work-related psychosocial stress and risk of preterm, low birthweight delivery. American Journal of Public Health, 80, 173-177.

Hueston, W., Knowx, M., Eilers, G., Pauwels, J., & Lonsdorf, D, (1995). The effectiveness of preterm birth prevention educational programs for high-risk women: A meta-analysis. Obstetrics and Gynecology, 86, 705-712.

Hulse, G., English, D., Milne, E., Holman, C., & Bower, C. (1997). Maternal cocaine use and low birth weight newborns: A meta-analysis. Addiction, 92, 1561-1570.

Humphrey, M., & Holzheimer, D. (2000). A prospective study of gestation and birthweight in Aborignal pregnancies in far north Queensland. Australia and New Zealand Journal of Obstetrics and Gynaecology, 40, 326-330.

Institute of Medicine. (1985). Preventing Low Birthweight - Summary. Washington, Dc: National Academy Press.

Institute of Medicine. (1990). Nutrition during pregnancy: Part I weight gain and Part II nutrient supplements. Washington, DC: National Academy Press.

Istvan, J. (1986). Stress, anxiety, and birth outcomes: A critical review of the evidence. Psychological Bulletin, 100, 331-348.

Joseph, K., & Kramer, M. (1997). Recent trends in infant mortality rates and proportions of low-birth-weight live births in Canada. Canadian Medical Association Journal, 157, 535-541.

Kaufert, P. (1996). Gender as a determinant of health: A Canadian perspective. Paper developed for the Canada-U.S.A. Women's Health Forum, August 8-10, 1996.

Kessner, D., Singer, J., Kalk, C., & Schlesinger, E. (1973). Infant death: An analysis by maternal risk and health care. In D. Kessner (Ed.), Contrasts in Health Status, volume 1. Washington, DC: Institute of Medicine.

Klein, L., & Goldenberg, R. (1990). Prenatal care and its effect on preterm birth and low birth weight. In I. Merkatz, J. Thompson, P. Mullen, & R. Goldenberg (Eds.), New Perspectives on Prenatal Care (pp. 501-529). New York: Elsevier.

Kogan, M. (1995). Social causes of low birth weight. Journal of the Royal Society of Medicine, 88, 611-615.

Kogan, M., & Alexander, G. (1998). Social and behavioral factors in preterm birth. Prenatal and Neonatal Medicine, 3, 29-31.

Kogan, M., Alexander, G., Kotelchuck, M., Nagey, D., &Jack, B. (1994). Comparing mothers' repots on the content of prenatal care received with recommended national guidelines. Public Health Reports, 109, 637-646.

Kogan, M., Alexander, G., Kotelchuck, M., & Nagey, D. (1994). Relationship of the content of prenatal care to the risk of low birth weight: Maternal reports of health behavior advice and initial prenatal care procedures. Journal of the American Medical Association, 271, 1340-1345.

Kolas, R., Nakling, J., & Salvesen, K. (2000). Smoking during pregnancy increases the risk of preterm births among parous women. Acta Obstetricia et Gynecologica Scandinavica, 79, 644-648.

Kotelchuck, M. (1994). An evaluation of the Kessner adequacy of prenatal care index and a proposed adequacy of prenatal care utilization index. American Journal of Public Health, 84, 1414-1420.

Kramer, M. (1998). Maternal nutrition, pregnancy outcome and public health policy. Canadian Medical Association Journal, 159, 663-665.

Kramer, M. (1987). Determinants of low birth weight: Methodological assessment and meta-analysis. Bulletin of the World Health Organization, 65, 663-737.

Kramer, M., McLean, F., Eason, E., & Usher, R. (1992). Maternal nutrition and spontaneous preterm birth. American Journal of Epidemiology, 136, 574-583.

Kramer, M, Seguin, L., Lydon, J., & Goulet, L. (2000). Socio-economic disparities in pregnancy outcome: Why do the poor fare so poorly? Paediatric and Perinatal Epidemiology, 14, 194-210.

Krueger, P., & Scholl, T. (2000). Adequacy of prenatal care and pregnancy outcome. Journal of the American Osteopathic Association, 100, 485-492.

Kyrklund-Blomberg, & Cnattingius, S. (1998). Preterm birth and maternal smoking: Risks related to gestational age and onset of delivery. American Journal of Obstetrics and Gynecology, 179, 1051-1055.

Lacy, J., Bartlett, L, & Ohlsson, A. (1998). A standard perinatal care record in Canada: Justification, acceptability and feasibility. Journal SOGC, 20, 557-565.

Lang, J., Lieberman, E., & Cohen, A. (1996). A comparison of risk factors for preterm labor and term small-for-gestational-age birth. Epidemiology, 7, 369-376.

Lasky, T., & Stolley, P. (1994). Selection of cases and controls. Epidemiologic Reviews, 16, 6-17.

Lilienfeld, D., & Stolley, P. (1994). Foundations of Epidemiology (3rd ed.). New York: Oxford University Press.

Lobel, M. (1994). Conceptualizations, measurement, and effects of prenatal maternal stress on birth outcomes. Journal of Behavioral Medicine, 17, 225-272.

Lobel, M., DeVincent, C., Kaminer, A., & Meyer, B. (2000). The impact of prenatal maternal stress and optimistic disposition on birth outcomes in medically high-risk women. Health Psychology, 19, 544-553.

Lobel, M., Dunkel-Schetter, C., & Scrimshaw, S. (1992). Prenatal maternal stress and prematurity: A prospective study of socioeconomically disadvantaged women. Health Psychology, 11, 32-40.

Lockwood, C. (1999). Stress-associated preterm delivery: The role of corticoptropin-releasing hormone. American Journal of Obstetrics and Gynecology, 180, S264-S266.

Lowery, B. (1987). Stress research: Some theoretical and methodological issues. Image: Journal of Nursing Scholarship, 19, 42-46.

Luke, B. (1998). Nutrition and prematurity. Prenatal and Neonatal Medicine, 3, 32.34.

Luke, B., Mamelle, N., Keith, L., Munoz, F., Minogue, J., Papiernik, E., & Johnson, R, in collaboration with the Research Committee of the Association of Women's Health, Obstetric and Neonatal Nurses. (1995). The association between occupational factors and preterm birth: A United States nurses' study. American Journal of Obstetrics and Gynecology, 173, 849-862.

Luginaah, I., Lee, K., Abernathy, T., Sheehan, D., & Webster, G. (1999). Trends and variations in perinatal mortality and low birthweight: The contribution of socio-economic factors. Canadian Journal of Public Health, 90, 377-381.

Lumley, J. (1993). The epidemiology of preterm birth. Bailliere's Clinical Obstetrics and Gynaecology, 7, 477-498.

Lumley, J., Oliver, S., Waters, E. (2000). Interventions for promoting smoking cessation during pregnancy. Cochrane Database of Systematic Reviews, Volume 2, CD001055.

Majzoub, J., McGregor, J., Lockwood, C., Smith, R., Taggart, M., & Schulkin, J. (1999). A central theory of preterm and term labor: Putative role for corticotropin-releasing hormone. American Journal of Obstetrics and Gynecology, 180, S232-S241.

Maloni, J. (2000). Preventing low birth weight: How smoking cessation counseling can help. AWHONN Lifelines, 5,(1), 32-35.

Mamelle, N., Laumon, B., & Lazar, O. (1984). Prematurity and occupational activity during pregnancy. American Journal of Epidemiology, 119, 309-322.

Mamelle, N., Segueilla, M., Munoz, R., & Berland, M. (1997). Prevention of preterm birth in patients with symptoms of preterm labor: The benefits of psychologic support. American Journal of Obstetrics and Gynecology, 177, 947-952.

Manitoba First Nations Regional Health Survey, Final Report. September 1998. Winnipeg: Assembly of Manitoba Chiefs, Manitoba Okimakanak Keewatiniowi, and Northern Health Research Unit.

Manitoba Health. (2000). Manitoba Perinatal Health Surveillance Report 1989-1998: Provincial and Winnipeg Geographic Breakdown. Winnipeg: Manitoba Health Public Health Branch, Epidemiology Unit.

Manitoba Round Table on Environment & Economy. (1999). Priorities for Action: Towards a Strategy for Aboriginal People Living in Winnipeg. Winnipeg: Author.

McDuffie, R., Beck, A., Bischoff, K., Cross, J., & Orleans, M. (1996). Effect of frequency of prenatal care visits on perinatal outcome among low-risk women. JAMA, 275, 847-851.

McFarlane, J., Parker, B., & Soeken, K. (1996a). Abuse during pregnancy: Associations with maternal health and infant birth weight. Nursing Research, 45, 37-42.

McFarlane, J., Parker, B., & Soeken, K. (1996b). Physical abuse, smoking, and substance use during pregnancy: Prevalence, interrelationships and effects of birth weight. Journal of Obstetrics, Gynecologic and Neonatal Nursing, 25, 313-320.

McFarlane, J., Parker, B., Soeken, K., Silva, C., & Reel, S. (1998). Safety behaviors of abused women after an intervention during pregnancy. Journal of Obstetric, Gynecologic and Neonatal Nursing, 27, 64-69.

McGregor, J., French, J., & Witkin, S. (1996). Infection and prematurity: evidence-based approaches. Current Opinion in Obstetrics and Gynecology, 8, 428-432.

McLean, D., Wingo, P., Hatfield-Timajchy, K., & Floyd, R. (1993). Psychosocial measurement: Implications for the study of preterm delivery in black women. American Journal of Preventive Medicine, 9, 39-81.

McMichael, A (1995). The health of persons, populations, and planets: Epidemiology comes full circle. Epidemiology, 6(6), 633-636.

McMichael, A. (1999). Prisoners of the proximate: Loosening the constraints on epidemiology in an age of change. American Journal of Epidemiology, 149, 887-897.

Meis, P. (1998). Indicated preterm births: A review. Prenatal and Neonatal Medicine, 3, 113-115.

Meis, P., Michielutte, R., Peters, T., Wells, H., Sands, R., Coles, E., & Johns, K. (1995a). Factors associated with preterm birth in Cardiff, Wales. I. Univariable and multivariable analysis. American Journal of Obstetrics & Gynecology, 173, 590-596.

Meis, P., Michielutte, R., Peters, T., Wells, H., Sands, R., Coles, E., & Johns, K. (1995b). Factors associated with preterm birth in Cardiff, Wales. II. Indicated and spontaneous preterm birth. American Journal of Obstetrics & Gynecology, 173, 597-602.

Mercer, B., et al for the National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. (1996). The preterm prediction study: A clinical risk assessment system. American Journal of Obstetrics and Gynecology, 174, 1885-1895.

Merkatz, I., & Thompson, J. (Eds.) (1990). New perspectives on prenatal care. New York: Elsevier.

Minister of Public Works and Government Services Canada. (1997). Healthy parents, healthy babies: A report by the National Council of Welfare. Ottawa: Author.

Moore, M., & Zaccaro, D. (2000). Cigarette smoking, low birth weight, and preterm births in low-income African American women. Journal of Perinatology, 3, 176-180.

Moutquin, J. (1998). A pledge to value the pregnant women in Canada. Journal of the Society of Obstetricians and Gynaecologists of Canada, 20, 123-126.

Moutquin, J. (1999). Preterm births in Canada: Where do we go from here? Journal of the Society of Obstetricians and Gynaecologists of Canada, 21, 115-116.

Moutquin, J., & Lalonde, A. (1998). The cost of prematurity in Canada. Background paper prepared for the Preterm Birth Consensus Conference, Ottawa, Ontario, April 24-25, 1998.

Moutquin, J., Milot-Roy, V., & Irion, O. (1996). Preterm birth prevention: Effectiveness of current strategies. Journal of the Society of Obstetricians and Gynaecologists of Canada, 18, 571-588.

Moore, M., & Zaccaro, D. (2000). Cigarette smoking, low birth weight, and preterm births in low-income African American women. Journal of Perinatology, 20, 176-180.

Morrison, J. (1990). Preterm birth: A puzzle worth solving. Obstetrics & Gynecology, 76, 5S-12S.

Mozurkewich, E., Luke, B., Avni, M., & Wolf, F. (2000). Working conditions and adverse pregnancy outcome: A meta-analysis. Obstetrics and Gynecology, 95, 623-635.

Munro, B., & Page, E. (1993). Statistical methods for health care research (2nd ed.). Philadelphia: J. B. Lippincott.

Murphy, P. (1993). Preterm birth prevention programs: A critique of current literature. Journal of Nurse-Midwifery, 38, 324-335.

Mustard, C. (1993). The utilization of prenatal care and relationship to birthweight outcome in Winnipeg, 1987-88. Winnipeg: Manitoba Centre for Health Policy and Evaluation.

Mustard, C., & Roos, N. (1994). The relationship of prenatal care and pregnancy complications to birthweight in Winnipeg, Canada. American Journal of Public Health, 84, 1450-1457.

National Forum on Health. (1997). The need for an Aboriginal health institute in Canada. In Canada Health Action: Building on the Legacy, Volume II. Ottawa: Minister of Public Works and Government Services.

Native Affairs Secretariat. (1995). Profile of Manitoba's Aboriginal Population. Winnipeg: Manitoba Northern Affairs.

Norbeck, J., DeJoseph, J., & Smith, R. (1996). A randomized trial of an empirically-derived social support intervention to prevent low birthweight among African American women. Social Science and Medicine, 43, 947-954.

Norbeck, J., & Tilden, V. (1983). Life stress, social support, and emotional disequilibrium in complications of pregnancy: A prospective, multivariate study. Journal of Health and Social Behavior, 24, 352-362.

Norton, L., Peipert, J., Zierler, S., Lima, B., & Hume, L. (1995). Battering in pregnancy: An assessment of two screening methods. Obstetrics and Gynecology, 85, 321-325.

Nuckols, C., Cassal, J., & Kaplan, B. (1972). Psychosocial assets, life crisis, and the prognosis of pregnancy. American Journal of Epidemiology, 95, 431-441.

Ottawa-Carleton Preterm Birth Prevention Initative. (1992). Ottawa-Carleton Health Department and Regional Perinatal Progam Questionnaire. Unpublished questionnaire. Ottawa: Author.

Orr, S., James, S., Miller, C., Barakat, B., Daikoku, N., Pupkin, M., Engstrom, K., & Huggins, G. (1996). Psychosocial stressors and low birthweight in an urban population. American Journal of Preventive Medicine, 12, 459-466.

Orr, S., Miller, C., James, S., & Babones, S. (2000). Unintended pregnancy and preterm birth. Paediatric and Perinatal Epidemiology, 14, 309-313.

Paarlberg, K., Vingerhoets, A., Passchier, J., Dekker, G., & Van Geijn, H. (1995). Psychosocial factors and pregnancy outcome: A review with emphasis on methodological issues. Journal of Psychosomatic Research, 39, 563-595.

Papiernik, E., Bouyer, J., Dreyfus, J. Collin, D., Winisdorffer, G., Guegen, S., Lecomte, M., & Lazar, P. (1985). Prevention of preterm births: a perinatal study in Haguenau, France. Pediatrics, 76, 154-158.

Papiernik, E., Bouyer, J., Yaffe, K., Winisdorffer, G., Collin,D., & Dreyfus, J. (1986). Women's acceptance of a preterm birth prevention program. American Journal of Obstetrics and Gynecology, 155, 939-946.

Parker, B., McFarlane, J., & Soeken, K. (1994). Abuse during pregnancy: Effects on maternal complications and birth weight in adult and teenage women. Obstetrics & Gynecology, 84, 323-328.

Parker, B., McFarlane, J., Soeken, K., Torres, S., & Campbell, D. (1993). Physical and emotional abuse in pregnancy: A comparison of adult and teenage women. Nursing Research, 42, 173-178.

Parker, J., Schoendorf, K., & Kiely, J. (1994). Associations between measures of socioeconomic status and low birth weight, small for gestational age, and premature delivery in the United States. Annals of Epidemiology, 4, 271-278.

Parsons, L., Goodwin, M., & Petersen, R. (2000). Violence against women and reproductive health: Toward defining a role for reproductive health services. Maternal and Child Health Journal, 4, 135-140.

Passaro, K., Little, R., Savitz, D., Noss, J., & the ALSPAC Study Team. (1996). The effect of maternal drinking before conception and in early pregnancy on infant birthweight. Epidemiology, 7, 377-383.

Peacock, J., Bland, J., & Anderson, H. (1995). Preterm delivery: Effects of socioeconomic factors, psychologic stress, smoking, alcohol, and caffeine. British Medical Journal, 311, 531-535.

Pearlin, L. (1989). The sociological study of stress. Journal of Health and Social Behavior, 30, 241-256.

Petersen, D. (1999). *Vive la Difference!* The international symposium, "Society and individual predisposition for successful pregnancy outcome". Maternal and Child Health Journal, 3, 61-62.

Petrou, S., & Davidson, L. (2000). Economic issues in the follow-up of neonates. Seminars in Neonatology, 5, 159-169.

Pickett, K., Abrams, B., & Selvin, S. (2000). Defining preterm delivery - the epidemiology of clinical presentation. Paediatric and Perinatal Epidemiology, 14, 305-308.

Pivarnik, J. (1998). Potential effects of maternal physical activity on birth weight: brief review. Medicine and Science in Sports and Exercise, 30, 400-406.

Preterm Birth Prevention Consensus Conference. (1998). Report and Background Papers. Ottawa, Canada: Perinatal Partnership Program of Eastern and Southeastern Ontario.

Pritchard, C., & Teo Mfphm, P. (1994). Preterm birth, low birthweight and the stressfulness of the household role for pregnant women. Social Science and Medicine, 38, 89-96.

Prochaska, J., & Velicer, W. (1997). The transtheoretical model of health behavior change. American Journal of Health Promotion, 12, 38-48.

Public Health Service Expert Panel on Prenatal Care. (1989). Caring for our future: The content of prenatal care. Washington, DC: Public Health Service, U.S. Department of Health and Human Services.

Ray, W., Mitchel, E., & Piper, J. (1997). Effect of Medicaid expansions on preterm birth. American Journal of Preventive Medicine, 13, 292-207.

Reid, A., Biringer, A., Carroll, J., Midmer, D., Wilson, L, Chalmers, B., & Stewart, D. (1998). Using the ALPHA form in practice to assess antenatal psychosocial health. Canadian Medical Association Journal, 159, 677-684.

Rini, C., Dunkel-Schetter, C., Wadhwa, P., & Sandman, C. (1999). Psychological adaptation and birth outcomes: The role of personal resources, stress, and sociocultural context in pregnancy. Health Psychology, 18, 333-345.

Ritter, C., Hobfoll, S., Lavin, J., Cameron, R., & Hulsizer, M. (2000). Stress, psychosocial resources, and depressive symptomatology during pregnancy in low-income, inner-city women. Health Psychology, 19, 576-585.

Rosenberg, M. (1965). Society and the adolescent self image. Princeton, NJ: Princeton University Press.

Roth, F., Hendrickson, J., Schilling, M., & Stowell, D. (1998). The risk of teen mothers having low birth weight babies: Implications of recent medical research for school health personnel. Journal of School Health, 68, 271-275.

Rothman, K., & Greenland, S. (1998). Modern Epidemiology (2nd ed.). Philadelphia: Lippincott-Raven Publishers.

Rowley, D. (1998). Beyond the medical model: research on social factors and preterm delivery. Prenatal and Neonatal Medicine, 3, 170-172.

Savitz, D., Blackmore, C., & Thorp, J. (1991). Epidemiologic characteristics of preterm delivery: Etiologic heterogeneity. American Journal of Obstetrics and Gynecology, 164, 467-471.

Schieve, L., Cogswell, M., & Scanlon, K. (1999). Maternal weight gain and preterm delivery: Differential effects by body mass index. Epidemiology, 10, 141-147.

Schieve, L., Cogswell, M., Scanlon, K., Perry, G., Ferre, C., Blackmore-Prince, C., Yu, S., & Rosenberg, D., for the NMIHS Collaborative Working Group. (2000). Prepregnancy Body Mass Index and pregnancy weight gain: Associations with preterm delivery. Obstetrics and Gynecology, 96, 194-200.

Schlesselman, J. (1982). Case-control studies: Design, conduct, analysis. New York: Oxford University Press.

Scholl, R., Hediger, M., Bendich, A., Schall, J., Smith, W., & Krueger, P. (1997). Use of multivitamin/mineral prenatal supplements: influence on the outcome of pregnancy. American Journal of Epidemiology, 146, 134-141.

Scholl, R., Hediger, M., Fisher, R., & Shearer, J. (1992). Anemia vs iron deficiency: Increased risk of preterm delivery in a prospective study. American Journal of Clinical Nutrition, 55, 985-989.

Seward, J., & Stanley, F. (1981). Comparison of births to Aboriginal and Caucasian mothers in Western Australia. The Medical Journal of Australia, 2, 80-84.

Shah, N., & Bracken, M. (2000). A systematic review and meta-analysis of prospective studies on the association between maternal smoking and preterm delivery. American Journal of Obstetrics and Gynecology, 182, 465-472.

Sheehan, T. (1998). Stress and low birth weight: A structural modeling approach using real life stressors. Social Science and Medicine, 47, 1503-1512.

Shiono, P., Rauh, V., Park, M., Lederman, S., & Zuskar, D. (1997). Ethnic differences in birthweight: The role of lifestyle and other factors. American Journal of Public Health, 87, 787-793.

Shiono, P., & Klebanoff, M. (1993). A review of risk scoring for preterm birth. Clinics in Perinatology, 20, 107-125.

Shoham-Vardi, I., Levy, E., Belmaker, I., Mazor, M., & Goldstein, D. (1997). Utilisation of prenatal services and birth outcomes: A community-based study in Israel. Paediatric and Perinatal Epidemiology, 11, 271-286.

Siega-Riz, A., Adair, L., & Hobel, C. (1998). Maternal hematologic changes during pregnancy and the effect of iron status on preterm delivery in a West Los Angeles population. American Journal of Perinatology, 15, 515-522.

Siega-Riz, A., Adair, L., & Hobel, C. (1996). Maternal underweight status and inadequate rate of weight gain during the third trimester of pregnancy increases the risk of preterm delivery. Journal of Nutrition, 126, 146-153.

Smylie, J. (2000). SOGC Policy Statement. A guide for health professionals working with Aboriginal peoples: The sociocultural context of Aboriginal peoples in Canada. Journal of the Society of Obstetricians and Gynaecologists of Canada, 22, 1070-1081.

Smylie, J. (2001a). SOGC Policy Statement. A guide for health professionals working with Aboriginal peoples: Health issues affecting Aboriginal peoples. Journal of the Society of Obstetricians and Gynaecologists of Canada, 23, 54-68.

Smylie, J. (2001b). SOGC Policy Statement. A guide for health professionals working with Aboriginal peoples: Cross cultural understanding. Journal of the Society of Obstetricians and Gynaecologists of Canada, 23, 157167.

Smylie, J. (2001c) SOGC Policy Statement. A guide for health professionals working with Aboriginal peoples: Aboriginal health resources. Journal of the Society of Obstetricians and Gynaecologists of Canada, 23, 255-261.

Society of Obstetricians and Gynecologists of Canada. (1996). Policy Statement: Violence against women, No. 46. Ottawa: Author.

Society of Obstetricians and Gynecologists of Canada. (1998). SOGC Clinical Practice Guidelines: Healthy Beginnings: Guidelines for care during pregnancy and childbirth, No. 71. Ottawa: Author.

Soeken, K., McFarlane, J., Parker, B., & Lominack, M. (1998). The Abuse Assessment Screen: A clinical instrument to measure frequency, severity, and perpetrator of abuse against women. In J. Campbell (Ed.), Empowering survivors of abuse: Health care for battered women and their children (pp. 195-203). Thousand Oaks, CA: Sage Publications.

Spinillo, A., Capuzzo, E., Piazzi, G., Ferrari, A., Morales, V., & Di Mario, M. (1998). Risk for spontaneous preterm delivery by combined body mass index and gestational weight gain patterns. Acta Obstetricia et Gynecologica Scandinavica, 77, 32-36.

Statistics Canada. (1991). General Social Survey. Ottawa: Author.

Statistics Canada. (1994). National Population Health Survey. Ottawa: Author.

Stewart, P. (1994). Population attributable risk for prematurity and small for gestation age babies. Unpublished final report, July 1994. Ottawa, ON: Ottawa-Carleton Preterm Birth Prevention Program.

Stewart, P. (1998). Primary prevention of preterm birth. Background paper prepared for the Preterm Birth Prevention Consensus Conference, April 1998. Ottawa, Canada.

Stewart, P., & Nimrod, C. (1993). The need for a community-wide approach to promote healthy babies and prevent low birth weight. Canadian Medical Association Journal, 149, 281-285.

Sokoloski, E. (1995). Canadian First Nations Women's beliefs about pregnancy and prenatal care. Canadian Journal of Nursing Research, 27, 89-100.

Stout, M. (1996). Aboriginal Canada: Women and Health. Paper prepared for the Canada-U.S.A. Women's Health Forum, August 8-10, 1996.

Tourangeau, R., & Smith, T. (1996). Asking sensitive questions: The impact of data collection mode, question format, and question context. Public Opinion Quarterly, 60, 275-304.

United States Public Health Service Expert Panel on the Content of Prenatal Care. (1989). Caring for our future: the content of prenatal care. Washington, DC: Public Health Service.

Ventura, S., Martin, J., Curtin, S., & Mathews, T. (1999). Births: Final data for 1997. National Vital Statistics Reports, 47(18), 1-74.

Ventura, S., Martin, J., Curtin, S., Menacker, F., & Hamilton, B. (2001). Births: Final data for 1999. National Vital Statistics Reports, 49(1), 1-21.

Wadhwa, P., Porto, M., Garite, T., Chicz-DeMet, A., & Sandman, C. (1998). Maternal corticotropin-releasing hormone levels in the early third trimester predict length of gestation in human pregnancy. American Journal of Obstetrics and Gynecology, 179, 1079-1085.

Wadhwa, P., Sandman, C., Porto, M., Dunkel-Schetter, C., & Garite, T. (1993). The association between prenatal stress and infant birth weight and gestational age at birth: A prospective investigation. American Journal of Obstetrics and Gynecology, 169, 858-865.

Walker, L. (1989). A longitudinal analysis of stress process among mothers of infants. Nursing Research, 38, 339-343.

Walker, S., Higgins, J., Permezel, M., & Brennecke, S. (1999). Maternal work and pregnancy. Australia and New Zealand Journal of Obstetrics and Gynaecology, 39, 144-151.

Weinbaum, Z., Adams, L., Motylewski-Link, C., & Chavez, G. (2000, December). Domestic violence victims among women giving birth in California in 1999. Paper presented at the CDC Sixth Annual Maternal and Child Health Epidemiology Conference, Atlanta, GA.

Wen, S., Goldenberg, R., Cutter, G., Hoffman, H., & Cliver, S. (1990). Intrauterine growth retardation and preterm delivery: prenatal risk factors in an indigent population. American Journal of Obstetrics and Gynecology, 162, 213-218.

Wiemann, C., Agurcia, C., Berenson, A., Volk, R., & Rickert, V. (2000). Pregnant adolescents: Experiences and behaviors associated with physical assault by an intimate partner. Maternal and Child Health Journal, 4, 93-101.

Wildschut, H., Nas, T., & Golding, J. (1997) Are sociodemographic factors predictive of preterm birth? A reappraisal of the 1958 British Perinatal Mortality Survey. British Journal of Obstetrics & Gynecology, 104, 57-63.

Wilkins, R., Sherman, G., & Best, P. (1991). Birth outcomes and infant mortality by income in urban Canada, 1986. Health Reports, 3(1), 7-31.

Wilkinson, D., Korenbrot, C., & Greene, J. (1998). A performance indicator of psychosocial services in enhanced prenatal care of Medicaid-eligible women. Maternal Child Health Journal, 2, 131-143.

Winnipeg Area Study. Winnipeg Area Survey, 1984-1998. Winnipeg: Department of Sociology, University of Manitoba.

Winnipeg Area Study. (2000). 2000 Winnipeg Area Study Codebook. Winnipeg: Department of Sociology, University of Manitoba.

Wisborg, K., Henriksen, T., Hedegaard, M., & Secher, N. (1996). Smoking during pregnancy and preterm birth. British Journal of Obstetrics and Gynecology, 103,800-805.

Young, T. K. (1994a). The Health of Native Americans: Toward a Biocultural Epidemiology. New York: Oxford University Press.

Young, T. K. (1994b). Measuring the Health Status of Canada's Aboriginal Population: A Statistical Review and Methodological Commentary. Winnipeg: University of Manitoba Northern Health Research Unit.

Zimmer-Gembeck, M., & Helfand, M. (1996). Low birth weight in a public prenatal care program: Behavioral and psychosocial risk factors and intervention. Social Science and Medicine, 43, 187-197.

APPENDICES

APPENDIX A

Determinants of Health

Determinant of Health	Description
Income and Social Status	This is the single most important determinant of health. Health status improves at each step up the income and social hierarchy. Higher income levels affect living conditions such as safe housing and the ability to buy sufficient good food.
Social Support Networks	Support from families, friends and communities is associated with better health. The health effect of the support of family and friends who provide a caring and supportive relationship may be as important as risk factors such as smoking, physical activity, obesity, and high blood pressure.
Education	Health status improves with level of education. Education increases opportunities for income and job security and gives people a sense of control over their lives – key factors which influence health.
Unemployment and Working Conditions	Unemployment, under-employment and stressful work are associated with poorer health. Those with more control over their work and fewer stress-related demands on the job are healthier.
Social Environments	The values and rules of a society affect the health and well-being of individuals and populations. Social stability, recognition of diversity, safety, good relationships and cohesive communities provide a supportive society which reduces or removes many risks to good health.
Physical Environment	Physical factors in the natural environment (e.g., air, water quality) are key influences on health. Factors in the human-built environment such as housing, workplace safety, community and road design are also important influences.
Personal Health Practices and Coping Skills	Social environments that enable and support healthy choices and lifestyles, as well as people's knowledge, behaviours, and coping skills for dealing with life in healthy ways, are key influences on health.
Healthy Child Development	The effect of prenatal and early childhood experiences on subsequent health, well-being, coping skills, and competence is very powerful. For example, a low weight at birth links with health and social problems throughout a person's life.

Culture	Culture and ethnicity come from both personal history and wider situational, social, political, geographic, and economic factors. Multicultural health issues demonstrate how necessary it is to consider the inter-relationships of physical, mental, spiritual, social, and economic well-being together.
Health services	Health services, particularly those which maintain and promote health, prevent disease and restore health, contribute to population health.
Gender	Gender refers to the many different roles, personality traits, attitudes, behaviours, values, relative powers and influences which society assigns to the two sexes. Each gender has specific health issues or may be affected in different ways by the same issues.
Biology and Genetic Endowment	The basic biology and organic make-up of the human body are fundamental determinants of health. Inherited predispositions influence the ways individuals are affected by particular diseases or health problems.

Note: Excerpted from: Health Promotion and Programs Branch. (1998). A Population Health Approach: Definitions and Guiding Principles. A Document in Progress (pp. 6-7). Ottawa: Health Canada.

APPENDIX B

Factors assessed for their causal effect on gestational duration in developed countries

Assessment	Factor
Causal effect ruled out with high probability	Infant sex Maternal height Paternal height & weight Parity Iron and anaemia Caffeine/coffee consumption
Causal effect unlikely, but evidence insufficient to rule out	Racial/ethnic origin Maternal hemodynamics Marital status Sexual activity Prior stillbirth or neonatal death Prior infertility Gestational weight gain Caloric intake Protein status/intake Folic acid and Vitamin B12 Zinc & copper Calcium, phosphorus, and vitamin D Malaria Urinary tract infection Alcohol consumption Narcotic addiction First antenatal care visit Number of antenatal care visits
Causal effect uncertain, but importance unlikely owing to small effect magnitude or low prevalence	Birth or pregnancy interval Prior induced abortion Vitamin B6 Other vitamins & trace elements
Causal effect well established and important, but unmodifiable	Prior history of prematurity Prior spontaneous abortion

Causal effect well established and important, but modifiable only over long term	Socioeconomic conditions
Causal effect well established, important, and modifiable over short term	Pre-pregnancy weight Very young maternal age Maternal education In utero exposure to DES Cigarette smoking
Causal effect uncertain, but potentially important and modifiable	Stress and anxiety Maternal work General morbidity, episodic illness Genital tract infection Environmental toxins Quality of antenatal care

(Adapted from Kramer, 1987)

APPENDIX C

Summary of studies on risk factors for preterm birth

Author	Design & Sample Size	Risk factors related to preterm birth
Kramer et al. (1992)	Cohort Study; n=13,102 women who delivered in Montreal, Canada between 1980 & 1989	-maternal short stature -noncompletion of high school -unmarried status -smoking -diabetes -UTI within 2 weeks of delivery -prepregnancy hypertension -severe PIH -previous history of preterm delivery, LBW or neonatal death
Parker et al. (1994)	Reanalysis of data from 1988 National Maternity and Infant Health Survey (U.S.); n=9953 births	-black women with income poverty, <13 years education -black and white women with operator, fabricator or laborer occupations
Meis et al. (1995)	Analysis of database of births in Cardiff, Wales; n=26,205 births	-young maternal age (<20 years) -low maternal weight -low or high parity -previous abortion -smoking -early pregnancy bleeding
Lang et al. (1996)	Estimated effect of 23 factors on prevalence of preterm labor; n=9,940 babies in Boston	-maternal education (<grade 12) -young maternal age (<16 years) -low prepregnancy weight (<100 pounds) -low weekly weight gain -nulliparity -previous preterm birth -history of 2 or more induced abortions, spontaneous abortions, or stillbirths -uterine exposure to DES -incompetent cervix -uterine anomaly -pyelonephritis
Harlow et al. (1996)	Cohort study; analyzed data from a large multicenter	-male fetus -nulliparity -black race

	RCT (RADIUS trial) in the U.S.; n=14,948 low risk singleton pregnancies	-prior LBW baby -cigarette smoking -high serum alpha fetoprotein
Peacock et al. (1995)	Prospective study of 1513 pregnant women in London, England	-lower social class -less education -single marital status -low income -help from professional agencies -little contact with neighbours -trouble with nerves and depression
Adams et al. (1995)	Retrospective chart review; n=1825 pregnant women delivered at U.S. army medical centers; used proportional hazards analysis	-history of preterm delivery -maternal race (black) -alcohol use (maternal drinking) -sexually transmitted disease during pregnancy -maternal height (<62 inches) -body mass index -initiation of prenatal care after first trimester
Stewart et al. (1994)	Cross-sectional study. N=7,940 pregnant women in Ottawa	-primiparity -presence of a serious health problem -high perceived stress during pregnancy -previous preterm birth -smoking after month 4 -short maternal height -previous abortion
Haas et al. (1991)	Case control study; n=140 cases and 280 control in Boston, MA	-history of prior preterm birth -smoking during pregnancy -prepregnancy weight <61.5 kg -history of maternal DES exposure -history of prior induced abortion
Pickett et al. (2000)	Analysis of UCSF Perinatal Database; n=7723 deliveries between 1980 & 1990; n=417 spontaneous PTBs	-Black race -married -primiparous -smoker
Orr et al. (2000)	Cohort study; n=922 women receiving prenatal care in Baltimore	-intendedness of pregnancy -alcohol use -drug use -bleeding during pregnancy

	City during 1994-1995	-hospitalization during pregnancy -poor weight gain <21 lbs -preeclampsia -previous poor pregnancy outcome -smoking
Foix-L'Helias & Blondel (2000)	National representative sample of births in France for 1995; n=12,869 infants; data collected from hospital records	-maternal age $\geq$ 35 -primiparous -previous induced abortion -previous adverse pregnancy outcome

APPENDIX D

Estimation of Sample Size and Sampling Plan

Note: *The following excerpt from my dissertation proposal (submitted on May 20, 1999 to my dissertation committee) outlines the sampling plan and estimates the required sample size for the study:*

The number of eligible cases anticipated at the two institutions in one year was taken into consideration prior to determining sample size. In 1996, there were 15,221 live births in Manitoba, of which 1,037 (6.8%) were preterm (<37 weeks gestation). Of these live births, 7,173 were delivered at St. Boniface General Hospital and Health Sciences Center combined, of which 743 (10.4%) were preterm. Thus the majority of preterm births in the province (743 of 1,037 births, or 72%) occurred at the two tertiary care hospitals in Winnipeg. One hundred twelve of these 743 preterm births (15.1%) were to Aboriginal women with treaty status (Personal communication, J. Blanchard, December 1997). Refer to Table 2. It should be noted that this approach provides an underestimate of Aboriginal women by approximately one half, since treaty status is not recorded for about 30% of Aboriginal women in the perinatal database at Manitoba Health, and non-status Aboriginal women cannot be identified (Personal communication, J. Blanchard, August 1998). Therefore it was anticipated that up to half as many more Aboriginal women would be available, yielding a potential sample of 168 Aboriginal women with preterm births in one year.

Table 2.
Preterm Births at St. Boniface General Hospital and Health Sciences Centre, 1992 to 1996

Year	Aboriginal PTBs	Non-Aboriginal PTBs	Total PTBs	Total Live Births	% PTBs
1992	81	657	738	7924	9.3%
1993	96	652	748	7654	9.8%
1994	97	616	713	7486	9.5%
1995	118	662	780	7452	10.5%
1996	112	631	743	7173	10.4%

The percentage of preterm births identified as indicated preterm births exhibits a wide variation in published studies, ranging from 16.9% to 37.1% (Meis, 1998). If we estimate that approximately 25% of all preterm births are due to adverse maternal or fetal diagnoses that warrant induction of labor or elective cesarean section for early delivery, then 75% of the preterm births at St. Boniface General Hospital and Health Sciences Center would occur spontaneously after preterm labor or premature rupture of membranes. This yields a potential number of cases of approximately 557 women in one year, of whom about 126 would be Aboriginal women. If a response rate of 70% is obtained, the number of potential cases will drop to approximately 389 women, of whom about 88 would be Aboriginal women. A fairly low response rate for cases was estimated because women who have delivered a premature infant receiving care in the Special Care Nursery may be experiencing high levels of stress and may not be willing to participate in the study when approached in the immediate postpartum period.

The average exposure rate among controls for some of the key risk factors also needed to be estimated prior to calculating sample size. Exposure among controls was estimated at 25% based on other studies showing smoking rates of 26.6 to 28.8% among pregnant women in Manitoba (Gupton & Hague, 1997; Mustard & Roos, 1994), low prepregnancy BMI among 28.6% of white women and 20.1% of black women (Hickey et al., 1997), inadequate weight gain in the third trimester among 23.9% of women (Siega-Riz et al., 1996), and inadequate prenatal care among 25% of Winnipeg women (Mustard & Roos, 1994), while violence during pregnancy occurs in 14 to16% of women (McFarlane et al., 1996; Parker et al., 1994).

Sample size was estimated using Epi Info, Version 6.04, based on the following parameters: one-sided alpha of 5%, power of 80%, minimum detectable odds ratio of 1.6, exposure among controls of 25%, and a ratio of controls per case of 2:1. When the number of subjects in the case group is limited, as in this study, an increase in the number of subjects in the control group will increase the study's power. Increases in the ratio of controls to cases lead to gains in power until a ratio of 4 to 1 is reached; after that point, gains in power usually become too small to be worthwhile (Lasky & Stolley, 1994, p.13). The various ratios (ie. 1:1, 2:1, 3:1, 4:1) were compared, with a ratio of 2 controls to every case yielding the best gain in power for this study. The estimated sample size consisted of 220 cases and 440 controls, for a total sample of 660 women. Using power calculation, a reduction in the minimum detectable odds ratio to 1.5 would decrease the power of this sample to 73%.

Consideration was given to the need for matching. Matching refers to the selection of a reference series - unexposed subjects in a cohort study or controls in a case-control study - that is identical, or nearly so, to the index series with respect to the distribution of one or more potentially confounding factors (Rothman & Greenland, 1998, p. 147). Matching is a useful means for improving study efficiency, but can also introduce a selection bias that must be accounted for in the analysis by control of the matching factors. Another drawback of matching is that it is no longer possible to estimate the effect of the matched factor on the risk of disease (Rothman & Greenland, 1998). As Schlesselman notes, unless one has very good reason to match, one is undoubtedly better off avoiding the inclination (p. 122). Therefore, alternatives to matching will be used, including stratified sampling to avoid large case-control imbalances on potential confounding variables, and the use of post-stratification and regression analysis to control for confounding in the analysis of data (Schlesselman, 1982).

Stratified sampling by race will be employed to obtain predetermined numbers in subgroups of Aboriginal and non-Aboriginal women among both cases and controls. Stratified sampling involves the formation of subgroups by partitioning the ranges of specified variables and sampling a predetermined number of cases and a predetermined number of controls within cells created by the multiple cross-classification. Controls are usually sampled so that every subgroup has the same ratio of cases to controls, such as 1:1 or 1:2 ratio (Schlesselman, 1982, p.113). The prespecified distribution of subjects across racial strata will be as depicted in Table 3.

Table 3.
Targeted Number of Cases and Controls in Each Subgroup

Subgroup	No. of Cases	No. of Controls
Aboriginal subjects	90	180
Non-Aboriginal subjects	130	260
Total	220	440

The power of the study for the Aboriginal subgroup of subjects was calculated, based on 90 cases and 180 controls, with a one-sided alpha of 5% and an exposure rate among the controls of 30%. This yields an 83% power of detecting a minimum detectable odds ratio of 2.0. It is anticipated that exposure rates will be higher among the Aboriginal women for some of the risk factors. For example, just under one-third (28.8%) of Manitoba women smoke during their pregnancies, but rates vary widely among regions, with the highest occurring in Burntwood (59.4%), which has a high proportion of Aboriginal residents (Gupton & Hague, 1997).

All eligible cases delivering at either St. Boniface General Hospital or Health Sciences Center during the data collection time frame will be approached to participate in the study. Once the target number of non-Aboriginal subjects (n=130) is reached, all cases of preterm birth will continue to be screened but data will only be collected from eligible Aboriginal subjects until that target is reached (n=90). Systematic sampling will be used to obtain the controls; of all eligible controls, every 3rd woman at each hospital will be approached to participate in the study. Once the target number of non-Aboriginal subjects (n=260) is reached, every 3rd eligible woman will continue to be screened but data will only be collected from eligible Aboriginal subjects until that target is reached (n=180). The Labor and Delivery unit logbooks (in which each delivery is recorded chronologically) will be used to identify eligible cases and controls, and will serve as a sampling frame for controls. Fink (1995) notes that "systematic sampling should not be used if repetition is a natural component of the sampling frame" (p. 14). Although there are repetitions in term births associated with inductions (women tend to deliver in the evening since inductions are started in the mornings) and elective cesarean births (only scheduled on weekdays), these are exclusion criteria for the control group and therefore should not affect the control group. No other inherently recurring order is anticipated for potential subjects who meet the inclusion criteria for the control group; controls should therefore have an equal chance of selection. A random start is needed to systematically sample from the sampling frame (Fink, 1995), and a die will be tossed to determine what name on the list would be selected first, based on deliveries recorded in the logbook on the first day of data collection.

APPENDIX E

Letters of Approval from Ethical Review Committee

The University of Manitoba

FACULTY OF NURSING
ETHICAL REVIEW COMMITTEE

APPROVAL FORM

Proposal Number #99/32

Proposal Title: Risk Factors for Spontaneous Preterm Birth Among Aboriginal and Non-Aboriginal Women in Manitoba

Name and Title of Researcher(s): Maureen Heaman RN MN PhD (c)

Date of Review: June 28, 1999

APPROVED BY THE COMMITTEE: August 23, 1999

Comments: Approved with the revisions and clarifications as outlined in your letter of August 13, 1999

Date: August 23, 1999 Susan McClement RN PhD (c)
Associate Chairperson

NOTE:
Any significant changes in the proposal should be reported to the Chairperson for the Ethical Review Committee's consideration, in advance of implementation of such changes.

Revised: 92/05/08/se

UNIVERSITY OF MANITOBA | Office of the President

Office of Research Services
244 Engineering Building
Winnipeg, MB R3T 5V6
Canada
Telephone: (204) 474-8418
Fax: (204) 261-0325

APPROVAL CERTIFICATE

26 April 2001

TO: **Maureen Heaman** **(Advisor A. Gupton)**
Principal Investigator

FROM: **Lorna Guse, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2001:031**
"Focus Group to Interpret Results for the Project: Risk Factors for Spontaneous Preterm Birth among Aboriginal and Non-aboriginal Women"

Please be advised that your above-referenced protocol has received human ethics approval by the **Education/Nursing Research Ethics Board**, which is organized and operates according to the Tri-Council Policy Statement. This approval is valid for one year only.

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

APPENDIX F

Letters of Approval for Access to Subjects at
St. Boniface General Hospital and Health Sciences Centre

Health Sciences Centre

OFFICE OF THE DIRECTOR OF RESEARCH

MS7 - 820 SHERBROOK STREET
WINNIPEG, MANITOBA R3A 1R9
DIAL DIRECT (204) 787-4587
FAX (204) 787-4547

MEMORANDUM

DATE: September 15, 1999

TO: Ms M. Heaman, Principal Investigator, Director of Research, WCA

FROM: Dr. L. Oppenheimer, Director of Research, MS7

10.

SUBJECT: **PROTOCOL APPROVAL: RISK FACTORS FOR SPONTANEOUS PRETERM BIRTH AMONG ABORIGINAL AND NON-ABORIGINAL WOMEN IN MANITOBA.**

ETHICS #: N#99/32 RIC #: RI99:119

The above-named protocol, **has been evaluated and approved** by the H.S.C. Research Impact Committee.

If your study is receiving funds and H.S.C. Finance Division will be administering the funds, please contact the H.S.C. Finance Department for a "Specific Purposes Account Application Form".

PLEASE NOTE: **THE SPECIFIC RESEARCH ACCOUNT NUMBER ASSIGNED FOR THIS STUDY, CAN ONLY BE USED FOR THIS PARTICULAR STUDY.**

My sincere best wishes for much success in your study.

cc: Dr. K. Oen, Chairperson, PRCC, RR149
Ms G. Dutchuk, Finance Division, HSC
Department Head

/ks

interoffice
MEMORANDUM

Local: 3266 Fax: 231-0891

TO: Maureen Heaman, R.N.
St. Boniface General Hospital

FROM: Dr. J. Foerster
Chairperson, Research Review Committee

DATE: August 23, 1999

SUBJECT: **Experimental Protocol Submission**

This is to inform you that the Research Review Committee, at its meeting held on August 20, 1999, reviewed the protocol titled "Risk Factors for Spontaneous Preterm Birth Among Aboriginal and Non-Aboriginal Women in Manitoba", Ref # RRC/99/0044.

The Committee made the following recommendation:

i) That the researcher's response submitted to the UofM Faculty of Nursing Ethics Committee be forwarded to the Committee along with final UofM approval

The Committee approved the study with the above proviso and may now be implemented.

Please note the following:

i) That if retrospective patient chart review is required, there will be a $5.00 charge by Health Records for each medical record pulled. If the patient chart is offsite, an additional $2.60 will be applied.

Please be advised that copies of the protocols which have been approved **must be retained by the physician** doing the protocol for **at least two years** after the study is completed. The protocol must be kept for a longer term if it is anticipated that there will be a long-term effect.

JF/clr

cc: Drs. J. Blanchard & M. Moffatt - Co-investigators
Dr. L. Grant, Clinical Director, Women's Health Program
Ms. K. Neufeld, Director, Quality & Standards and CNO
Dr. I. Ripstein, President of the Medical Staff
Ms. H. Milan, Head, Pharmacy Department
Ms. D. Halhead, Finance Department

APPENDIX G

Invitation to Participate

You are invited to take part in a study to identify the risk factors for preterm birth in Manitoba women, and to compare risk factors among Aboriginal and non-Aboriginal women. Women who have had a premature baby at St. Boniface General Hospital or Health Sciences Centre, or whose baby has been transferred to these hospitals after birth, and a comparison group of women who delivered their baby at full term, are being approached to participate in the study. Information gained from this study will provide a better understanding of what factors may place women at greater risk of having a premature baby, and the differences in risk factors among various groups of women. Your assistance will be greatly appreciated.

If you agree to participate in this study, it will involve participating in an interview that will ask you a series of questions regarding risk factors for preterm birth that you many have experienced during your pregnancy. You will be asked about lifestyle factors, as well as your obstetric history and basic demographic data. The interview will take about 30 minutes of your time. Your hospital chart will also be reviewed to collect information such as your prenatal care, lab test results, how your labour went, and your baby's birthweight. Although there will be no immediate benefits to participants, the study may produce valuable information about factors related to preterm birth. There are no known negative consequences to study participants, although a discussion of risk factors may be upsetting for some women who have delivered a premature baby.

All information gathered in the course of the study will be kept completely confidential, and at no time will your identity be revealted. Because of the personal nature of some of the questions, your name will not appear on the forms. Only the study investigator and her faculty advisor, the research assistant, the data entry clerk, and a statistician will have access to the data. All data will be stored in a locked filing cabinet and destroyed when the study is completed. The results will be based on group data, not individual responses. No one will know how you, as an individual, answered the questions. The results of the study, presented as group data, may be published in a journal article. A summary of the study findings will be made available to those who would like them. This project has been approved by the Faculty of Nursing Ethical Review Committee at the University of Manitoba.

Participation in this study is entirely voluntary. You are free to refuse to answer any of the questions you are asked in the interview. You are also free to withdraw from the study at any time, without affecting the care you receive. If you have any questions that you would like answered about the study, you may call Maureen Heaman, PhD Student, (Phone 474-6222) or Annette Gupton, Associate Professor, Faculty of Nursing, University of Manitoba (Phone 474-7135). Thank you for taking the time to read this explanation about the study.

Maureen Heaman, RN, MN   Annette Gupton, RN, PhD

PhD Student, Interdisciplinary Program

University of Manitoba

Associate Professor, Faculty of Nursing
University of Manitoba

Appendix G (continued)

Consent Form

Risk Factors for Spontaneous Preterm Birth Among Manitoba Women

I,____, agree to participate in a study of risk factors for preterm birth among Aboriginal and non-Aboriginal women in Manitoba.

I have read the attached information sheet on this study. I understand that I am being asked to participate in an interview and agree to have my medical chart reviewed. The interview will take about 30 minutes of my time. I understand that if I agree to participate in this study, any information provided by me will be kept in strict confidence, and that results of the study will be presented as group data. I understand that my participation in this study is entirely voluntary. I am free to refuse to answer any questions I consider too personal or objectionable. I also understand that I may withdraw my participation at any time, without affecting my care.

I am aware that Maureen Heaman, her advisor Dr. Annette Gupton, a research assistant, a data entry clerk, and a statistician will have access to my questionnaires, but no others will have access to the individual surveys. I am also aware my name will not be placed on the data forms. Health records that contain my identity will be treated as confidential in accordance with the Personal Health Information Act of Manitoba, and only used for research purposes.

This research has been approved by the Faculty of Nursing Ethical Review Committee. I understand that I may contact either Maureen Heaman, PhD Student (Ph. 474-6222) or Dr. Annette Gupton, Associate Professor, Faculty of Nursing (Ph. 474-7135), at any time if I have concerns, questions, or need additional information.

__________________ ____________________________________

Date Signature of Study Participant

__________________ ____________________________________

Date Signature of Research Assistant

Participant Copy

Appendix G (continued)

Consent Form

Risk Factors for Spontaneous Preterm Birth Among Manitoba Women

I,______________________________________, agree to participate in a study of risk factors for preterm birth among Aboriginal and non-Aboriginal women in Manitoba. I have read the attached information sheet on this study. I understand that I am being asked to participate in an interview and agree to have my medical chart reviewed. The interview will take about 30 minutes of my time. I understand that if I agree to participate in this study, any information provided by me will be kept in strict confidence, and that results of the study will be presented as group data. I understand that my participation in this study is entirely voluntary. I am free to refuse to answer any questions I consider too personal or objectionable. I also understand that I may withdraw my participation at any time, without affecting my care.

I am aware that Maureen Heaman, her advisor Dr. Annette Gupton, a research assistant, a data entry clerk, and a statistician will have access to my questionnaires, but no others will have access to the individual surveys. I am also aware my name will not be placed on the data forms. Health records that contain my identity will be treated as confidential in accordance with the Personal Health Information Act of Manitoba, and only used for research purposes.

This research has been approved by the Faculty of Nursing Ethical Review Committee. I understand that I may contact either Maureen Heaman, PhD Student (Ph. 474-6222) or Dr. Annette Gupton, Associate Professor, Faculty of Nursing (Ph. 474-7135), at any time if I have concerns, questions, or need additional information.

____________________ ____________________________________

Date Signature of Study Participant

____________________ ____________________________________

Date Signature of Research Assistant

Researcher Copy

APPENDIX H

Subject Recruitment

Cumulative Totals

Date	Non-Aboriginal Controls	Aboriginal Controls	Non-Aboriginal Cases	Aboriginal Cases	Cumulative Total
Oct. 12-28, 1999	29	7	12	2	50
Oct. 29-Nov. 17	66	18	23	4	111
Nov. 18-Dec. 1	94	30	28	10	162
Dec. 2, 1999-Jan. 12, 2000	157	48	55	17	277
Jan. 13- Jan. 26, 2000	186	57	63	18	324
Jan. 27 - Feb. 15, 2000	212	68	70	23	373
Feb. 16-Mar 14, 2000	254	87	84	32	457
Mar. 14-Mar. 22, 2000	282	104	93	39	518
Mar. 23 - Apr. 5, 2000	--	114	98	39	533
Apr. 6 - Apr. 19, 2000	--	126	107	43	558
Apr. 20-May 3, 2000	--	140	114	47	583
May 4-May17, 2000	--	149	124	52	607
May 18-May 31, 2000	--	157	129	55	623
June 1 - 14, 2000	--	166	144	55	647
June 15- June 28, 2000	--	175	--	60	661
June 29 - Aug. 9, 2000	--	176*	--	68	670
Aug. 10 - Dec. 31, 2000	--	--	--	82**	684

*Note: Recruitment ended when the target number of 180 Aboriginal controls had been obtained, but 4 of these subjects were subsequently re-classified into other groups (due to errors in coding gestation or race), reducing the total number of Aboriginal controls to 176.

**Note: Because of the slow accrual of Aboriginal cases, the decision was made to stop subject recruitment as of December 31, 2000, even though the target of 90 cases had not been achieved.

APPENDIX I

Survey Questionnaire

RISK FACTORS FOR PRETERM BIRTH

Subject ID No.: ____________

Group:
- Preterm (Case) 1
- Term (Control) 0

Ethnic Background:
- Aboriginal..1
- Non-Aboriginal..0

Interviewer Initials: ________

Date of interview: _____/_____/_____
Day Month Year

Place of interview:
- Hospital..1
- Home...2
- Other (specify _______________)..............3

Place of delivery
- St. Boniface General Hospital....................1
- Health Sciences Centre............................2
- Other (specify __________________).........3

Start time of interview:
____________ hours (24 hour clock)

I'd like to begin the interview by asking you some questions about your delivery.

1. What was the date of your delivery?
   _____/_____/_____
   Day Month Year

2. What was your expected date of delivery, or your due date?
   _____/_____/_____
   Day Month Year

3. Did you plan to deliver your baby at this hospital?

Yes.................................1
No..................................0

If no, where did you originally plan to deliver your baby?

____

Why did your intended place of delivery change?

____

4. How many times throughout your life have you been pregnant? This would include any pregnancies which did not go full term.

______ times
DK. 98
NR..99
(adapted from Ottawa Carleton Health Department and Regional Perinatal Program Questionnaire)

5. How many babies have you had?

______ babies
DK..98
NR..99
(adapted from Ottawa Carleton Health Department and Regional Perinatal Program Questionnaire)

6. Have any of your pregnancies been multiple births (e.g. Twins or triplets)?

Yes...1
No..0
DK..8
NR..9
(adapted from Ottawa Carleton Health Department and Regional Perinatal Program Questionnaire)

7. Have you ever had a miscarriage, ectopic pregnancy, abortion, or a stillbirth? If so, how many times?

Miscarriage:

No, none................................0
Yes, one.................................1
Yes, two.................................2
Yes, three or more..................3
NA...7
DK...8
NR...9

Ectopic pregnancy:

No, none................................0
Yes, one.................................1
Yes, two.................................2
Yes, three or more..................3
NA...7
DK...8

NR...9

Abortion:

No, none.................................0
Yes, one.................................1
Yes, two.................................2
Yes, three or more..................3
NA...7
DK...8
NR...9

Stillbirth:

No, none.................................0
Yes, one.................................1
Yes, two.................................2
Yes, three or more..................3
NA...7
DK...8
NR...9

(adapted from Ottawa Carleton Health Department and Regional Perinatal Program Questionnaire)

8. Have you ever had a (previous) premature delivery?

No, none...............................0
Yes, one...............................1
Yes, two...............................2
Yes, three or more.................3
NA.......................................7
DK.......................................8
NR.......................................9

(adapted from Ottawa Carleton Health Department and Regional Perinatal Program Questionnaire)

9. Now I'd like to ask about any chronic health problems you may have had before you became pregnant. Do you have any of the following chronic health problems?

Diabetes:

Yes.....................................1
No......................................0
DK......................................8
NR......................................9

High blood pressure:

Yes.....................................1
No......................................0
DK......................................8
NR......................................9

Heart disease

Yes.....................................1
No......................................0
DK......................................8

NR..9

Kidney disease:

Yes..1
No..0
DK..8
NR..9

Asthma:

Yes..1
No..0
DK..8
NR..9

Other (specify________________________________):

Yes..1
No..0
DK..8
NR..9

(adapted from Ottawa Carleton Health Department and Regional Perinatal Program Questionnaire)

10. Did you have any of the following health problems during your pregnancy?

Gestational diabetes (diabetes which started during this pregnancy):

Yes..1
No..0
DK..8
NR..9

Kidney infection (pyelonephritis):

Yes..1
No..0
DK..8
NR..9

Bladder infection:

Yes..1
No..0
DK..8
NR..9

Vaginal bleeding after 12 weeks (3 months) of pregnancy:

Yes..1
No..0
DK..8
NR..9

Excess amniotic fluid around the baby (polyhydramnios):

Yes..1
No..0
DK..8
NR..9

High blood pressure (preeclampsia):

Yes..1

No..0
DK..8
NR..9

Sexually transmitted disease (specify: eg. chlamydia, gonorrhea, herpes, syphilis_____________________________):

Yes..1
No..0
DK..8
NR..9

Surgery on your abdomen:

Yes..1
No..0
DK..8
NR..9

Other problems during your pregnancy (specify_____________________________):

Yes..1
No..0
DK..8
NR..9

(adapted from Ottawa Carleton Health Department and Regional Perinatal Program Questionnaire)

11. The next question is about the times you may have had to stay in the hospital while you were pregnant. Not counting the time you came to the hospital to have your baby, how many other times during your pregnancy did you go into a hospital and stay at least one night?

___ ___ times
DK..............98
NR..............99

12. The next questions are about the prenatal care you got during your pregnancy. How many weeks or months pregnant were you when you had your first visit for prenatal care? Don't count a visit that was only for a pregnancy test.

______ weeks or ______ months
DK....................................98
NR....................................99

13. About how many visits for prenatal care did you have during your pregnancy? If you don't know how many, please give me your best guess.

______ visits
DK.............................98
NR.............................99

14. (Ask term mothers only.) How many visits for prenatal care did you have between 36 weeks and your delivery date?

___ visits
DK.............................8
NR.............................9

15. Did your membranes break (fluid leak) before you went into labour?

Yes....................................1
No......................................0
DK.....................................8
NR.....................................9

How far along were you in your pregnancy?

______ weeks

(adapted from Ottawa Carleton Health Department and Regional Perinatal Program Questionnaire)

Now I'd like to ask you several questions about yourself.

16. What is your age (in years)? _______

17. How tall are you without your shoes on?

_____/_____ or ______
feet inches cms.

(adapted from General Social Survey, Statistics Canada, 1991)

18. How much did you weigh before getting pregnant?

_______ or _____
pounds kgs.

(adapted from General Social Survey, Statistics Canada, 1991)

19. What is your current living arrangement?

Now married and living with spouse.....................1
Common-law relationship or live-in partner.........2
Single - never married...3
Divorced..4
Separated..5
Widowed...6
NR...9

(adapted from Winnipeg Area Survey, 1984-1998, University of Manitoba Department of Sociology)

20. What is your highest level of education? This includes complete and incomplete. (PROVIDE A CARD WITH RESPONSE CATEGORIES ON IT.)

No schooling...01
Elementary school
  Incomplete..02
  Complete...03
Junior High School
  Incomplete..04
  Complete...05
High School
  Incomplete..06
  Complete...07
Non-University (Vocational/technical)
  Incomplete..08

Complete...09

University

Incomplete..10

Diploma/Certificate (e.g. hygienists).........11

Bachelor's Degree.......................................12

Professional Degree (Vet,Dr., Lawyer).....13

Master's Degree..14

Doctorate..15

NR..99

(adapted from Winnipeg Area Survey, 1984-1998, University of Manitoba Department of Sociology)

21. In total, how many years of schooling do you have? This includes total of grade school, high school, vocational, technical, and university.

______ years

(adapted from Winnipeg Area Survey, 1984-1998, University of Manitoba Department of Sociology)

22. Did you have a paid job of any kind during your pregnancy?

Yes..............................1 (---->GO TO Q #24)

No...............................0

NR...............................3

(adapted from Winnipeg Area Survey, 1984-1998, University of Manitoba Department of Sociology)

23. During your pregnancy, were you unemployed, that is, out of work and looking for work?

Yes...............................1 (--->GO TO Q #31)

No................................0 (--->GO TO Q #31)

NA................................7

NR................................9

(adapted from Winnipeg Area Survey, 1984-1998, University of Manitoba Department of Sociology)

24. During your pregnancy, were you employed full time?

Yes..1

No...0

NA...7

NR...9

(adapted from Winnipeg Area Survey, 1984-1998, University of Manitoba Department of Sociology)

25. During your pregnancy, were you (also) employed part time?

Yes..1

No...0

NA...7

NR...9

(adapted from Winnipeg Area Survey, 1984-1998, University of Manitoba Department of Sociology)

26. On average, how many hours did your work for pay each week during your pregnancy? (This total includes all of your jobs: full-time and part-time)

_______ hours
NA......................97
DK......................98
NR......................99

(adapted from Winnipeg Area Survey, 1984-1998, University of Manitoba Department of Sociology)

27. On what date did you last work prior to your delivery?

______/______/______
Day Month Year
NA......................97
DK......................98
NR......................99

28. For what type of business, industry or service did you work for the longest time during your pregnancy? (Give full description, e.g., paper box manufacturing, retail shoe store, municipal board of education)

____

____

(adapted from General Social Survey, Statistics Canada, 1991)

29. What kind of work were you doing? (Give full description, e.g. accounts clerk, dairy farmer, primary school teacher)

____

____

(adapted from General Social Survey, Statistics Canada, 1991)

30. Which of the following best describes the hours you usually worked?

Regular day time schedule......................................1
Regular afternoon or evening schedule..................2
Regular night shift...3
Rotating shift (one that changes periodically)........4
Other...5
NA...7
NR...9

(adapted from General Social Survey, Statistics Canada, 1991

I am now going to ask you questions about the amount of time you spent on physical activity at work or while doing your daily chores, but not leisure time activity.

31. During your pregnancy, how many hours per day did you usually spend standing or walking but not carrying or lifting things? Would that be...

None..0
Less than 15 minutes.............................1
15 minutes to less than 2 hours............2
Two to less than 4 hours........................3
Four to less than 6 hours........................4
Six hours of more..................................5

NA...7
DK...8
NR...9
(adapted from General Social Survey, Statistics Canada, 1991)

32. During your pregnancy, how many hours per day did you usually spend lifting or carrying light loads, climbing stairs or hills? Would that be...
None...0
Less than 15 minutes.............................1
15 minutes to less than 2 hours............2
Two to less than 4 hours.........................3
Four to less than 6 hours.......................4
Six hours of more..................................5
NA...7
DK...8
NR...9
(adapted from General Social Survey, Statistics Canada, 1991)

33. During your pregnancy, how many hours per day did you usually spend doing heavy work or carrying very heavy loads? Would that be...
None...0
Less than 15 minutes.............................1
15 minutes to less than 2 hours............2
two to less than 4 hours.........................3
Four to less than 6 hours.......................4
Six hours of more..................................5
NA...7
DK...8
NR...9
(adapted from General Social Survey, Statistics Canada, 1991)

34. People also do a variety of other types of work even though it may not involve a paid job. For each of the following, please tell me if it applied to you during your pregnancy. (RESPONDENT ANSWERS ALL QUESTIONS. RECORD "SHARED" ONLY IF VOLUNTEERED).

	Yes	No	Shared	NA	NR
Mainly responsible for housework	1	2	3	4	5
Mainly responsible for raising child(ren)	1	2	3	4	5
Taking care of some other dependent person (elderly, disabled, grandparent)	1	2	3	4	5
Going to school or studying in some program	1	2	3	4	5
Doing some volunteer work	1	2	3	4	5

(adapted from Winnipeg Area Survey, 1984-1998, University of Manitoba Department of Sociology)

35. What is the total income of all the members of your household for this past year before tax and deductions? (PROVIDE A CARD WITH RESPONSE CATEGORIES ON IT)
No income......................................01
Under $10,000................................02

$10,000-19,999................................03
$20,000-29,999................................04
$30,000-39,999................................05
$40,000-49,999................................06
$50,000-59,999................................07
$60,000-69,999................................08
$70,000-79,999................................09
$80,000-89,999................................10
$90,000-99,999................................11
$100,000 or over.............................12
DK..98
NR..99
(adapted from Winnipeg Area Survey, 1984-1998, University of Manitoba Department of Sociology)

36. Which of the following best describes your racial background? Would you say...
White...1
Black................. 2
Aboriginal..3
Asian..4
Latino (Hispanic)..............................5
Other (specify ______________)......6
NR...9
(adapted from Fink, 1995)

37. The ancestors of Canadians come from many ethnic and cultural groups such as Inuit, French, Scottish, and Chinese. Which of the following best describes the ethnic or cultural group(s) to which you belong? (Accept multiple responses)
English...01
French..02
German...03
Scottish...04
Italian...05
Irish..06
Ukrainian...07
Chinese..08
Dutch (Netherlands)..............................09
Jewish...10
Polish..11
Black...12
First Nations (Treaty status)..................13
First Nations (Non status).......................14
Metis...15
Inuit/Eskimo..16
Other (specify________________).........17
Canadian (probe: Any other group?)....18
DK...98
NR...99
(adapted from General Social Survey, Statistics Canada, 1991)

38. What language do you speak most often at home? (Accept multiple response only if languages are spoken equally)

English...01
French..02
Italian..03
German...04
Ukrainian..05
Dutch...06
Chinese...07
Hungarian..08
Portuguese...09
Polish...10
Cree..11
Ojibway...12
Saulteaux...13
Island Lake.................................14
Other (specify_________________).......15
DK..98
NR..99
(adapted from General Social Survey, Statistics Canada, 1991)

I would now like to ask you some questions about your use of cigarettes, alcohol and drugs during your pregnancy.

39. Did you smoke cigarettes during the month before you became pregnant?

Yes..1
No...0 (--->GO TO Q #41)
NR..9
(adapted from Ottawa Carleton Health Department and Regional Perinatal Program Questionnaire)

40. How many cigarettes did you smoke each day in the month before you became pregnant (on average)?

No. of cigarettes per day ______
NA..7
DK..8
NR..9
(adapted from Ottawa Carleton Health Department and Regional Perinatal Program Questionnaire)

41. Did you smoke cigarettes after you knew you were pregnant?

Yes..1
No...0 (--->GO TO Q# 43)
NR..9
(adapted from Ottawa Carleton Health Department and Regional Perinatal Program Questionnaire)

42. How many cigarettes did you smoke each day, on average,...

During the first three months of your pregnancy? _____

During the second three months of your pregnancy? _____
During the third three months of your pregnancy? _____

43. How often did you drink alcohol during your pregnancy (eg. beer, wine, hard liquor, liqueurs)? (Do not read list, mark one only)

Never ....01 (--->GO TO Q#45)
Less than once a month.............02
1-3 times a month......................03
Once a week...............................04
2-3 times a month......................05
4-6 times a week.........................06
Every day....................................07
NA...97
DK...98
NR...99

(adapted from National Population Health Survey, Statistics Canada, 1994)

44. When we use the word drink it means: one beer, one small glass of wine, or 1 1/2 ounces of liquor. On the days that you drank, how many drinks did you usually have?

Before realizing you were pregnant? ______
During the first three months of your pregnancy? _____
During the second three months of your pregnancy? _____
During the third three months of your pregnancy? _____

(adapted from National Population Health Survey, Statistics Canada, 1994)

45. Did you take any recreational drugs such as marijuana, LSD or cocaine during your pregnancy?

Yes.................................1
No..................................0 (---> GO TO Q#48)
NR.................................9

(adapted from National Population Health Survey, Statistics Canada, 1994)

46. Which of the following drugs did you take?

Marijuana/Hashish/Cannabis:
- Yes.............................1
- No..............................0
- NA..............................7
- NR..............................9

LSD:
- Yes.............................1
- No..............................0
- NA..............................7
- NR..............................9

Cocaine:
- Yes.............................1
- No..............................0
- NA..............................7
- NR..............................9

Heroin:
- Yes.............................1

No...............................0
NA...............................7
NR...............................9

Other (specify ______________________):

Yes..............................1
No...............................0
NA...............................7
NR...............................9

(adapted from National Population Health Survey, Statistics Canada, 1994)

47. At what stage in your pregnancy did you take these drugs? (READ LIST. MARK ALL THAT APPLY)

Before realizing you were pregnant?

Yes..............................1
No...............................0
NA...............................7
NR...............................9

During the first three months?

Yes..............................1
No...............................0
NA...............................7
NR...............................9

During the second three months?

Yes..............................1
No...............................0
NA...............................7
NR...............................9

During the third three months?

Yes..............................1
No...............................0
NA...............................7
NR...............................9

Throughout your pregnancy?

Yes..............................1
No...............................0
NA...............................7
NR...............................9

(adapted from National Population Health Survey, Statistics Canada, 1994)

I'd now like to ask you some questions about the amount of stress you experienced during your pregnancy. It is important to think back to how you felt during your pregnancy and not let how you are feeling now influence your answer.

48. During your pregnancy, would you describe your life as ...

Very stressful....................................1
Somewhat stressful............................2
Not very stressful...............................3
Not at all stressful..............................4
DK..8
NR..9

(adapted from General Social Survey, Statistics Canada, 1991)

For each of the next four questions, you will be asked how often you felt or thought a certain way, choosing from the following answers: never, almost never, sometimes, fairly often, very often. *(from Cohen's perceived stress scale)*

49. In the last month of your pregnancy, how often did you feel that your were unable to control the important things in your life?

Never..0
Almost never..................................1
Sometimes.....................................2
Fairly often....................................3
Very often.....................................4
DK..8
NR..9

50. In the last month of your pregnancy, how often did you feel confident about your ability to handle your personal problems?

Never..0
Almost never..................................1
Sometimes.....................................2
Fairly often....................................3
Very often.....................................4
DK..8
NR..9

51. In the last month of your pregnancy, how often did you feel that things were going your way?

Never..0
Almost never..................................1
Sometimes.....................................2
Fairly often....................................3
Very often.....................................4
DK..8
NR..9

52. In the last month of your pregnancy, how often did you feel difficulties were piling up so high that you could not overcome them?

Never..0
Almost never..................................1
Sometimes.....................................2
Fairly often....................................3
Very often.....................................4
DK..8
NR..9

Assessment of Stress, Social Support and Self-Esteem
(using Prenatal Psychosocial Profile instrument; Curry, Campbell, & Christian, 1994)

Psychosocial Assessment Tool

Assessment of Stress

Ask woman to what extent the following factors were stressors/hassles for her during her pregnancy. Circle the number corresponding to the appropriate response.

	To what extent were (READ CHOICE) a stressor/ hassle for you during your pregnancy?	No Stress	Some Stress	Moderate Stress	Severe Stress
53.	Financial worries (e.g., food, shelter, health care, transportation)	1	2	3	4
54.	Other money worries (e.g., bills, etc.)	1	2	3	4
55.	Problems related to family (partner,children, etc.)	1	2	3	4
56.	Having to move, either recently or in the future	1	2	3	4
57.	Recent loss of a loved one	1	2	3	4
58.	Your pregnancy	1	2	3	4
59.	Abuse, sexual, emotional, or physical.	1	2	3	4
60.	Problems with alcohol and/or drugs.	1	2	3	4
61.	Work problems (e.g., being laid off, etc)	1	2	3	4
62.	Problems related to friends	1	2	3	4
63.	Feeling generally "overloaded"	1	2	3	4

Psychosocial Assessment Tool

Assessment of Support

This next set of questions asks how satisfied you were with the amount of support you received from your partner and/or other people during your pregnancy.

64. First of all, do you have a partner?
    0. No (ask only about support from others)
    1. Yes

I will read you a list of statements describing types of support. On a scale of 1 to 6, with 1 being very dissatisfied and 6 being very satisfied, I want you to tell me how satisfied you are with the support you received from (your partner/other people) during your pregnancy.

	Partner						Other People					
	Very Dissatisfied					Very Satisfied	Very Dissatisfied					Very Satisfied
65. Shared similar experiences with me.	1	2	3	4	5	6	1	2	3	4	5	6
66. Helped keep up my morale	1	2	3	4	5	6	1	2	3	4	5	6
67. Helped me out when I was in a pinch	1	2	3	4	5	6	1	2	3	4	5	6
68. Showed interest in my daily activities and problems	1	2	3	4	5	6	1	2	3	4	5	6
69. Went out of his/her way to do special or thoughtful things for me	1	2	3	4	5	6	1	2	3	4	5	6
70. Allowed me to talk about things that are very personal and private	1	2	3	4	5	6	1	2	3	4	5	6
71. Let me know I am appreciated for the things I do for him/her	1	2	3	4	5	6	1	2	3	4	5	6
72. Tolerated my ups and downs and unusual behaviour	1	2	3	4	5	6	1	2	3	4	5	6
73. Took me seriously when I had concerns	1	2	3	4	5	6	1	2	3	4	5	6
74. Said things that made my situation clearer and easier to understand	1	2	3	4	5	6	1	2	3	4	5	6
75. Let me know that he/she would be around if I needed assistance	1	2	3	4	5	6	1	2	3	4	5	6

If respondent has partner: Now I will read these statements again and I want you to tell me how satisfied you are with the support your receive from people other than your partner.

Psychosocial Assessment Tool

Assessment of Self Esteem

We all have some kind of "picture" of ourselves we carry with us. I'm going to read you a list of statements that people have used to describe themselves. I would like you to tell me how much you agree or disagree that this statement described yourself during your pregnancy.

		Strongly Agree	Agree	Disagree	Strongly Disagree
76.	Felt that you were a person of worth, at least on an equal basis with others.	1	2	3	4
77.	Felt that you had a number of good qualities.	1	2	3	4
78.	All in all, felt that you were a failure.	1	2	3	4
79.	Felt you were able to do things as well as most other people.	1	2	3	4
80.	Felt you did not have much to be proud of	1	2	3	4
81.	Took a positive attitude toward yourself.	1	2	3	4
82.	On the whole, felt satisfied with yourself.	1	2	3	4
83.	Wished you could have had more respect for yourself.	1	2	3	4
84.	Felt useless at times.	1	2	3	4
85.	At times thought you were no good at all.	1	2	3	4
86.	Felt like you had control over your life.	1	2	3	4

Abuse Assessment Screen (McFarlane, Parker, Soeken, & Bullock, 1992)

I would like to ask you some questions about emotional and physical abuse. We know that the incidence of abuse increases during pregnancy, and some studies have linked abuse to preterm birth.

87. Have you ever been emotionally or physically abused by your partner or someone important to you?
    - Yes..1
    - No...0
    - NR...9

88. Within the last year, have you been hit, slapped, kicked, or otherwise physically hurt by someone?
    - Yes..1
    - No...0
    - NR...9

89. While you were pregnant, were you hit, slapped, kicked, or otherwise physically hurt by someone?
    - Yes..1
    - No...0
    - NR...9

90. Within the last year, has anyone forced you to have sexual activities?
    - Yes..1
    - No...0
    - NR...9

91. Are you afraid of your partner or anyone else?
    - Yes..1
    - No...0
    - NR...9

92. Did this interview bring up any concerns or questions that you would like to discuss with your health care provider?
    - Yes..............................1
    - No...............................0

93. Would you like me to approach your health care provider with this concern or question for you?
    - Yes..............................1
    - No...............................0

We're almost finished with the interview. I just have a few questions left about where you live.

94. We'd like to know whether we have included women from all areas of the province in this study. Which of the following best describes where you live?

Urban (Winnipeg or Brandon)..................1
South Rural Manitoba................................2
North Rural Manitoba................................3
Other (specify________________)......4
NR...9

95. How many times have you moved (that is, changed residences) in the last year?

______
DK................8
NR...............9

96. How many times have you moved (that is, changed residences) in the last five years, including the last year?

______
DK....................98
NR....................99

97. What is your current your postal code?

______ ______
DK...................999 998
NR...................999 999

That concludes the interview. Is there anything you would like to add?
Thank you very much for your participation.

Finish time for interview: ____________ hours (24 hour clock)

Length of interview in minutes: _________ minutes

APPENDIX J

Research Project: Risk Factors for Preterm Birth

Health Record Data Collection Form

Subject ID No.: ___________

Group: Preterm (Case) 1
Term (Control) 0

Ethnic Background: Aboriginal...1
Non-Aboriginal.......................................0

Interviewer Initials: _______

Date of chart review: _____/_____/_____
Day Month Year

---

98. Date of delivery
_____/_____/_____
Day Month Year

99. Gestational age at delivery (expressed in completed weeks from the first day of the last menstrual period if that figure agreed within 2 weeks with one based on the first ultrasound examination before 20 weeks; if there is more than a 2-week discrepancy or if the woman was uncertain of the LMP data, gestational age is based on the first ultrasound examination - Hickey et al, 1995)
______ weeks gestation

100. Type of labor
Spontaneous labor not preceded by rupture of membranes...............................1
Spontaneous rupture of membranes at least 1 hour before the onset of uterine contractions...2
DK..8

101. Type of delivery
Spontaneous vaginal delivery.................1
Forceps delivery....................................2
Vacuum extraction.................................3
Cesarean section....................................4

102. Gravida (status after delivery): _____

103. Para (status after delivery): ______

104. Sex of newborn
    Male..1
    Female.......................................2

105. Birthweight of newborn (grams): ____________

106. Mother's pregravid weight: _________ or _________
    pounds kilograms

107. Mother's height: _________ or _________
    inches cm.

108. First trimester weight gain (last weight observation during 10-13 weeks gestation minus the recalled prepregnancy weight): _________ or _________
    Pounds kilograms

    (from Hickey et al., 1995)

109. Second trimester weight gain (last weight observation during weeks 24-27 minus the first weight observation during weeks 14-18): _________ or _________
    Pounds kilograms

110. Third trimester weight gain (last weight observation before delivery minus the first weight observation during weeks 28-32): _________ or _________
    Pounds kilograms

111. Gestational age (in weeks) at first prenatal visit: ______

112. Dates of each prenatal visit:

Visit 1	______/______/______ Day Month Year
Visit 2	______/______/______ Day Month Year
Visit 3	______/______/______ Day Month Year
Visit 4	______/______/______ Day Month Year
Visit 5	______/______/______ Day Month Year
Visit 6	______/______/______ Day Month Year
Visit 7	______/______/______ Day Month Year
Visit 8	______/______/______ Day Month Year

Visit 9 ______/______/______
Day Month Year

Visit 10 ______/______/______
Day Month Year

Visit 11 ______/______/______
Day Month Year

Visit 12 ______/______/______
Day Month Year

Visit 13 ______/______/______
Day Month Year

Visit 14 ______/______/______
Day Month Year

113. Total number of prenatal visits (include first visit): ______

114. Hematocrit at 28-32 weeks gestation: _________
Date taken: ______/______/______
Day Month Year

115. Hemoglobin at 28-32 weeks gestation: ________
Date taken: ______/______/______
Day Month Year

116. Which of the following urogenital infections did the mother have during her pregnancy?

Gonorrhea
No................0
Yes...............1
If yes, number of times_____

Syphilis
No................0
Yes...............1
If yes, number of times_____

Chlamydia
No................0
Yes...............1
If yes, number of times_____

Bacterial vaginosis
No................0
Yes...............1
If yes, number of times_____

Urinary tract infection (UTI)
No................0
Yes...............1
If yes, number of times_____

Pyelonephritis
No................0

Yes……………1
If yes, number of times_____

Beta Strep
No……………..0
Yes……………1
If yes, number of times_____

Herpes
No……………..0
Yes……………1
If yes, number of times_____

Other (specify________________________________)
No……………..0
Yes……………1
If yes, number of times_____

APPENDIX K

Abuse Assessment Screen

(Circle Yes or No for each question)

1. Have you *ever* been emotionally or physically abused by your partner or someone important to you? Yes No

2. *Within the last year*, have you been hit, slapped, kicked or otherwise physically hurt by someone? Yes No
   If yes, by whom (circle all that apply)
   Husband Ex-husband Boyfriend Stranger Other Multiple
   Total number of times _______

3. *Since you've been pregnant*, have you been hit, slapped, kicked or otherwise physically hurt by someone?
   If yes, by whom (circle all that apply)
   Husband Ex-husband Boyfriend Stranger Other Multiple
   Total number of times _______

Mark the area of injury on the body map*.
Score each incident according to the following scale: [If any of the descriptions for the higher number apply, use the higher number]

1 = Threats of abuse including use of a weapon	Score _____
2 = Slapping, pushing; no injuries and/or lasting pain	Score _____
3 = Punching, kicking, bruises, cuts and/or continuing pain	Score _____
4 = Beating up, severe contusions, burns, broken bones	Score _____
5 = Head injury, internal injury, permanent injury	Score _____
6 = Use of weapon; wound from weapon	Score _____

4. *Within the last year*, has anyone forced you to have sexual activities? Yes No
   If yes, by whom (circle all that apply)
   Husband Ex-husband Boyfriend Stranger Other Multiple
   Total number of times _______

5. Are you afraid of your partner or anyone you listed above? Yes No

From: Soeken, McFarlane, Parker, & Lominack, 1998, p. 197.
*For body map, see Parker, McFarlane, Soeken, Torres, & Campbell, 1993, p. 176.

APPENDIX L

Prenatal Psychosocial Profile

(Curry et al., 1994; 1998)

Psychosocial Assessment Tool

Study ID# ________

Assessment of Stress

Ask women to what extent the following factors are current stressors/hassles. Circle the number corresponding to the appropriate response.

To what extent are (READ CHOICE) a current stressor/ hassle for you?		No Stress 1	Some Stress 2	Moderate Stress 3	Severe Stress 4
B18A.	Financial worries (e.g., food, shelter, health care, transportation)	1	2	3	4
B18B.	Other money worries (e.g., bills, etc.)	1	2	3	4
B18C.	Problems related to family (partner, children, etc.)	1	2	3	4
B18D.	Having to move, either recently or in the future.	1	2	3	4
B18E.	Recent loss of a loved one	1	2	3	4
B18F.	Current pregnancy	1	2	3	4
B18G.	Current abuse, sexual, emotional, or physical	1	2	3	4
B18H.	Problems with alcohol and/or drugs	1	2	3	4
B18I.	Work problems (e.g., being laid off, etc)	1	2	3	4
B18J.	Problems related to friends	1	2	3	4
B18K.	Feeling generally "overloaded"	1	2	3	4

Psychosocial Assessment Tool

Study ID# ________

Assessment of Support

This next set of questions asks how satisfied you are with the amount of support you receive from your partner and/or other people.

B19. First of all, do you have a partner?

- ☐ 0. No *(ask only about support from others)*
- ☐ 1. Yes

I will read you a list of statements describing types of support. On a scale of 1 to 6, with 1 being very dissatisfied and 6 being very satisfied, I want you to tell me how satisfied you are with the support you receive from *(your partner/other people)*.

		Partner						Other People					
		Very Dissatisfied					Very Satisfied	Very Dissatisfied					Very Satisfied
B19A.	Shares similar experiences with me	1	2	3	4	5	6	1	2	3	4	5	6
B19B.	Helps keep up my morale	1	2	3	4	5	6	1	2	3	4	5	6
B19C.	Helps me out when I'm in a pinch	1	2	3	4	5	6	1	2	3	4	5	6
B19D.	Shows interest in my daily activities and problems	1	2	3	4	5	6	1	2	3	4	5	6
B19E.	Goes out of his/her way to do special or thoughtful things for me	1	2	3	4	5	6	1	2	3	4	5	6
B19F.	Allows me to talk about things that are very personal and private	1	2	3	4	5	6	1	2	3	4	5	6
B19G.	Lets me know I am appreciated for the things I do for him/her	1	2	3	4	5	6	1	2	3	4	5	6
B19H.	Tolerates my ups and downs and unusual behaviors	1	2	3	4	5	6	1	2	3	4	5	6
B19I.	Takes me seriously when I have concerns	1	2	3	4	5	6	1	2	3	4	5	6
B19J.	Says things that make my situation clearer and easier to understand	1	2	3	4	5	6	1	2	3	4	5	6
B19K.	Lets me know that he/she will be around if I need assistance	1	2	3	4	5	6	1	2	3	4	5	6

If respondent has partner: Now I will read these statements again, and I want you to tell me how satisfied you are with the support you receive from people other than your partner.

Psychosocial Assessment Tool

Study ID# ________

Assessment of Self Esteem

We all have some kind of "picture" of ourselves we carry with us. I'm going to read you a list of statements that people have used to describe themselves. I would like you to tell me how much you agree or disagree that this statement describes yourself.

		Strongly Agree	Agree	Disagree	Strongly Disagree
B20A.	Feel that you're a person of worth, at least on an equal basis with others.	1	2	3	4
B20B.	Feel that you have a number of good qualities.	1	2	3	4
B20C.	All in all, feel that you are a failure.	1	2	3	4
B20D.	Feel you are able to do things as well as most other people.	1	2	3	4
B20E.	Feel you do not have much to be proud of.	1	2	3	4
B20F.	Take a positive attitude toward yourself.	1	2	3	4
B20G.	On the whole, feel satisfied with yourself.	1	2	3	4
B20H.	Wish you could have more respect for yourself.	1	2	3	4
B20I.	Feel useless at times.	1	2	3	4
B20J.	At times think you are no good at all.	1	2	3	4
B20K.	Feel like you have control over your life.	1	2	3	4

B20L. Did this interview bring up any concerns or questions that you would like to discuss with your prenatal care provider?

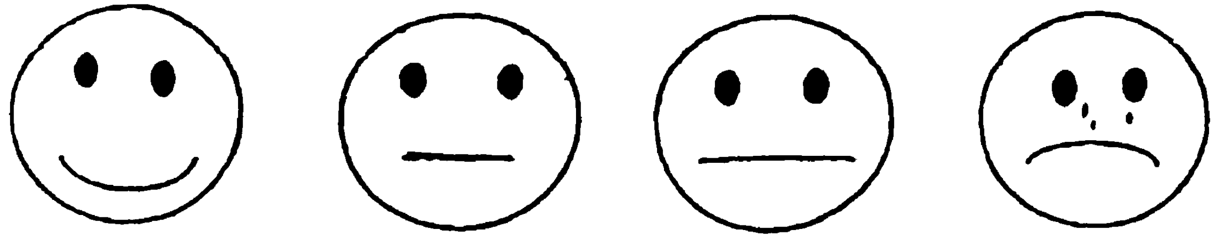
- ☐ 0. No
- ☐ 1. Yes

B20M. Would you like me to approach your prenatal care provider with this concern or question for you?

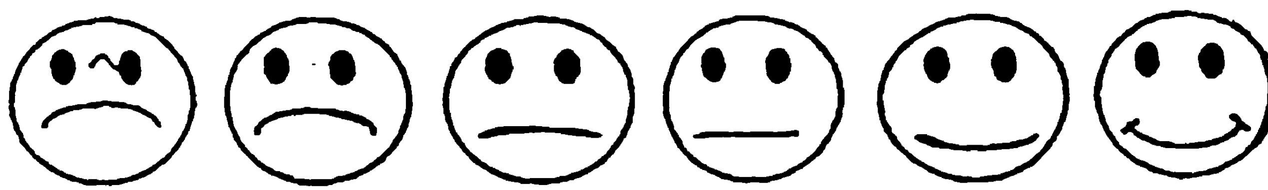
- ☐ 0. No
- ☐ 1. Yes

APPENDIX M

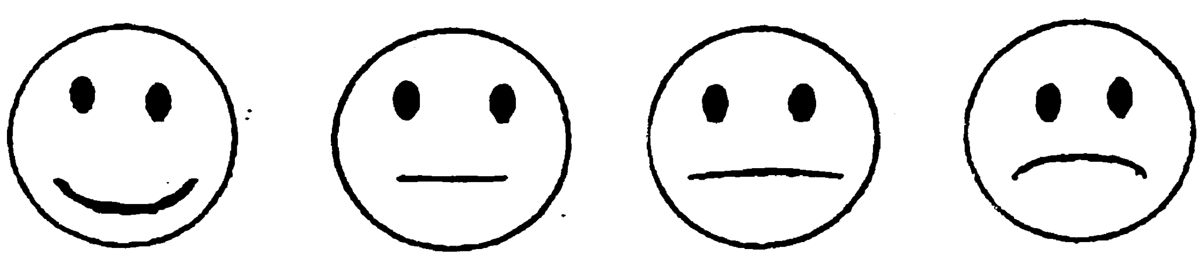
Response Cards for Prenatal Psychosocial Profile



1	2	3	4
No Stress	Some Stress	Moderate Stress	Severe Stress



1	2	3	4	5	6
Very Dissatisfied					Very Satisfied



1	2	3	4
Strongly Agree	Agree	Disagree	Strongly Disagree

APPENDIX N

Prenatal Psychosocial Scores for Different Groups of Participants

(From Curry et al., 1998, p. 216)

Table 2. Mean Scale Scores, Standard Deviations, and Cronbach's Alphas

Study	Stress *M* (*SD*) α	Partner Support *M* (*SD*) α	Other Support *M* (*SD*) α	Self-Esteem *M* (*SD*) α
Rural Native American[a] (*n* = 83)	18.26 (4.4) .71	52.17 (14.2) .96	52.9 (11.2) .95	34.44 (5.4) .85
Rural Hispanic[a] (*n* = 100)	16.17 (4.0) .72	62.37 (7.2) .94	59.13 (10.2) .96	32.12 (3.6) .76
Caucasian[a] (*n* = 1,223)	19.44 (4.8) .69	53.98 (11.5) .94	52.13 (10.9) .93	35.22 (5.6) .89
African American[b] (*n* = 406)	19.60 (5.1) .69	51.88 (13.5) .94	52.16 (11.7) .92	36.11 (5.1) .85
Hispanic[b] (*n* = 80)	18.52 (4.5) .67	56.96 (9.6) .92	52.38 (12.6) .96	35.22 (5.1) .87
Native American[b] (*n* = 60)	19.80 (5.2) .73	50.43 (14.9) .96	49.54 (13.3) .95	35.08 (5.2) .89
African American[c] (*n* = 791)	18.59 (5.1) .78	53.85 (13.9) .94	52.43 (13.3) .93	35.17 (4.9) .81
Caucasian[c] (*n* = 234)	18.89 (4.5) .74	56.97 (10.5) .92	52.74 (12.7) .93	34.37 (4.9) .86
Caucasian[d] (*n* = 349)	21.13 (5.3) .74	52.43 (12.5) .95	51.04 (11.7) .94	36.87 (3.9) .76
African American[e] (*n* = 118)	18.22 (5.6) .78	46.83 (17.4) .98	45.94 (15.8) .97	33.97 (5.9) .83

[a]Rural Oregon Minority Prenatal Project. [b]Low Birthweight Study. [c]North Carolina Study. [d]Oregon Preterm Birth Prevention Study. [e]San Francisco Study.

APPENDIX O

Population Attributable Risk Percent

Population attributable risk percent (PAR%), or etiologic fraction, was calculated using the following formula (Schlesselman, 1982):

$$PAR\% = \frac{Pe\,(RR - 1)}{1 + [Pe\,(RR - 1)]} \times 100$$

where P*e* = proportion of exposed controls, used as an estimate of exposed individuals in the target population, and RR = the adjusted odds ratio from Table 41 (multiple logistic regression model excluding medical risk factors), used as an approximation of the relative risk (RR).

Smoking prior to pregnancy:

All subjects	PAR = .470 (1.69-1) / 1 + [.470 (1.69-1)] X 100 = 24.5%
Non-Aboriginal subjects	PAR = .317 (1.61-1) / 1 + [.317 (1.61-1)] X 100 = 16.2%
Aboriginal subjects	PAR = .716 (1.59-1) / 1 + [.716 (1.59-1)] X 100 = 29.7%

Inadequate prenatal care:

All subjects	PAR = .080 (3.36-1) / 1 + [.080 (3.36-1)] X 100 = 15.9%
Non-Aboriginal subjects	PAR = .032 (3.05-1) / 1 + [.032 (3.05-1)] X 100 = 6.2%
Aboriginal subjects	PAR = .160 (3.21-1) / 1 + [.160 (3.21-1)] X 100 = 26.1%

Weight gain <20 pounds during pregnancy:

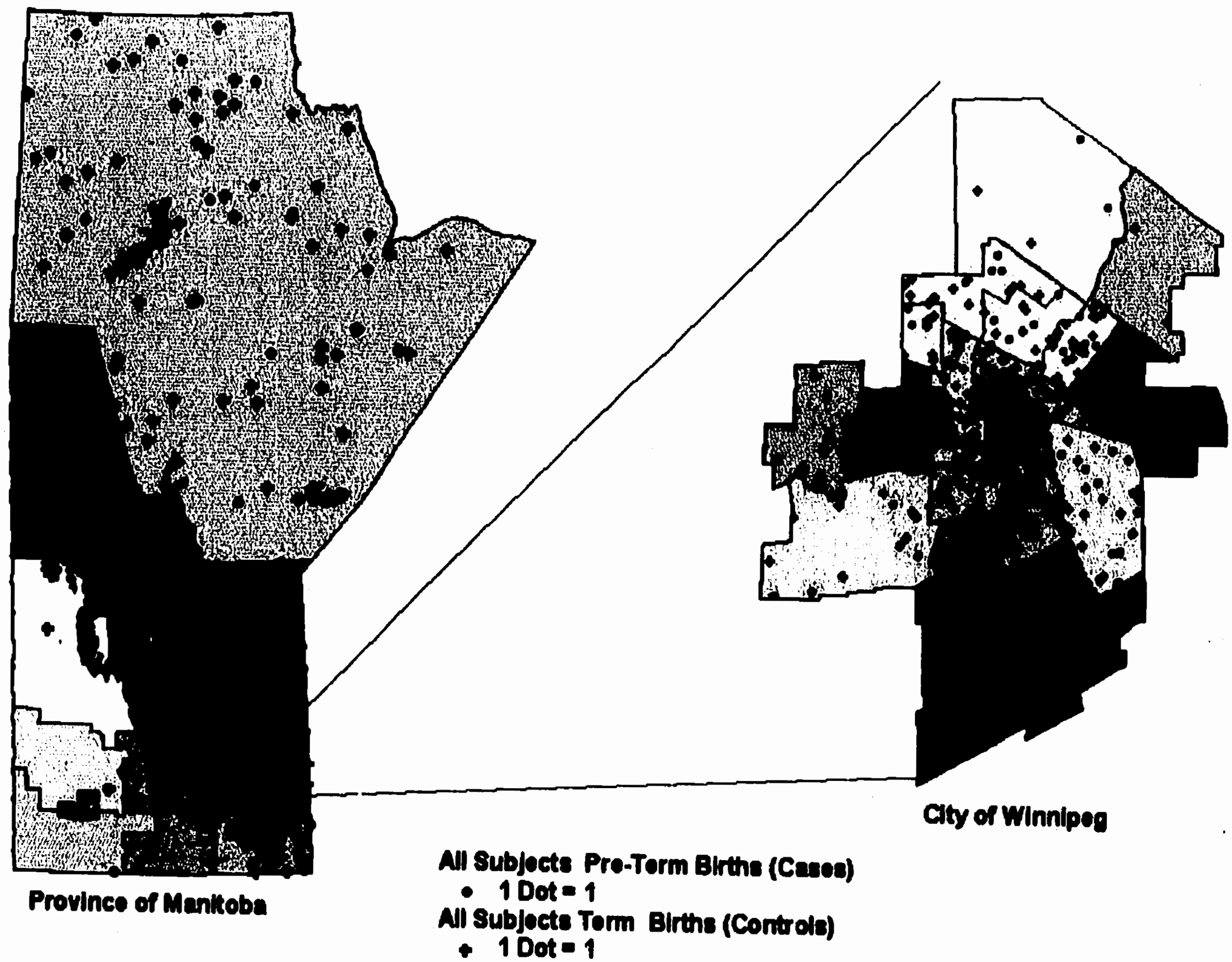
All subjects	PAR = .119 (3.41-1) / 1 + [.119 (3.41-1)] X 100 = 22.3%
Non-Aboriginal subjects	PAR = .120 (2.22-1) / 1 + [.120 (2.22-1)] X 100 = 12.8%
Aboriginal subjects	PAR = .120 (5.31-1) / 1 + [.120 (5.31-1)] X 100 = 34.1%

APPENDIX P

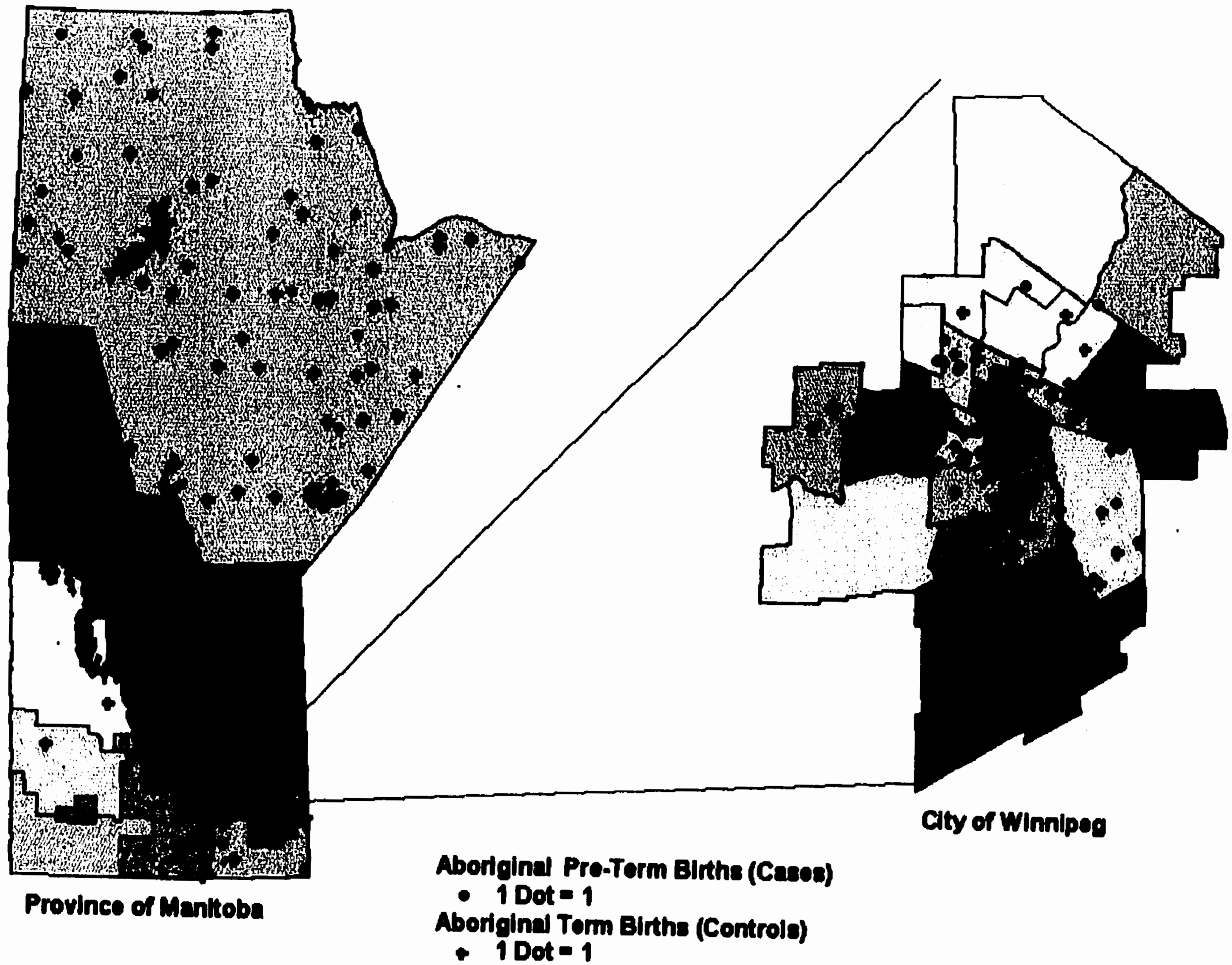
Maps

(Note: The dots representing subjects' place of residence are randomly distributed within each region to protect confidentiality of respondents.)

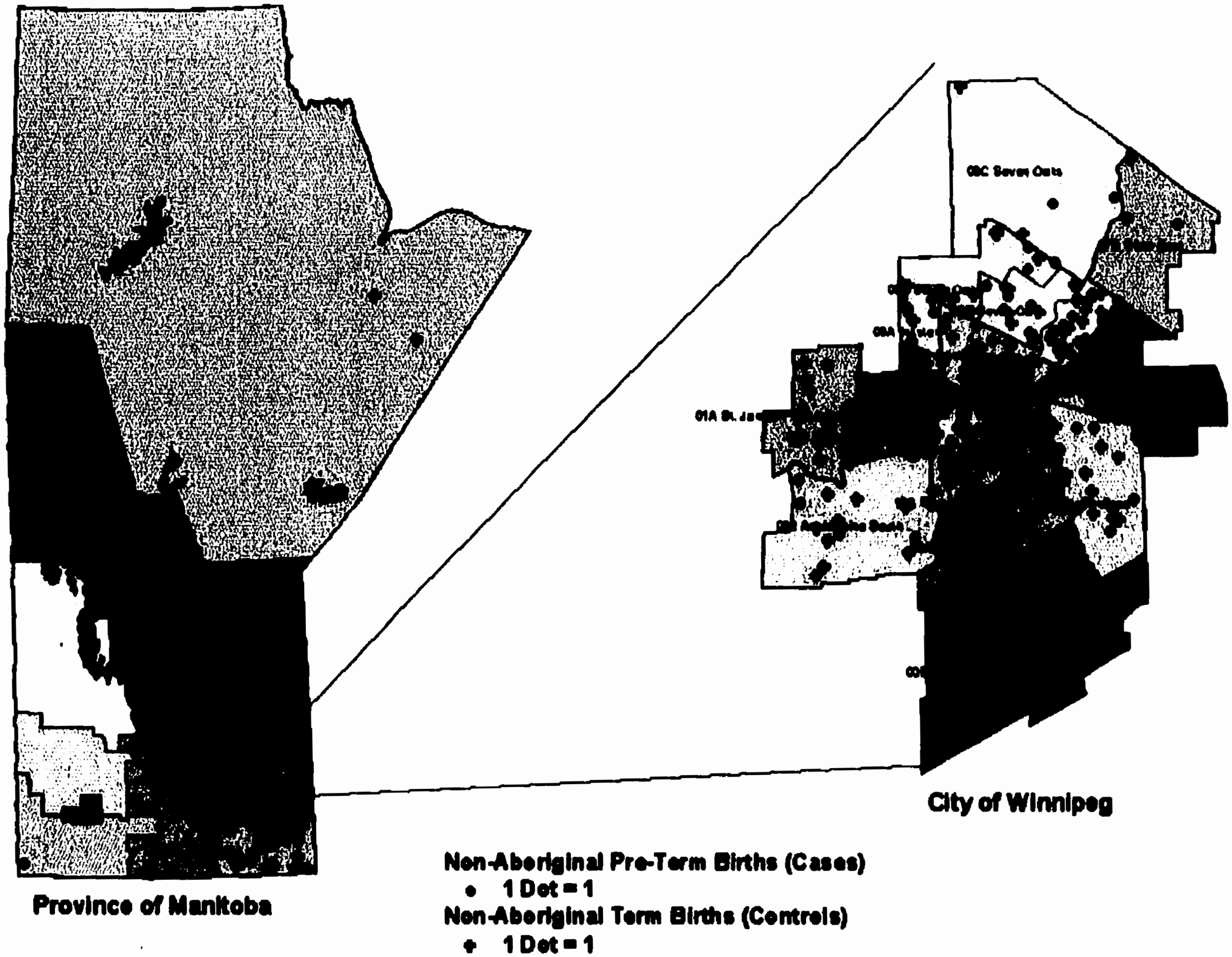
Place of Residence: All Subjects



Place of Residence: Aboriginal Subjects



Place of Residence: Non-Aboriginal Subjects



APPENDIX Q

Recommendations from the SOGC Policy Statement:

A Guide for Health Professionals Working with Aboriginal Peoples

A1. Health professionals should have a basic understanding of the appropriate names with which to refer to the various groups of Aboriginal peoples in Canada.

A2. Health professionals should have a basic understanding of the current sociodemographics of Aboriginal peoples in Canada.

A3. Health professionals should familiarize themselves with traditional geographic territorites and language groups of Aboriginal peoples.

A4. Health professionals should have a basic understanding of the disruptive impact of colonization on the health and well-being of Aboriginal peoples.

A5. Health professionals should recognize that the current sociodemographic challenges facing many Aboriginal individuals and communities have a significant impact on health status.

A6. Health professionals should recognize the need to provide health services for Aboriginal peoples as close to home as possible.

A7. Health professionals should have a basic understanding of government obligations and policies regarding the health of Aboriginal peoples in Canada.

A8. Health professionals should recognize the need to support Aboriginal individuals and communities in the process of self-determination.

B1. Health professionals should appreciate holistic definitions of health as defined by Aboriginal peoples.

B2. Health professionals should recognize that the degree of ill health in Aboriginal populations is unacceptable, and work with Aboriginal individuals and communities towards improved health outcomes.

B3. Health professionals should recognize and respond to key areas of morbidity and mortality without stereotyping.

C1. Relationships between Aboriginal peoples and their car providers should be based on a foundation of mutual respect.

C2. Health professionals should recognize that the current health care system presents many gaps and barriers for Aboriginal individuals and communities seeking health care.

C3. Health professionals should work proactively with Aboriginal individuals and communities to address these gaps and barriers.

C4. Health professionals should work with Aboriginal individuals and communities to provide culturally appropriate health care.

C5. Aboriginal peoples should receive treatment in their own languages, whenever possible.

C6. Health care programs and institutions providing service to significant numbers of Aboriginal peoples should have cultural interpreters and Aboriginal health advocates on staff.

C7. Aboriginal peoples should have access to informed consent regarding their medical treatment.

C8. Health services for Aboriginal peoples should recognize the importance of family and community roles and responsibilities when attempting to service Aboriginal individuals.

C9. Health professionals should respect traditional medicines and work with Aboriginal healers to seek ways to integrate traditional and western medicine.

C10. Health professionals should take advantage of workshops and other educational resources to become more sensitive to Aboriginal peoples.

C11. Health professionals should get to know Aboriginal communities and the people in them.

D1. Aboriginal communities and health professionals working with Aboriginal peoples should support the creation of community-directed health programs and services for Aboriginal peoples.

D2. Aboriginal communities and health professionals working with Aboriginal peoples should support the development of community-directed, participatory health research for Aboriginal peoples.

D3. **Aboriginal communities and health professionals working with Aboriginal peoples should encourage the education of Aboriginal health professionals committed to future work in Aboriginal communities.**

D4. **Aboriginal communities and health professionals working with Aboriginal peoples should recognize the need for preventative health programming in Aboriginal communities.**