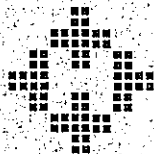


#93-01

The Utilization of Prenatal Care and Relationship to Birthweight Outcome in Winnipeg, 1987-88

January, 1993



**Manitoba Centre for
Health Policy and Evaluation**
Department of Community Health Sciences
Faculty of Medicine, University of Manitoba

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The Manitoba Centre for Health Policy and Evaluation

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Summary of Findings

Combining several different sources of administrative data, this study has described the use of routine prenatal care provided by physicians to approximately 12,000 pregnant women in Winnipeg between July 1987 and December 1988.

The objectives of the study were: 1) to examine the completeness and accuracy of routinely collected information on the characteristics of pregnant women and the prenatal care they received, 2) to determine whether inequities exist in the amount of prenatal care received by different groups of women, and 3) to assess the effectiveness of prenatal care in reducing the incidence of adverse birth outcome, specifically, low birthweight.

Prenatal care is a series of regular contacts between a health care provider, typically a physician, and a pregnant woman, that take place at scheduled intervals between the confirmation of pregnancy and the initiation of labour. The primary function of this care is to monitor the progress of pregnancy to identify complications, to provide information to the woman on beneficial practices and to co-ordinate the involvement of other providers in the mother's labour and the delivery of the newborn.

Prenatal care is commonly understood to have a beneficial effect on pregnancy outcome, either through the diagnosis and timely treatment of pregnancy complication or by contributing to the elimination or reduction of modifiable maternal risk factors. As a normal biological process, in most cases, pregnancy proceeds to term without adverse incident, and in such cases, prenatal care would not be expected to have a substantial effect on the outcome of pregnancy. One central premise of prenatal medical care is that the early initiation of care and the routine monitoring of the progress of pregnancy is important for the detection of complication. A second premise is that prenatal medical

care is effective in moderating or averting the impact of complication on fetal health and birth outcome. Women who do not have adequate access to prenatal care, therefore, may be at risk of undetected complications of pregnancy and may not receive care that might mitigate the adverse effects of complication on the duration of gestation and on birthweight.

The study's findings are presented in considerable detail in the following report. The main observations are described in this summary, followed by a set of recommendations.

The Utilization of Prenatal Care

On average, during the study period pregnant women in Winnipeg first sought care in the seventh week of gestation and saw their physician 11 times over the course of their pregnancy. Nine of every 10 women in the sample initiated care by the 13th week of pregnancy, and in only 2.2% of pregnancies was the initiation of care delayed until the third trimester. In general, these measures show prenatal care in Manitoba to be very good relative to other jurisdictions and to the standards of care defined by professional bodies, such as the Society of Obstetricians and Gynaecologists of Canada. In the time period of this study, Winnipeg women had access to an adequate supply of physician services for the provision of prenatal care.

However, not all women received this level of care. More than 1,000 women, or 8% of the sample, had fewer than five prenatal visits as measured by this study, and a further 14% had between five and eight prenatal contacts with physician providers (TABLE 4). Using criteria that reflect the date when care was initiated, the number of contacts and the length of gestation, the study found that approximately 25% of women received less than ideal care in the course of their pregnancy. Throughout this report, women who sought care early and saw their health care provider frequently have been classified as receiving adequate care, which is defined relative to current clinical standards.

Women living in poor neighbourhoods were much more likely to receive inadequate care

than women living in neighbourhoods of median or high average income. A total of 17% of poor women initiated care later than the first trimester, compared to less than 7% of women in median- or high-income neighbourhoods. At the same time, it appears that poor women in Winnipeg have better access to care than has been reported for typical U.S. samples. For example, 82.9% of poor women in Winnipeg initiated care by the end of the first trimester of pregnancy, compared to 69% of poor women in a study of prenatal care in Washington State (44) and 62% of Medicaid-insured women in a southern California study (14).

Poor women were found to have a higher incidence of complication in pregnancy than women from median- or high-income neighbourhoods (TABLE 6). In addition, many social and behavioral characteristics that are risk factors for adverse birth outcomes were found to be concentrated among poorer women. Relative to women in the wealthiest neighbourhoods, poor women were more than twice as likely to have reported smoking during pregnancy, were more than three times more likely to be unmarried and were four times more likely to be under the age of 20.

The Effectiveness of Prenatal Care

One objective of this study was to examine the effectiveness of prenatal care in the prevention of low birthweight births. In this sample, the 75% of women who received adequate prenatal care gave birth to heavier infants and fewer infants of low birthweight than the 25% of women who received inadequate care. However, the differences in birthweight between the two groups were subtle and suggest that prenatal care may in fact have a limited effect on the birthweight outcome of pregnancy.

In uncomplicated pregnancies, there is no plausible biological model to propose any significant benefit of prenatal medical care on birthweight outcome. This expectation was confirmed in this study: among uncomplicated pregnancies, women who received adequate care gave birth to infants who were on average only 55 g heavier than infants born to women who received inadequate care (TABLE 15). In these uncomplicated

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pregnancies, women who received inadequate care were at only marginally greater risk of having a low birthweight infant than women who received adequate care (ODDS RATIO 1.31, $p < .05$, TABLE 14), and the incidence of low birthweight in these pregnancies was very low (21/1000 births). These small differences in mean birthweight and in the incidence of low birthweight, although statistically significant, confirm the expectation that prenatal care does not have a clinically significant effect on the outcome of uncomplicated pregnancy.

It is only in complicated pregnancy that the early initiation of care and a frequent schedule of provider contacts are expected to favourably influence the outcome of pregnancy. However, a key finding from this study was the absence of a beneficial effect of prenatal care on birthweight among the 25% of women experiencing a complicated pregnancy. The difference in mean birthweight among complicated pregnancies between women who received adequate care and those who received inadequate care was only 63 g, although infants born to women experiencing a complication were on average 215 g lighter than babies born to women with uncomplicated pregnancies (TABLE 15). And while the incidence of low birthweight in complicated pregnancies, 124/1000, was six times higher than the rate in uncomplicated pregnancies, there was no meaningful difference in the rate of low birthweight between women who received adequate care and those who received inadequate care. If prenatal care is to confer substantial benefit on pregnancy outcome, this influence is expected to be most substantial among women whose pregnancies deviate from a normal course. The lack of difference in birthweight among complicated pregnancies between women who seek care early in pregnancy and have frequent visits and those with inadequate care challenges the premise that medical interventions are effective in the primary and secondary prevention of low birthweight.

In a very high proportion of cases, low birthweight is due to premature delivery. The findings of this study may be an accurate representation of the effectiveness of current medical therapies for the prevention of preterm birth. The causes of preterm labour remain unclear, and techniques to identify women at risk of preterm birth have not been

found to be sufficiently discriminatory to be of value in clinical settings. With the exception of some recent interest in tocolytic therapies, there has not been significant progress in the prevention and management of prematurity in the past two decades.

Inequities in Pregnancy Outcome

This study has placed a significant emphasis on describing differences in the use of prenatal care and pregnancy outcome in relation to a woman's socio-economic resources. After accounting for the higher prevalence of smoking during pregnancy, the higher incidence of pregnancy complication and the lower utilization of prenatal care among poor women, there still remained a difference in average birthweight of 89 g between the wealthiest and poorest women in this population (TABLE 12).

The crude incidence of low birthweight among poor women was almost twice that among women in the highest income stratum (ODDS RATIO 1.82, $p < .001$, TABLE 13). This excess risk was predominantly associated with four factors: the incidence of complication, smoking during pregnancy, being single and inadequate prenatal care. If a causal role for these factors is assumed, as much as 78% of the excess incidence of low birthweight could potentially be prevented if the prevalence or effect of these factors among poor women could be modified to equal the experience of the wealthiest women. Specifically, the data suggest that the higher incidence of complication among poor women accounts for 30% of the difference in the rate of low birthweight between the wealthiest and poorest women, 17% of the difference is attributable to the higher frequency of smoking, 15% to the higher prevalence of single marital status, only 12% to poorer utilization of antenatal care, and 22% of the difference is unexplained.

Limitations of the Study

There are a number of limitations of this study that must be considered when interpreting the implications of the findings. Some aspects of care are inadequately measured on the current administrative data systems. For example, prenatal care provided by non-physicians is not represented, and there is very strong evidence that contacts with

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community-based clinics are under-estimated in this study. The study did not include information on hospital-based prenatal interventions, such as ultrasound examination and fetal assessment procedures. These diagnostic procedures are used extensively to screen for abnormalities that threaten fetal viability and to anticipate complications of labour. Much of this information is not recorded in a manner that permits incorporation into individual maternal utilization histories.

While this study has focused on measures of the quantity of care, there are good reasons to believe that the quality of care is also important in contributing to a favourable pregnancy outcome. Aspects of the quality of care range from the skill with which clinical history taking and examination are performed, to the empathy and directness of counsel and advice. There is no adequate measure of the quality of care on the available administrative records documenting prenatal care. The study has also not described continuity of care. Women who receive most of their care from a single provider may receive higher quality care than women who see more than one provider during their pregnancy.

Finally, it must be emphasized that this study was based on an observational research design. Accordingly, inferences about cause and the order of effects based on these data must be made tentatively.

Recommendations

The Utilization of Prenatal Care

It is an achievement of the insurance mechanism of the Canadian health care system that the proportion of poor Winnipeg women who seek prenatal care early in pregnancy is much higher than is typically reported from jurisdictions in the United States. Despite this favourable external comparison, however, there are significant inequities in the use of care among Winnipeg women. Poor women face numerous obstacles to receiving adequate levels of prenatal care that are not addressed by insuring the cost of medical services. For example, the costs of transportation and the provision of care for young children in the home may represent serious financial barriers to the use of timely and frequent prenatal care. Women frequently may have to choose between a prenatal visit and a more pressing expenditure.

There are many initiatives with the potential to increase levels of use of prenatal care among poor women. On evidence from this study that community-based clinics are successful in recruiting poor women to their services, services could be expanded at such clinics and at similarly structured hospital-based clinics. Alternatively, direct cash grants could be provided to poor women to compensate for the indirect costs of frequent visits, along the lines of programs in place in many European jurisdictions.

Initiatives such as these may succeed in increasing the levels of use of prenatal care among poor women. However, the evidence from this study indicates that the higher rate of low birthweight among babies of poor women is not likely to be reduced by achieving higher use of medical care. Almost 70% of all low infants of birthweight in this study were born to women with a complication in pregnancy. Yet in complicated pregnancies, the incidence of low birthweight among women who received inadequate care was only marginally higher than that among women who received adequate care. Based on the outcomes in this study, measures to increase access to care among the 25% of women

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who received less than adequate care are estimated to have the potential to avert no more than 40 of the approximately 600 cases of low birthweight infants born to women in this sample.

In concluding that only a limited reduction in low birthweight outcomes would be expected to follow from improving the utilization of prenatal medical care, this study challenges popular and strongly held beliefs about the benefits of such care. It is extremely important that this conclusion not be generalized beyond the specific issue of the effectiveness of medical therapies in the prevention of low birthweight. There are, for example, many effective medical interventions in the primary and secondary prevention of disease. If the pattern of lower use of routine preventive care among poor women observed in this study also exists in the use of these services, then there are grounds to be very concerned about the consequences to health of inequities in utilization. Second, it would be inappropriate to conclude that prenatal medical care has a limited effect on maternal and newborn health on the basis of the effectiveness of prenatal care in the prevention of low birthweight. Prenatal care may be relatively ineffective in moderating the influence of pregnancy complications, or in preventing premature birth, but routine monitoring of pregnancy does provide important benefits in the co-ordination of care during labour and delivery.

This study was unable to examine hospital-based diagnostic services provided to women in the course of pregnancy. These institutions should be encouraged to examine the effectiveness of these services, especially the practice of numerous ultrasound examinations in normal pregnancies, in light of the limited evidence of a significant effect of early and frequent prenatal care on birthweight.

More than 85% of the women in this study received care from physicians who billed the single, global fee for antepartum and post-partum care. There is absolutely no evidence that the global fee acts as an incentive to physicians to reduce the frequency of contacts during pregnancy. The fact that more than 15% of women had 14 or more visits in the

course of their pregnancy indicates that physicians are providing care as required within the reimbursement structure of the global fee.

Recommendations:

1. The Manitoba Medical Association and Manitoba Health should be encouraged to retain the global fee mechanism for the reimbursement of antepartum and postpartum medical care.
2. The College of Physicians and Surgeons of Manitoba, in co-operation with the principal obstetrical hospitals in the province, should examine the cost-effectiveness of hospital-based diagnostic services, especially prenatal ultrasound examination, and, if necessary, develop guidelines on indicated use of these services in the antepartum period. Current limitations in the administrative reporting of these services are discussed in a following section.
3. On the evidence of inequities in utilization of medical care reported in this study, Manitoba Health should undertake an examination of socio-economic differences in the use of effective preventive care services, including screening for cervical cancer, hypertension and diabetes mellitus. Where inequities are evident, consideration should be given to implementing cost-effective strategies for reducing differences in rates of use. The Manitoba Immunization Monitoring System is one important example of such an innovative strategy.

Inequities in Pregnancy Outcome

Universal insurance of medical services may be a necessary condition to reducing socio-economic inequities in birth outcome, but based on the evidence of this study, access to medical care alone is not sufficient to moderate the effect of poverty on maternal and newborn health. Without an innovative initiative focused on the needs of poor urban women, it should be expected that the inequities in birth outcome described in this study will persist.

There are well-documented non-medical interventions that appear to have succeeded in improving birth outcomes among poor women, relying on two primary strategies: 1) providing nutritional resources, beginning in early pregnancy, and 2) increasing the

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number of educational contacts in early pregnancy, with a focus on practices that may reduce the risk of premature labour.

Recommendations:

1. It should be an explicit goal of the healthy public policy in Manitoba to act to reduce socio-economic inequities in pregnancy outcome. Achieving this goal will require a collaboration of interests larger than those within the traditional health care system.
2. In collaboration with the City of Winnipeg, Manitoba Health should develop, field and evaluate a demonstration program to determine whether a comprehensive, integrated initiative can moderate the excess incidence of low birthweight among poor urban women.

This demonstration program would focus on early pregnancy, with the objectives of increasing nutritional resources for pregnant women and reducing the prevalence of practices such as smoking, which is thought to increase the risk of premature birth. Consideration should be given to delivering services in this demonstration program through contracted or competitively bid arrangements with community-based organizations.

Monitoring Prenatal Care

Recommendation:

Manitoba Health should review the administrative reporting of prenatal care services in light of the findings of this study and should consider integrating information from several additional sources to improve the routine monitoring of prenatal care.

Information reported routinely to the Manitoba Health Services Commission has the potential to provide a population-based, comprehensive profile of antenatal care services delivered to the women of Manitoba, combining details of prenatal ambulatory contacts, maternal characteristics, pregnancy morbidity and hospital-based diagnostic and therapeutic services. Currently, a substantial number of the key components of an ideal system are recorded. The College of Physicians and Surgeons of Manitoba and individuals within the University of Manitoba, Faculty of Medicine have played an important role in implementing the routine collection of information on prenatal care. The following section outlines some of the observed shortcomings of the current measures of care and provides recommendations to enhance the range and quality of information. An enhanced profile of prenatal care would be useful in assessing the delivery of services and in monitoring the effect of new services or innovations in the organization of care on pregnancy outcome.

1) Missing Data

The two variables abstracted from the Prenatal Care Record, the number of visits and the date of initiation of care, were missing for approximately 10% of pregnancies in the study period. This study has shown that the records with missing data disproportionately represent women with social and demographic risks for poor birth outcomes, those who are low users of care, those with a higher incidence of pregnancy complication, those who give birth prematurely, and those who give birth to infants of lower birthweight.

2) Validity of Measures

Current measures of care are limited to visits with a single provider: The number of visits and the date of initiation of care abstracted from the Prenatal Care 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.

Idiosyncrasy in the definition of the date of initiation of care:

The current practice of measuring the initiation of care as of the second visit misrepresents the true initiation of antenatal care, typically by approximately one month. This practice appears to be due largely to the evolution of billing practices. All physicians may be reimbursed for a first visit, at which the pregnancy is confirmed. It is the subsequent visit that is currently defined as the first prenatal care contact. This practice has important implications for comparisons between Manitoba and other jurisdictions.

Absence of measures of care provided by non-physicians: In general, episodes of care provided by non-physicians are not enumerated in the current measures. Care provided by nurses or other practitioners, in hospital or clinic settings, is not recorded.

Non-reporting of some hospital-based services: Diagnostic ultrasound procedures performed in hospitals on an out-patient basis during the prenatal period are not recorded on any administrative data system that would allow these contacts to be included in maternal care histories. A substantial number of these procedures are performed, with significant implications for the costs of antenatal care services.

Options:

To improve the monitoring of prenatal care and to meet the needs of pregnant women, Manitoba Health should consider:

1. Revising the reporting of prenatal care contacts to permit the description of maternal rather than physician-based histories of care.
2. Extending a standardized reporting mechanism, such as the Prenatal Care Record adopted by physicians, to all providers of prenatal care.
3. Producing an annual report on use of prenatal care in the province, as a mechanism for monitoring efforts to reduce inequities in the use of care and pregnancy outcome. This report should combine measures of care with an indicator of neighbourhood socio-economic status and should integrate information from the Post-Partum Referral Database on maternal smoking status, and enrolment in prenatal education programs.

Introduction

Objectives of the Study

At the request of Manitoba Health, the Manitoba Centre for Health Policy and Evaluation has assessed the coverage and adequacy of prenatal care received by women resident in Winnipeg during the years 1987-88.

The study had three principal objectives. The first objective was to assess the precision and accuracy of routinely collected information on prenatal care currently available in Manitoba. By combining data from three secondary sources, the study has compiled a composite picture of prenatal care for Winnipeg women who gave birth between July 1987 and December 1988.

The second objective of the study was to describe the degree to which the utilization of prenatal care is distributed equitably in relation to social characteristics of women resident in Winnipeg, specifically age, marital status, native status and socio-economic status. Women who are single, young and poor have a substantially increased risk of unfavourable birth outcomes, and the pattern of prenatal care in this population is of special interest to this study.

The final objective was to assess the effectiveness of prenatal care: that is, the relationship between the utilization of prenatal care and birth outcome among Winnipeg women. This analysis examines the assumptions that frequent and timely prenatal care can mitigate the effect of pregnancy complications and can modify maternal behaviours to reduce the risk of unfavourable outcomes.

Background

Prenatal care is commonly understood to have a potentially beneficial impact on pregnancy outcome, either through the diagnosis and timely treatment of pregnancy complications or by contributing to the elimination or reduction of modifiable maternal risk factors. Prenatal care may extend the length of gestation (1-2), and early initiation of care has been reported in some studies to be associated with heavier birthweight outcomes (3-6).

However, many unresolved issues surround the efficacy and effectiveness of prenatal care as a primary or secondary intervention for the prevention of low birthweight. McCormick observed that the substantial increase in the proportion of women seeking care in the first trimester in the past two decades in the United States has not been accompanied by a significant decline in the incidence of low birthweight infants (7-8). Prenatal care is clearly important in identifying the onset of complications in the course of a pregnancy, but the early initiation of regular prenatal care has not been shown to directly reduce the incidence of low birthweight (1,4,6,9-16) or to moderate the incidence of preterm birth (17-18). In a recent comprehensive review, Kramer concluded that the evidence that early care improves intrauterine growth or increases the length of gestation is unconvincing (19).

This uncertainty is reflected in divergent clinical guidelines. Professional bodies guiding North American obstetrical practice recommend establishing care as early as possible in the first trimester, while the Royal College of Obstetricians and Gynaecologists of Great Britain recommends that antenatal care not commence until after the 12th week of gestation. It has been suggested that the frequency of visits for women with previously normal births could be reduced by one-half (20). In spite of this uncertainty, recent consensus statements from U.S. sources have argued that expanding access to prenatal care is a cost-effective strategy for reducing the incidence of low birthweight (1,21).

Where antenatal care can be shown to be effective, constraints on access to that care can

limit the numbers of women who may derive that benefit. The absence of financial barriers to access in Canada, while necessary to achieve high population coverage of prenatal services, may be insufficient to achieve optimum and equitable prenatal care coverage (22). Maternal factors, including dissatisfaction with the organization and content of care, or socio-economic barriers other than the costs of care may lead to underutilization in certain groups of women (20,23-25). Physician practices may also diminish the effectiveness of the prenatal care encounter (26-27).

Finally, quantity of care is not synonymous with quality of care. Most investigations of the relationship of care to outcome in population-based samples have used measures of the quantity of care: specifically, the timing of initiation of care and the frequency of visits. This information is often routinely available from administrative or surveillance data systems. Studies of the quality of care, which includes factors such as continuity, content of care (26,28-29) and organization of care (10,30-32), are much less frequently conducted. Kramer observed that the type of antenatal care may be more important than the timing of initiation of care or the number of visits, but that there is an absence of investigations which have definitively tested this hypothesis (19). There are also interventions in pregnancy with important evidence of beneficial effects that are primarily non-clinical in focus. The nutrition component of the Women, Infant and Children (WIC) public health program in the United States is one example of a non-medical intervention with apparently positive effects on newborn birthweight outcomes (30,33-34).

Analytic Approach

To assess the effectiveness of prenatal care, the study compared pregnancy outcomes across groups of women who received different amounts of care or who initiated care at different points in their pregnancy. In an observational setting, there are three substantial methodological obstacles in the evaluation of antenatal care for which no ideal analytic solution exists (33).

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The most fundamental problem in comparing outcomes across groups of women with different patterns of utilization is that women who give birth prematurely -- an adverse outcome -- will most certainly be shown to use less care than women whose pregnancies go to term. In this case, evidence of low use of prenatal care is in fact the effect rather than the cause of preterm delivery. A second problem, with an opposite effect on utilization, is confounding by indication. Women who experience complications early in pregnancy may be expected to seek medical care earlier than women with an uncomplicated first trimester. If this pattern is pervasive, early initiation of care may actually be observed to be correlated with poorer outcomes relative to late initiation of care. More typically, this confounding would be expected to obscure a true beneficial effect of early care. The final obstacle to valid inference about the effect of care on outcome in an observational study is selection bias. It is plausible that an association between early initiation of care and favourable pregnancy outcome is not directly attributable to care, but rather, to the characteristics and circumstances of women who seek care early.

The analytic approach of this study was designed to minimize these problems. In particular, to reduce the chance of bias due to preterm delivery, the study adopted an index of the adequacy of prenatal care that classifies the use of care according to the length of gestation (35) (Appendix A); however, this classification precludes examination of evidence for a beneficial effect of prenatal care on pregnancy duration. The study also emphasized the ascertainment of pregnancy complications. With this information it was possible to adjust statistically for the influence of complication on use of care.

Methods

Population and Study Period

The population study consisted of the 13,349 women resident in metropolitan Winnipeg who had a hospital admission resulting in a live birth in the 18 month period between July 1, 1987, and December 31, 1988. Residence was defined as of the date of hospital admission. Excluded from this population were 288 women (2.2%) whose hospital separation abstract could not be linked to a newborn hospital record and 415 women (3.1%) who were not registered with the Manitoba Health Services Commission for the complete nine-month interval immediately before delivery. In cases in which the woman gave birth to more than one baby, only one linked mother-infant pair was retained. After these exclusions, 12,646 women were retained in the study sample.

Sources of Data

The study combined information on antenatal care from three computerized administrative databases: hospital separation abstracts, physician claims for reimbursement of ambulatory care, including diagnostic tests performed in a physician's office or a laboratory, and records of the post-partum referral program. These data sources were supplemented by data on neighbourhood socio-economic characteristics derived from the 1986 Canadian census.

Physician Claim Files: Physician claims for reimbursement of prenatal care are submitted to a single payer, the Manitoba Health Services Commission (MHSC). The claims record includes information on the service provided, the date of service and a single three-digit ICD-9-CM (36) diagnosis code defining the reason for the care encounter. When providing antenatal and post-partum care, a physician may choose to claim for reimbursement on a fee-for-service basis, submitting a claim for each care encounter, or may submit a single claim for a fixed-fee global tariff that covers all care

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provided in the antenatal and post-partum periods. In this sample, 86.7% of pregnancies were supervised by physicians claiming the global tariff, and the remaining 13.3% of women received care from physicians who billed on a fee-for-service basis.

Ambulatory claims for pregnancy care consist of three broad categories of service: office visits, in-office or laboratory diagnostic tests, and referrals for consultation. Office visits were defined as any claim with a tariff code of 8501, 8507 or 8540 and an ICD-9-CM diagnostic code indicating a complication related to pregnancy (ICD-9-CM 640-648), other indications for care in pregnancy, labour and delivery (ICD-9-CM 650-659), or complications occurring in the course of labour and delivery (ICD-9-CM 660-669). Additionally, claims with ICD-9-CM diagnostic codes for normal pregnancy (V22), or supervision of high-risk pregnancy (V23) were also defined as office visits.

For specific diagnostic tests, physician and laboratory claims were defined as associated with prenatal care regardless of whether the claim contained a pregnancy-related diagnosis code. The selected tests were glucose monitoring (tariff code 9140, 9141, 9142 or 9144), haemoglobin (tariff code 9150), urinalysis (tariff codes 9641 or 9644), pap smear (tariff code 9795) or a hormonal pregnancy test (tariff code 9521). The first three tests are the standard monitoring tests in pregnancy.

Length of pregnancy in days was calculated individually for each woman from the measure of gestation period on the hospital record. For the 41 cases (0.3%) with a missing or out-of-range gestation period, a gestation period of 280 days was imputed. Claim service dates were converted to a count of days prior to birth. All claims with service dates shorter than the length of the pregnancy that met the conditions specifying pregnancy care were retained.

A comprehensive ambulatory health care history was compiled for each woman in the sample, capturing all instances of use of ambulatory care services in the period from 365 days before birth to 90 days post-partum. Of the 497,062 claims abstracted,

approximately 54% were associated with the provision of prenatal or post-partum care and were retained. The average number of eligible claims per case was 21.5.

For the 13.3% of women who received care from physicians who billed on a fee-for-service basis, direct measures of both the timing of initiation of care and the number of episodes of care could be established directly from the individual claims. However, for the majority of women who received care from physicians billing the global tariff, direct enumeration of service claims was not possible: physicians billing the global tariff submit a single claim, normally in the post-partum period. For these women, direct billing of in-office or laboratory diagnostic tests was used as a surrogate measure of use.

Reimbursement of these diagnostic tests is not included within the global tariff for physician services.

Hospital Separation Files: Individual separation abstracts are issued for mothers and their newborns. The newborn separation abstract contains information on birth weight, Apgar score at one and five minutes, gestational age and a range of ICD-9-CM diagnostic codes describing neonatal morbidity. The maternal obstetrical record provides information on age, neighbourhood of residence, treaty status, parity, gravidity, diagnostic codes defining morbidity associated with pregnancy, labour and delivery, an indicator of prior fetal assessment, the method of delivery and a range of ICD-9-CM procedure codes describing obstetrical interventions during labour and delivery. The maternal record also contains a number of fields abstracted from the Prenatal Care Record, which is a mandatory record completed by the primary care physician during the antenatal period. The information retained on the hospital abstract includes a count of the number of prenatal visits (to a maximum of eight), the week of gestation in which care was initiated and risk assessment scores measured at 36 weeks and at admission to hospital for delivery. The infant abstract was linked to the mother's record. Of eligible pregnancies, 288 mothers (2.1%) could not be linked to a newborn and were deleted from the final sample.

Post-Partum Referral Files: A referral to a public health nurse is made for all women who have given birth, with the objective of completing at least one contact following discharge. The Community Health Division of Manitoba Health has established a computerized database of these referral records, which at the time of the study was complete for the period July 1, 1987, through December 31, 1988. The referral record is completed before discharge and contains information obtained during an interview with the woman, including attained maternal education, prenatal care and participation in prenatal education classes, smoking status and infant feeding practices. Among the 12,646 women eligible for study, files for 806 (6.4%) could not be located in the Post-Partum Referral Database. These women were imputed the status of non-smokers and also were imputed the status of enrollees in prenatal education or childbirth programs.

Public-Use Census Files: Data from the 1986 Canadian census are available for public use, aggregated to the geographic unit of the enumeration area. In Winnipeg, there are approximately 800 enumeration areas containing residential households, with an average population of 700 people. These residential areas can be characterized by several demographic and economic indicators, including mean household income, mean educational level of women and labour force participation. A measure of the mean household income for a given enumeration area was used in the study (Appendix A).

Record Linkage Procedures: Each of the three sources of administrative data contains common case identifiers that allow records to be combined to create a composite maternal history of prenatal care. The primary common identifier is the MHSC registration number, which is shared by members of a nuclear family and which is present in all three databases. The individual woman of interest to the study was distinguished from other family members through sex and birth date. In addition, the postal code was used to link the maternal record to census information on neighbourhood characteristics. Of the 12,646 women, 71 (0.6%) could not be assigned a measure of mean household income and were imputed the sample average. Direct personal identifiers, such as name and street address, were explicitly excluded from the study data and were not used to link records.

Measures

Table 1 summarizes the measures of maternal, newborn and prenatal care characteristics used in this study. Detailed definitions of these variables are provided in Appendix A. A summary measure of the quantity of prenatal care, defining the adequacy of care relative to an ideal standard, was constructed from measures of the timing of initiation of care, the frequency of visits and the length of gestation. This index has been used in other settings to adjust for the effects of shortened gestation on the use of antenatal care (6,10,61). Inadequate care is defined as initiation of care in the third trimester or a very low frequency of contacts.

Analytic Methods

Differences between groups in demographic risk factors, prenatal care utilization and the incidence of complication were examined using a chi-square test of association or an F-test statistic derived from an analysis of variance. Separate multivariate analyses of the predictors of utilization and of complication were performed using logistic regression methods. The relationship of measures of prenatal care, maternal characteristics and pregnancy complication to birthweight outcome was examined in two forms. In one model, birthweight in grams was regressed on the set of independent variables in a multivariate linear regression analysis. In the second model, birthweight was classified as a dichotomous variable, with weight less than 2,501 g defined as low birthweight. This measure of birthweight formed the dependent variable in a logistic regression analysis. In a final analysis, the population was stratified into two groups on the basis of complication status, and the linear and logistic regressions were repeated.

Table 1

Summary of Measures

See Appendix A for details on definition

Maternal Characteristics		Source
Socio-economic Status	Mean household income of neighbourhood	1986 Canadian Census
Smoking Status	Maternal self-report	Post-Partum Referral Database
Marital Status	Inferred from MHSC registration information	MHSC Registration Files
Treaty Indian Status	Reserve status	MHSC Registration Files
Maternal Age	Age in years	MHSC Registration Files
Parity	Number of previous live births	Hospital Separation Files
Prior Pregnancy Loss	Number of previous losses	Hospital Separation Files
Length of Gestation	Gestation length, in weeks	Hospital Separation Files
Pregnancy Complications		Source
Pregnancy Complication	ICD-9-CM diagnostic codes 640 Haemorrhage in early pregnancy 641 Antepartum haemorrhage 642 Hypertension 643 Excessive vomiting 644 Early or threatened labour 646 Other antenatal complications	Physician Claim Files Hospital Separation Files
Newborn Characteristics		Source
Birthweight	Birthweight, in grams	Hospital Separation Files
Low Birthweight	Birthweight less than 2,500 g	Hospital Separation Files
Characteristics of Care		Source
Frequency of Care	Number of visits during pregnancy	Physician Claim Files
Timing of Initiation of Care	First provider contact for pregnancy-related care in gestation period	Physician Claim Files
Number of Consultations	Count of referred physician contacts	Physician Claim Files
Adequacy of Care	Index of care, adjusted for length of gestation	Physician Claim Files Hospital Separation Files
Prenatal Education	Maternal self-report of participation in prenatal education or childbirth preparation program	Post-Partum Referral Database
Source of Care	Identification of care provided by community-based clinics	Physician Claim Files

Findings

Assessment of the Precision and Accuracy of Routinely Collected Information on Prenatal Care

A principal objective of this study was to examine the accuracy and precision of the prenatal care measures on the hospital abstract, through comparison with information from physician claim records. The source of information for prenatal care utilization recorded on the hospital abstract is the Prenatal Care Record, which enumerates a woman's contacts with a single provider. In cases in which the woman consults more than one provider of care during pregnancy, the Prenatal Care Record will underestimate actual use and may mis-specify the earliest date of antenatal care. A second objective was to supply data from physician claim records for the 12.3% of women with missing information on use on the hospital abstract. A final objective was to use physician claim records to more fully describe the range of prenatal care use in the population. Because the visit count on the hospital record is limited to eight, median utilization cannot be estimated, and the prevalence of high levels of use cannot be described.

Extent of Missing Information on Prenatal Care on Hospital Separation Abstracts

In contrast to the birth outcome measures of gestational age and birthweight, which are complete in almost 100% of hospital separation abstracts, in many cases data on prenatal care are missing on the hospital abstract. The reported week of initiation of prenatal care was missing for 12.3% of the women, and the total number of prenatal visits was missing for 9.2% of the women (TABLE 2). As has been found in other studies of administrative data (37), women with socio-demographic risk factors for poor pregnancy outcome were over-represented among cases with missing data on prenatal care on the hospital separation abstract. In addition, women with missing data had lower rates of use and poorer birth outcomes than those without missing information. The characteristics of the

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Table 2
 Distribution of Missing Data on Prenatal Care
 on Hospital Separation Abstracts
 By Length of Gestation and Maternal Demographic Characteristics

Births to women resident in Winnipeg, July 1987 to December 1988, N=12,646

		TOTAL	NUMBER OF VISITS MISSING		WEEK OF INITIATION OF CARE MISSING	
			%	N	%	N
	N	12646	9.2	1158	12.3	1557
LENGTH OF GESTATION	<30 WEEKS	73	65.7	48	73.9	54
	30-36 WEEKS	667	36.7	245	40.5	270
	>36 WEEKS	11906	7.3	865	10.4	1233
INCOME QUINTILE	Q1 LOWEST	3019	13.6	409	17.3	521
	Q2	2144	10.1	215	13.2	283
	Q3	2133	7.8	167	10.7	229
	Q4	2894	7.1	205	9.7	281
	Q5 HIGHEST	2456	6.5	162	9.9	243
TREATY STATUS	NATIVE	557	23.3	130	27.8	154
	NON-NATIVE	12089	8.5	1028	11.6	1403
MATERNAL AGE	<20	887	15.7	139	20.8	184
	20-34	10183	8.6	883	11.8	1200
	>34	1576	8.6	136	11.0	173
PARITY	1ST BIRTH	5561	8.3	463	11.5	639
	2ND-4TH	6818	9.4	639	12.5	850
	5TH OR SUBSEQUENT	267	21.1	56	25.6	68
MARITAL STATUS	NOT MARRIED	3361	13.3	446	17.3	579
	MARRIED	9285	7.7	712	10.5	978

women with missing data are examined in more detail in Appendix C.

Comparison of Information on Prenatal Care on Hospital Separation Abstracts and Physician Claims

A series of analyses were performed to examine the agreement between physician claim records and the hospital abstract on measures of utilization of care. A detailed description of these analyses is presented in Appendix C. In general, physician claims were found to yield measures of care comparable to those of the hospital abstract, subject to two patterns of difference: 1) the timing of initiation of care was approximately four weeks earlier on physician claims records than on the hospital abstract, and 2) the mean number of prenatal visits determined from physician claims records was approximately 2.5 visits greater than the number calculated from the hospital abstract.

In the subsequent analyses reported in this paper, measures of use derived from physician claims have been exclusively applied. This decision was made in contrast to an alternative course, that of using physician claim measures only to substitute for cases with missing utilization measures on the hospital abstract, in light of the evidence that physician claims can be demonstrated to be a more valid measure of use. By identifying additional utilization that is not represented on the Prenatal Care Record and by allowing the more precise dating of the initiation of care, physician claims provide increased accuracy in the measurement of antenatal care utilization from all provider sources.

The Coverage and Adequacy of Prenatal Care

The social and demographic characteristics of the population by income quintile are shown in Table 3. A total of 7% of the women were under the age of 20 years, and 9% were older than 35 years. First births accounted for 43.9% of the cases. Smoking during pregnancy was reported by 27.6% of the women, 26.5% were unmarried at the time of delivery, and 24.1% had experienced a prior pregnancy loss.

Most of these characteristics are social or behavioral markers of increased risk of unfavourable birth outcomes. In turn, many of these risk factors were unequally distributed across the five categories of neighbourhood income rank. For example, women residing in the poorest 20% of neighbourhoods (Quintile 1) were more than twice as likely as women residing in the wealthiest 20% of neighbourhoods to have reported smoking during pregnancy, were three times as likely to be unmarried and were four times as likely to be under the age of 20.

Overall, 4.7% of the infants weighed less than 2,500 g at birth, and 5.9% of births occurred before the 37th week of gestation. The crude incidence of low birthweight among women in Quintile 1 was 62/1000 live births, almost twice the observed rate among women in Quintile 5, 35/1000.

Table 4 summarizes measures of prenatal care utilization, stratified by the income quintile of the mother's neighbourhood of residence. On a population basis, the utilization of prenatal care in Winnipeg over the study period was very good. Pregnant women in the sample had an average of 11.2 visits to primary care providers and were referred for an average of 0.6 consultations to other physicians. This measure of average use is in accord with the current recommended standard of 12 visits in the course of an uncomplicated pregnancy. However, not all women achieved the norm: 8.2% (1,037 women) had fewer than five visits, and a further 14.1% of women had between five and eight antenatal visits to medical providers.

Table 3
Maternal Demographic Characteristics
by Income Quintile

Births to women resident in Winnipeg, July 1987 to December 1988, N = 12,646
Income Quintiles: 1 = lowest, 5 = highest

MATERNAL CHARACTERISTICS			INCOME QUINTILE					TOTAL SAMPLE
		N	1	2	3	4	5	
		N	3,019	2,144	2,133	2,894	2,456	12,646
MATERNAL AGE	<20	%	14.1	7.5	5.5	3.8	2.9	7.0
	>35	%	6.5	7.7	7.5	9.5	13.9	9.0
MARITAL STATUS	NOT MARRIED	%	45.3	29.2	23.7	16.5	15.3	26.5
TREATY STATUS	NATIVE	%	13.4	3.8	1.7	1.0	0.2	4.4
PARITY	1ST BIRTH	%	44.2	47.4	47.2	43.1	38.9	43.9
	4TH OR GREATER	%	9.9	5.7	5.4	4.3	5.0	6.2
PRIOR PREGNANCY LOSS		%	25.3	25.9	22.9	23.0	23.0	24.1
SMOKING STATUS	SMOKED DURING PREGNANCY	%	38.1	33.5	27.9	22.7	15.3	27.6

BIRTH OUTCOMES			INCOME QUINTILE					TOTAL SAMPLE
			Q1	Q2	Q3	Q4	Q5	
BIRTHWEIGHT	<1,500 g	%	1.2	0.9	0.7	0.7	0.7	0.8
	1,500-2,500 g	%	5.0	4.6	3.6	3.5	2.8	3.9
LENGTH OF GESTATION	<37 WEEKS	%	6.3	6.7	6.2	5.7	4.6	5.9

COVERAGE			INCOME QUINTILE					TOTAL PREGNANCIES
			Q1	Q2	Q3	Q4	Q5	
NOT REGISTERED WITH MHSC FOR COMPLETE ANTENATAL PERIOD: EXCLUDED FROM STUDY SAMPLE		N	124	79	83	65	64	415
		%	3.9	3.4	3.6	2.1	2.7	3.1
NOT LINKED TO POST-PARTUM REFERRAL DATABASE: RETAINED IN STUDY SAMPLE		N	217	126	125	207	131	806
		%	7.1	5.9	5.9	7.1	5.3	6.2

Table 4
 Characteristics of Prenatal Care
 By Income Quintile

Utilization Measures based on Physician Claims
 Births to Women Resident in Winnipeg, July 1987 to December 1988, N=12,646
 Income Quintiles: 1 = lowest, 5 = highest

		INCOME QUINTILE					TOTAL	
		Q1	Q2	Q3	Q4	Q5	SAMPLE	p
	N	3,019	2,144	2,133	2,894	2,456	12,646	
EPISODES OF CARE	AVERAGE NUMBER OF VISITS	10.09	11.26	11.49	11.69	11.70	11.21	<.001 ₁
	< 5 VISITS	% 14.8	7.4	6.7	5.6	5.0	8.2	<.001 ₂
	5-8 VISITS	% 19.1	14.7	12.8	11.4	11.9	14.1	
	> 13 VISITS	% 21.9	29.7	32.5	32.3	32.5	29.3	
INITIATION OF CARE	MEAN WEEK OF INITIATION	8.9	7.7	7.3	7.2	7.2	7.7	<.001 ₁
	INITIATION:							
	2ND TRIMESTER	% 13.0	8.4	6.3	6.0	4.9	7.8	<.001 ₂
	3RD TRIMESTER	% 4.1	1.8	1.7	1.4	1.4	2.2	
ADEQUACY OF CARE	ADEQUATE	% 61.1	74.0	77.9	80.0	81.1	74.3	<.001 ₂
	INTERMEDIATE	% 22.9	18.0	14.5	13.7	13.3	16.7	
	INADEQUATE	% 15.9	7.9	7.5	6.0	5.6	8.9	
NUMBER OF CONSULTATIONS	0	% 57.0	54.7	56.6	56.0	55.3	56.0	<.01 ₂
	>2	% 11.0	13.7	13.3	13.2	14.9	13.1	

1. Analysis of variance, testing for differences across income strata
2. Chi-Square Test of Association, testing for differences across income strata

The early initiation of care may be more important in providing benefit than the number of visits. As determined from physician claims, care was initiated, on average, during the seventh week of gestation. Nine of every ten women in the sample initiated prenatal care by the 13th week of pregnancy. In only 2.2% of pregnancies was the first visit delayed until the third trimester.

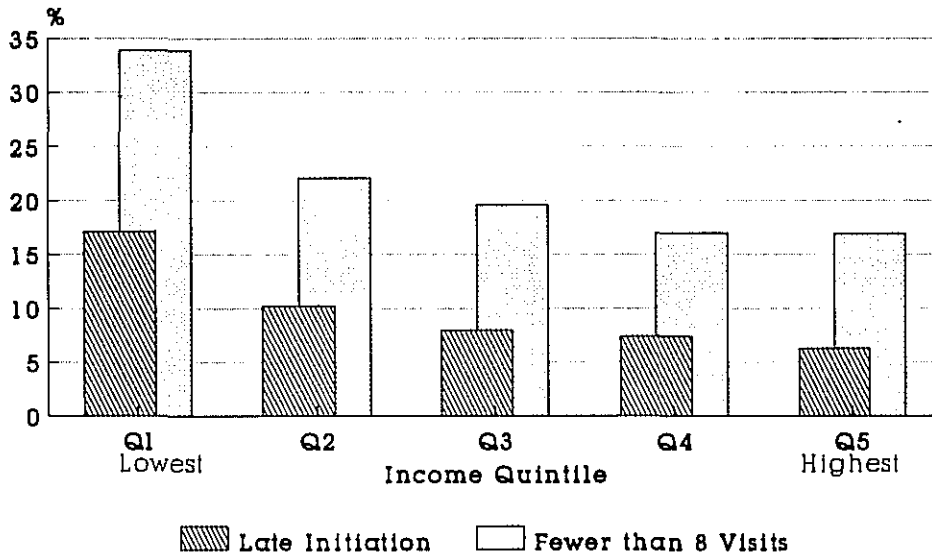
When utilization is expressed in terms of the index of the adequacy of care, 74.3% of the women received adequate care and 8.9% received inadequate care, where inadequate care is defined as initiation later than the second trimester (27 weeks) or in the case of earlier initiation, where few provider contacts are established over the course of the pregnancy.

Important differences in the use of prenatal care were noted when the population was stratified by income quintile. Only marginal differences were observed across the 60% of women in the three highest income quintiles. However, the 20% of women in the lowest income quintile had consistently and substantially poorer use of care than those in the mid to high quintiles. Poor women had an average of 1.5 fewer visits in the course of their pregnancies and first sought care an average of 1.5 weeks later. A total of 17% of the poorest women initiated care later than the first trimester, compared to less than 7% of the women in the mid to high quintiles (FIGURE 1).

Women under the age of 20 averaged 1.5 fewer visits in the course of their pregnancy than women aged 20-35 years, and treaty status natives averaged 1.9 fewer visits than non-natives (TABLE 5). Multiparous poor women used significantly less care than did median- or higher-income women giving birth to their second or subsequent child. These differences were especially pronounced among women with three or more previous live births (FIGURE 2). Whereas there was little difference across parity groups for women in the median to high quintiles, the number of visits by poorer women dropped sharply as the number of children in the household increased.

As expected, the duration of gestation was positively associated with the number of

Figure 1
Initiation of Prenatal Care and
Number of Visits By Income Quintile



Late Initiation: > 13 weeks gestation

Prenatal Care Index
Score Distribution By Income Quintile

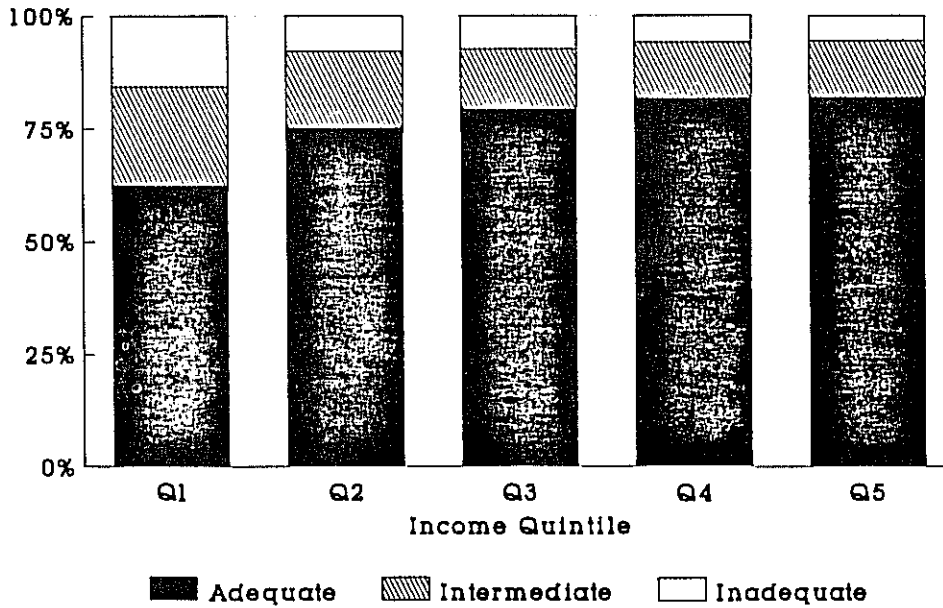
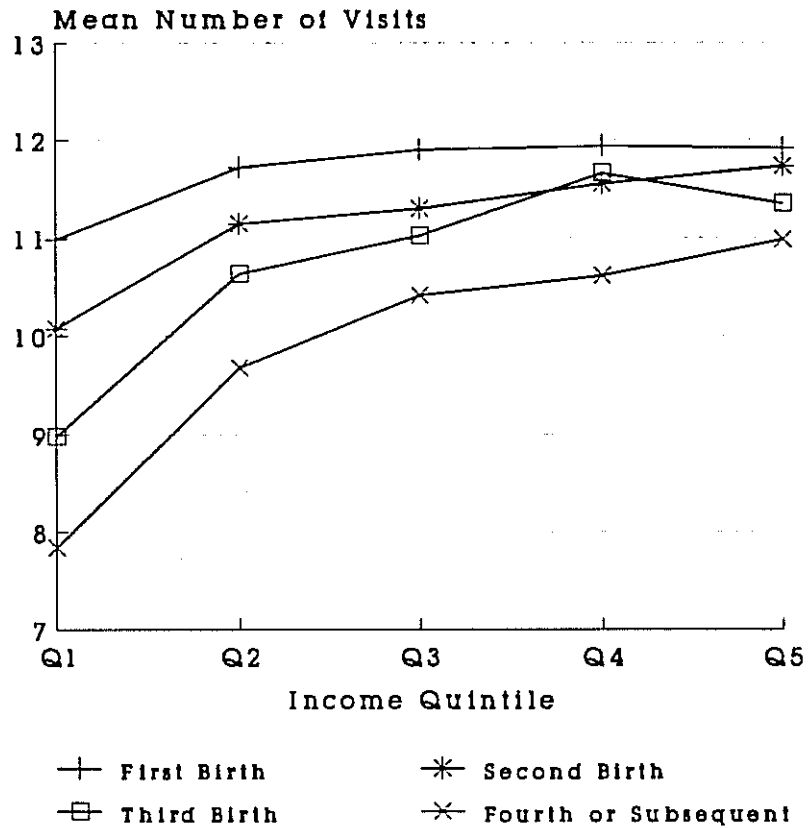


Figure 2
 Number of Episodes of Care
 By Parity and Income Quintile



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Table 5
 Multivariate Linear Regression Analysis of the Relationship
 Between Maternal and Pregnancy Characteristics and
 Number of Episodes of Prenatal Care

Births to women resident in Winnipeg, July 1987 to December 1988, N = 12,646
 Income Quintiles: 1 = lowest, 5 = highest

ESTIMATED DIFFERENCE IN TOTAL NUMBER OF PRENATAL CARE EPISODES		MODEL 1 ADJUSTED FOR ALL FACTORS	MODEL 2 ADJUSTED FOR INCOME ONLY
	R2	14.3	2.6
	INTERCEPT (Estimated Number of Prenatal Care Episodes in Reference Group)	11.47	11.71
INCOME QUINTILE	Q1 / Q5	-0.53 <.001	-1.61 <.001
	Q2 / Q5	-0.04 ns	-0.45 <.001
	Q3 / Q5	-0.00 ns	-0.21 ns
	Q4 / Q5	0.09 ns	-0.01 ns
LENGTH OF GESTATION	<37 WKS / 40-41 WKS	-2.95 <.001	
	37-39 WKS / 40-41 WKS	-1.08 <.001	
	>41 WKS / 40-41 WKS	0.90 <.001	
PREGNANCY COMPLICATION		0.85 <.001	
PRIOR PREGNANCY LOSS		0.12 ns	
MATERNAL AGE	<20 / 20-34 YEARS	-1.54 <.001	
	≥35 / 20-34 YEARS	0.40 <.001	
PARITY	1ST / 2-3 BIRTHS	0.53 <.001	
	4TH OR MORE / 2-3 BIRTHS: Q1	-1.95 <.001	
	4th OR MORE / 2-3 BIRTHS: Q2-5	-0.53 ns	
NOT MARRIED		-0.78 <.001	
TREATY STATUS NATIVE		-1.95 <.001	
SMOKED DURING PREGNANCY		-0.45 <.001	
ATTENDED PRENATAL EDUCATION PROGRAM		0.55 <.001	
CARE PROVIDED BY COMMUNITY CLINIC		-0.85 <.001	

REFERENCE GROUP MODEL 1 Income Quintile 5, 40-41 Weeks Gestation, No
 Complication, No Prior Pregnancy Loss, Age 20-
 34, 2nd-3rd Birth, Married, Non-native, Non-
 smoker
 MODEL 2 Income Quintile 5

prenatal care encounters (TABLE 5). Women who gave birth before the 37th week of gestation averaged three fewer antenatal contacts than women who gave birth at term (40-41 weeks). Prolonged pregnancies (> 41 weeks) were associated with more frequent contacts. Women experiencing a complication of pregnancy had an average of one additional primary care encounter and were twice as likely to be referred for a consultation as women without a complication.

Complications of Pregnancy

Infants born to the 25.2% of women defined as having an antenatal complication were on average 243 g lighter at birth than infants born to women with no reported complications. The observed rate of low birthweight (< 2,500 g) was six times greater in the group with complications than in the no-complication group (124/1000 vs 21/1000).

The incidence of antenatal complications (ICD 640-644, 646) is associated with several maternal characteristics. As determined from either physician claims records or the hospital abstract, treaty status natives resident in Winnipeg had an incidence of complications of 32.4/100 births, compared to 24.9/100 for non-natives (TABLE 6, TABLE 7). Women having their first child, high-parity women and women with a prior pregnancy loss were also found to have higher rates of reported complications. Independent of these factors, mean neighbourhood income was also associated with the incidence of antenatal complications. The 20% of poorest women in the sample had an adjusted risk of complication 1.42 times greater than that observed for the wealthiest 20% of women ($p < .001$: TABLE 7). When adjusted for the joint presence of other factors, neither young maternal age, smoking status or marital status was found to have an independent association with reported antenatal complications.

Table 6
Complications of Pregnancy
by Maternal Demographic Characteristics

Complication defined as ICD-9-CM diagnostic codes 640-644,646 recorded on
either physician claims or hospital abstract
N = 12,646

		INCOME QUINTILE									
		Q1		Q2		Q3		Q4		Q5	
		%	N	%	N	%	N	%	N	%	N
	Overall	29.1	3019	28.0	2144	24.5	2133	23.1	2894	21.5	2456
Treaty Status	Native	34.0	405	31.7	83	14.2	35	34.4	30	50.0	4
	Non-Native	28.4	2614	27.8	2061	24.6	2098	23.0	2864	21.5	2452
Maternal Age	< 20	31.7	427	28.7	161	33.3	118	23.4	111	25.7	71
	20-34	28.3	2315	27.8	1773	24.0	1799	23.2	2411	20.7	1886
	> 34	32.3	277	29.2	210	23.8	216	22.6	372	23.9	499
Parity	1st birth	30.4	1336	30.7	1016	27.4	1007	26.5	1245	24.0	955
	2nd-4th	27.4	1553	25.2	1077	21.8	1092	20.6	1619	19.9	1478
	5th or subsequent	36.1	130	34.0	51	24.2	34	20.7	30	17.4	23
Marital Status	Unmarried	30.4	1369	29.1	627	26.5	509	21.9	479	22.6	377
	Married	28.1	1650	27.5	1517	23.8	1624	23.4	2415	21.3	2079
Smoking Status	Smoker	31.0	1067	26.3	677	27.4	560	23.7	612	22.1	357
	Non-smoker	27.9	1735	29.3	1341	24.3	1448	22.5	2075	21.2	1968
	Missing *	29.0	217	23.2	126	15.7	125	27.5	207	25.2	131
Prior Pregnancy Loss	First Pregnancy	30.5	1069	30.4	789	25.1	817	24.5	1001	24.2	782
	Prior Loss	28.9	766	29.8	556	31.4	517	26.9	667	24.6	565
	No Prior Loss	28.0	1184	24.3	799	19.7	799	19.9	1226	18.0	1109

Column % report the percent of women in the table cell (N) with a diagnosed complication of pregnancy

* Cases that could not be located on the Post-Partum Referral Database.

Table 7
Demographic and Behavioral Risk Factors
for Complication of Pregnancy

Complication defined as ICD-9-CM diagnostic codes 640-644, 646 recorded on
either physician claims or hospital abstract, N = 12,646
Unadjusted and adjusted odds ratios estimated from logistic regression analysis

		UNADJUSTED ODDS RATIOS				ADJUSTED ODDS RATIOS		
		Proportion with Complication	Parameter Estimate	Odds Ratio	p	Parameter Estimate	Odds Ratio	p
Reference Group*						1.5233		
Treaty Status	Native	.324	.3646	1.44	<.001	.2409	1.27	<.01
	Non-native	.249	--			--		
Age	<20	.299	.2541	1.29	<.001	.0798	1.08	ns
	20-34	.248	--			--		
	>34	.257	.0485	1.05	ns	.1313	1.13	<.05
Parity	1st birth	.279	.2647	1.30	<.001	.2836	1.32	<.001
	2nd-4th	.229	--			--		
	5th or subsequent	.309	.4087	1.50	<.01	.2201	1.24	ns
Marital Status	Unmarried	.275	.1551	1.17	<.001	.0285	1.02	ns
	Married	.245	--			--		
Smoking Status	Smoker	.266	.1019	1.11	<.01	.0357	1.03	ns
	Non-smoker	.247	--			--		
Prior Pregnancy Loss	Prior Loss	.282	.2017	1.22	<.001	.2143	1.23	<.001
	No Prior Loss	.243	--			--		
Income Quintile	Q1 lowest	.291	.4050	1.50	<.001	.3519	1.42	<.001
	Q2	.280	.3489	1.42	<.001	.3149	1.37	<.001
	Q3	.245	.1685	1.18	<.05	.1493	1.16	<.05
	Q4	.231	.0942	1.09	ns	.0868	1.09	ns
	Q5 highest	.215	--			--		

Reference Group: non-native, age 20-34, 2nd-4th birth, married, non-smoker,
no prior pregnancy loss, income quintile 5 (highest)

Table 8
Self-reported Enrolment in
Prenatal or Childbirth Education Programs, by Income Quintile

Births to women resident in Winnipeg, July 1987 to December 1988, N = 12,646

		INCOME QUINTILE								
		Q1	Q2	Q3	Q4	Q5				
TOTAL CASES	N	3019	2144	2133	2894	2456				
NUMBER OF CASES LINKED TO POSTPARTUM REFERRAL DATABASE	N	2802	2018	1939	2687	2325				
PERCENT OF LINKED CASES ENROLLED IN PROGRAM	%	26.1	36.5	41.3	42.4	43.9				
ALL LINKED CASES										
SITE	COMMUNITY HEALTH	%	11.0	12.8	11.8	12.2	11.4			
OF CLASS	HOSPITAL	%	11.9	19.0	24.8	24.5	26.4			
	PRIVATE	%	3.0	4.6	4.5	5.6	6.1			
ENROLLED WOMEN ONLY										
SITE	COMMUNITY HEALTH	%	42.6	35.1	28.7	28.8	26.1			
OF CLASS	HOSPITAL	%	45.7	52.2	60.3	57.8	60.1			
	PRIVATE	%	11.6	12.6	10.9	13.3	13.8			
FIRST BIRTHS										
	N	1238	957	913	1157	902				
	% OF TOTAL	44.2	47.4	47.0	43.0	38.8				
PERCENT FIRST BIRTHS ENROLLED IN PROGRAM										
	%	N	%	N	%	N	%	N	%	N
OVERALL	47.2		60.5		67.1		75.9		78.0	
NOT MARRIED	43.1	660	49.1	358	54.8	299	63.0	295	70.1	244
MARRIED	51.7	578	67.2	599	73.1	614	80.4	862	81.0	658
TREATY STATUS NATIVE	29.3	116	41.2	17	30.7	13	41.6	12	--	0
NON-NATIVE	49.0	1122	60.8	940	67.6	900	76.3	1145	78.0	902
<20 YEARS OF AGE	38.2	301	45.6	114	32.5	89	50.6	85	62.0	58
20-34 YEARS	50.9	867	63.0	793	71.2	778	78.1	1017	79.5	737
>34 YEARS	40.0	70	54.0	50	65.2	46	74.5	55	76.6	107
SMOKER	43.3	416	54.6	313	59.1	254	69.7	258	67.5	145
NON-SMOKER	49.3	822	63.3	644	70.2	659	77.7	899	80.5	757

Prenatal and Childbirth Education

Enrolment in a prenatal education program was reported by 38% of the women (TABLE 8). A total of 31% attended programs operated by the public health departments of either the Province of Manitoba or the City of Winnipeg (who split jurisdiction of the city), 56% attended hospital-based programs and 13% attended programs operated by other organizations. Although important, descriptive information on differences in course content, instructional methods and program duration was not available, and these aspects are not examined in this report.

Women attending prenatal education programs are predominantly first-time mothers: 75% of all women who reported attending a prenatal class were pregnant with their first child. Over 65% of the 5,400 women having their first child attended some form of program in the antenatal period, compared with fewer than 15% of women having a second or subsequent child.

The 20% of women residing in the city's poorest neighbourhoods were much less likely to attend prenatal education programs: only 26.1% of the poorest women reported enrolment, compared to an average of 40% of women in the three wealthiest quintiles. The pattern is similar among primiparous women: 47.2% of first-time mothers in Quintile 1 reported attending a prenatal education program, compared to 78.0% of first-time mothers in Quintile 5.

In the time period under review, the public health services in the city appear to have delivered programs equitably across all income groups, enrolling approximately 11% of all women. The public health services were the site for 42.6% of all enrolments among the poorest women. This comparatively high proportion is essentially due to the low recruitment of hospital and other programs in this population. Approximately 25% of women in the median to higher income groups were enrolled in hospital-based programs, compared with less than 12% of women in the lowest income quintile.

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Table 9
Utilization Of Community-Based Clinics
by Maternal Demographic Characteristics

Births to women resident in Winnipeg,
July 1987 to December 1988, N = 12,646

		ATTENDED CLINIC		DID NOT ATTEND CLINIC	
N		290		12,356	
MATERNAL CHARACTERISTICS		N	%	N	%
INCOME QUINTILE	Q1	159	54.8	2,860	23.1
	Q2	54	18.6	2,090	16.9
	Q3	39	13.4	2,094	16.9
	Q4	18	6.2	2,876	23.3
	Q5	20	6.9	2,436	19.7
TREATY STATUS	NATIVE	59	20.0	498	4.0
	NON-NATIVE	231	79.7	11,858	96.0
MATERNAL AGE	<20	72	24.8	815	6.6
	20-34	212	73.1	9,971	80.7
	>34	6	2.1	1,570	12.7
PARITY	1ST BIRTH	160	55.2	5,401	43.7
	2ND-4TH	112	38.6	6,706	54.3
	5TH OR SUBSEQUENT	18	6.2	249	2.0
MARITAL STATUS	NOT MARRIED	200	69.0	3,161	25.6
	MARRIED	90	31.0	9,195	74.4

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MARITAL STATUS	NOT MARRIED	200	69.0	3,161	25.6
	MARRIED	90	31.0	9,195	74.4

Community-based Clinics as a Source of Prenatal Care

The study attempted to identify care provided in five community-based clinic services in the city: Mt. Carmel Clinic, Kclinic, Women's Health Clinic, the two community-based clinics operated by the City of Winnipeg and the Health Action Centre. In the early phase of the study, it became apparent that the contribution of clinics in the provision of antenatal care would be underestimated on the administrative databases. For example, during the study period, Kclinic was exempt from a requirement to submit claims to MHSC to document patient visits with the organization's salaried physicians. As a result, no antenatal care visits originating at this clinic were identified. Similarly, the Mt. Carmel Clinic has an in-house diagnostic laboratory that is operated within the global facility budget. Claims for individual tests are therefore not submitted to MHSC, which suggests that episodes of care will be underestimated when diagnostic tests are enumerated. The two City of Winnipeg clinics rely primarily on nurses for the delivery of prenatal services, again with the result that many episodes of care will not be represented on the administrative databases.

Some suggestive data on clinic-based care can be offered. It must be recognized that these data probably underestimate the care provided by these organizations. The magnitude of this underestimation is unknown. The clinics in question, both by geography and by mandate, seek to provide care to low-income, culturally heterogeneous populations. The limited data indicate that the clinics do in fact serve their target population. Of the 290 women who received one or more episodes of care from a clinic, 54.8% were in the lowest income quintile. While 7% of the overall study population were under the age of 20 years, this age group accounted for one-quarter of clinic attendees. A total of 69% of the women who received clinic-based care were unmarried, compared to 26.6% of the overall population. Native women accounted for 20% of clinic attendees (TABLE 9).

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Table 10
 Characteristics of Use of Prenatal Care
 by Attendees and Non-Attendees of
 Community-Based Clinics

Births to women resident in Winnipeg,
 July 1987 to December 1988, N = 12,646

		ATTENDED CLINIC		DID NOT ATTEND CLINIC	
N		290		12,356	
UTILIZATION CHARACTERISTICS		N	%	N	%
NUMBER OF TOTAL VISITS	<5	57	19.7	978	7.9
	5-8	69	23.8	1,711	13.8
	>8	164	56.6	9,667	78.2
TRIMESTER OF INITIATION OF CARE	1ST	258	88.9	11,103	89.9
	2ND	23	7.9	981	7.9
	3RD	9	3.1	272	2.2
ADEQUACY OF CARE	ADEQUATE	156	53.8	9,255	74.9
	INTERMEDIATE	74	25.5	2,036	16.5
	INADEQUATE	60	20.7	1,065	8.6
PRENATAL EDUCATION	YES	94	32.4	4,336	35.1
	NO	174	60.0	7,167	58.0
	MISSING *	22	7.6	853	6.9
PROPORTION OF CARE FROM CLINIC	<.25	148	51.0		
	.25-.49	63	21.7		
	.50-.74	32	11.0		
	≥.75	47	16.2		

* Cases that could not be located on the Post-Partum Referral Database.

Those who attended clinics initiated care in the first trimester at the same rate (89%) as the non-clinic sample and reported similar rates of enrolment in prenatal education programs. However, clinic attendees appeared to be low utilizers of care (TABLE 10). Almost 45% of the clinic sample were found to have fewer than nine visits in the course of their pregnancy, compared to 22% of women who received care from non-clinic providers. Clinic attendees also had a lower frequency of adequate care (53.8%) than would be expected given the age and income distribution of this group (Expected: 67.9%). Of the women who attended a clinic at least once and who had nine or more care encounters with a physician during their pregnancy, 68% received less than 25% of their care from a clinic provider.

These data suggest that most clinic attendees have an early contact with a clinic-based physician. Subsequent to this initial contact, some clinics substitute nursing staff for routine care. These contacts are not reported to the administrative data sources in this study and are a plausible explanation for the low rates of use observed in this group.

The Relationship Between Prenatal Care and Birth Outcome

In this population, prenatal care was associated with higher birthweight and with a reduced incidence of births of infants weighing less than 2,500 g. However, these associations were subtle. In these analyses, prenatal care was dichotomized as adequate or not adequate. The latter category combines both intermediate and inadequate care.

Among women with uncomplicated pregnancies, those with adequate prenatal care gave birth to infants who were on average 73 g heavier than infants born to women who received less than adequate care ($p < .001$, TABLE 11). After adjusting for maternal characteristics and income rank, this difference was reduced to an estimated 58.6 g ($p < .001$, TABLE 12).

The average birthweight of infants born to women who experienced complications in pregnancy was substantially lower (by 243 g) than that of babies born to women with uncomplicated pregnancies (TABLE 11). On an aggregate basis, these results were expected. The set of complications measured in this study are prevalent in early gestation and are strongly predictive of premature birth.

However, an unexpected finding was that among women with complicated pregnancies, only a subtle difference in birthweight (72 g) was observed between the adequate care and the less than adequate care groups. The estimated positive contribution of care to birthweight outcome was no greater in complicated pregnancies than in pregnancies without noted complication.

As shown in Figure 3, this weak relationship was stable across all income groups. The expectation that prenatal care would have a more pronounced beneficial effect on complicated pregnancies among poor women than among women with median to higher

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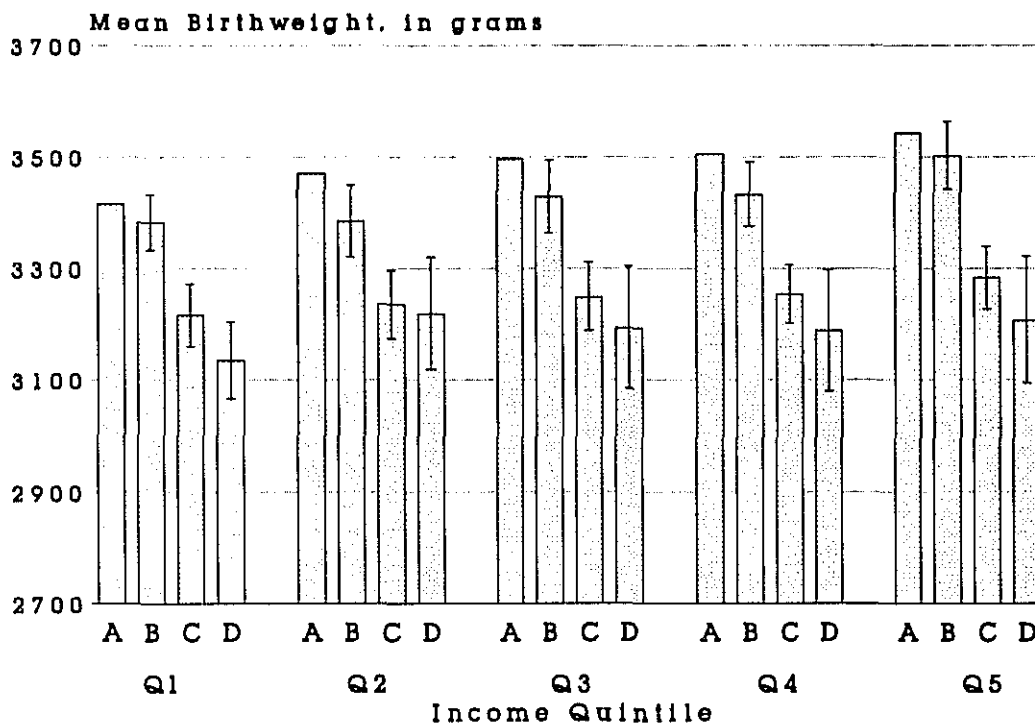
Table 11
 Unadjusted Mean Birthweight
 By Complication Status and Adequacy of Prenatal Care

Measure of adequacy of care based on physician claims
 Births to women resident in Winnipeg, July 1987 - December 1988, N=12,646

TOTAL SAMPLE		N	Mean Birthweight, g	95% Confidence Limits
No Complication		9,450	3,473	
Complication		3,196	3,229	
No Complication	Adequate Care	7,125	3,491	--
	Inadequate Care	2,325	3,418	(3,392, 3,444)
Complication	Adequate Care	2,437	3,247	(3,222, 3,272)
	Inadequate Care	759	3,175	(3,134, 3,217)

SAMPLE STRATIFIED BY INCOME QUINTILE		N	Mean Birthweight, g	95% Confidence Limits
QUINTILE 1 (Poorest)				
No Complication	Adequate Care	1,327	3,416	--
	Inadequate Care	814	3,383	(3,333, 3,432)
Complication	Adequate Care	559	3,217	(3,161, 3,273)
	Inadequate Care	319	3,136	(3,066, 3,205)
QUINTILE 2				
No Complication	Adequate Care	1,152	3,471	--
	Inadequate Care	392	3,385	(3,320, 3,449)
Complication	Adequate Care	460	3,236	(3,175, 3,297)
	Inadequate Care	140	3,220	(3,120, 3,320)
QUINTILE 3				
No Complication	Adequate Care	1,275	3,497	--
	Inadequate Care	336	3,429	(3,363, 3,492)
Complication	Adequate Care	418	3,249	(3,189, 3,311)
	Inadequate Care	104	3,194	(3,085, 3,305)
QUINTILE 4				
No Complication	Adequate Care	1,798	3,506	--
	Inadequate Care	428	3,433	(3,376, 3,492)
Complication	Adequate Care	562	3,255	(3,203, 3,307)
	Inadequate Care	106	3,189	(3,080, 3,298)
QUINTILE 5 (wealthiest)				
No Complication	Adequate Care	1,573	3,544	--
	Inadequate Care	355	3,503	(3,443, 3,564)
Complication	Adequate Care	438	3,284	(3,228, 3,340)
	Inadequate Care	90	3,207	(3,095, 3,321)

Figure 3
 Mean Birthweight, By Income Quintile
 Pregnancy Complication and Prenatal Care



A = No Complication, Adequate Care
 B = No Complication, Inadequate Care
 C = Complication, Adequate Care
 D = Complication, Inadequate Care

Complication = ICD9CM 640-644, 646

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Table 12
 Multivariate Linear Regression Analysis of the Relationship
 of Maternal Characteristics, Pregnancy Complications and
 Adequacy of Prenatal Care to Birthweight Outcome

Measure of adequacy of care based on physician claims
 Births to Women resident in Winnipeg, July 1987 - December 1988, N=12,646

Estimated mean difference in grams, relative to reference group*		Income Only		Income, Maternal Factors		Income, Maternal Factors, Complications, Adequacy of Care	
R2		0.7		4.1		7.2	
Intercept (g)		3480.0		3703.9		3785.6	
Income Quintile	Q1	-139.1	<.001	-107.6	<.001	-88.8	<.001
	Q2	-91.1	<.001	-55.4	<.001	-41.4	<.01
	Q3	-57.4	<.001	-32.2	ns	-25.8	ns
	Q4	-44.8	<.01	-32.5	<.05	-29.3	<.05
	Q5	--	--	--	--	--	--
Treaty Status	Non-Native			-139.4	<.001	-163.3	<.001
	Native			--	--	--	--
Maternal Age	< 20			10.8	ns	23.5	ns
	20-34			--	--	--	--
	> 34			-62.8	<.001	-57.9	<.001
Parity	1st Birth			-183.5	<.001	-167.5	<.001
	2nd-4th Birth			--	--	--	--
	5th or subsequent			17.3	ns	41.8	ns
Marital Status	Unmarried			-4.3	ns	- 9.1	ns
	Married			--	--	--	--
Smoking Status	Smoker			-168.9	<.001	-163.8	<.001
	Non-smoker			--	--	--	--
Prior Pregnancy Loss	Yes			-31.2	<.01	-22.0	<.01
	No			--	--	--	--
Prenatal Education	Yes			38.0	<.05	32.3	ns
	No			--	--	--	--
Prenatal Education X First Birth				80.2	<.001	71.9	<.001
Pregnancy Complication	Yes					-228.9	<.01
	No					--	--
Adequate Care	No					-58.6	<.001
	Yes					--	--
Inadequate Care X Complication						-4.1	ns

* Reference Group: --

Table 13
 Multivariate Logistic Regression Analysis of the Relationship
 of Maternal Characteristics, Pregnancy Complications and Adequacy
 of Prenatal Care to Incidence of Low Birthweight (<2,500g)

Measure of adequacy of care measure based on physician claims
 Births to women resident in Winnipeg, July 1987 - December 1988, N=12,646

Estimated odds of low birthweight relative to reference group*		Income Only		Income, Maternal Factors		Income, Maternal Factors, Complications, Adequacy of Care	
		Odds Ratio	p	Odds Ratio	p	Odds Ratio	p
Income Quintile	Q1	1.82	<.001	1.50	<.01	1.29	ns
	Q2	1.62	<.001	1.41	<.01	1.25	ns
	Q3	1.26	ns	1.16	ns	1.09	ns
	Q4	1.21	ns	1.19	ns	1.14	ns
	Q5	--		--		--	
Treaty Status	Non-Native Native			1.17 --	ns	1.39 --	ns
Maternal Age	< 20			0.87	ns	0.80	ns
	20-34			--		--	
	> 34			1.45	<.01	1.39	<.01
Parity	1st Birth			1.99	<.001	1.78	<.001
	2nd-4th Birth			--		--	
	5th or subsequent			0.93	ns	0.79	ns
Marital Status	Unmarried Married			1.25 --	<.01	1.24 --	<.05
	Smoking Status	Smoker Non-Smoker		1.56 --	<.001	1.55 --	<.001
Prior Pregnancy Loss	Yes No			1.47 --	<.001	1.38 --	<.001
	Prenatal Education	Yes No		1.19 --	ns	1.24 --	ns
		1st Birth x Prenatal Education		1.01	<.001	0.98	<.001
Pregnancy Complication	Yes No					6.55 --	<.001
Adequate Care	No Yes					1.43 --	<.05
	Inadequate Care X Complication					0.85	ns

* Reference Group: --

incomes was not supported. These findings raise significant questions about the effectiveness of prenatal medical care in the prevention of low birthweight. The implications of these findings are developed in the discussion section of this report.

Table 13 examines the relationship between adequacy of care and the incidence of low birthweight. The adjusted odds ratio for complication in pregnancy was 6.55 and for inadequate care is 1.43, both significant predictors of an elevated risk of newborn birthweight of less than 2,500 g. Again, the presence of both pregnancy complication and inadequate care did not increase the probability of low birthweight.

The crude association of income rank with the incidence of low birthweight describes a significantly increased risk for women in Quintile 1 (ODDS RATIO 1.82) and Quintile 2 (ODDS RATIO 1.62) relative to women in Quintile 5 (TABLE 13). The magnitude of the risk associated with income is reduced when maternal factors are included in the analytic model. This reduction in the crude estimate of risk associated with income rank reflects in part the concentration of maternal risk factors such as smoking and being unmarried among women of lower socio-economic status. Following the addition of variables measuring pregnancy complications and use of prenatal care, the association of low birthweight with income rank was further reduced and was no longer significant. The results of this hierarchical analysis indicate that the crude excess risk of low birthweight observed for women in Quintiles 1 and 2 can be attributed to the combination of maternal factors, a higher incidence of complications and poorer utilization of antenatal medical care.

Infants born to first-time mothers were estimated to have an adjusted mean birthweight approximately 167.5 g lighter than infants born to women with one to four prior births (TABLE 12). First-time mothers who attended a prenatal education program, however, gave birth to babies whose mean adjusted birthweight was an estimated 100 g higher than that of babies of non-attending first-time mothers. First-time mothers who reported enrolment in a prenatal education program had no excess risk of having a low birthweight infant relative to women with one to four prior births, while non-attending first-time mothers

had an excess risk of low birthweight 1.78 times greater. These results should be interpreted cautiously. In part, this association is due to duration of gestation. The 5.8% of women in the population with a gestation of less than 37 weeks may not have had the opportunity to enrol in a childbirth or prenatal education program. Second, it would be inappropriate to interpret a causal relationship between enrolment in a prenatal education program and higher birthweight. The same maternal factors that motivate a woman to enrol in an education program may also contribute to higher birthweight.

Tables 14 and 15 present the results of an alternative analytic approach in which the total population is stratified into two groups according to the presence or absence of recorded complication in pregnancy. The relationship between adequacy of care and birthweight outcome was found to be similar to that observed in the unstratified analysis. Among uncomplicated pregnancies, women who received less than adequate care gave birth to infants whose mean birthweight was 55 g lower than that of newborns whose mothers received adequate care. In complicated pregnancies, less than adequate care was associated with a similarly moderate birthweight deficit.

There are notable differences in the relationship between maternal factors and birthweight when stratified by complication. Among uncomplicated pregnancies, native women gave birth to infants whose mean birthweight was 153 g heavier than that of babies of non-natives; this difference increased to 188 g among complicated pregnancies. In complicated pregnancies, infants of women having their fifth or subsequent birth were estimated to be 150 g heavier than babies of women having their second to fourth birth, while no difference was observed among women with uncomplicated pregnancies.

Among uncomplicated pregnancies, the poorest 20% of women in the city (Quintile 1) gave birth to infants whose mean birthweight was almost 100 g lower than women in Quintile 5, after other maternal factors and the adequacy of prenatal care were adjusted for. This association was also evident in the analysis of low birthweight among women with an uncomplicated pregnancy. However, there was no association of income rank with birthweight outcome among women with complicated pregnancies.

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Table 14
 Multivariate Linear Regression Analysis of the Relationship of
 Maternal Characteristics and Adequacy of Prenatal Care to
 Incidence of Low Birthweight
 by Incidence of Complication in Pregnancy

Measure of adequacy of care based on physician claims
 Births to Women resident in Winnipeg, July 1987 - December 1988, N=12,646
 Low Birthweight = < 2,500g

		No Complication in Pregnancy			Complication in Pregnancy		
N		9,450			3,196		
Low Birthweight /1000 births		21/1000			124/1000		
		%	Odds Ratio	p	%	Odds Ratio	p
Income Quintile	Q1	.226	1.68	<.05	.274	1.13	ns
	Q2	.163	1.57	ns	.187	1.09	ns
	Q3	.164	1.31	ns	.159	0.97	ns
	Q4	.235	1.33	ns	.209	1.06	ns
	Q5	--	--	--	--	--	--
Treaty Status	Non-Native	.960	1.07	ns	.943	1.58	ns
	Native	--	--	--	--	--	--
Maternal Age	< 20	.065	0.64	ns	.082	0.91	ns
	20-34	--	--	--	--	--	--
	> 34	.123	1.48	ns	.126	1.34	ns
Parity	1st birth	.424	2.04	<.001	.485	1.61	<.01
	2nd-4th	--	--	--	--	--	--
	5th or subsequent	.019	0.88	ns	.025	0.76	ns
Marital Status	Unmarried	.258	1.57	<.01	.289	0.92	ns
	Married	--	--	--	--	--	--
Smoking Status	Smoker	.251	1.88	<.001	.275	1.39	<.01
	Non-Smoker	--	--	--	--	--	--
Prior Pregnancy Loss	Yes	.231	0.91	ns	.269	1.70	<.001
	No	--	--	--	--	--	--
Prenatal Education	Yes	.354	0.91	ns	.345	0.86	ns
	No	--	--	--	--	--	--
Adequate Care	No	.248	1.31	<.05	.235	1.28	<.05
	Yes	--	--	--	--	--	--

Reference Group: --

Table 15
 Multivariate Linear Regression Analysis
 of the Relationship of Maternal Characteristics and
 Adequacy of Prenatal Care to Birthweight (g)
 By Incidence of Complication in Pregnancy

Adequacy of Care measure based on physician claims
 Births to Women resident in Winnipeg, July 1987 - December 1988, N=12,646

		No Complication in Pregnancy			Complication in Pregnancy		
N		9,450			3,196		
Reference (g)		3,779			3,564		
R2		4.9			3.1		
		%	g	P	%	g	P
Income Quintile	Q1	.226	-96.0	<.001	.274	-62.8	ns
	Q2	.163	-48.9	<.01	.187	-16.4	ns
	Q3	.164	-28.5	ns	.159	-12.1	ns
	Q4	.235	-30.6	<.05	.209	-17.3	ns
	Q5		--			--	
Treaty Status	Non-Native	.960	-153.5	<.001	.943	-188.5	<.001
	Native		--			--	
Maternal Age	< 20	.065	11.4	ns	.082	51.5	ns
	2--34		--			--	
	> 34	.123	-37.8	<.01	.126	-107.9	<.001
Birth Order	1st Birth	.424	-159.8	<.001	.485	-180.3	<.001
	2nd-4th		--			--	
	5th or Subsequent	.019	-8.7	ns	.025	150.8	<.001
Marital Status	Unmarried	.258	-10.4	ns	.289	6.5	ns
	Married		--			--	
Smoking Status	Smoker	.251	-169.9	<.001	.275	-146.2	<.001
	Non-Smoker		--			--	
Prior Pregnancy Loss	Yes	.231	2.0	ns	.269	-84.1	<.01
	No		--			--	
Prenatal Education	Yes	.354	53.2	<.001	.345	105.9	<.001
	No		--			--	
Adequate Care	No	.248	-55.6	<.001	.235	-63.1	<.05
	Yes		--			--	

Reference Group: --

Discussion

In examining the hypothesis that early and frequent prenatal care can have a beneficial effect on pregnancy outcome, this investigation has a number of strengths compared to previous studies applying a similar analytic approach. Information on maternal smoking status and a proxy measure of socio-economic status were available for this population. The exclusion of cases because of missing data was minimized by developing measures of prenatal care utilization from physician claims records. As a result, the study includes information on a virtually complete population of women who gave birth between July 1987 and December 1988. Finally, the study developed an indicator of the incidence of pregnancy complication and directly tested the hypothesis that effective antenatal care would have greatest impact on complicated pregnancies.

Data Quality

Overall, the quality of the information on the obstetrical hospital abstract for women resident in Winnipeg is very high. This is principally due to the collaboration of physicians, institutions and MHSC, under the leadership of the College of Physicians and Surgeons of Manitoba. The one demonstrated inadequacy on hospital obstetrical abstracts was the proportion of records with missing information on prenatal care. This study has demonstrated that the records with missing data disproportionately represent women with social and demographic risks for poor birth outcomes, women who are low users of care, women who have a higher incidence of pregnancy complication and women who have abbreviated gestation and whose infants have poor birthweight outcomes.

The study has shown that the measure of smoking behaviour derived from the Post-Partum Referral Database appears to have significant predictive validity. The substantial suppression of birthweight associated with maternal smoking observed in this study replicates the well-known relationship between smoking and intrauterine growth retardation of the fetus. Tobacco use is the single most important modifiable determinant

Table 16
 Comparison of Distribution of Prenatal Care Index

	LOCATION MANITOBA 1987-88	PORTLAND, OREGON 1973-74 (10)	SOUTH CAROLINA 1987 (61)	CALIFORNIA ALAMEDA CO. 1978 (6)
	SOURCE OF DATA			
	PHYSICIAN CLAIMS	BIRTH CERTIFICATE WHITE WOMEN	LIVE BIRTH FILE	BIRTH CERTIFICATE
N	12,646	19,116	51,580	25,091
ADEQUACY OF CARE				
ADEQUATE	75.6%	72.5%	52.6%	52.3%
INTERMEDIATE	15.6%	18.5%	28.7%	17.4%
INADEQUATE	8.7%	5.5%	11.5%	2.9%
MISSING	0.0%	3.5%	7.3%	27.2%

of birthweight deficit, and may be a contributing factor in preterm birth (38). To improve public health surveillance of this behaviour, the information on smoking practice during pregnancy contained on the Post-Partum Referral Database should be routinely linked to birth outcome data.

A total of 25% of the women in this study were defined as having a complication of pregnancy. This estimated incidence of complication is generally higher than is typically reported in other studies. However, the literature describing the incidence of complications in complete populations is poorly standardized, with wide variations in measurement method, source of data and inclusion criteria (6,10,14,30,33,39-43). Estimates of the prevalence of complications in pregnancy vary widely. In general, however, the rate observed in the Winnipeg population is within the range reported in other settings in developed countries. A British study (37) reported the rate of antepartum haemorrhage to be 8.8%, which compares well with the rate of 6.9% observed in the Winnipeg population when information from both physician claims and the hospital abstract was consolidated. The British study reported an incidence rate of severe pre-eclampsia of 5.6/100 births, while the rate of pre-existing and pregnancy-induced hypertension was 6.2/100 in a sample of New York City births (39), 6.0/100 in New South Wales, Australia, and 6.5/100 in the current study.

Utilization of Prenatal Care

Table 16 compares the distribution of adequacy of care in the Winnipeg population and in three typical U.S. samples. The adequacy of the care received by Winnipeg women, who are universally insured for comprehensive prenatal services, compares favourably with rates observed in other North American populations (8). As measured by trimester of initiation of care, access to prenatal care for the Winnipeg women was better than has been reported for typical U.S. samples, and these differences are more pronounced among women of lower socio-economic status. Among women of median or high socio-economic status, prenatal care was initiated before the end of the first trimester by 93.7% of the

women in the Winnipeg sample, 88% of a sample of urban women in Washington State (44) and 91.7% of urban women in southern California (14). A total of 82.9% of the poor women in the Winnipeg sample initiated care by the 13th week of pregnancy, compared to 69% of poor women in the Washington State sample and 70% of low-income women not eligible for Medicaid and 62% of Medicaid-insured women in southern California.

Despite this favourable external comparison, however, it is also clear that universal health insurance does not remove all barriers to access. The Winnipeg women in the lowest income quintile had consistently and substantially poorer utilization of care relative to median and high income women. Poor women had an average of 1.5 fewer visits in the course of their pregnancies and first sought care an average of 1.5 weeks later in pregnancy. A total of 17% of the poorest women initiated care later than the first trimester, compared to less than 7% of women of median or high income.

Effectiveness of Prenatal Care

After maternal characteristics and early complications of pregnancy were adjusted for, Winnipeg women receiving less than adequate care gave birth to infants whose mean birthweight was 58 g lighter than women receiving adequate care. The size of this association of inadequate care with poorer birthweight outcome is of much smaller magnitude than has been reported in several studies in which comparable methods were used. For example, in a sample of 18,000 California births, Showstack reported a difference of 197 g between the adequate and inadequate care groups (6). Adolescents in New Jersey who received adequate care gave birth to infants with an average birthweight 157 g higher than in the inadequate care group (41). Adequate care was associated with an increase in birthweight of 159 g among babies of women in Portland, Oregon (10).

The smaller effect of care in the current study may be due to a number of factors. The Winnipeg cohort may be a healthier population than other samples, with a lower rate of

unfavourable birthweight outcomes compared to the comparison populations. The overall incidence of low birthweight in the Winnipeg sample during the study interval was 47/1000 births. A similarly small improvement in birthweight was reported in a study among women enrolled in the Kaiser-Permanente health plan in northern California in which the observed incidence rate of low birthweight was 42/1000 births (45). In the Kaiser population, in which 83% of women initiated care in the first trimester of pregnancy, the estimated contribution of early initiation of care to birthweight, after maternal factors were adjusted for, was 29.9 g. This pattern suggests that the impact of prenatal care, when measured on an aggregate population basis, becomes increasingly small as the reproductive health of the population improves and argues for analysis focused on specific populations at high risk.

A surprising and unsettling finding from this study is the absence of a beneficial effect of prenatal care on birthweight outcome in complicated pregnancies. Fundamentally, prenatal care is premised on the effectiveness of routine and regular surveillance of pregnancy to detect the onset of complications, leading to therapeutic responses which seek to mitigate the negative impact of the complication on newborn or maternal health. There is, in fact, no biological model to propose any benefit of prenatal care in an uncomplicated normal pregnancy. Plausible explanations for this finding include the possibility that the study failed to accurately identify complicated pregnancies, that the study erred in the specification of complication in the analysis, or that the therapeutic management of gestational complication is relatively ineffective.

The failure to demonstrate a beneficial effect of early prenatal care on birthweight outcome may be due to errors in the analytic approach. Most of the complications examined in this study are strongly predictive of preterm birth. Identification and successful treatment of these complications in the course of prenatal care would result in longer gestation and increased average birthweight. However, the analytic approach used in the study would not be sensitive to interventions that extended the duration of pregnancy, thereby contributing to fetal maturity at birth, but that did not enhance fetal

weight gain. It is also possible that the decision to combine a group of discrete complications into a single measure obscured successful complication-specific interventions. In addition, the study did not test the hypothesis that antenatal medical care can actually prevent the onset of complications. To the extent that this is a plausible expectation, the study has underestimated the contribution of care by failing to estimate averted morbidity in the no-complication group. Finally, it is possible that the measure of complication derived from administrative data may have resulted in misclassification of a significant number of women (20,40). However, even if a substantial number of women with normal pregnancies were defined as having a complicated pregnancy, this would not be expected to obscure a beneficial effect of prenatal care in true complicated pregnancies.

The absence of a significant beneficial effect of care among women with complicated pregnancies may be an accurate representation of the effectiveness of current medical therapies for the prevention of preterm birth. In a very high proportion of cases, low birthweight is due to premature delivery. With the exception of some recent interest in tocolytic therapies, however, there has not been significant progress in the prevention and management of prematurity in the past two decades (7,17-18,46-51). The causes of preterm labour remain unclear, and techniques to identify women at risk of preterm birth have not been found to be sufficiently discriminatory to be of value in clinical settings.

Among the most consistent markers of the risk of a preterm or low birthweight birth is low socio-economic status (52). Compared to middle-income or wealthy women, poor women may experience greater nutritional deficits in pregnancy, may be more likely to be employed in physically demanding occupations, may be exposed more frequently to vaginal infection and may in general have fewer resources available with which to respond to the demands of pregnancy (17,53-54). This study has demonstrated that poor women in Winnipeg are more likely to be under the age of 20 and unmarried. Poor women more frequently reported smoking during pregnancy and experienced a higher incidence of complication than women of median or high income. After maternal factors,

smoking status, complications and the use of prenatal care were adjusted for, a residual difference in average birthweight of 88.8 g was found between the wealthiest and poorest groups.

The crude incidence of low birthweight among poor women in this study was almost twice that among women in the highest income stratum (ODDS RATIO: 1.82, $p < .001$, TABLE 13). The results of the multivariate analysis reported in Table 13 indicate that the excess risk associated with socio-economic status can be predominantly attributed to four factors: the incidence of complication, smoking during pregnancy, being single and inadequate prenatal care. If the prevalence or impact of these factors among poor women could be modified to equal the experience of the wealthiest women, as much as 78% of the excess incidence of low birthweight could potentially be prevented. Specifically, the data suggest that the higher incidence of complication among poor women accounts for 30% of the difference in the rate of low birthweight between the wealthiest and poorest women, 17% of the difference is attributable to the higher frequency of smoking, 15% to the higher prevalence of single marital status and only 12% to poorer utilization of antenatal care.

Focusing on these factors suggests a number of strategies for improving birth outcomes among poorer women. On the basis of findings of this study, the impact of pregnancy complication on birthweight outcome will not be substantially mitigated by improving the utilization of routine antenatal care.

It is plausible, however, that the underlying causes of pregnancy complication, which may include nutritional factors and reproductive tract infection, can be addressed. On the evidence of the beneficial effect of programs that provide nutritional resources to poor pregnant women (19,30,33,34,55-59), consideration should be given to implementing such programs in Manitoba, perhaps linked to the receipt of antenatal care. If such benefits are linked to the receipt of care, consideration should be given to developing meaningful incentives for poor women of reproductive age to maintain a continuous relationship with health care providers and to encouraging those forms of organization of

care, such as community clinics, that appear to be responsive to the needs of this population of women.

Following two decades of observational studies, the evidence for a beneficial effect of early and frequent prenatal care on the prevention of low birthweight remains ambiguous. To resolve this uncertainty, there are increasingly frequent recommendations to conduct randomized trials of specific questions in the organization and delivery of antenatal care (9,19,60). Without evidence from such definitive studies, the findings from this research do not support the proposition that the route to moderating socio-economic inequities in birthweight outcome is through improved access to conventional prenatal care.

APPENDIX A Definition of Measures

Maternal Characteristics

Socio-Economic Status: Public-use data from the 1986 Census provides a measure of mean household income for each of the approximately 800 enumeration areas with residential households in the City of Winnipeg. These enumeration areas were ranked from poorest to wealthiest and were then grouped into five population quintiles, each quintile containing 20% of the city's population. Each case in the sample was linked to an enumeration area by postal code, and a quintile income rank (with Quintile 1 being the poorest) was assigned. Less than 1% of the women (N = 71) could not be linked to an enumeration area and were imputed the median quintile rank.

Smoking Status: This measure is derived from the Post-Partum Referral Database and was based on maternal self-report of smoking status during the pregnancy (smoker vs non-smoker). No information was available on smoking frequency or on cessation during pregnancy.

Marital Status: Marital status was inferred from MHSC family registration data. Women who shared a registration number with an adult male were classified as married for the purposes of the study. All other women were classified as non-married.

Treaty Indian Status: Women of aboriginal ancestry who hold treaty status under the federal Indian Act were identified in MHSC registration data through municipality codes indicating their registered reserve. The home reserve is reported for all status natives, regardless of actual residency.

Age: Maternal age in years was computed from the date of birth reported in MHSC registration files.

Parity: For obstetrical cases, the number of previous live births is recorded in the hospital abstract.

Prior Pregnancy Loss: A history of prior pregnancy loss is indicated for women for

whom the number of prior pregnancies reported on the obstetrical hospital abstract is greater than the number of previous live births.

Complications of Pregnancy

Measures of pregnancy complications, coded to the ICD-9-CM schedule, are available from both physician reimbursement claims and the hospital separation abstract. On physician claims, ICD-9-CM codes are limited to three digits, while the full five-digit series is available on the hospital file. For each woman, physician claims for antenatal care and the separation abstract were reviewed separately for the presence of 17 specific diagnoses representing conditions complicating pregnancy, labour or delivery.

A series of analyses were performed to assess the accuracy and precision of the reporting of complications in the two data sources. Within each class of complication, the degree of agreement between physician claims and the hospital record was examined. In addition, the relationship between the reported diagnosis of complication and the utilization of antenatal care was investigated. It was expected that women who had few or infrequent provider contacts would have a lower rate of complication, either due to a true uncomplicated pregnancy or because of reduced opportunity for the care provider to detect the presence of existing complications. The results of these analyses are detailed in Appendix B.

To investigate the relationship between antenatal complications and prenatal care, a summary complication measure was used. On the basis of the association with birthweight, six ICD-9-CM diagnostic groups were selected: 640 (haemorrhage in early pregnancy), 641 (antepartum haemorrhage), 642 (hypertension), 643 (excessive vomiting), 644 (early or threatened labour) and 646 (other antenatal complications). A pregnancy was defined as having an antenatal complication if the presence of one or more of these complications was noted on either physician claims or the maternal hospital abstract.

Characteristics of Care

Frequency of Visits: A measure of the frequency of care is available from both the hospital separation abstract and physician claims. The measure on the hospital separation abstract is summed from the visit record on the Prenatal Care Record, and when transcribed is recorded in a range from 0 to 8, where the value 8 represents 8 or more visits. This measure generally does not include the first visit, when the pregnancy is confirmed. Operationally, the frequency of care as measured on the hospital separation abstract is defined as the number of visits subsequent to the confirmation of pregnancy. In addition, the hospital abstract measure reports the care provided by a single provider: it does not include formal referrals for consultations with other physicians or prenatal visits with other providers initiated by the woman.

The measure of frequency of care derived from physician claims does permit the enumeration of care provided by multiple providers and does count the first antenatal contact, generally when pregnancy is confirmed, as a visit. For women who received care from physicians submitting global tariff, claims for diagnostic testing were used in place of direct claims for physician visits. All eligible diagnostic tests with service dates within five days of a first test were grouped to represent a single episode of care. Referrals for consultation are not included in this measure.

Initiation of Care: A measure of the timing of initiation of care is also available from both the hospital separation abstract and physician claims. On the hospital abstract, this measure, derived from the Prenatal Care Record, is expressed as the week of gestation of the first provider contact following the visit at which the diagnosis of pregnancy was established. This measure was missing for 12.4% of the women.

As measured from physician claims, the initiation of care, defined as the week of gestation of the first provider contact for pregnancy-related care in the pregnancy, is available for all the women. Because the claim-based measure counts the first antenatal

contact as the first visit and because the measure was available for all the women, the claim-based measure was used in all subsequent analyses.

Number of Consultations: Evidence of referral for consultation is available only from physician claim files. Consultations were defined as claims with a tariff code of 8550 and a pregnancy-related ICD-9-CM code. Consultations were summed separately from routine antenatal visits.

Adequacy of Care: A three-level index of the adequacy of prenatal care was constructed that classifies the use of care according to the length of gestation (35). For example, a woman who gives birth five weeks prematurely would be expected to have up to four fewer antenatal visits than a woman who gives birth at 40 weeks. Inadequate care is defined as initiation later than the second trimester, or a very low frequency of contacts if initiation occurs in the first or second trimester. The index has been used in other settings to adjust for the effects of abbreviated gestation on the utilization of antenatal care (6,10,61). A comparison of the two sources of information on care is given in Appendix C.

PRENATAL CARE INDEX*

ADEQUATE CARE

Initiation of Care in the first trimester, and
9 or more visits if gestation > 35 weeks, or
8 or more visits if 34-35 weeks gestation, or
7 or more visits if 32-33 weeks gestation, or
6 or more visits if 30-31 weeks gestation, or
5 or more visits if 26-29 weeks gestation, or
4 or more visits if 22-25 weeks gestation, or
3 or more visits if 18-21 weeks gestation, or
2 or more visits if 14-17 weeks gestation, or
1 or more visits if 13 weeks gestation.

INADEQUATE CARE

Initiation later than second trimester, or
1 or less visits and 14-29 weeks gestation, or
2 or less visits and 30-31 weeks gestation, or
3 or less visits and 32-33 weeks gestation, or
4 or less visits and 34 or more weeks gestation

INTERMEDIATE CARE

All other combinations of care

- * 35 Kessner, D.M., Singer, J. and Kalk, C.W. Infant death: an analysis by maternal risk and health care. In: *Contrasts in Health Status*, Vol 1, Washington : Institute of Medicine, 1973.

Prenatal Education: The Post-Partum Referral Database contains information on maternal self-report of participation in an antenatal education program and a description of the program site (hospital, public health program or program provided by a private organization). No information is available on program duration or content.

Source of Care: The study did not examine provider characteristics beyond the classification of the population into two groups on the basis of physician billing practice. However, an attempt was made to study the organization of care by identifying care delivered from provider sites organized as community clinics. Active billing numbers were ascertained for the five clinic sites of interest to the study, and care delivered by these sites was enumerated.

Continuity of care (the extent to which a single provider functions as the primary caregiver) was not investigated in this study, although the existing administrative data are well suited to research in this area. In addition, services provided by hospital facilities on an out-patient basis were not examined. These services include very high volumes of diagnostic ultrasound examination and a range of fetal assessment procedures. Currently in the province much of this out-patient service is not recorded on administrative data systems.

APPENDIX B

Measures of Pregnancy Complication

Both physician claims and the hospital separation abstract contain diagnostic codes describing complications of pregnancy that were identified during the antenatal period. In both data sources the ICD-9-CM coding system is used. Physician claims contain a single three-digit diagnosis, from a set of 17 categories defining pregnancy complication in the antenatal period or indications for care in pregnancy and labour. The hospital abstract provides for a maximum of 16 five-digit diagnostic codes, which are used to summarize antenatal complications, complications of labour and delivery, and post-partum complications.

Table B.1 reports the agreement between physician claims and hospital separation abstracts on the identification of complications (ICD-9-CM codes 640-648). For antenatal complications, 23.7% of hospital abstracts and 28.3% of physician claim histories reported at least one complication. However, when both data sources were considered, 38.4% of the population showed evidence of a pregnancy complication. Agreement between the two sources was low: of the 4,844 women with evidence of a complication, only 34.9% were found to have an equivalent diagnosis on both the physician claims record and the hospital abstract.

Also reported in Table B.1 is the correspondence between the hospital abstract and physician claims in the identification of other indications for care in labour and delivery (ICD-9-CM codes 652-659). These indications were reported to be more prevalent than pregnancy complication on both the physician claims (55.8% of pregnancies) and the hospital abstract (37.6%). Again, the concordance between the two data sources was low (43.1%).

A very high proportion of pregnancies were reported to have at least one complication

Table B.1
Agreement Between Hospital Separation Abstract and Antenatal Physician Claims on the Diagnosis of Pregnancy Complication

Births to women resident in Winnipeg, June 1987 to December 1988,
 N = 12,646
 Excluding 41 cases with missing gestational age

Complications Related to Pregnancy
 (ICD-9-CM 640-648)

Physician Claims	Hospital Abstract		Total	
	No	Yes		
No	7,761	1,288	9,049	71.7%
Yes	1,861	1,695	3,556	28.3%
Total	9,622	2,983	12,605	
	76.3%	23.7%		

% Overall Agreement = 75.0% (7761 + 1695 / 12,605)
 % Specific Agreement = 34.9% (1695 / 1695 + 1861 + 1288)

Other Indications for Care in Pregnancy, Labour and Delivery
 (ICD-9-CM 652-659)

Physician Claims	Hospital Abstract		Total	
	No	Yes		
No	4,386	1,189	5,575	44.2%
Yes	3,480	3,550	7,030	55.8%
Total	7,866	4,739	12,605	
	62.4%	37.6%		

% Overall Agreement = 62.9% (4386 + 3550 / 12,605)
 % Specific Agreement = 43.1% (3550 / 3550 + 3480 + 1189)

when both complications of pregnancy (ICD-9-CM 640-648) and indications for care (ICD-9-CM 652-659) were considered jointly. As reported in Table B.2, physician claims identified 67.7% of pregnancies as having a pregnancy complication or other condition indicating care, while 50.6% of pregnancies were similarly identified on the hospital abstract.

Table B.3 describes the prevalence of complications for 17 specific diagnostic groupings. Some categories, such as vomiting (ICD-9 643) included a very narrow range of conditions. Other categories, however, pooled a very heterogeneous group of morbidities, with different management prognoses.

Only two of the complication categories show even moderate agreement between the two data sources. Of the 6.9% of cases with a diagnosis of hypertension on either source, 56% were identified on both the physician claims and the hospital abstract. Similarly, of the 8.4% of pregnancies with a diagnosis of abnormality of the pelvic organs or soft tissues (including previous cesarean section), 59.5% were identified on both sources. The remaining categories showed very low concordance.

The predictive validity of the two sources of data is examined in Table B.4. The deviation from the mean birthweight of the newborns whose mothers had no reported complications is reported for each diagnostic category. Pregnancies with a diagnosis of haemorrhage in early pregnancy, antepartum haemorrhage, hypertension, excessive vomiting, early or threatened labour, or other complications showed a general pattern of lower birthweight. In cases in which the diagnosis was present on both data sources, the magnitude of the birthweight deficit was increased. Conditions grouped under ICD-9-CM code 648, which include anaemia and diabetes mellitus, are sufficiently heterogeneous as to show no overall association with birthweight.

The prevalence of pregnancy complications (ICD 640-648) was found to be higher on

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Table B.2

Prevalence of Complications of Pregnancy (ICD 640-648) and Indications for Care in Pregnancy, Labour and Delivery (ICD 652-659)

Hospital Separation Abstract

Complications of Pregnancy (640-648)	Indications for Care (652-659)		Total N	% OF TOTAL
	No N	Yes N		
No	6,245 (49.3%)	3,411 (27.0%)	9,656	76.3%
Yes	1,650 (13.0%)	1,340 (10.6%)	2,990	23.6%
Total	7,895	4,751	12,646	
% OF TOTAL	62.4%	37.5%		

Physician Claims Measure
Excluding 41 cases with missing gestational age

Complications of Pregnancy (640-648)	Indications for Care (652-659)		Total N	% OF TOTAL
	No N	Yes N		
No	4,067 (32.1%)	4,982 (39.3%)	9,049	71.7%
Yes	1,508 (11.9%)	2,048 (16.2%)	3,556	28.3%
Total	5,575	7,030	12,605	
% OF TOTAL	44.2%	55.8%		

Table B.3
Incidence of Pregnancy Complications
By Source of Data

Births to women resident in Winnipeg, June 1987 to December 1988, N = 12,646

	A. Physician Claims		B. Hospital Abstract		C. Both A & B		D. Either A or B		Agreement (C/D)		
	%	N	%	N	%	N	%	N	%		
Complications of Pregnancy (ICD-9-CM 640-648)											
640	Hemorrhage in Early Pregnancy		2.3	(301)	0.0	(0)	0.0	(0)	2.3	(301)	.000
641	Antepartum Hemorrhage		3.5	(442)	1.6	(207)	0.9	(117)	4.2	(532)	.219
642	Hypertension		5.6	(686)	5.2	(637)	3.8	(473)	6.9	(850)	.560
643	Excessive Vomiting		1.4	(173)	0.0	(1)	0.0	(0)	1.4	(174)	.000
644	Early or Threatened Labour		5.9	(752)	3.4	(444)	0.8	(100)	8.6	(1096)	.092
645	Long Pregnancy		5.8	(731)	5.1	(660)	2.6	(333)	8.3	(1058)	.318
646	Other		4.8	(611)	2.5	(326)	0.3	(49)	6.9	(888)	.056
647	Infection		0.3	(35)	0.6	(94)	0.1	(13)	0.8	(116)	.127
648	Other (includes diabetes)		4.6	(590)	8.3	(1050)	2.7	(351)	10.2	(1288)	.272
Indications for Care (ICD-9-CM 652-659)											
652	Malposition		6.9	(879)	7.7	(973)	4.0	(508)	10.6	(1344)	.378
653	Disproportion		3.0	(381)	3.7	(475)	1.7	(217)	5.0	(639)	.339
654	Abnormality of Pelvic Organs		5.5	(704)	7.8	(990)	4.9	(632)	8.4	(1062)	.595
655	Known/Suspected Fetal Abnormality		0.2	(29)	0.2	(24)	0.0	(3)	0.4	(50)	.060
656	Other Problems		22.2	(2819)	14.8	(1882)	6.2	(787)	30.9	(3914)	.201
657	Polyhydramnios		1.4	(175)	0.4	(55)	0.1	(19)	1.6	(211)	.091
658	Complications of Amniotic Cavity		10.0	(1272)	10.0	(1268)	3.3	(421)	16.7	(2119)	.198
659	Other		19.6	(2485)	3.9	(493)	1.0	(128)	22.5	(2850)	.044

Table B.4
 Deviation in Mean Birthweight for Specific Pregnancy Complications
 by Source of Data

Births to women resident in Winnipeg, June 1987 to December 1988, N = 12,646
 p < .001 unless noted: * = ns, ** = <.05

Mean birthweight for reference group (6,211 infants whose mothers had no reported complications) is 3454 g.

Complications of Pregnancy (ICD-9-CM 640-648)	A. Physician Claims		B. Hospital Abstract		C. Both A & B		D. Either A or B	
	g	N	g	N	g	N	g	N
640 Hemorrhage in early pregnancy	-172	(301)	0	(0)	0	(0)	-172	(301)
641 Antepartum Hemorrhage	-396	(442)	-887	(207)	-1044	(117)	-444	(532)
642 Hypertension	-215	(686)	-216	(637)	-317	(473)	-159	(850)
643 Excessive Vomiting	-109	(173)	-812	(1)*	0	(0)	-113	(174)
644 Early or Threatened Labour	-192	(752)	-1072	(444)	-1302	(100)	-448	(1096)
645 Long Pregnancy	270	(731)	276	(660)	290	(333)	269	(1058)
646 Other	-140	(611)	-94	(326)	-141	(49)**	-124	(888)
647 Infection	165	(35)**	-132	(94)	62	(13)*	-64	(116)*
648 Other (includes diabetes)	-8	(590)*	-12	(1050)*	29	(351)*	-22	(1288)*
Indications for Care (ICD-9-CM 652-659)								
652 Malposition	-120	(879)	-184	(973)	-210	(508)	-132	(1344)
653 Disproportion	227	(381)	272	(475)	285	(217)	241	(639)
654 Abnormality of Pelvic Organs	-21	(704)*	-54	(990)	-29	(632)*	-47	(1062)
655 Known/Suspected Fetal Abnormality	-323	(29)	-671	(24)	-1505	(3)	-419	(50)
656 Other Problems	-135	(2819)	-48	(1882)	-157	(787)	-95	(3914)
657 Polyhydramnios	-126	(175)	51	(55)*	-99	(19)*	-82	(211)
658 Complications of Amniotic Cavity	-154	(1272)	-254	(1268)	-392	(421)	-168	(2119)
659 Other	-9	(2485)*	29	(493)*	63	(128)*	-6	(2850)*

physician claims than on the hospital abstract (Tables B.3, B.4). In general, this would be expected. Some diagnostic codes record presumptive rather than definitive diagnoses, which may be subsequently excluded. Second, successful management of complications in early pregnancy may reduce the salience of these conditions when the primary antenatal provider signs off on the hospital medical chart. For example, in the case of some early conditions of pregnancy, such as haemorrhage before 22 weeks gestation, successful antenatal management would perhaps not be noted on the hospital abstract. Finally, this study has found that for 9% of cases, the prenatal care record appears not to have been available to the hospital records staff, which may have led to under-reporting of complications observed in the antenatal period.

There are thus several plausible processes that would result in a lack of concordance in the recording of complications between physician claims and the hospital separation abstract. As described in Appendix A, the study used a summary measure of complication that incorporates information present on either physician claims or the hospital separation abstract. The six pregnancy complication codes selected were found to significantly predict lower mean birthweight, whether present singly or jointly on physician claims and the hospital separation abstract. Also, as reported in the discussion section, the prevalence of complication estimated from the combined sources agrees more closely with estimates in the published literature than do estimates from either source alone.

A series of analyses were also performed to examine the relationship between use of care and the reported diagnosis of antenatal complication. It may be expected that women who have few or infrequent contacts with health care providers during pregnancy will show a lower rate of complications, either due to a true uncomplicated pregnancy or because of reduced opportunities for providers to ascertain the presence of existing complications. The relationship between the frequency of visits and the ascertainment of complications is reported in Tables B.5 and B.6. For complications of pregnancy (ICD 640-648) and for indications for care in labour (ICD 652-659), the frequency of visits during pregnancy

was inversely related to the reporting of complications on the hospital abstract (Table B.5). This pattern was most prominent for diagnoses of indication for care. In the global tariff group, 57.6% of women who had more than eight antenatal visits had at least one indication noted on the hospital abstract, compared to 50.3% of women who had less than five antenatal visits. The corresponding figures for the fee-for-service group were 58% and 39.4%.

Table B.6 shows the relationship between the trimester of initiation of care and the diagnosis of pregnancy complications. Whether the complications were enumerated from physician claims records or the hospital abstract, pregnancy complications were more prevalent among women who sought care late than among those who sought care early. Indications for care showed the reverse pattern. The 12.4% of pregnancies for which the timing of initiation of care was missing on the hospital abstract showed a higher rate of reported complications and other indications for care. This result is consistent with the earlier discussion about this population.

These findings are inconclusive concerning the extent to which poor utilization of prenatal care results in failure to diagnose pregnancy complications. There is no strong evidence that low use is associated with lower reported rates of complication, and, by inference, that low use is suggestive of under-ascertainment of the true prevalence of complications. The approach used in this study, relying solely on administrative data, should be validated by a direct chart review.

Table B.5
 Relationship Between Frequency of Antenatal Care
 and the Identification of Complications of Pregnancy (ICD 640-648) and
 Indications for Care in Pregnancy, Labour and Delivery (ICD 652-659)

Complications enumerated from hospital separation abstract only.
 Measures of utilization based on physician claims

Physicians Billing by Global Tariff		Number of Episodes of Care			TOTAL	
	N	> 8	5-8	<5		
	%					
		%	%	%	N	%
Number of Complications (ICD9-CM 640-648)	0	72.1	75.4	78.6	7,997	73.0
	1	22.6	20.3	19.2	2,414	22.0
	2	4.6	3.8	2.0	474	4.3
	3 or more	0.6	0.4	0.1	61	0.6
Number of Other Indications for Care (ICD9-CM 652-659)	0	42.3	50.3	49.7	4,817	44.0
	1	44.6	38.3	40.2	4,755	43.4
	2	11.7	10.5	9.4	1,243	11.4
	3 or more	1.3	0.8	0.7	131	1.2
Physicians Billing by Fee-for-Service		Number of Episodes of Care			TOTAL	
	N	> 8	5-8	<5		
	%					
		%	%	%	N	%
Number of Complications (ICD9-CM 640-648)	0	64.0	63.2	61.3	1,081	63.5
	1	27.3	29.0	32.6	479	28.1
	2	6.8	6.2	4.7	111	6.5
	3 or more	1.8	1.3	1.3	29	1.7
Number of Other Indications for Care (ICD9-CM 652-659)	0	41.9	51.1	60.6	768	45.2
	1	43.4	38.2	36.7	712	41.9
	2	13.7	9.1	2.7	204	11.9
	3 or more	0.9	1.5	0.0	16	0.9

Table B.6
Relationship Between the Timing of Initiation of Antenatal Care
and the Identification of Complications of Pregnancy (ICD 640-648) and
Indications for Care in Pregnancy, Labour and Delivery (ICD 652-659)

Complications enumerated from hospital separation abstract and physician claims
 Utilization measures based on hospital abstract (Measure A) and physician claims (Measure B)

Measure A		Trimester of Initiation					Total
Week of Gestation of First Visit Hospital Abstract		First	Second	Third	Missing		
	N	8,063	2,609	417	1,557	12,646	
	%	63.7	20.6	3.3	12.4		
Pregnancy Complication (ICD 640-648)							
Physician Claim	%	26.2	27.9	33.5	37.7	28.1	
Hospital Abstract	%	22.8	19.8	26.3	33.4	23.6	
Indication for Care (ICD 652-659)							
Physician Claim	%	56.7	53.7	51.4	55.3	55.8	
Hospital Abstract	%	37.5	37.4	31.7	39.5	37.6	
Measure B							
Week of Gestation of First Visit Physician Claims		Trimester of Initiation			Missing	Total	
		First	Second	Third			
	N	11,361	1,004	281	0	12,646	
	%	89.8	7.9	2.2	0.0		
Pregnancy Complication (ICD 640-648)							
Physician Claim	%	27.5	34.1	32.4		28.1	
Hospital Abstract	%	22.7	32.2	33.1		23.6	
Indication for Care (ICD 652-659)							
Physician Claim	%	56.4	50.1	49.8		55.8	
Hospital Abstract	%	37.8	36.1	33.1		37.6	

APPENDIX C
Comparison of Hospital Separation Abstracts
and Physician Claims
as Sources of Information on Use of Prenatal Care

Table C.1 and Figure C.2 contrast the distribution of episodes of care as measured by physician claims and the hospital abstract. Similarly, Table C.3 and Figure C.4 compare measures of the timing of initiation of care. Information on the frequency of care is missing on the hospital abstract for 9.2% of the cases, and the timing of initiation of care is missing for 12.4% of the cases.

Women who gave birth prematurely had very high frequencies of missing data on prenatal care (Table 2). Among the 73 women whose pregnancy duration was less than 30 weeks, information on the number of visits was missing for 65.7% and on the timing of initiation for 73.9%. The corresponding figures for the 667 women whose pregnancy duration was between 30 and 36 weeks were 36.7% and 40.5%. However, the great majority of women whose hospital separation abstracts had missing prenatal care data had pregnancies of normal duration.

As has been found in other studies of administrative data (37), women with socio-demographic risk factors for poor pregnancy outcome, are over-represented among cases with missing data on prenatal care on the hospital separation abstract. Data on the timing of initiation of care were missing for 17% of women in the lowest income quintile but for less than 10% of women in the two upper income quintiles (Table 2). This information was missing for almost 28% of native women. Women who were young, had several children or were unmarried were also more likely to be without these primary sources of information about use of prenatal care.

APPENDIX C: 66

Table C.1
 Number of Episodes of Care,
 Enumerated from the Hospital Abstract and Physician Claims

Births to women resident in Winnipeg, July 1987 to December 1988, N = 12,646

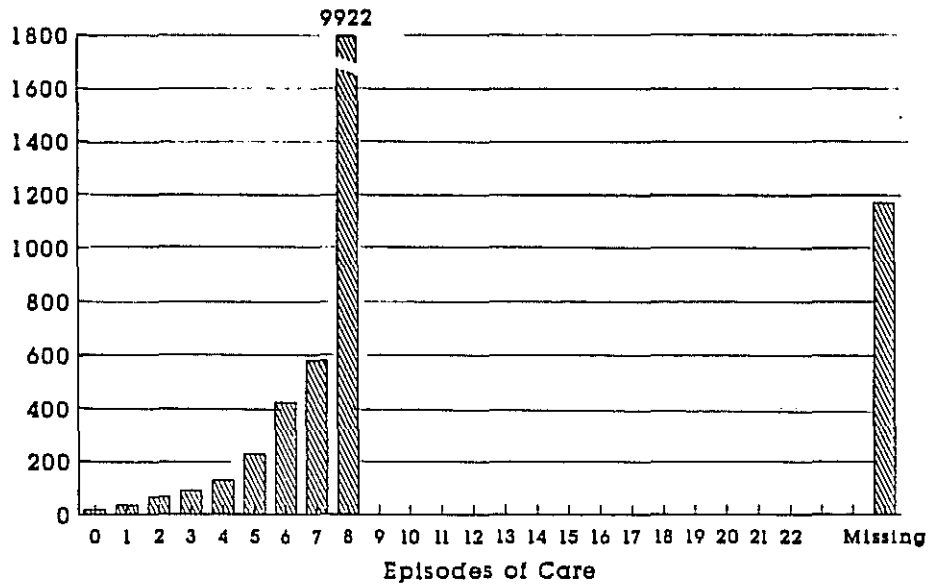
HOSPITAL ABSTRACT

NUMBER OF EPISODES	TOTAL		GLOBAL TARIFF		FEE-FOR-SERVICE	
	N	%	N	%	N	%
0	15	0.1	4	0.0	11	0.6
1	34	0.3	22	0.2	12	0.7
2	65	0.5	46	0.4	19	1.1
3	89	0.7	62	0.6	27	1.6
4	127	1.0	85	0.8	42	2.5
5	226	1.8	186	1.7	40	2.4
6	422	3.3	356	3.3	66	3.9
7	579	4.6	500	4.6	79	4.6
8	9,922	78.6	8,792	80.3	1,130	66.5
MISSING	1,167	9.2	893	8.2	274	16.1
TOTAL	12,646		10,946		1,700	

PHYSICIAN CLAIMS

NUMBER OF EPISODES	TOTAL		GLOBAL TARIFF		FEE-FOR-SERVICE	
	N	%	N	%	N	%
0	61	0.1	33	0.1	28	0.1
1	152	1.2	115	1.1	37	2.2
2	206	1.6	174	1.6	32	1.9
3	262	2.1	221	2.0	41	2.5
4	354	2.8	300	2.7	54	3.2
5	419	3.3	356	3.3	63	3.8
6	387	3.1	329	3.0	58	3.5
7	416	3.3	340	3.1	76	4.5
8	558	4.4	471	4.3	87	5.2
9	745	5.9	643	5.9	102	6.1
10	980	7.8	858	7.9	122	7.3
11	1293	10.3	1140	10.4	153	9.2
12	1556	12.4	1372	12.6	184	11.0
13	1532	12.2	1365	12.5	167	10.0
14	1371	10.9	1198	11.0	173	10.3
15	1046	8.3	894	8.2	152	9.1
16	629	5.0	550	5.0	79	4.7
17	331	2.6	294	2.7	37	2.2
18	176	1.4	155	1.4	21	1.3
19	71	0.6	56	0.5	15	0.9
20	43	0.3	34	0.3	9	0.5
21	22	0.2	20	0.2	2	0.1
22	11	0.1	7	0.1	4	0.2
23	9	0.1	9	0.1		
+23	16	0.1	12	0.1	4	0.2
TOTAL	12,646		10,946		1,700	

Figure C.2
 Number of Episodes of Care
 Hospital Abstract



Number of Episodes of Care
 Physician Claims

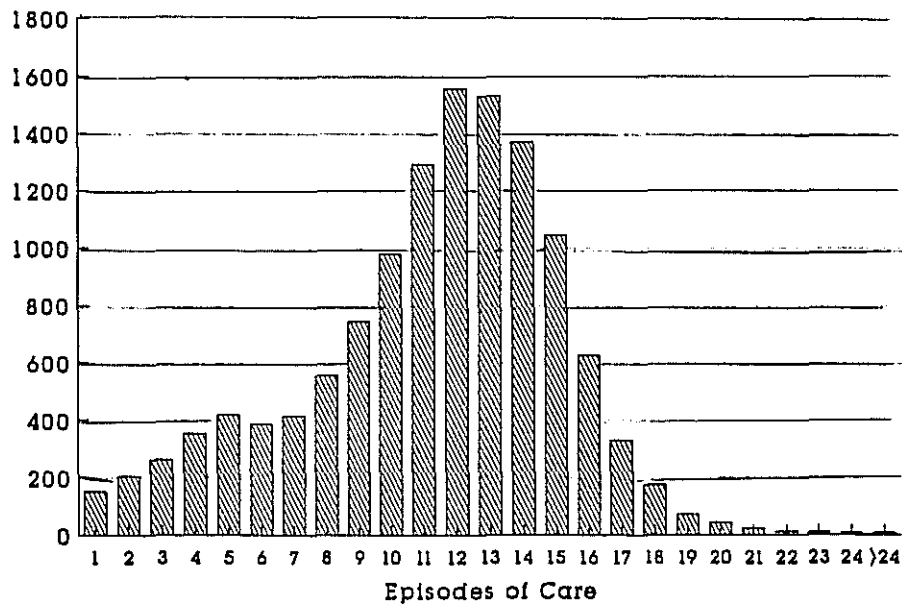


Table C.3
 Month of Initiation of Care,
 Measured by Hospital Abstract and Physician Claims

Births to women resident in Winnipeg, July 1987 to December 1988, N = 12,646

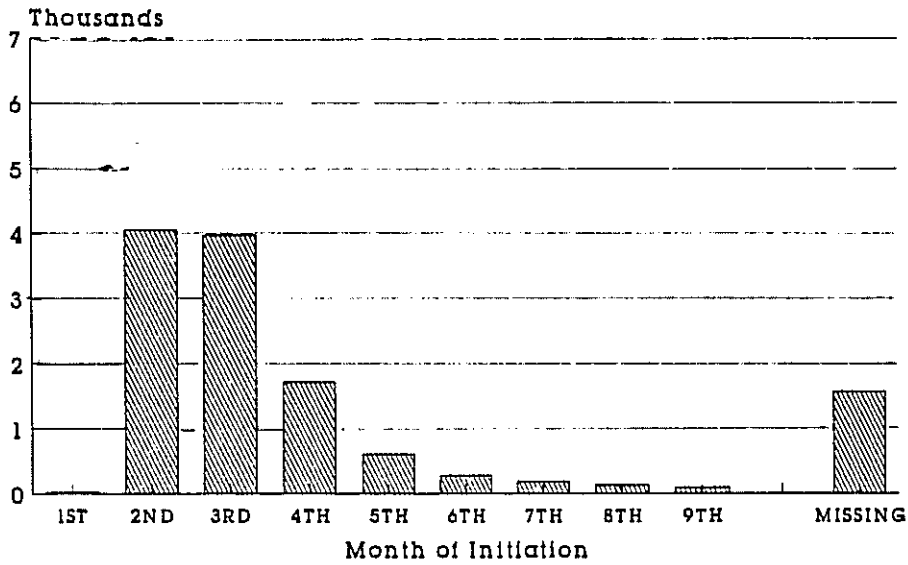
HOSPITAL ABSTRACT

MONTH OF INITIATION	TOTAL		GLOBAL CLAIM		FEE FOR SERVICE CLAIM	
	N	%	N	%	N	%
1ST	31	0.2	29	0.2	2	0.1
2ND	4056	32.0	3645	33.2	412	24.2
3RD	3976	31.4	3518	32.1	458	26.9
4TH	1718	13.5	1502	13.7	215	12.6
5TH	611	4.8	520	4.7	91	5.4
6TH	280	2.2	233	2.1	47	2.8
7TH	189	1.5	137	1.2	52	3.1
8TH	129	1.0	94	0.8	35	2.1
9TH	99	0.8	75	0.7	24	1.4
MISSING	1557	12.4	1193	11.0	364	21.4
TOTAL	12,646		10,946	(86.7)	1,700	(13.3)

PHYSICIAN CLAIMS

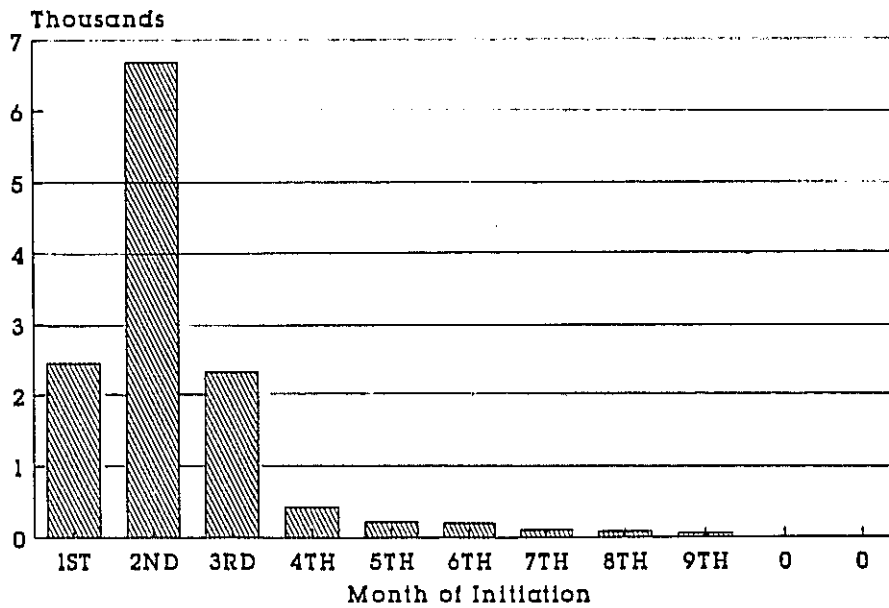
MONTH OF INITIATION	TOTAL		GLOBAL CLAIM		FEE FOR SERVICE CLAIM	
	N	%	N	%	N	%
1ST	2447	19.4	2153	19.7	294	17.3
2ND	6687	52.9	5924	54.1	763	44.9
3RD	2332	18.4	1997	18.2	335	19.7
4TH	431	3.4	342	3.1	89	5.2
5TH	219	1.7	156	1.4	63	3.7
6TH	201	1.6	157	1.4	44	2.6
7TH	106	0.8	80	0.7	26	1.5
8TH	87	0.7	58	0.5	29	1.7
9TH	57	0.5	36	0.3	21	1.2
MISSING	79	0.6	43	0.4	36	2.1
TOTAL	12,646		10,946	(86.7)	1,700	(13.3)

Figure C.4
 Month of Initiation of Care
 Hospital Abstract



GEST1

Month of Initiation of Care
 Physician Claims



Physician billing type was also associated with missing data. Information on when care was first sought was missing on the hospital abstract for 11% of women who received care from physicians billing a global tariff, compared to 21% of women in the fee-for-service group (Table C.3).

Missing prenatal care data on the separation abstract was associated with both lower use and poorer outcomes. When a count of the number of episodes of care derived from physician claims was used, women with missing data on the hospital abstract were observed to have lower average use of care than women without missing data (Figure C.5). Similarly, when a measure of the timing of initiation of care derived from physician claims was used, women with missing information on initiation on the hospital separation abstract tended to have sought care later (Figure C.5). These differences were more pronounced for women who received care from physicians billing on a fee-for-service basis.

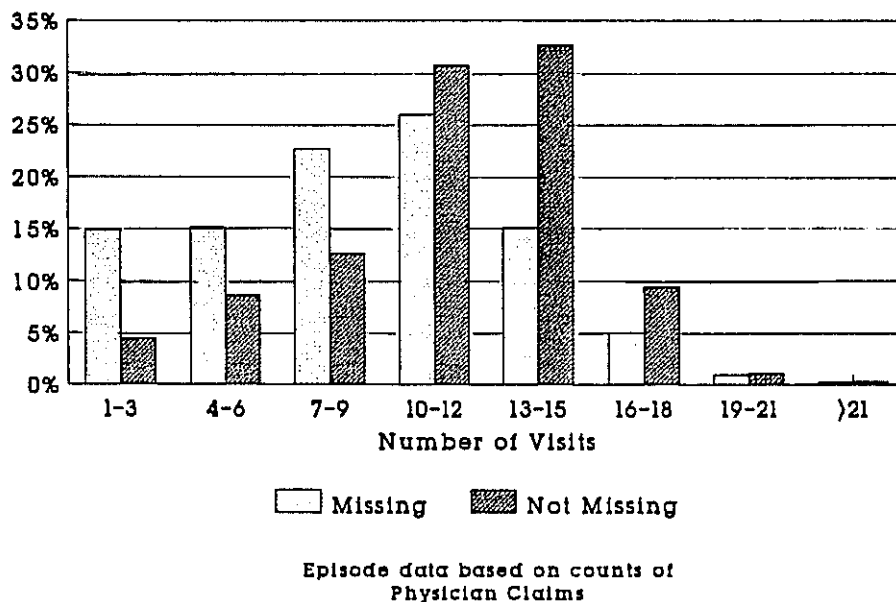
As measured from physician claims, 77.5% of women with complete data on the hospital abstract had adequate care, while only 58.1% of women with missing data had adequate care (Table C.6). A total of 15.1% of women with missing prenatal care data on the hospital abstract gave birth to an infant weighing less than 2500 g, compared to only 3.3% of women with no missing data (Table C.6).

A portion of the difference in the measurement of the timing of initiation of care and the frequency of visits between physician claims and the hospital separation abstract is due to different construct definitions. The conventional practice on the Prenatal Care Record is to identify the initiation of care as the first visit following the visit at which the pregnancy was confirmed. For care initiated early in pregnancy, the interval between confirmation of pregnancy and a subsequent visit for women with no pre-existing medical conditions would normally be approximately 4 weeks. Of the 87.7% of cases with a measure of the timing of initiation of care from both physician claims and the hospital abstract, 8.9%

were in perfect agreement, and for a further 49.6% the date on the physician claims record was no more than four weeks earlier than that on the hospital abstract. In only 4.2% of the remaining cases was the date on the physician claims record later than the date on the hospital abstract. In the remaining cases (37.3%), the woman received antenatal care from another provider before seeing the physician who provided the care described on the Prenatal Care Record.

A substantially more favourable profile of care was observed when the prenatal care index was calculated using data from physician claims than when data from the hospital abstract were used. Of the 87.7% of cases with data on the hospital abstract required to calculate the index, only 61.3% were defined as having received adequate antenatal care using measures of use from the hospital abstract, compared to 75.6% of cases defined as having received adequate care when the physician claim data were applied (Table C.7). By counting the first antenatal visit (which typically is not included in the hospital abstract measure), the physician claim data on average advance the timing of initiation of care by one month. Early initiation of care is a primary determinant of classification in the Prenatal Care Index (see Appendix A).

Figure C.5
 Distribution of Episodes of Care
 By Quality of Hospital Record Data



Distribution of Month of Initiation
 By Quality of Hospital Record Data

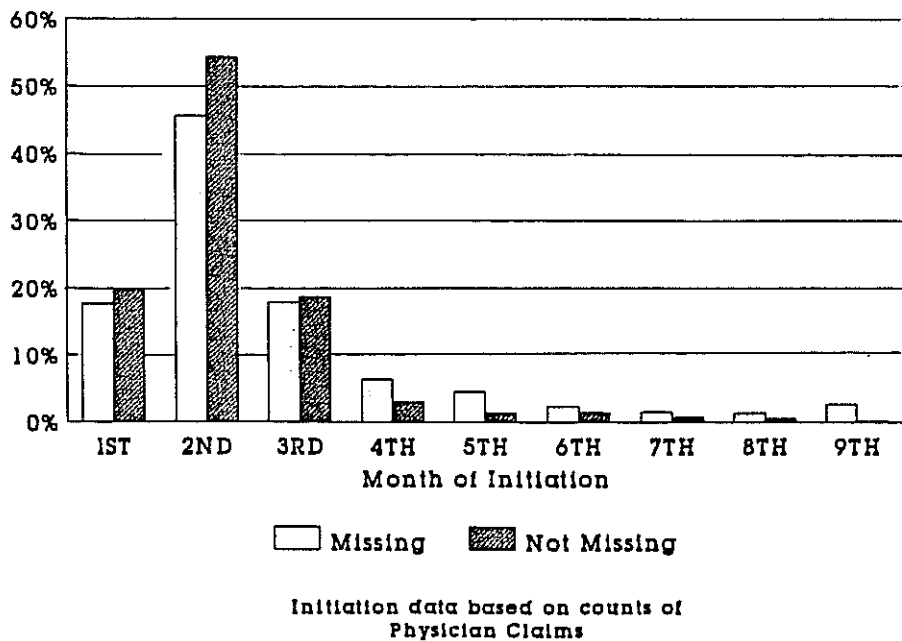


Table C.6
 Comparison of Birthweight Outcomes
 Across Two Measures of the Prenatal Care Index
 Hospital Separation Abstract vs Physician Claims

HOSPITAL SEPARATION ABSTRACT

PRENATAL CARE INDEX	DATE OF INITIATION PRESENT			DATE OF INITIATION MISSING			TOTAL SAMPLE	
	NUMBER OF LBW BIRTHS	LBW /1000	TOTAL BIRTHS	NUMBER OF LBW BIRTHS	LBW /1000	TOTAL BIRTHS	LBW /1000	TOTAL BIRTHS
ADEQUATE	214	31.5	6,789	102	111.8	912	41.0	7,701
INTERMEDIATE	112	34.2	3,269	92	242.0	380	55.9	3,649
INADEQUATE	40	39.3	1,018	44	158.0	278	64.8	1,296
TOTAL	366	33.0	11,076	238	151.5	1,570	47.7	12,646

PHYSICIAN CLAIM

PRENATAL CARE INDEX	DATE OF INITIATION PRESENT			DATE OF INITIATION MISSING			TOTAL SAMPLE	
	NUMBER OF LBW BIRTHS	LBW /1000	TOTAL BIRTHS	NUMBER OF LBW BIRTHS	LBW /1000	TOTAL BIRTHS	LBW /1000	TOTAL BIRTHS
ADEQUATE	221	25.7	8,589	102	111.8	912	34.0	9,501
INTERMEDIATE	116	70.3	1,649	92	242.0	380	102.5	2,029
INADEQUATE	29	33.1	876	44	158.3	278	63.2	1,154
TOTAL	366	33.0	11,076	238	151.5	1,570	47.7	12,646

Table C.7
 Comparison of Two Measures of the Prenatal Care Index
 Hospital Separation Abstract vs Physician Claims

PHYSICIAN CLAIM	HOSPITAL RECORD				MISSING		TOTAL	
	ADEQUATE N	INTERMEDIATE N	INADEQUATE N		N	%	N	%
ADEQUATE	6735	1761	93		976	62.1	9565	75.6
INTERMEDIATE	52	1482	115		325	20.7	1974	15.6
INADEQUATE	2	26	810		269	17.1	1107	8.7
TOTAL	N 6789	3269	1018		1570		12646	
	% 53.6	25.8	8.1		12.4			

PERCENT CONCORDANT: 81.5% *

* Cases with non-missing data only

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