Too Early, Too Small:

A Profile of Small Babies Across Canada

Canadian Institute for Health Information
Institut canadien d'information sur la santé

Production of this report is made possible by financial contributions from Health Canada and provincial and territorial governments. The views expressed herein do not necessarily represent the views of Health Canada or any provincial or territorial government.

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ISBN 978-1-55465-480-2 (PDF)

How to cite this document:
Canadian Institute for Health Information, *Too Early, Too Small: A Profile of Small Babies Across Canada* (Ottawa, Ont.: CIHI, 2009).

Cette publication est aussi disponible en français sous le titre *Nés trop vite et trop petits : étude sur les bébés de faible poids au Canada.*
ISBN 978-1-55465-482-6 (PDF)

Table of Contents

About the Canadian Institute for Health Information

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Acknowledgements

The Canadian Institute for Health Information (CIHI) would like to acknowledge and thank the many individuals and organizations that contributed to the development of this report.

In particular, this report benefited from consultations with our stakeholders across the country. The feedback and comments provided by many individuals in provinces and territories who reviewed the results from their jurisdictions are gratefully acknowledged.

We would like to thank the members of the expert advisory panel, who provided invaluable advice throughout the process. Members of the panel were:

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- **Dr. Elizabeth Whynot**, President, British Columbia Women's Hospital and Health Centre
- **Dr. K. S. Joseph**, Professor, Dalhousie University and the IWK Health Centre
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It should be noted that the analyses and conclusions in this report do not necessarily reflect the opinions of the individual members of the expert advisory panel or their affiliated organizations.

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This report represents the work of many CIHI staff members who compiled and validated the data; worked on the print and web design, translation, communications and distribution; and provided ongoing support to the core team. We also wish to thank our practicum student, Silas Lamb, who assisted with the quality assurance of this report.

Executive Summary

- Babies who are born preterm (before 37 weeks of gestation) or small for their gestational age (SGA) are at increased risk of mortality and morbidity. Understanding the factors related to preterm or SGA births can help reduce mortality, morbidity and associated health care costs. It can also help inform health care planning and decision-making in obstetrical practice. This report examines the relationship between selected factors and preterm and SGA births using data from CIHI's Discharge Abstract Database.

- In 2006–2007, the Canadian in-hospital preterm birth and SGA rates were approximately 8.1% and 8.3%, respectively, accounting for more than 54,000 live births combined. Among the provinces, Alberta and Newfoundland and Labrador demonstrated the highest preterm birth rates, at 8.7% and 8.6%, respectively. The highest provincial SGA rates occurred in Ontario (8.9%) and Alberta (8.7%).

- New analyses revealed several factors that were strongly associated with preterm and SGA births. After adjusting for the simultaneous effect of other influences, biological factors such as multiple birth status, maternal comorbidities (diabetes and hypertension) and previous preterm deliveries were most strongly associated with preterm births. While the effects were smaller, the strongest factors associated with delivering an SGA baby were maternal hypertension and parity (first-time mothers). Moreover, social factors (such as neighbourhood income and urban residence) were more highly associated with SGA than with preterm births.
  - Preterm birth and SGA rates decreased as neighbourhood income increased—though the gradient was steeper for SGA rates. The SGA rate was also significantly higher in urban areas, compared to rural areas (8.7% versus 7.0%).
  - The highest preterm birth rates were associated with mothers age 35 and older (9.5%). Mothers younger than 20 were associated with the highest SGA rate (10.0%). However, among first-time mothers, women 35 years and older demonstrated the highest SGA rate (11.6%), though this rate was not statistically different from the other age groups.
  - The in-hospital multiple birth rate in Canada (excluding Quebec) was 3.0% in 2006–2007. While only 6.6% of singletons were born preterm, more than half of twins and almost all higher-order multiples were born preterm. Older women and those living in higher-income neighbourhoods were more likely to have multiple births.

- Overall, first-time mothers and women with three or more previous children were more likely to have a preterm birth (9.2% and 9.6%, respectively). The increased chance of delivering an SGA birth was only associated with first-time mothers (10.9%).
- In 2006–2007, 5.1% and 6.2% of babies born in Canada (excluding Quebec) were born to mothers with diabetes and hypertension, respectively. Women with diabetes or hypertension were more likely to deliver preterm. Preterm birth rates were also significantly higher for women with a pre-existing condition, compared to women whose conditions developed during pregnancy. In contrast, only women with hypertension (and not diabetes) had an increased chance of delivering an SGA baby.
- The preterm birth rate was significantly higher for babies delivered by Caesarean section (13.3%) compared to induced (6.9%) or non-induced vaginal deliveries (6.5%). In contrast, the highest SGA rates were associated with deliveries that were induced (9.6%).

• Birth weight and gestational age were found to be important determinants of hospital costs—as birth weight and gestational age decreased, average in-hospital costs increased. Furthermore, multiple-birth babies had higher hospital costs than singleton babies. Some of these costs are highlighted below (please note that these costs are limited to costs incurred for typical newborns in their hospital of birth and exclude payments to physicians from provincial/territorial health insurance plans).

- In 2005–2006, the average in-hospital cost for a low birth weight baby (less than 2,500 grams) was more than 11 times higher than for those weighing 2,500 grams or more—$12,354 compared to $1,084.
- Among singletons, the average in-hospital cost associated with preterm babies (less than 37 weeks) was nine times higher than for full-term babies—$9,233 versus $1,050. Among multiples, the average cost for a preterm baby was about seven times higher—$12,479 versus $1,871.
- In contrast, the average cost of an SGA baby was less than twice the cost of a non-SGA baby—$2,297 versus $1,407. Our analyses suggest that SGA status alone may not be a strong predictor of hospital utilization and in-hospital costs at the time of birth—while the average hospital cost for a singleton non-SGA baby born extremely preterm (less than 28 weeks gestation) was $85,103, this estimate rose to $109,286 for a singleton SGA baby born at 28 weeks or less gestation.

Introduction

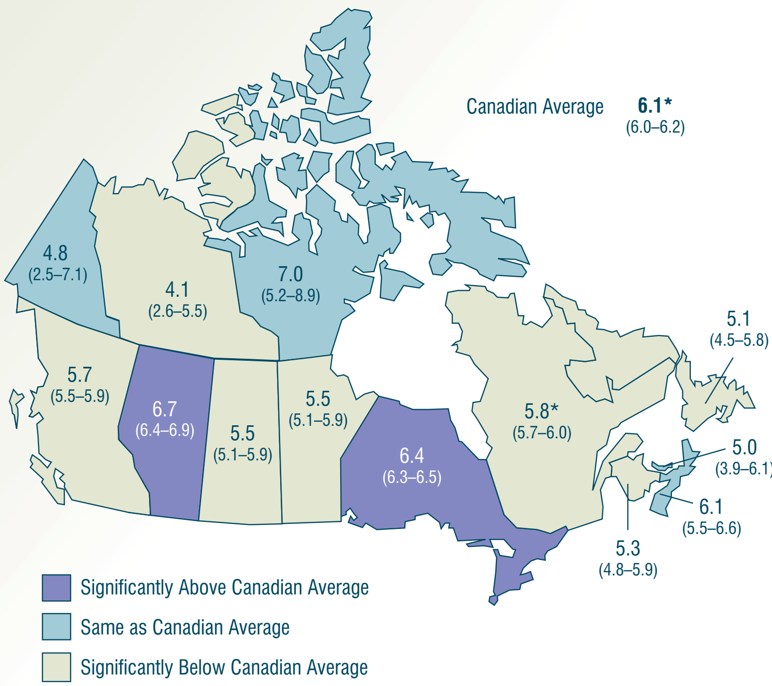
Each year, approximately 350,000 babies are born in Canada. In the past, most births took place at home with the help of local midwives, friends and/or family. Over time, however, patterns of delivery changed in Canada and in other economically developed countries. Today, most Canadian women give birth in a hospital. In 2006, according to Statistics Canada, only 1.1% of women gave birth outside a hospital (at home, in a birthing centre, etc.).[1] Although most (more than 90%) babies are born with a normal birth weight (2,500 to 4,499 grams, or 5 pounds, 8 ounces to 9 pounds, 15 ounces), about 6% are born with low birth weight (less than 2,500 grams).[1] A slight increase in the low birth weight (LBW) rate was observed in recent years, following a period of decline.[2] Other economically developed countries, such as the United States, also reported an increase in LBW rates.[3] Despite the recent rise in LBW rates, the Canadian LBW rate is lower than rates reported by several other economically developed countries, such as the U.S. (8.2%),[4] Australia (6.4%)[5] and England (7.6%).[6]

Low birth weight has long been used as an indicator of perinatal health due to its association with infant survival, health and development.[7] Some of the risks associated with LBW babies include perinatal (the period approximately five months before and one week after birth) and infant death, physical and cognitive disabilities and chronic health problems later in life.[8] Pregnancy and childbirth account for approximately 14% of all acute care hospitalizations,[9] and roughly 1 out of every 10 dollars that hospitals spend on care for patients with overnight stays goes toward childbirth and newborn care.[10] LBW and preterm babies account for a disproportionately high percentage of the health care costs among all newborns.[11]

1 Figure

Low Birth Weight Rate: The Picture Across Canada,* 2006–2007

Across Canada, in-hospital LBW rates varied across provinces and territories. In 2006–2007, the LBW rates for Ontario and Alberta were significantly higher than the Canadian average.



(Rates within brackets denote the 95% confidence interval.)

Notes

* Provincial and territorial data (excluding Quebec) came from CIHI's Discharge Abstract Database (DAD). Quebec data came from Statistics Canada's Canadian Vital Statistics System.[1] Data for all provinces and territories (including Quebec) were included in the Canadian average to provide a national estimate.

This analysis was limited to live births discharged from an acute care facility with known birth weight that could be linked to mothers' abstracts.

Results are presented for the mothers' place of residence, rather than the location of the facility where hospitalization occurred.

Sources

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information; and Canadian Vital Statistics System, 2006, Statistics Canada.

Although LBW is frequently used as an indicator of perinatal mortality and morbidity, there are limitations to its use. The first limitation is due to the fact that LBW babies are not a homogeneous group—LBW may result from a preterm birth (less than 37 weeks of gestation), intrauterine growth restriction (IUGR) or a combination of these conditions.[12] The diagnosis of IUGR is typically based on a baby being small for its gestational age (SGA)—meaning that it is smaller than 90% of babies of the same gestational age and sex. Furthermore, there are differences in the health outcomes and factors associated with a baby who is born preterm or SGA. It is important, therefore, to examine the factors associated with preterm birth and SGA. The second limitation to using LBW as a perinatal indicator is that preterm birth and SGA are not limited to babies born with LBW. Indeed, preterm birth and SGA can occur across the entire spectrum of birth weight.[13] Consequently, the LBW indicator does not capture the perinatal mortality and morbidity risks associated with being preterm and SGA in infants who weigh more than 2,500 grams at birth.

The use of SGA and preterm birth rates as indicators of perinatal health remains rather limited, despite growing awareness that they are preferable to the use of LBW. This is largely due to the lack of accurate information on gestational age to define preterm birth and SGA. Improving the measurement of gestational age and SGA would lead to increased knowledge about the factors associated with preterm birth and SGA in Canada and elsewhere. A greater understanding of the factors and population characteristics related to preterm birth and SGA could help to reduce the risk of infant mortality and morbidity associated with these outcomes. It would also help to inform health care planning and decision-making in obstetrical practice.

This report aims to:

1. Provide information on selected factors associated with preterm birth and SGA, based on information from CIHI's Discharge Abstract Database (DAD);

2. Examine the relationship between these factors and preterm birth and SGA rates at the pan-Canadian level; and

3. Examine the hospital costs of preterm birth, SGA and LBW infants.

The factors examined in this report were selected based on associations with preterm birth and SGA reported in the literature, as well as their availability in the 2006–2007 DAD maintained by the Canadian Institute for Health Information (CIHI). These include neighbourhood income, urban/rural residence, maternal age, multiple births, parity (number of previous live births), previous preterm deliveries, maternal diabetes, maternal hypertension and mode of delivery. It is important to note that this is not an exhaustive list—other factors such as smoking, nutrition and maternal ethnicity[13–16] are also associated with preterm birth and SGA. However, these were not included in the current analyses because they were not captured in the available data.

This report is organized in four chapters. The first chapter provides an in-depth discussion of preterm birth and SGA and describes the geographical variation of preterm birth and SGA rates in Canada. The second chapter focuses on maternal characteristics that can influence the chances of giving birth to a preterm or SGA baby. These characteristics include maternal age, multiple birth pregnancies, parity, previous preterm deliveries and maternal comorbidities (hypertension and diabetes). The relationship between mode of delivery for preterm and SGA babies is highlighted in the third chapter, along with a discussion of the hospital costs associated with preterm and SGA babies. Finally, in the fourth chapter, we discuss the relative contribution of each associated factor for preterm birth and SGA—findings from a logistic regression model highlight how each factor discussed in this report affects the odds of giving birth to a preterm or SGA baby, after taking into account the effect of the other factors.

Important Notes About This Report

Data

- Data for all in-hospital-based indicators were obtained from CIHI's 2006–2007 Discharge Abstract Database (DAD). This data holding captures administrative, clinical and demographic information on inpatient events from acute care hospitals in Canada. All provinces and territories submit to DAD except for Quebec, which submits data to CIHI's Hospital Morbidity Database (HMDB). Quebec data for 2006–2007 were not available during the production of this report; where available, data from alternate sources were used.
- All provinces and territories submitting to DAD in 2006–2007 use the enhanced Canadian version of the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada (ICD-10-CA) and Canadian Classification of Health Interventions (CCI). Indicator definitions were based on these systems of coding diagnoses and interventions.

Important Notes About This Report (cont'd)

- This report presents data based on patients' place of residence, which may differ from the place of hospitalization. The Postal Code Conversion File plus (PCCF+)[17] from Statistics Canada was used to assign patients with a current postal code to their province/territory of residence, and to assign urban/rural residence and socio-economic status information using the 2001 census. Alternate methods were used to assign patients with a retired or incomplete postal code to their place of residence.
- The hospital cost information presented in this report was derived from DAD and the Canadian MIS Database (CMDB) for 2005–2006. The CMDB contains financial and statistical information on hospitals and regional health authorities across Canada. Further detail is provided in the text box on page 62.
- For more information on any of CIHI's data holdings, please refer to www.cihi.ca.

Analyses

- Analyses of the in-hospital birth statistics and logistic regression models were based on a population of live newborns who subsequently died or were discharged alive from an acute care hospital and who could be linked to their mothers' abstracts in DAD. More details on how this population was defined are provided in the Technical Notes, which can be found online accompanying the electronic version of this report at www.cihi.ca.
- The terms "newborns," "babies" and "births" are used interchangeably throughout this report. These terms refer only to live births and exclude stillbirth records.
- It is important to note that the methodology used was developed specifically for this report. For this reason, the results presented in this report may differ from other CIHI publications that may have a different focus and/or use a different methodology.
- The unit of analysis in this report was babies, not mothers. Therefore all rates represent the proportion of in-hospital births. For ease of reference, some of these rates are interpreted for the mother.
- International comparisons of perinatal statistics were made where comparable data could be found. However, definitions of these statistics may vary slightly among countries.
- The SGA analysis was limited to singleton babies only, since the standard to classify babies as SGA does not include multiple births.
- Additional details on the methodology for this report are provided on page 77, as well as in the Technical Notes at www.cihi.ca.

Chapter 1

Preterm and Small-for-Gestational-Age Babies—Where Do They Live?

This chapter provides an in-depth look at preterm and small-for-gestational-age (SGA) babies. We will present preterm birth and SGA rates in Canada in 2006–2007 and show how the rates varied among the provinces and territories. We will also report on how these rates varied according to the neighbourhood income of the mothers' places of residence and whether they lived in a rural or urban area. A flow chart showing how the analytic population for the preterm and SGA analyses was derived is provided in Appendix A.

Preterm Babies

Babies that are born before 37 completed weeks of gestation are considered preterm. Figure 2 shows the distribution of babies born in Canadian hospitals by their gestational age in 2006–2007. Of the more than 350,000 babies born in Canada in 2006–2007, most (91.5%) were born at term, while a small number (0.4%) were born post-term (that is, at 42 weeks of gestation or later). Overall, the average gestational age for preterm babies was approximately 34 weeks (compared to 39 weeks for all babies).

Preterm births are an important public health concern, as they are the leading cause of infant mortality in economically developed countries and account for about three out of four (75%) deaths that occur in the perinatal period (about five months before and one week after birth).[20–23] Preterm births also contribute to both short- and long-term morbidity and are associated with considerable health care costs.[11, 24, 25] Given that the last several weeks of normal gestation are responsible for more than one-third (35%) of brain growth,[26] as well as significant lung and general fetal development,[27] it is not uncommon for preterm babies to have increased rates of respiratory distress, temperature instability, hospital re-admission and neuro-cognitive problems compared to full-term infants.[24] Moreover, certain health issues—such as cerebral palsy, psychiatric illness and attentional disorders—often extend into adulthood.[24, 28, 29]

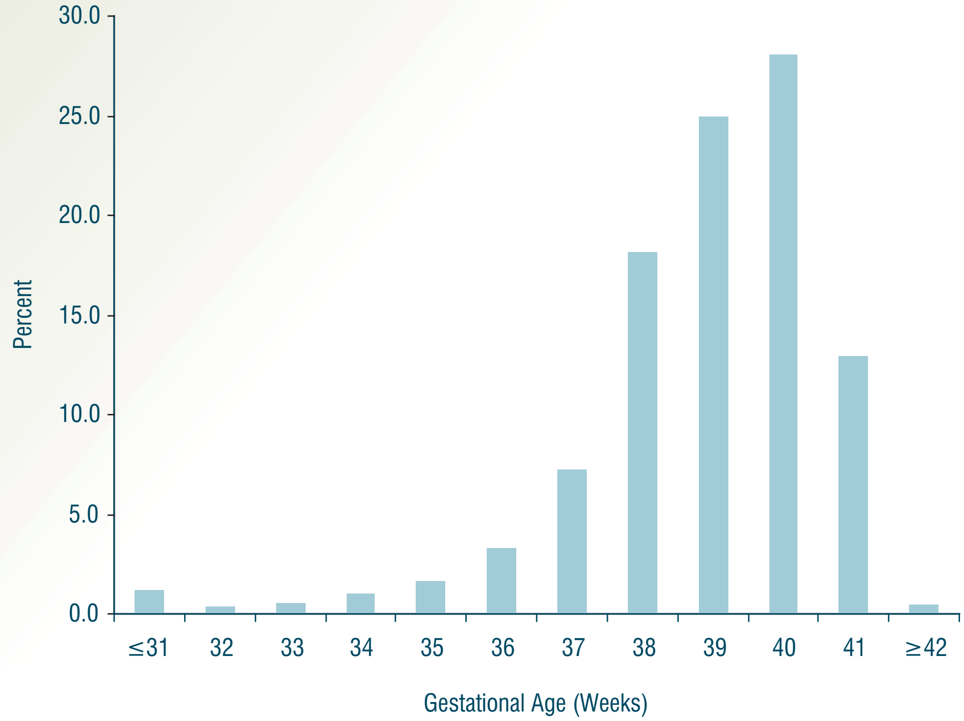
Gestational Age—How Is It Derived?

Gestational age may be calculated using the first day of the mother's last menstrual period (LMP) or by using early ultrasound measurements. Ultrasound-based estimates are considered to be more precise than estimates based on LMP.[18, 19] In the Discharge Abstract Database, gestational age is recorded in completed weeks and is derived from medical charts—this represents the best clinical estimate of gestation, which includes both ultrasound- and LMP-based estimates.

Figure 2

Distribution of Babies Born by Gestational Age in Canada,* 2006–2007

Although the gestational age at which babies were born varied across Canada, most were born full-term. A significantly smaller number of babies were born preterm (before 37 weeks of gestation). Even fewer were born post-term (42 or more weeks of gestation).



Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication.

This analysis was limited to live births discharged from an acute care facility with known gestational age that could be linked to mothers' abstracts.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

There are many reasons why a baby might be born preterm. Preterm births may be medically indicated or spontaneous. In cases where continuation of a pregnancy would lead to serious maternal or fetal risk—about 30% of preterm births fall into this category—a medically indicated preterm delivery by Caesarean section or induction is performed in order to improve obstetrical outcomes.[30] Complications such as hypertensive disorders, maternal bleeding, intrauterine growth restriction and fetal distress[31] are among the most common reasons for medically indicated preterm deliveries. Spontaneous preterm births—the other 70% of preterm births fall into this category—may also be caused by fetal distress or poor intrauterine growth.[15] Some of the factors associated with preterm births include low socio-economic status; urban/rural place of residence; younger and older maternal age; multiple births; high or low parity; history of preterm delivery; and maternal medical conditions such as hypertension and diabetes.[14, 15, 32–34] These factors are examined in this report as these data are available in CIHI databases. Other factors that can also contribute to preterm births, but were not included in our analyses, include maternal ethnicity; physical and psychological stress; genitourinary infections; placental disorders; substance use; and poor prenatal care.[14, 15]

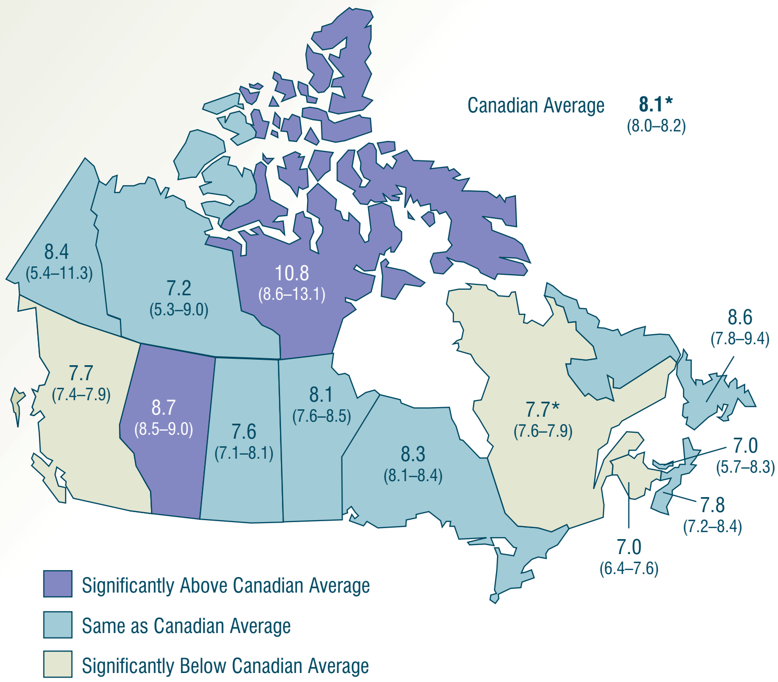
In North America, preterm birth rates increased over the last few decades. Several factors, such as delayed child-bearing and the use of assisted reproductive technologies, contributed to the increase in multiple births and preterm deliveries. Increases in obstetrical interventions (that is, those linked to medically indicated preterm births) substantially contributed to the increase.[31, 35] In Canada, the preterm birth rate steadily increased from approximately 6% in the early 1980s[35] to 8% in more recent years.[1]

Figure 3 shows the in-hospital preterm birth rate by province and territory in 2006–2007. The Canadian preterm birth rate was approximately 8.1%—accounting for almost 29,000 births during this period. Almost three-quarters (74.0%) of these preterm births were late preterm (born between 34 and 36 weeks of gestation), while 11.7% were moderately preterm (32 to 33 weeks of gestation) and 14.3% were early preterm births (less than 32 weeks of gestation). Among the provinces, Alberta and Newfoundland and Labrador had the highest preterm birth rates—at 8.7% and 8.6%, respectively—while New Brunswick and Prince Edward Island had the lowest rates (both at 7.0%). Nunavut had the highest preterm birth rate overall at 10.8%. Among low birth weight babies born in Canada (excluding Quebec) in 2006–2007, almost three-quarters (72.2%) were born preterm. More than one-half (54.5%) of preterm births were low birth weight.

Figure 3

Preterm Birth Rate: The Picture Across Canada,* 2006–2007

In 2006–2007, the estimated Canadian preterm birth rate was 8.1%. However, this figure varied across the provinces and territories. Among the provinces, the preterm birth rate ranged from a low of 7.0% in Prince Edward Island and New Brunswick to highs of 8.7% and 8.6% in Alberta and Newfoundland and Labrador, respectively. This variation may be reflective of differences in the distribution of maternal characteristics across the provinces and territories, such as age, parity or comorbid conditions such as diabetes and hypertension. These factors will be explored in the following chapters.



(Rates within brackets denote the 95% confidence interval.)

Notes

* Provincial and territorial data (excluding Quebec) came from CIHI's Discharge Abstract Database (DAD). Quebec data came from Statistics Canada's Canadian Vital Statistics System.[1] Data for all provinces and territories (including Quebec) were included in the Canadian average to provide a national estimate.

This analysis was limited to live births discharged from an acute care facility with known gestational age that could be linked to mothers' abstracts.

Results are presented for the mothers' place of residence, rather than the location of the facility where hospitalization occurred.

Sources

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information; and Canadian Vital Statistics System, 2006, Statistics Canada.

Not only was there variation in the rate of preterm births across Canada, but these rates varied internationally as well. Some countries experienced a more significant rise in their preterm birth rates than has occurred in Canada. For example, between 1981 and 2006, the preterm birth rate in the United States rose from 9.4%[4] to 12.8%.[36] Other countries experienced decreases in their preterm birth rates relative to Canada. For example, rates in Finland decreased from 5.4% in the late 1990s to 5.2% in the period 2001 to 2005.[37] The following chapters will explore selected factors associated with preterm birth.

Small-for-Gestational-Age Babies

Fetal growth restriction is the failure to attain optimal fetal growth. The SGA indicator was proposed several decades ago as a measure of fetal growth restriction, largely due to difficulties estimating intrauterine growth.[38, 39] An SGA birth refers to a newborn with a birth weight lower than an expected normative threshold, or cut-off, for a given gestational age and sex.[16, 40] Following standard practice,[8] we used the gender-specific 10th percentile value of birth weight for gestational age from a recent Canadian reference for identifying SGA live births in this report. This means that an SGA baby is defined here as one that is smaller than 90% of babies from a standard reference population of the same gestational age and sex. For example, using the standard Canadian reference[40] for babies born at 37 weeks of gestation, male infants who weighed less than 2,552 grams and female infants who weighed less than 2,452 grams were considered to be SGA. Only singletons were included in the SGA analyses in this report as there is no consensus in the medical literature on how to determine SGA status among multiple births.

Small for Gestational Age—The Canadian Reference

In this report, babies born with a birth weight below the 10th percentile for their gestational age and sex were considered to be small for their gestational age (SGA). In other words, babies classified as SGA are smaller than 90 percent of the babies from a standard reference population of the same gestational age and sex. Standard percentile charts of birth weight for gestational age for each sex were developed by Kramer et al. using all singleton births in Canada between 1994 and 1996 (excluding Ontario) born between 22 and 43 weeks of gestation.[40] Live births from Ontario were excluded because of concerns regarding the quality of birth weight and gestational age information.[41]

Small for Gestational Age—The Canadian Reference (cont'd)

One limitation of using the SGA indicator is that not all SGA newborns are truly growth restricted. Many babies that are classified as SGA may actually be appropriately sized once important associations—such as the maternal ethnic group, weight, height and gender of the baby—are taken into consideration.[42, 43] For certain groups, these babies are considered to be constitutionally small but not growth restricted. In general, the short- and long-term health risks associated with truly growth-restricted babies may not extend to this group of infants. However, this problem can be alleviated by choosing a representative reference population for SGA classification.

This population-based Canadian reference is considered to be superior to those previously developed for a number of reasons:

- The creation of sex-specific standards recognized the fact that male babies are constitutionally larger than female babies.
- These standards were based on a very large sample with sufficient numbers of babies at the extreme ends of the gestational age distribution and were derived using statistical techniques to smooth curves and remove biologically implausible weights for age.
- Gestational ages for this reference population were obtained from birth certificates. There is evidence to suggest that these estimates of gestational age were based primarily on early ultrasound estimates,[44] which are considered more accurate than the traditional calculation based on using the first day of the last menstrual period.[18, 19]

A limitation of the population-based Canadian reference, however, is that infants born in Ontario were excluded from the standard population due to data quality issues. This may have introduced biases to the standard. For example, ethnic-specific factors have been argued to impact SGA classification,[45] and more than half of Canada's visible minority population resides in Ontario,[46] including those that are constitutionally smaller than individuals of Caucasian descent. Furthermore, the standard population reference was based on births from 1994 to 1996. Given Canada's (particularly Ontario's) changing ethno-racial composition, the current ethnic profile of Canada may not be adequately represented by this reference population. It therefore remains unclear whether the current Canadian standard can be used to identify SGA births among various ethnic groups, and controversies surrounding the need to customize standards on the basis of ethnicity and other factors have not been resolved.[47] Still, while it is important to keep these limitations in mind when interpreting the SGA results, this reference remains the best available standard for Canada and is widely used by clinicians and researchers.

Infants with fetal growth restriction are at a higher risk of morbidity and mortality at all stages of life—this extends to both full-term and preterm growth-restricted babies.[42] The perinatal mortality rate for growth-restricted infants is 10 to 20 times higher than among infants who are not growth restricted.[16] Newborns with growth restriction also experience higher rates of immediate and long-term health consequences, some of which can extend far beyond infancy and childhood.[16] For example, individuals who were born growth restricted have increased rates of hypertension, cardiovascular disease and diabetes.[48]

Growth restriction in the womb is primarily the result of placental insufficiency—meaning that the placenta is not able to adequately transfer oxygen, glucose or other vital nutrients to and from the fetus.[42, 49] Other factors that influence fetal growth include poor nutrition during pregnancy; substance abuse; maternal age; birth order (that is, first-born babies); and maternal comorbidities such as hypertension and infection.[16, 32] Maternal smoking, in particular, has been estimated to account for about one-third of growth-restricted births in economically developed countries.[43]

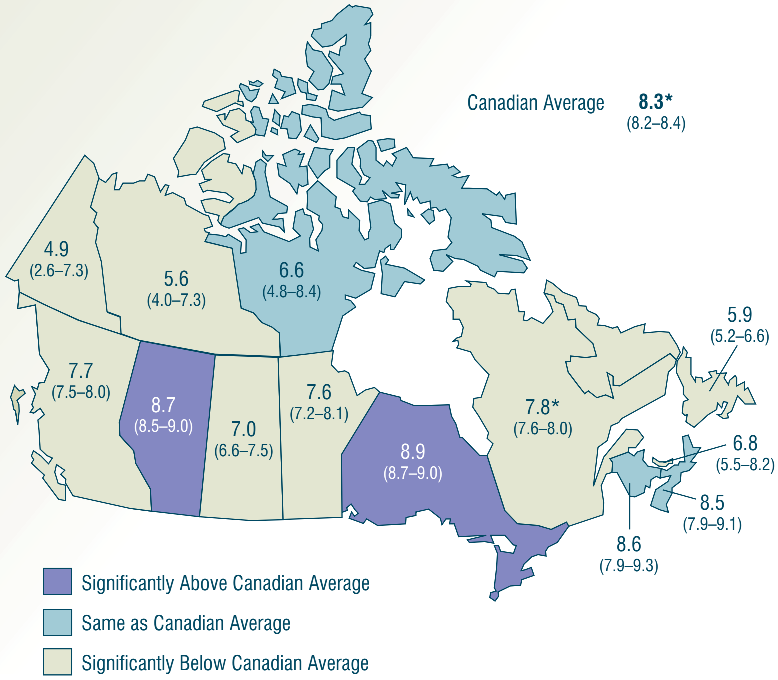
Unlike preterm birth rates, SGA rates have decreased over the last few decades in Canada—from around 11% in the early 1990s[39] to about 8% in more recent years.[50] As shown in Figure 4, approximately 8.3% of singleton births in Canada were born SGA in 2006–2007—accounting for nearly 28,000 live births. The highest provincial SGA rates were found in Ontario (8.9%) and Alberta (8.7%), while Newfoundland and Labrador (5.9%) and Prince Edward Island (6.8%) had the lowest provincial rates. The territories also experienced low SGA rates—between 4.9% and 6.6%. This may highlight the fact that large or macrosomic babies (newborns weighing 4,500 grams or more) are more common among Aboriginal women in Canada,[51] which has been linked to the high diabetes rates among this population.[52, 53] Among singleton low birth weight babies born in Canada in 2006–2007 (excluding babies born in Quebec), 43.3% were SGA, while only one-quarter (24.2%) of SGA babies were low birth weight. Furthermore, more than 1,600 singletons were born both SGA and preterm, accounting for 7.4% of SGA babies and 9.5% of singleton preterm births. Comparable international data were unavailable due to the lack of standards in defining SGA in most countries.

4

Figure

Small-for-Gestational-Age Rate: The Picture Across Canada,* 2006–2007

In 2006–2007, the estimated Canadian SGA birth rate was 8.3% among singletons. However, this figure varied across the provinces and territories. Among the provinces, the SGA rate ranged from 5.9% in Newfoundland and Labrador and 6.8% in Prince Edward Island to 8.7% and 8.9% in Alberta and Ontario, respectively.



(Rates within brackets denote the 95% confidence interval.)

Notes

* Provincial and territorial data (excluding Quebec) came from CIHI's Discharge Abstract Database (DAD). Quebec data came from the *Canadian Perinatal Health Report, 2008 edition*.[50] Data for all provinces and territories (including Quebec) were included in the Canadian average to provide a national estimate.

This analysis was limited to live singleton births discharged from an acute care facility with known birth weight and sex, with a gestational age between 22 and 43 weeks, that could be linked to the mothers' abstracts.

Results are presented for the mothers' place of residence, rather than the location of the facility where hospitalization occurred.

Sources

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information; and Canadian Vital Statistics System, 2004, Statistics Canada.

Neighbourhood Characteristics: The Importance of Place

Neighbourhood characteristics are associated with preterm and SGA births. The following section will focus on neighbourhood income and urban/rural residence as factors associated with these perinatal health outcomes.

Neighbourhood Income

Socio-economic status (SES) describes a person's social and economic position within society. The association between SES and health, including birth outcomes, is well documented in the literature.[54–56] In general, individuals with lower SES experience worse health outcomes than individuals with higher SES. Different types of indicators are used to define SES, including educational attainment, income and occupation. In this report, average neighbourhood income was used as an aggregate measure of SES. Neighbourhoods (that is, census dissemination areas) were ranked into fifths (quintiles) among their local census metropolitan area (CMA) or census agglomeration area (CA). After adjusting for household size, neighbourhoods assigned to quintile 1 represent those neighbourhoods with the lowest average income, while neighbourhoods assigned to quintile 5 represent those with the highest average income.

Mothers living in low-income neighbourhoods may experience many social and economic disadvantages that can affect perinatal outcomes. Poor neighbourhoods are more likely to have higher rates of unemployment, low maternal education and poor living conditions.[55, 57] Furthermore, low SES can lead to poor birth outcomes through lifestyle and behavioural factors—low SES is associated with high smoking rates, alcohol and drug use, teenage pregnancies, poor nutrition and poor access to prenatal care.[32, 58–60] In Canada and other economically developed countries, governments typically cover access to essential health care services like prenatal and maternity care. However, even in a country with universal access to health care, women living in poor neighbourhoods may not use health care resources effectively.[61, 62] For example, they may start prenatal care later in their pregnancies, be less compliant with prenatal advice or not use all available resources. Women with low SES may also experience generally poor maternal health as well as high physical or emotional stress.[14]

Canadian Births by Neighbourhood Income

Among babies that were born in a Canadian hospital (excluding Quebec) in 2006–2007, more than one in five (21.8%) were born to mothers living in the lowest income neighbourhoods (quintile 1), whereas fewer (18.2%) were born to mothers living in the highest income neighbourhoods (quintile 5). At the provincial level, Manitoba and Saskatchewan reported the highest proportion of babies born in quintile 1 (31.2% and 29.4%, respectively). Manitoba had the greatest disparity in preterm rates between the highest- and lowest-income neighbourhoods. Among the territories, Nunavut and the Northwest Territories had a high proportion of newborns born in quintile 1 (25.9% and 25.6%, respectively). Provincial/territorial proportions of in-hospital births by neighbourhood income quintile are shown in Appendix B.

Our analyses support the findings in the literature. Figure 5 shows the Canadian preterm birth and SGA rates by neighbourhood income quintiles in 2006–2007. As neighbourhood income increased, preterm birth and SGA rates decreased—though the gradient was steeper for SGA rates. For both preterm birth and SGA, the rate in quintile 1 (neighbourhoods with the lowest average income) was significantly higher than the rate in quintile 5 (neighbourhoods with the highest average income).

Figure 5

Preterm Birth (PTB) and Small-for-Gestational-Age (SGA) Rates by Neighbourhood Income in Canada,* 2006–2007

Preterm birth and SGA rates varied by neighbourhood income. Specifically, neighbourhoods with the highest average income (quintile 5) experienced the lowest preterm birth and SGA rates.

Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication.

This analysis was limited to live births discharged from an acute care facility with known gestational age that could be linked to the mothers' abstracts, where the mothers were assigned to a neighbourhood income quintile. Income data were based on the 2001 census from Statistics Canada, as 2006 census income data were not available at the time of analysis.

SGA rates were limited to singleton babies with known birth weight and sex, with gestational age between 22 and 43 weeks.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

At the provincial level, Manitoba and Nova Scotia showed the greatest disparities in preterm birth rates between the lowest and highest neighbourhood income quintiles, as shown in Table 1. However, this difference was only statistically significant in Manitoba. No other significant differences were observed in the remaining provinces and territories.

Among the provinces, the greatest disparities in SGA rates between the highest and lowest neighbourhood income quintiles occurred in Newfoundland and Labrador, Ontario and New Brunswick—these differences were statistically significant. Alberta and British Columbia also demonstrated significant disparities in SGA rates between the highest and lowest quintiles. No statistically significant difference was observed in the remaining jurisdictions.

Table 1

Preterm Birth (PTB) and Small-for-Gestational-Age (SGA) Rate and Neighbourhood Income Quintile by Province/Territory*, 2006-2007

The preterm birth and SGA rates varied across the country according to neighbourhood income quintile. They varied within each province and territory as well.

Province/ Territory	Preterm Birth Rate				Small-for-Gestational-Age Rate			
	Quintile 1		Quintile 5		Quintile 1		Quintile 5	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
N.L.	8.8	(6.9–10.7)	9.0	(7.1–10.9)	8.2	(6.3–10.0)	2.9	(1.7–4.0)
P.E.I.	8.2	(5.1–11.2)	7.5	(4.3–10.6)	5.5	(2.9–8.0)	5.0	(2.4–7.7)
N.S.	8.4	(7.1–9.7)	6.8	(5.6–8.1)	10.4	(8.9–11.8)	8.0	(6.6–9.4)
N.B.	6.4	(5.1–7.7)	5.4	(4.2–6.6)	10.7	(9.0–12.4)	6.9	(5.5–8.2)
Ont.	8.4	(8.1–8.7)	7.8	(7.5–8.2)	11.0	(10.6–11.4)	7.2	(6.9–7.6)
Man.	9.4	(8.6–10.3)	7.0	(5.9–8.1)	7.3	(6.5–8.0)	6.4	(5.4–7.4)
Sask.	8.8	(7.8–9.8)	7.9	(6.6–9.1)	6.6	(5.8–7.5)	6.9	(5.7–8.1)
Alta.	9.6	(9.0–10.2)	8.5	(7.9–9.2)	10.2	(9.6–10.9)	7.3	(6.8–7.9)
B.C.	8.3	(7.7–8.9)	7.3	(6.7–7.9)	8.7	(8.1–9.3)	7.0	(6.4–7.6)
Y.T.	†	†	†	†	†	†	†	†
N.W.T.	6.4	(2.8–10.1)	†	†	4.1	(1.1–7.1)	†	†
Nun.	12.1	(7.4–16.8)	12.8	(7.3–18.3)	10.1	(5.7–14.5)	†	†
Canada*	**8.6**	**(8.4–8.9)**	**7.8**	**(7.5–8.0)**	**9.9**	**(9.6–10.1)**	**7.1**	**(6.8–7.3)**

Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication and were excluded from the 2006–2007 Canadian rate.

† Results suppressed due to rate instability.

This analysis was limited to live births discharged from an acute care facility with known gestational age that could be linked to the mothers' abstracts, where the mothers were assigned to a neighbourhood income quintile. Income data were based on the 2001 census from Statistics Canada, as 2006 census income data were not available at the time of analysis.

SGA rates were limited to singleton babies with known birth weight and sex, with gestational age between 22 and 43 weeks.

Results are presented for the mothers' place of residence, rather than the location of the facility where hospitalization occurred.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Urban and Rural Variation

In the 19th century, urban areas were often associated with poor health outcomes, likely due to factors associated with increased population density.[63] However, rural communities also face a number of socio-demographic and economic challenges,[64] and the urban/rural relationship to health outcomes is less clear for perinatal health outcomes. While some studies reported worse perinatal outcomes in urban areas—especially among low-SES groups—others demonstrated worse outcomes in rural areas, particularly those most isolated from metropolitan areas.[34, 57, 65, 66] Poor health outcomes for pregnant women living in isolated geographic areas may be due to limited access to health care providers, specialists and other prenatal resources.[66–68] In this report, an urban area was defined as a community (CMA or CA) with at least 10,000 people. Rural areas and small towns with a population of less than 10,000 persons (not in any CMA or CA) were considered to be rural.[69] This definition follows the same approach used in other research.

Urban and Rural Births in Canada

In 2006–2007, more than 8 in 10 births (81.7%) were among mothers living in urban areas of Canada (excluding Quebec). Among the provinces, Ontario (89.6%), British Columbia (87.9%) and Alberta (76.2%) had the highest proportions of births in urban areas, while New Brunswick and Newfoundland and Labrador had the highest proportion of births in rural areas (42.4% for both). Provincial/territorial proportions of in-hospital births by urban/rural maternal place of residence are shown in Appendix B.

Our analyses found no statistically significant difference in the 2006–2007 Canadian preterm birth rates based on urban or rural residence (8.2% versus 8.0% across Canada). As well, there were no statistically significant differences in the 2006–2007 provincial and territorial preterm birth rates between urban and rural areas. In contrast, the SGA rate was significantly higher in urban compared to rural areas (8.7% versus 7.0%; refer to Table 2). At the provincial level, SGA rates were significantly higher in urban areas in Alberta (9.2% versus 7.4%), Ontario (9.1% versus 6.6%) and Manitoba (8.1% versus 6.8%).

Table 2

Small-for-Gestational-Age Rate by Rural–Urban Residence and Province/Territory,* 2006–2007

SGA rates were significantly higher in urban compared to rural areas. At the provincial level, these rates were significantly higher in urban areas in Alberta, Ontario and Manitoba.

Province/ Territory	Urban		Rural	
	%	95% CI	%	95% CI
N.L.	6.3	(5.3–7.2)	5.3	(4.2–6.3)
P.E.I.	6.6	(4.8–8.3)	7.3	(5.2–9.4)
N.S.	8.3	(7.6–9.0)	8.9	(7.8–10.0)
N.B.	8.6	(7.7–9.5)	8.6	(7.6–9.7)
Ont.	9.1	(9.0–9.3)	6.6	(6.2–7.0)
Man.	8.1	(7.6–8.7)	6.8	(6.1–7.5)
Sask.	7.4	(6.8–8.0)	6.5	(5.8–7.2)
Alta.	9.2	(8.9–9.5)	7.4	(6.9–7.9)
B.C.	7.8	(7.5–8.0)	7.5	(6.7–8.2)
Y.T.	5.2	(2.5–8.0)	†	†
N.W.T.	7.1	(4.3–10.0)	4.7	(2.6–6.7)
Nun.	‡	‡	6.7	(4.8–8.5)
Canada*	**8.7**	**(8.6–8.9)**	**7.0**	**(6.8–7.3)**

Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication and were excluded from the 2006–2007 Canadian rate.

† Data were suppressed due to rate instability.

‡ The entire territory of Nunavut is classified as rural.

This analysis was limited to live singleton births discharged from an acute care facility with known birth weight and sex, with gestational age between 22 and 43 weeks, that could be linked to the mothers' abstracts, where the mothers' urban/rural status was known.

Results are presented for the mothers' place of residence, rather than the location of the facility where hospitalization occurred.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

In other analyses (not shown here) the difference in SGA rates between urban and rural areas was more pronounced in low-income neighbourhoods. Specifically, the 2006–2007 Canadian SGA rate in low-income neighbourhoods (quintiles 1 and 2) was 10.0% in urban areas compared to 7.2% in rural areas. Among high-income neighbourhoods (quintiles 4 and 5), a slightly higher SGA rate was observed in urban areas (7.5% versus 7.0%). Both comparisons were statistically significant.

Chapter 2

Mothers of Preterm and Small-for-Gestational-Age Babies

The previous chapter showed that rates of preterm and small-for-gestational-age (SGA) babies are influenced by social factors (for example, differences in socio-economic status) and environmental factors (for example, urban/rural differences). This chapter builds on those findings by exploring selected maternal factors that can influence birth outcomes: maternal age; multiple gestations (such as twins or triplets); parity (that is, number of previous births); previous preterm deliveries; maternal diabetes; and maternal hypertension. Although there are other maternal factors that are associated with poor birth outcomes (such as substance use/abuse), the factors explored here are those for which information is available in CIHI's Discharge Abstract Database (DAD).

Maternal Age

The age at which a woman becomes pregnant impacts her likelihood of giving birth to a preterm or SGA baby. Babies born to mothers who are either younger (teenage mothers) or older (35 or older) are more likely to be preterm or small for their gestational age.

Teenagers are more likely to give birth to a small baby, in part, because of their physical immaturity. These factors make it more difficult for the teenage body to adapt to the physiological demands of pregnancy and may impact fetal growth.[70, 71] A teenage pregnancy can also reflect other perinatal (that is, around the time of birth) risk factors, such as low socio-economic status, low pre-pregnancy weight, inadequate nutrition and delayed or inadequate prenatal care.[32] Studies show that other factors such as smoking, alcohol consumption and other substance abuse behaviours are also more frequently observed among pregnant teens.[60, 72] These factors also increase the chance of giving birth to an SGA or preterm baby.

In Canada, the teenage pregnancy rate has declined steadily since the mid-1990s—from 49.2 per 1,000 females age 15 to 19 in 1994,[73] to 30.5 per 1,000 females age 15 to 19 in 2004.[74] Although similar declines were noted in other economically developed countries, Canadian rates are about one-half by comparison. For example, the 2004 teenage pregnancy rate was 60.3 per 1,000 females younger than 20 in England and Wales[75] and 72.2 per 1,000 females age 15 to 19 in the United States.[76]

Older women (35 or older) are also more likely to give birth to a small or preterm baby. Research has noted the impact of biological aging—which affects the functional capacity of the uterus—as a contributing factor to poor birth outcomes among older women.[77–80] Moreover, biological aging can decrease a woman's chance of becoming pregnant. Difficulties conceiving are associated with a growing dependence on assisted reproductive technologies (ARTs), which are thought to contribute to increased rates of multiple, preterm and growth-restricted births.[81–83] Furthermore, although older mothers who delay child-bearing tend to be better educated, more affluent and engage in healthier behaviours compared to younger mothers, they are also more likely to have multiple births, chronic diseases such as diabetes and hypertension, and experience placental complications during pregnancy that may result in early delivery.[32, 78, 84, 85]

In contrast to the decreasing trend observed for teenage pregnancies, the proportion of older women giving birth in Canada has increased steadily over the last few decades. The proportion of live births among women 35 and older more than tripled, from 5% in 1982[84] to about 18% in recent years.[1] The text box on page 29 discusses some possible reasons for this shift, which was also observed in other economically developed countries.[36, 86] Despite this similarity, there are some differences between Canada and other economically developed countries. While the 2006 Canadian age-specific live birth rate was 44.9 per 1,000 women age 35 to 39,[1] rates in the United States (47.3 per 1,000)[36] and England and Wales (53.8 per 1,000)[87] were higher in the same year.

Maternal Age in Canada—New Analyses From CIHI

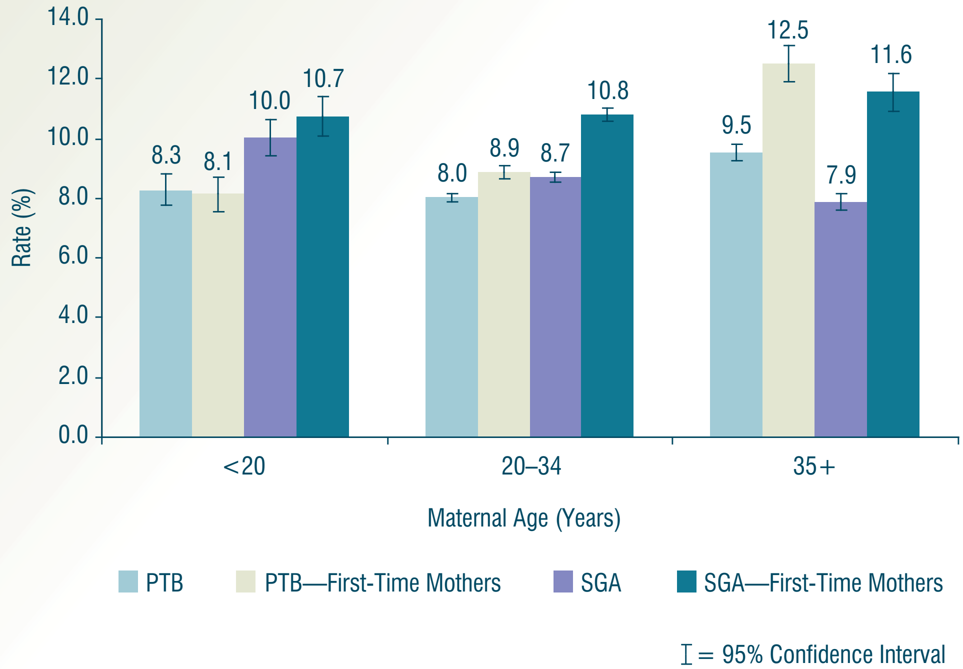
In 2006–2007, the average maternal age (of all live births) was 29.3 years for all areas of the country, excluding Quebec. More than 13,000 births were attributed to teenage pregnancies in Canada (excluding Quebec), accounting for 4.8% of all in-hospital births. Among the provinces, Saskatchewan and Manitoba had the highest proportion of teenage births (10.3% and 9.1%, respectively), while British Columbia and Ontario had the lowest proportion (3.6% and 3.7%, respectively). Mothers age 35 and older accounted for 18.4% of births in Canada. British Columbia and Ontario had the highest proportion of babies born to mothers 35 and older (22.2% and 20.5%, respectively), while Saskatchewan and New Brunswick reported the lowest among the provinces (10.2% and 12.0%, respectively). Among the territories, Nunavut and the Northwest Territories had a relatively high proportion of babies born to teenage mothers (22.7% and 11.2%, respectively). Provincial/territorial proportions of in-hospital births by maternal age are shown in Appendix B. While the proportion of teenage mothers was higher in England and Wales (about 6.8%)[87] and the United States (10.4%)[36] in 2006, the proportion of mothers age 35 and older was lower in the United States (14.3%)[36] but higher in England and Wales (about 20.0%)[87].

Figure 6 shows the preterm and SGA rates for selected jurisdictions by maternal age for all mothers and first-time mothers in 2006–2007. The preterm birth rate among babies born to mothers 35 and older (9.5%) was significantly higher than those in the younger age groups. Mothers younger than 20 were associated with the highest SGA rate (10.0%). However, among first-time mothers, women 35 years and older demonstrated the highest SGA rate (11.6%), though this rate was not statistically different from the other age groups.

Figure 6

Preterm Birth (PTB) and Small-for-Gestational-Age (SGA) Rate by Maternal Age for All and First-Time Mothers in Selected Jurisdictions,* 2006–2007

The highest preterm birth rate was associated with mothers age 35 and older. Mothers younger than 20 were associated with the highest SGA rate; however, among first-time mothers, women 35 and older demonstrated the highest SGA rate.



Notes

* This analysis was limited to residents of Ontario, Manitoba, Saskatchewan, Alberta and the territories, as parity information from other provinces was unavailable.

This analysis was limited to live births discharged from an acute care facility with known gestational age that could be linked to the mothers' abstracts, where maternal age and parity were known.

SGA rates were limited to singleton babies with known birth weight and sex, with gestational age between 22 and 43 weeks.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Canadian Women, Canadian Families: Then and Now

Over the last several decades there has been a major shift in the work and birthing practices of Canadian women. Over this period, there was a notable increase in the number of women in the paid workforce. For example, 42% of women 15 and older were employed in 1976, compared to more than half (58%) in 2006.[88] The employability of women improved, in part, because of increasing skill sets. For example, 18% of women 15 and older held a university degree in 2006[89]—up from 3% in 1971.[90] Women with a university degree are more often employed compared to those with a high school diploma.[88]

The cost of living also increased over the years, with many families now finding dual incomes a necessity. In 2003, both spouses were employed in two-thirds (66%) of all two-spouse families. This is double the figure in 1967, when both spouses were employed in only one-third (33%) of such families. It is estimated that if wives' earnings were deducted from the income of these families today, the proportion of families with low incomes would increase from 3% to 9%.[90]

At the same time, the birth rate declined sharply among Canadian women. In 2005, there were just 45 births for every 1,000 women age 15 to 49,[1] about a third of the figure in 1959 (116 births per 1,000).[90] Not surprisingly, the average size of Canadian families also decreased—from 3.7 persons in 1971 to 3.0 persons in 2006.[91] Furthermore, the average age of first-time mothers rose from 23 in the late 1960s to 27 in 2002.[90] Increasingly, women are choosing to concentrate on education and careers instead of early motherhood. The desire for financial independence and a stable relationship, as well as concerns about increasing divorce rates, appear to be influencing these decisions.[92] Additionally, it has been suggested that while child-bearing later in life has become more socially acceptable, younger motherhood has become less so.[92] These economic and social changes have occurred in an era where improved reproductive technology has increased the chances for older women to conceive through infertility treatments. In combination, these factors have contributed to the increased number of women who delay childbirth. This sizable demographic shift has become an emerging public health concern, given that many studies indicate that advanced maternal age (35 years or older) increases the likelihood of poor maternal and fetal birth outcomes.[78, 84, 93]

Multiple Births

In Canada, as in other economically developed countries, there has been an increase in multiple births.[4, 5, 50, 85] The most common form of multiple births (hereafter referred to as multiples) is in the form of twins. However, multiples can also reflect triplets or higher-order multiples (quadruplets, quintuplets, etc.). Although the short- and long-term viability of multiples have improved in recent years, multiple births are often a cause for concern because these babies are more likely to be growth restricted, born preterm and have low birth weights.[32, 94] As a result, they are more susceptible to short- and long-term health consequences such as perinatal and infant death, circulatory problems, cerebral palsy and physical and cognitive disabilities.[24, 94, 95] Generally, as the number of fetuses increases, morbidity and mortality increase—quadruplets have greater risks than triplets, and triplets have greater risks than twins.[96] Furthermore, for families, the cost of raising multiples is much greater compared to the cost of raising the same number of singleton babies.[97]

Multiples are likely to be growth restricted due to limited space in the uterus and a competition for nutrients. Up until the third trimester (about 27 weeks), the growth rate of twins is similar to that of singletons. However, by the 30th week, twins grow about 50 to 80 grams less per week than singletons. Among triplets, the risk is even higher—by the 38th week their average weight is at the 10th percentile of the weight of a singleton baby[32] (meaning that they are smaller than 90 percent of singleton babies at the 38th week). Despite the association between multiple births and growth restriction, there is no Canadian standard for classifying multiples as small for their gestational age. As such, all SGA analyses in this report are limited to singleton births.

In addition to hereditary traits, multiple births occur for several reasons. There was a significant increase in multiple birth pregnancies over the last 30 years, with many economically developed countries showing an increase in the rate of multiple births after the introduction of fertility treatments in the 1970s.[85] These types of medical interventions result in a multiple birth about one-third of the time.[98] However, the trend towards delayed child-bearing in more recent years also contributed to increasing multiple birth rates, as older maternal age (35 or older) is associated with multiple births. For example, before the wider use of infertility treatments in the late 1970s, the multiple birth rate was significantly higher among mothers age 35 to 39 compared to younger age groups in France[99] and the United States.[100] Delayed child-bearing and the use of fertility treatments individually and jointly contributed to the increase in multiple births.

Multiple birth rates continue to increase in many economically developed countries, largely due to twin births.[4, 5, 50, 85] In Canada, the multiple birth rate increased steadily from 2.1% of all live births in 1991,[39] to 3.0% in 2004.[50] The preterm birth rate among multiple births also increased in Canada—the rate for twins increased from 38.5% between 1981 and 1983, to 50.2% between 1995 and 1998. Preterm birth rates also increased for triplets, rising from 82.1% in the years 1981 to 1983, to 96.8% in the years 1995 to 1998.[85]

Multiple Births in Canada—New Analyses From CIHI

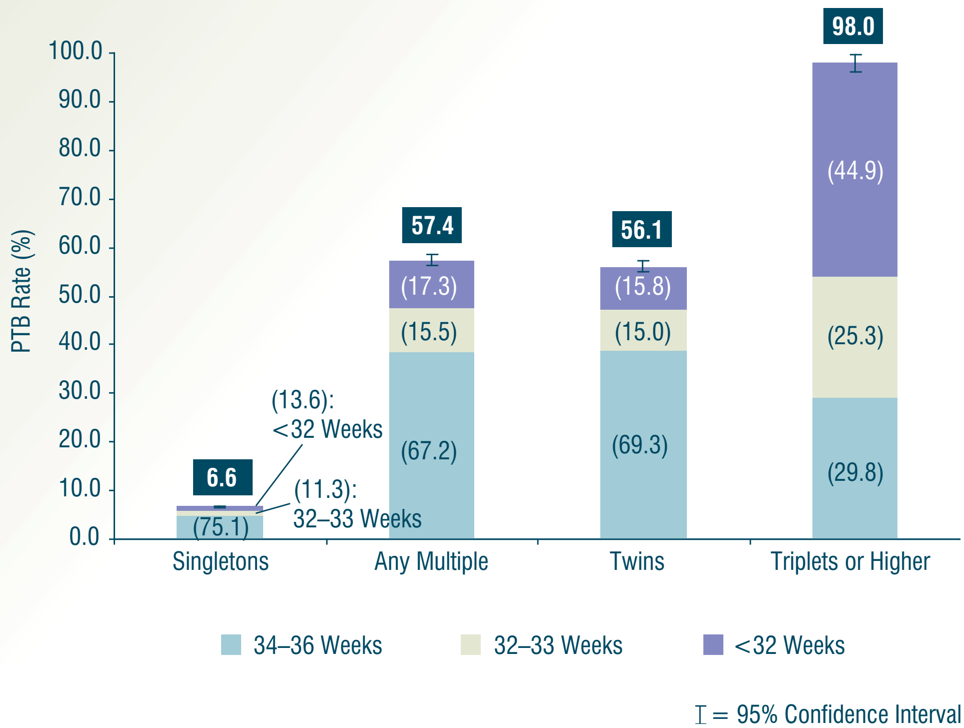
In 2006–2007, the in-hospital multiple birth rate in Canada (excluding Quebec) was 3.0% (more than 8,000 births), the majority of which were twin births (97.0%). While the multiple birth rate among all babies was only 3.0%, the multiple birth rate among preterm babies was 21.2% in 2006–2007. Similarly, while the average gestational age for all babies (who are largely singletons) was 39 weeks, the average gestational age for twins and higher-order multiples was 35 and 31 weeks, respectively. Among the provinces, Prince Edward Island (3.2%), Ontario (3.1%), Alberta (3.1%) and British Columbia (3.1%) had the highest multiple birth rates, while Saskatchewan (2.6%), Newfoundland and Labrador (2.7%) and Manitoba (2.7%) had the lowest multiple birth rates. Provincial/territorial proportions of in-hospital births by multiple birth status are shown in Appendix B. The multiple birth rate in Canada is lower than the rate in the United States and Australia (3.4% in 2005 for both countries).[4, 5]

Figure 7 shows the preterm birth rate by multiple birth status in 2006–2007. While only 6.6% of singletons were born preterm, more than half of twins (56.1%) and almost all higher-order multiples (98.0%) were born before 37 weeks of gestation. The high rate of preterm births among multiples is largely explained by medically indicated deliveries—estimates from the literature report that about 60% of preterm twins are due to medically indicated rather than spontaneous delivery.[14, 101] A much higher proportion of triplets and higher-order births (44.9%) were born very preterm (less than 32 weeks of gestation), compared to only 15.8% of twins and 13.6% of singletons. When only twins and singletons are considered, the preterm birth rate was 8.1%—meaning that twin births effectively caused the preterm birth rate to increase by 1.5%, from 6.6%. The addition of triplets and higher-order births raised the preterm birth rate an additional 0.1%, from 8.1% to 8.2%. The 2006–2007 preterm birth rate among all multiple births in Canada (57.4%) was higher than that observed in Australia (54.4% in 2005)[5] and England (about 51% in 2005–2006)[102].

Figure 7

Preterm Birth Rate by Multiple Birth Category in Canada,* 2006–2007

More than half of twins and almost all higher-order multiples were born preterm, compared to only 6.6% of singletons. A higher percentage of triplets and higher-order births were born very preterm (less than 32 weeks of gestation) compared to twins and singletons.



Legend

■ = Preterm birth rate specific to each multiple birth category.

( ) = Proportion of preterm births for each gestational age group within each multiple birth category.

Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication.

This analysis was limited to live births discharged from an acute care facility with known gestational age and multiple birth status that could be linked to the mothers' abstracts.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

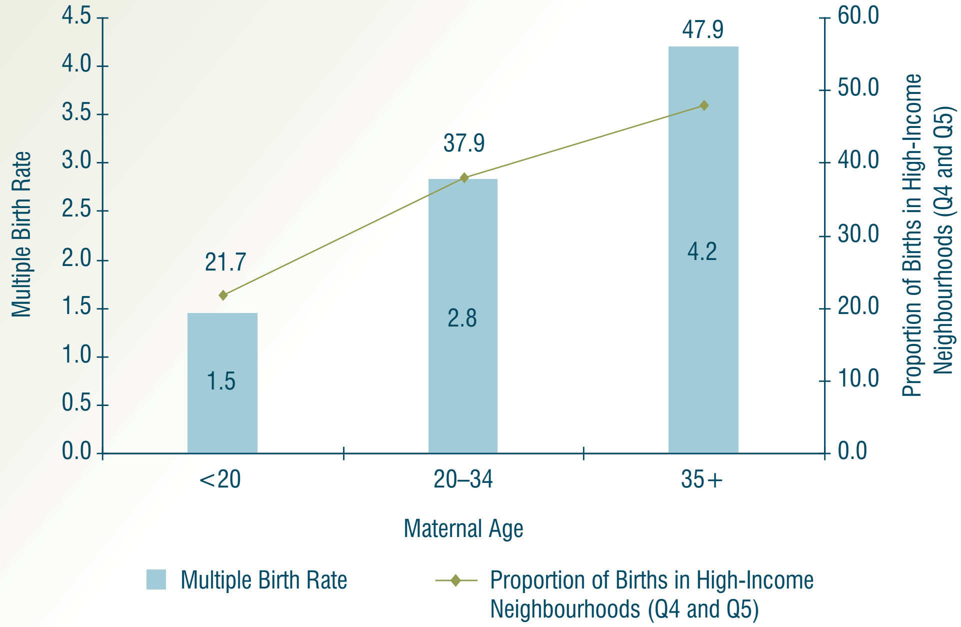
Maternal Age, Multiple Births and Neighbourhood Income

As discussed earlier in this chapter, there is an association between the mother's age, multiple birth status and socio-economic status (SES). Figure 8 illustrates the fact that older women were more likely to have multiple births and be living in high-income neighbourhoods (quintiles 4 and 5). As shown by the trend line, the proportion of births in the higher neighbourhood income brackets increased as maternal age increased—while about one-quarter (22%) of teenage births occurred in high-income neighbourhoods, almost half (48%) of those in the 35 years and older group came from high-income areas. Furthermore, as shown by the vertical bars, the multiple birth rate increased as maternal age increased—while the multiple birth rate associated with mothers younger than 20 was only 1.5%, it was more than 4% for women 35 and older. Additional analyses (not shown in Figure 8) also revealed that the multiple birth rate increased as neighbourhood income increased—in 2006–2007, the multiple birth rate in Canada (excluding Quebec) was 2.6% in quintile 1 versus 3.5% in quintile 5.

Figure 8

Multiple Birth Rate and Proportion of Births in High-Income Neighbourhoods (Quintiles 4 and 5), by Maternal Age in Canada,* 2006–2007

The proportion of births occurring in high-income neighbourhoods increased as maternal age increased. Furthermore, the multiple birth rate increased as maternal age increased.



Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication.

This analysis was limited to live births discharged from an acute care facility with known gestational age and multiple birth status that could be linked to the mothers' abstracts, where the mothers' age and neighbourhood income quintile were known. Income data were based on the 2001 census from Statistics Canada, as 2006 census income data were not available at the time of analysis.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Some of these associations may be linked to the use of infertility treatments. Women experience a considerable decrease in the probability of conceiving a child by their late 30s[103] and may therefore be more likely to use assisted reproductive technology (ART) procedures.[104] Recent estimates by Health Canada suggest that up to one in eight (12.5%) couples experience infertility,[105] compared to an estimated 7% of the reproductive-aged population in the United States[106] and 14% in the U.K.[107] In Canada, the coverage of fertility services and ART procedures varies across jurisdictions. For example, some provincial/territorial health insurance plans cover diagnostic evaluation, while in Ontario, women with completely blocked fallopian tubes may receive funding for up to three cycles of in vitro fertilization treatments.[10] For the most part, since many infertility treatments are not covered by provincial insurance health care programs in Canada, the costs of infertility treatments are incurred privately. As such, it is often older women—likely those who delayed child-bearing in order to pursue higher education, advancement in their careers and a better income[92]—who have increased access to ART treatments.

Although older maternal age and fertility treatments are associated with multiple births, they are also independently associated with adverse perinatal outcomes among singleton births. Babies conceived through ART procedures—either as a singleton or a multiple birth—have an increased likelihood of low birth weight, fetal growth restriction, perinatal mortality and being born preterm.[81, 108, 109] However, it is not clear how much of this association is influenced by the ART procedures themselves and how much is due to the underlying pathology responsible for the infertility.[85, 109] In 2005, 11,414 ART treatment cycles were initiated in Canada, with 3,443 resulting in a clinical pregnancy—at least 2,713 of these resulted in a delivery, of which at least 99% were live births.[98]

Parity: Number of Previous Births

In this report, parity was defined as the number of previous live births. First-time (that is, primiparous) mothers and those who already have three or more children (that is, high parity) are associated with poorer perinatal outcomes.[32, 33] Women having babies for the first time are affected partly because uterine and vascular structures may not be fully developed and undergo a period of maturation during the first pregnancy. When a woman becomes pregnant again, her body benefits from the improved uterine conditions which allow for better placental development and fetal nutrition.[32] First-time mothers are associated with both preterm and SGA births.

Women of high parity are also associated with poor perinatal outcomes. This is likely due to the shorter period of time between births.[110] A short birth interval—varying from one to two years—is thought to lead to poor birth outcomes largely due to maternal depletion and postpartum stress. At a biological level, a woman's body benefits from sufficient time between pregnancies to replenish essential vitamins, minerals and amino acids which are depleted during pregnancy—the uterus itself also needs some time to return to its normal condition.[14] High parity may also be indicative of low SES and other related lifestyle factors which can influence birth outcomes.[111]

Adverse outcomes associated with higher or lower parity also differ depending on maternal age. For example, young mothers with high parity are particularly vulnerable due to close birth spacing and the socio-economic conditions associated with teenage pregnancies.[60, 112] Older mothers giving birth for the first time—a growing population in Canada today[90]—are also vulnerable to poor birth outcomes due to the combined effects of biological aging and uterine immaturity.[32, 77]

Parity of Canadian Mothers—New Analyses From CIHI

First-time mothers accounted for 44.7% of all live births across Ontario, Manitoba, Saskatchewan, Alberta and the territories. This compares to only 7.4% for mothers who had three or more children. Among the four provinces examined, Ontario and Alberta had the highest proportion of births among first-time mothers (45.7% and 44.5%, respectively), while Manitoba and Saskatchewan had the highest proportion of high-parity births (13.8% and 12.8%, respectively). Nunavut (29.0%) and the Northwest Territories (15.2%) also had high rates of babies born to women in the highest-parity group. Provincial/territorial proportions of in-hospital births by parity status are shown in Appendix B. Compared to the rates in the United States, Australia and England and Wales, Canadian jurisdictions have a greater proportion of first-born babies and a lower proportion of newborns with three or more older siblings.[5, 36, 113] However, these comparisons should be interpreted with caution as some variation exists in the definition of these parity groups.

Figure 9 shows the preterm and SGA birth rates by parity status for 2006–2007 for Ontario, Manitoba, Saskatchewan, Alberta and all three territories (jurisdictions that captured parity status in the Discharge Abstract Database in 2006–2007). A distinct U-shaped relationship was seen for preterm births, with the highest associations observed for babies born to first-time mothers and to mothers with three or more previous children. These rates were significantly higher than those for women with one or two previous children. In contrast, the increased chance of delivering an SGA baby was only observed for first-time mothers—the rate was significantly increased compared to the other two parity categories. For first-time mothers, the rate for SGA births was significantly greater than for preterm births.

Figure 9

Preterm Birth (PTB) and Small-for-Gestational-Age (SGA) Rate by Parity Status in Selected Jurisdictions,* 2006–2007

A U-shaped relationship can be seen for preterm births, with the highest associations belonging to babies born to first-time mothers and to mothers with three or more previous children. In contrast, only first-time mothers demonstrated an increased chance of delivering an SGA baby.

Notes

* This analysis was limited to residents of Ontario, Manitoba, Saskatchewan, Alberta and the territories, as parity information from other provinces was unavailable.

This analysis was limited to live births discharged from an acute care facility with known gestational age that could be linked to the mothers' abstracts, where parity status was known.

SGA rates were limited to singleton babies with known birth weight and sex, with gestational age between 22 and 43 weeks.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Women who had a previous preterm delivery were more likely to deliver a preterm baby in a subsequent pregnancy.[31] The magnitude of this association depends on the gestational age of the previous preterm birth.[14] For example, the earlier the previous baby was born (that is, the lower the gestational age), the greater the likelihood that the next baby will be born preterm. This association also increases as the number of previous preterm births increases.[15] The increased hazard is observed for both spontaneous and medically indicated preterm births—though the mechanisms underlying the early birth may be slightly different. For example, recurrent spontaneous preterm births have been linked to women who experience ongoing genitourinary infections during pregnancy, while recurrent medically indicated preterm deliveries are usually associated with medical disorders such as diabetes or hypertension.[14] Additionally, maternal ethnicity and cervical length are also associated with recurrent preterm births.[15] Repeated preterm deliveries may also be indicative of poor maternal health, poor nutrition, low SES or other factors.

Across Ontario, Manitoba, Saskatchewan, Alberta and the three territories used in these analyses, the preterm birth rate among women who had a previous preterm delivery was 22.7%, compared to 6.4% among women who had previously only delivered at term or post-term. A similar though less dramatic relationship was observed for SGA rates (8.2% versus 6.7%, respectively). Provincial/territorial proportions of in-hospital births by previous preterm delivery status are shown in Appendix B.

Maternal Comorbidities: Diabetes and Hypertension

Diabetes and hypertension are two of the most common maternal health conditions that complicate pregnancy—these conditions increase the chances of adverse health effects such as preterm birth and SGA.

Diabetes

Diabetes mellitus occurs when the body is unable to make or respond to insulin—a hormone which is needed to convert glucose into energy. This condition results in elevated levels of glucose in the blood. Prolonged high blood glucose levels can result in damage to the kidneys, eyes, nerves, heart and blood vessels.[114]

The Three Main Types of Diabetes

Type 1 diabetes arises when the pancreas is unable to produce insulin.[115] The onset of this disease typically occurs in childhood, and regular injections of insulin are usually necessary due to the severity of the insulin deficiency. The risk factors associated with type 1 diabetes are not fully understood, but both genetic and environmental components play a role.[116]

Type 2 diabetes occurs when the body does not use the insulin that is produced effectively, and may also be accompanied by deficiencies in insulin secretion from the pancreas.[115] The risk factors for the development of type 2 diabetes include a family history of diabetes, obesity and physical inactivity.[114, 117] Women who have a previous history of gestational diabetes are at greater risk of developing type 2 diabetes.[117, 118] Older age is also a risk factor for type 2 diabetes; however, the rates of this disease have been increasing in younger adults due to changing lifestyle patterns.[119, 120]

Gestational diabetes may develop during pregnancy when the production of insulin is not sufficient to overcome the effect of the placental hormones (cortisol and human placental lactogen) which have insulin-desensitizing effects.[121] In a normal pregnancy, more insulin is secreted to compensate for this insulin resistance. Women are typically screened for gestational diabetes between 26 and 28 weeks of gestation. Gestational diabetes has been associated with several risk factors, including high pre-pregnancy weight, family history, older maternal age (especially for those 35 years or older) and multiple pregnancy.[118, 122]

Some women have diabetes before they become pregnant—this is referred to as pre-existing diabetes. These women can either have *type 1* or *type 2* diabetes (see text box for more information). Diabetes may also occur for the first time during pregnancy—this is known as *gestational* diabetes. Although health outcomes for women with a diabetic pregnancy have been shown to improve with adequate maternal glycemic control,[123] diabetes continues to be associated with poor health outcomes for diabetic mothers and their babies.[114] The nature and extent of these health problems depend on the clinical type and severity of the disease and the degree to which blood glucose levels are controlled.[124] For example, women with pre-existing diabetes are more likely to experience adverse perinatal outcomes compared to women with gestational diabetes.[125] This is primarily due to increased severity and longer duration of the diabetes. Additionally, women with pre-existing diabetes are more likely to have underlying vascular damage, which is associated with poorer fetal outcomes as well as an increased risk of developing pre-eclampsia during pregnancy[126, 127] (see text box on page 42 for more information about pre-eclampsia). Some of the fetal outcomes associated with maternal diabetes include perinatal death, various malformations and exaggerated insulin production, which can lead to low blood sugar levels (hypoglycemia) after delivery.[42, 128]

Babies born to diabetic mothers (especially those who are severely diabetic) are also at increased risk of a spontaneous or medically indicated preterm birth.[126, 129, 130] The main indication for a preterm delivery by medical intervention among women with diabetes is the development of pre-eclampsia.[131, 132] Although the mechanism behind the increased risk of spontaneous preterm delivery among women with diabetes remains unclear,[126, 129] a relationship between poor glycemic control and spontaneous preterm birth has been noted.[130] Furthermore, some of the risk factors associated with developing pre-existing type 2 and gestational diabetes—for example, high pre-pregnancy weight and older maternal age—may themselves predispose these women to a preterm delivery. Babies born to diabetic mothers with underlying vascular disease may also be growth restricted due to the lack of oxygen and nutrient flow to the fetus.[127]

The proportion of pregnancies affected by diabetes rose in recent years in economically developed countries.[123, 133] Approximately 3.8% of live newborns in the United States were born to mothers affected by diabetes (pre-existing or gestational) in 2005—this rate increased steadily since 1990.[4] The rising obesity (body mass index, or BMI, ≥30) rates in such countries have been associated with an increase in the number of women of child-bearing age that are developing type 2 diabetes.[134–136] Canadian trend data indicate that the prevalence of obesity steadily increased, from 7% to 14%, among Canadian women between 1985 and 2001.[137] Other causes for the increasing rates of diabetes in pregnancy include rising maternal age,[138] low levels of physical activity,[136] increasing immigration from high-risk populations[114, 138] and changes in the criteria for diagnosing gestational diabetes.[139]

Maternal Diabetes in Canada—New Analyses From CIHI

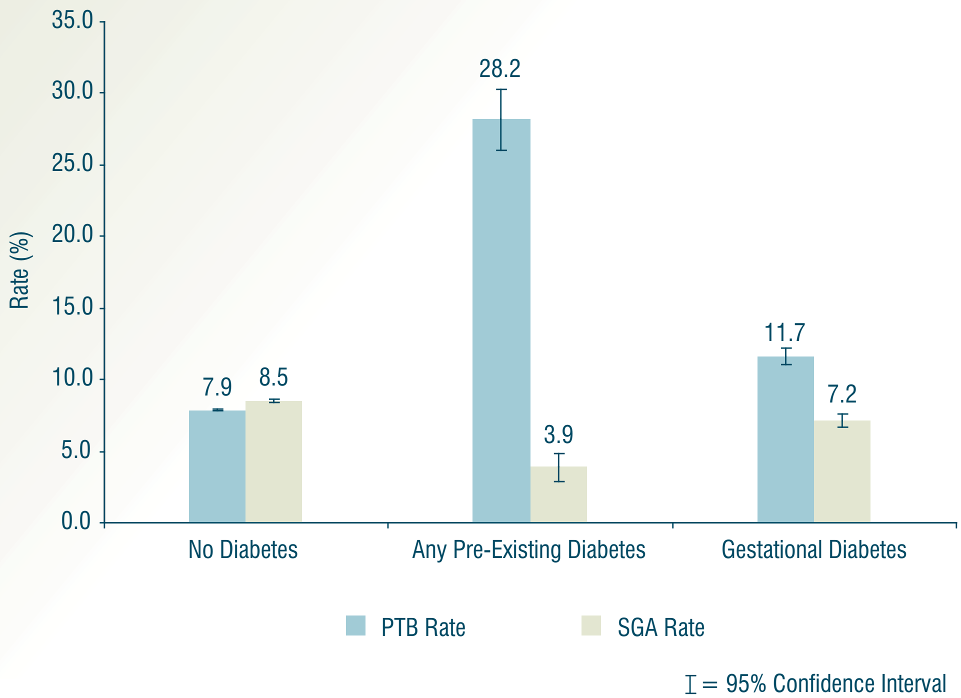
In 2006–2007, 5.1% of babies in Canada (excluding Quebec) were born to mothers with pregnancies complicated by diabetes. Among the provinces, the proportion of babies affected by maternal diabetes ranged from 2.4% in Prince Edward Island and 4.1% in Saskatchewan to 4.9% in Ontario and 7.6% in British Columbia. The overall occurrence of maternal diabetes was largely driven by gestational diabetes. In 2006–2007, of the babies born to mothers with a pregnancy complicated by diabetes, 87.8% were affected by gestational diabetes and 12.2% by pre-existing diabetes. The pre-existing cases with an identified type of diabetes were distributed fairly evenly, with slightly more babies born to mothers affected by type 2 (53.3%) compared to type 1 (46.7%). Provincial/territorial proportions of in-hospital births by diabetes status are shown in Appendix B.

As shown in Figure 10, the preterm birth rate was significantly higher for women affected by pre-existing diabetes (28.2%) compared to those with gestational diabetes (11.7%) or no diabetes (7.9%). In contrast to the increased rate of preterm birth, the SGA rate was significantly lower for women with pre-existing diabetes (3.9%) and gestational diabetes (7.2%) compared to the SGA rate for women without diabetes (8.5%).

Figure 10

Preterm Birth (PTB) and Small-for-Gestational-Age (SGA) Rate by Maternal Diabetes Status in Canada,* 2006–2007

The preterm birth rate was significantly higher among babies born to mothers with diabetes compared to those without. In contrast to the increased preterm birth rate, the SGA rate was significantly lower for women with diabetes compared to the SGA rate for women without.



Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication.

This analysis was limited to live births discharged from an acute care facility with known gestational age that could be linked to the mothers' abstracts.

SGA rates were limited to singleton babies with known birth weight and sex, with gestational age between 22 and 43 weeks.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

The low SGA rate among women with diabetes is likely due to the metabolic effects of this condition, which predispose women to deliver large or macrosomic babies (that is, birth weight of 4,500 grams or more).[42, 124] This condition occurs as a consequence of high blood glucose levels in the mother which cross the placenta and result in high blood glucose levels in the fetus. As a response to high glucose levels (that is, a hyperglycemic state), the fetus responds by producing more insulin which leads to rapid fetal growth and the accumulation of fat.[42] Among women with diabetes, the rate of macrosomia was inverse to the observed SGA rate. The macrosomia rate was 7.0%, 3.2% and 1.9% for pre-existing, gestational and no diabetes pregnancies respectively. Although we might expect higher rates of SGA in pregnancies affected by pre-existing diabetes, research suggests that the association is strongest for the subset of this population with poor glycemic control and severe underlying pathology.[127]

Hypertension

Hypertension, or high blood pressure, is typically defined as *systolic*—when the heart is contracting—blood pressure of 140 mm Hg or greater and/or *diastolic*—when the heart is at rest—blood pressure of 90 mm Hg or more. Risk factors for hypertension include older age, family history, obesity, alcohol consumption, high salt intake and lack of physical activity.[140] Similar to diabetes, hypertension can be pre-existing (that is, high blood pressure preceding pregnancy or before 20 weeks of gestation) or gestational (a temporary condition which occurs when high blood pressure develops during pregnancy).[141] Gestational hypertension is more common in women giving birth for the first time and for women carrying multiples.[142] Pregnancies affected by gestational or chronic hypertension can be further complicated by the development of pre-eclampsia.

What Is Pre-Eclampsia?

Pre-eclampsia is defined by high blood pressure in pregnancy accompanied with high levels of protein in the urine (proteinuria). This condition typically occurs in the second or third trimester[143] and is one of the leading causes of morbidity and mortality among mothers and infants.[144–146] Pre-eclampsia worsens the effects of hypertension, further reducing the delivery of oxygen and nutrients to the fetus.[147] Severe pre-eclampsia can progress to a condition referred to as eclampsia, which is characterized by the occurrence of maternal seizures, coma or both.[42] Despite extensive research into the causes of pre-eclampsia, delivery of the fetus and placenta is the only effective treatment for this condition.[148] Other factors associated with increased risk of pre-eclampsia include pre-existing diabetes, multiple pregnancy, primiparity (first-time mothers), high maternal age (35 years or older) and a high pre-pregnancy BMI.[149]

Women who develop pre-eclampsia have a significantly higher chance of preterm birth compared to those with hypertension alone.[150] In addition, infants born to mothers with pre-eclampsia are more likely to be growth restricted.[151] Obstruction of blood flow to the placenta—which is typical of this condition—can reduce the amount of nutrients and oxygen delivered to the growing fetus and lead to sub-optimal growth.[147, 152] However, although pre-eclampsia appears to be the greatest contributing factor to adverse perinatal outcomes in pregnancies affected by hypertension, high blood pressure on its own can result in adverse fetal outcomes. The severity of health outcomes for pregnant women with hypertension (but without pre-eclampsia) is linked to the severity of the condition.[42] In addition, severe hypertension is independently associated with placental abruption (that is, premature separation of the placenta),[153] which is associated with an increased chance of a preterm delivery.[154]

Hypertension appears to be on the rise in many countries.[155] However international data on pregnancies affected by hypertension are limited. One recent study reported that the incidence of gestational hypertension and pre-eclampsia in the United States increased over the past 20 years.[156] The gestational hypertension rate in the U.S. was 4.0% in 2005, the highest reported since these data became available.[4] Chronic hypertension also steadily increased in the United States since 1990. Approximately 1.0% of all pregnancies in 2005 were affected by pre-existing hypertension.[4] Older maternal age and rising obesity rates are thought to be some of the factors behind this increase.[156]

Maternal Hypertension in Canada—New Analyses From CIHI

In Canada (excluding Quebec), 6.2% of all babies were born to mothers with pregnancies affected by hypertension (including pre-existing and gestational). Specifically, 0.6% were affected by pre-existing hypertension and 5.4% with gestational hypertension. Among the provinces, Newfoundland and Labrador had the highest proportion of babies born to mothers with hypertension (9.0%), followed by Nova Scotia (8.3%), while the lowest proportion was observed in Ontario (5.7%) and Saskatchewan (5.6%). Provincial/territorial proportions of in-hospital births by hypertension status are shown in Appendix B.

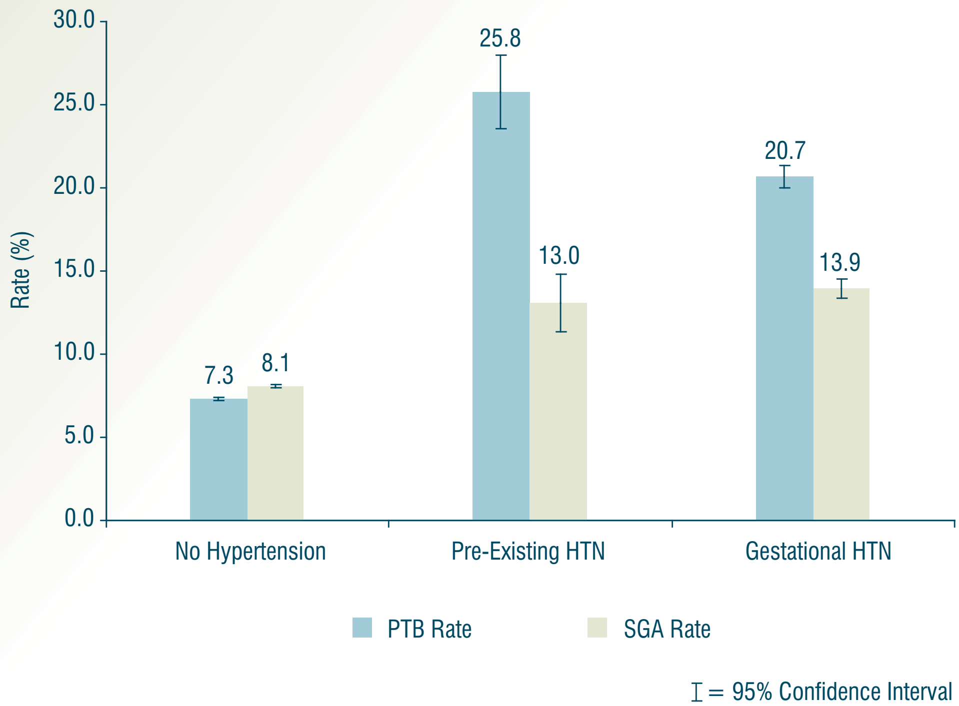
In this report, pregnancies were categorized according to whether hypertension occurred for the first time during the pregnancy period (gestational hypertension) or was a pre-existing condition prior to pregnancy (pre-existing hypertension). These groups were not further divided by pregnancies affected by pre-eclampsia. Therefore, the preterm birth and SGA rates presented for hypertension in this report are likely influenced by the varying distribution of pre-eclampsia between these two groups.

As shown in Figure 11, infants born to mothers with pre-existing hypertension had a significantly increased preterm birth rate (25.8%) compared to those with gestational hypertension (20.7%). As well, the preterm birth rate for both these groups was considerably higher than the rate for pregnancies not affected by hypertension (7.3%). The SGA rate was similar for infants born to mothers with gestational hypertension (13.9%) and pre-existing hypertension (13.0%). The SGA rate for pregnancies not affected by hypertension was 8.1%, which was significantly lower than both of the hypertension categories.

Figure 11

Preterm Birth (PTB) and Small-for-Gestational-Age (SGA) Rate by Maternal Hypertension (HTN) Status in Canada,* 2006–2007

The preterm birth rate was significantly higher among infants born to mothers with pre-existing hypertension compared to those with gestational hypertension. The SGA rate for pregnancies not affected by hypertension was significantly lower than both of the hypertension categories.



Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication.

This analysis was limited to live births discharged from an acute care facility with known gestational age that could be linked to the mothers' abstracts.

SGA rates were limited to singleton babies with known birth weight and sex, with gestational age between 22 and 43 weeks.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Several maternal characteristics directly affect birth outcomes. Although there are many other maternal factors which we were not able to examine here (such as poor maternal nutrition, smoking and fertility treatments), these analyses clearly demonstrate that maternal age, multiple gestations, parity, previous preterm deliveries and maternal comorbidities are significant contributors to perinatal outcomes among Canadian women. However, it is important to note that these factors are related to each other, and each can influence another's effect on the odds of delivering a preterm or SGA baby. Since the preceding analyses only consider each factor's independent effect on preterm birth and SGA, a multiple factor model is presented in Chapter 4 that provides the relative odds of a preterm and SGA birth associated with each factor, after taking all other factors into account. The following chapter will focus on the role of obstetrical interventions (inductions and Caesarean sections) and their relationship with preterm and SGA births, as well as the in-hospital costs associated with these babies.

Chapter 3

The Role of Medical Interventions and Hospital Costs Among Preterm and Small-for-Gestational-Age Babies

Women with pre-existing associated factors or those who develop problems during labour and delivery often require the use of a variety of interventions to minimize the risk to themselves and/or their babies. This chapter explores the relationship between obstetrical interventions—specifically induction of labour and Caesarean section—and preterm birth and small-for-gestational-age (SGA) deliveries. This chapter will also include a discussion of hospital costs associated with babies who are born preterm or small for their gestational ages.

Mode of Delivery: Inductions and Caesarean Sections

Obstetrical interventions are used when the fetal and/or maternal risks associated with continuing the pregnancy outweigh the benefits of waiting for labour to begin spontaneously. Improvements in health outcomes—such as the prevention of stillbirth and infant morbidity and mortality[157]—are some of the benefits of these interventions. For example, although preterm birth rates increased over the past decade as a result of obstetrical intervention, a corresponding decline in the perinatal mortality rate has been observed.[31, 35, 50, 158, 159] Induction of labour and performing a Caesarean section (C-section) are two examples of obstetrical interventions.

Induction of labour is defined as the artificial initiation of labour before its spontaneous onset. Labour can be induced using drugs (pharmacologically) or surgically by an artificial rupture of membranes. Induction of labour is carried out when delivery fails to begin spontaneously at the end of the normal period of gestation (about 40 weeks) or can be used before term when the balance of risks and benefits indicates that delivering the baby early is preferable to a compromised intrauterine environment.[159] Common indications for preterm labour induction include hypertensive disorders, evidence of fetal compromise and growth restriction, and premature rupture of membranes.[157, 160–162] Although induction of labour is typically considered to reduce the risk of some negative health outcomes for the mother and baby, there are risks associated with inducing labour. These include prolonged labour, instrumental delivery, postpartum hemorrhage and longer maternal length of stay.[42, 163, 164]

A C-section delivery—defined as the birth of a fetus through incisions in the abdominal wall and the uterine wall—may be performed to ensure rapid delivery of a newborn showing signs of fetal distress or in cases where vaginal delivery could harm the mother or the baby. It can also occur in complicated pregnancies such as multiple births or when problems arise during labour—such as maternal distress or an abnormal fetal heart rate. In addition to the indications for labour induction, placental abnormalities (premature placental separation or abnormal placental position) are also common indications for preterm C-section.[157, 160–162] C-sections are performed to facilitate safe delivery of the baby and minimize poor health outcomes for the mother. However, C-sections are not without risk to the mother and baby and are associated with maternal hemorrhage, longer recovery, infections and fetal respiratory problems.[165–167]

In Canada and the United States, the rate of inductions and C-sections performed among preterm births has increased steadily.[4, 157] These increases may be influenced by population characteristics such as increases in maternal age, pre-pregnancy obesity and multiple births.[159, 168] However, improvements in the ability to monitor the health of a pregnant woman and her fetus have led to changes in practice patterns which are linked to increases in medically indicated labour induction and C-section delivery, as well as increases in preterm birth rates in economically developed countries.[158, 159, 161] The text box on page 52 highlights some of the recent advances in fetal surveillance and its relationship to the use of medical interventions in deliveries.

Regional Variation in C-Section and Induction Rates Among Preterm and Small-for-Gestational-Age Babies—New Analyses From CIHI

The steadily increasing rate of C-sections among *all* deliveries in many industrialized countries is frequently cited in the literature as a cause of concern,[169] since they are not without danger to the mother and baby and result in increased health care costs.[10] However, among preterm and SGA births—which comprised approximately 16% of all deliveries in Canada in 2006–2007—the high rates of interventions such as C-sections and inductions presented below likely reflect the availability of appropriate obstetric intervention across jurisdictions. Unfortunately, what constitutes an optimal rate remains unknown.

More than one-third (38.7%) of preterm babies born in Canada (excluding Quebec) in 2006–2007 were delivered by C-section only, while 16.8% were induced. Among the provinces, Prince Edward Island (43.0%) and British Columbia (42.4%) reported the highest C-section rates among preterm babies, while Manitoba (32.9%) and Saskatchewan (33.0%) reported the lowest rates. With respect to inductions, Manitoba (21.2%) and Alberta (20.3%) had the highest rates, while Saskatchewan (16.6%) and Prince Edward Island (16.0%) had the lowest.

Among SGA babies born in Canada (excluding Quebec) in 2006–2007, 21.5% were delivered by C-section only, while 22.8% were delivered by induction. The highest provincial C-section rates among SGA babies were observed in Newfoundland and Labrador (27.3%) and Ontario (22.3%), while the lowest rates were observed in Saskatchewan (19.0%) and Manitoba (18.8%). Provincial induction rates among SGA babies were highest in New Brunswick (32.1%) and Prince Edward Island (28.7%), while the lowest were observed in British Columbia (20.7%) and Manitoba (18.6%).

Further detail is provided in Appendix B. It is important to note that inductions initiated outside of the hospital setting (such as in the doctor's office) were not captured in these analyses. As such, the extent to which the overall induction rate is underestimated is unknown.

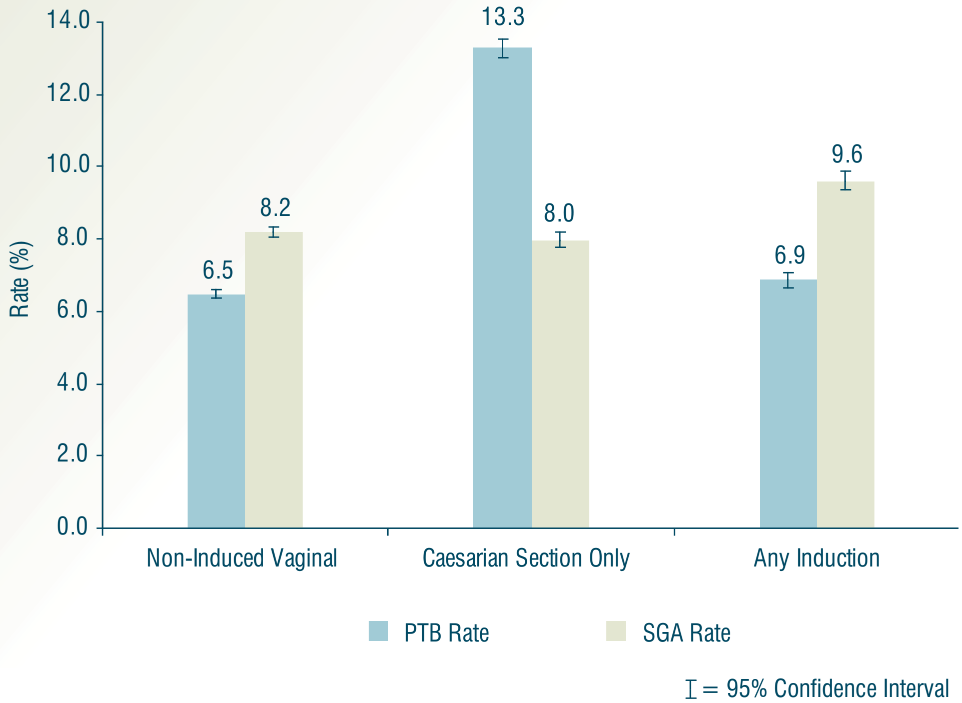
As discussed in Chapter 2, diabetes and hypertension are two factors that predispose women to deliver a preterm or SGA baby. These conditions are also linked to the use of medical interventions during labour and delivery. For example, more than two-thirds (69.6%) of the preterm births from pregnancies affected by diabetes were induced or delivered by C-section. This compares to an obstetric intervention rate of 54.2% for preterm deliveries among pregnancies without diabetes. A high proportion (87.2%) of preterm babies born to mothers with hypertension were also delivered by C-section or induction of labour—almost double the obstetric intervention rate for preterm deliveries without hypertension (49.5%).

Other common reasons for medically indicated preterm birth include pre-eclampsia and placental abnormalities, which can cause distress in the mother and/or the fetus.[160, 162] Fetal growth restriction is another indicator that is often used to determine whether a medically indicated delivery is warranted. Once growth restriction is identified, the fetus is monitored closely for signs of fetal distress to determine the optimal timing for delivery.[38] Women who are pregnant with multiples are also more likely to require a medically indicated delivery. In Canada (excluding Quebec), 57.3% of multiples were delivered by C-section, compared to 22.8% of singletons. The rate of induction was similar for multiples (20.4%) and singletons (20.0%).

Figure 12

Preterm Birth (PTB) and Small-for-Gestational-Age (SGA) Rates by Mode of Delivery in Canada,* 2006–2007

The preterm birth rate was significantly higher among babies delivered by C-section compared to non-induced or induced vaginal deliveries. In contrast, the SGA rate was lowest for babies delivered by C-section and highest for babies born following an induction.



Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication.

This analysis was limited to live births discharged from an acute care facility with known gestational age that could be linked to the mothers' abstracts.

SGA rates were limited to singleton babies with known birth weight and sex, with gestational age between 22 and 43 weeks.

In the event that both a C-section and induction were performed during a delivery, this birth was assigned to the *any induction* category.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

As shown in Figure 12, the preterm birth rate was significantly higher among babies delivered by C-section (13.3%) compared to non-induced (6.5%) or induced (6.9%) vaginal deliveries. Further analysis (data not shown) indicates that the C-section rate was highest for early preterm (less than 32 weeks) infants at 51.0%, followed closely by moderately preterm (32 to 33 weeks) infants (48.5%). In comparison, only 34.7% of late preterm babies (34 to 36 weeks) were born by C-section. Similar trends were observed in the United States in 2005.[4] The Canadian preterm birth rate was significantly higher for induced compared to non-induced vaginal deliveries. The Canadian induction rate among preterm births was 16.8%, which is higher than the rate reported in the United States in 2005 (approximately 14%).[4] Contrary to the trend observed for C-sections, further analysis (data not shown) indicates that inductions are more frequently performed among late preterm babies—the induction rate ranged from 4.2% for early preterm babies (less than 32 weeks) to 20.5% for late preterm (34 to 36 weeks) babies.

In contrast to the findings for preterm birth rates, the SGA rate (Figure 12) was lowest for babies delivered by C-section (8.0%) and highest for babies born following an induction of labour (9.6%). In the case of SGA babies, induction of labour may be performed more frequently than C-sections, since more than 90% of SGA babies are born at term; therefore, these babies may be more stable and more likely to survive a vaginal delivery than preterm babies.

Improvement in Fetal Monitoring and Surveillance

Fetal surveillance is used to monitor fetal development and to identify any warning signs of distress. There was a marked increase in fetal surveillance in recent years. In the United States, electronic fetal monitoring and prenatal ultrasonography were used in 85% and 67% (respectively) of pregnancies in 2003, compared to 68% and 48% (respectively) in 1989.[170] In addition, new technologies were developed to detect fetal complications early on, when interventions can be used to reduce the risk of stillbirth or perinatal morbidity.[171]

Improvement in Fetal Monitoring and Surveillance (cont'd)

Improvements in ultrasound imaging are instrumental in helping obstetricians detect structural and functional abnormalities in the womb. The fetal biophysical profile (BPP), first introduced in the early 1980s, was one of the first techniques to extend the use of ultrasound into a more comprehensive fetal well-being assessment.[172] The BPP monitors the fetus's movement and breathing and estimates amniotic fluid volume.[173] The Doppler ultrasound is another important tool that is used to detect abnormal blood flow to the placenta in high-risk pregnancies.[42] Abnormal uterine blood flow is associated with pre-existing and gestational hypertension.[174] The Doppler ultrasound is also used to assess the pattern of blood flow redistribution in the fetal cardiovascular system, which can help to inform the optimum timing for delivery.[171] Advances in fetal monitoring during the intrapartum period (between the beginning of labour and delivery) helped to identify babies who are compromised due to a lack of oxygen and who may benefit from a C-section delivery or instrument-assisted vaginal birth.

Improvements in detecting fetal distress, along with advances in neonatal care, have contributed to the increasing rates of medically indicated labour induction and C-sections, with the goal of reducing adverse perinatal outcomes.[159] Selective and carefully timed early delivery—in situations where a fetus is compromised—has been referred to as the cornerstone of modern obstetrics.[159] Technological advances in neonatal care contributed to the reduction of infant mortality at gestational ages as early as 24 to 25 weeks.[175] However, given that being born preterm is not without risk to the infant,[24] medically indicated preterm births should only be performed when the risks of continuing the pregnancy outweigh the benefits of a longer gestation.

Hospital Costs Associated With Preterm and Small-for-Gestational-Age Babies

Although most babies are born without the need for extensive medical intervention, a large proportion of pediatric hospital stays are for conditions that occur right after the baby is born—the neonatal period.[10] Preterm or SGA babies may require special monitoring and care in the first days and weeks of their lives and tend to remain longer in hospital after delivery. Although other factors, such as the presence of illnesses/problems as well as the type and number of interventions performed, can influence resource consumption, gestational age and birth weight have been shown to be strong predictors of increased hospital costs for newborns.[11, 176] In this report we estimate hospital costs for newborns using CIHI's relative resource allocation methodology. This grouping methodology is based on estimates of the expected resource consumption for the average patient within similar clinical groups. Further detail is provided in the text box on page 62.

The cost estimates presented here reflect the relative average hospital costs associated with three neonatal outcomes (low birth weight, preterm birth and SGA) for "typical patients." Typical patients are those who have undergone a normal and expected course of treatment. Atypical patients—those who are transferred between acute care facilities, deaths, sign-outs and long-stay cases—are excluded. Because this methodology is based on typical cases, some of the sickest babies—those who have a higher risk of mortality and are more likely to require longer hospital stays, or who are transferred to other facilities for specialized treatment—are not included in these analyses. Neonatal intensive care units (NICUs) have specialized technology and highly trained specialists in the care of atypical newborns and have the potential to improve survival for babies born preterm or with low birth weight.[177, 178] Since NICUs are not available in all hospitals, babies who are transferred represent a significant proportion of atypical cases among newborns.

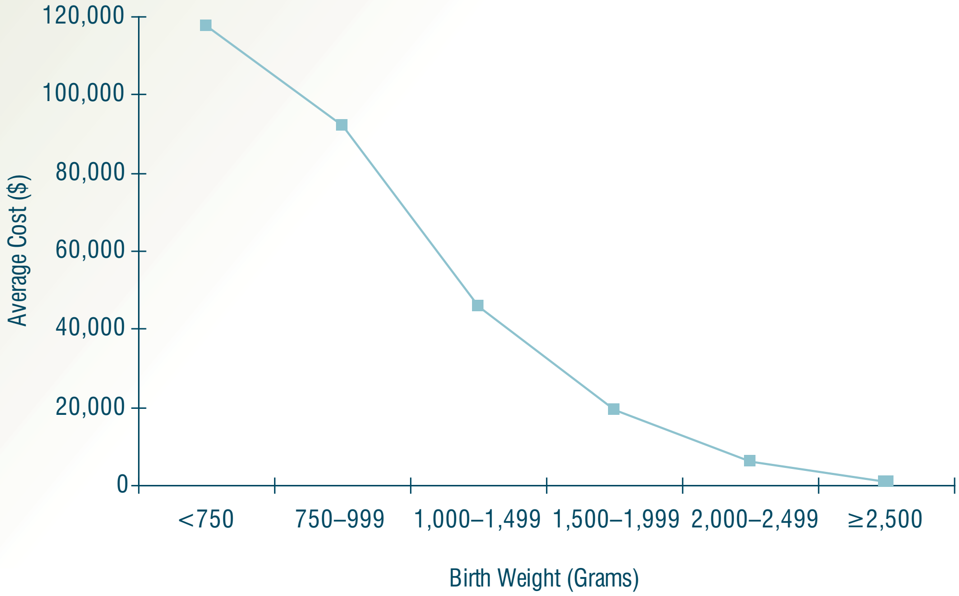
Another limitation of the cost estimates in our analyses is that they are limited to inpatient hospital costs such as nursing care, other personnel salaries, drugs, laboratory work, equipment and supplies. These estimates do not include payments to physicians from provincial/territorial health insurance plans, re-admission costs, out-of-pocket expenses for non-insured care (for example, midwives, doulas), outpatient or home care expenses. The text box on page 62 provides more detail regarding the costing information available in the CIHI databases and highlights how this costing information was used to estimate various components of health care spending in Canada.

The results presented here, therefore, reflect only the hospital costs among newborns who received treatment in the hospital in which they were born and discharged. As such, the estimates provided do not reflect the total costs for newborn care, nor do they include costs associated with care for the mother. These analyses are intended to show the *relative increase* in hospital costs for different neonatal outcomes rather than the total hospital costs associated with a preterm or SGA delivery.

Figure 13

Average Hospital Cost for "Typical" Newborns,* by Birth Weight Category, 2005–2006

Hospital costs decreased as birth weight increased, with the smallest infants having the highest cost and longest length of stay. The average hospital costs per newborn in Canada in 2005–2006 ranged from just more than $1,000 for newborns who weighed 2,500 grams or more to more than $117,000 for newborns who weighed less than 750 grams. Similarly, the average length of hospital stay increased as birth weight decreased (not shown), ranging from 2 days for babies weighing 2,500 grams or more to 104 days for those less than 750 grams for typical newborns.



Notes

* This analysis was restricted to live births discharged from an acute care facility located in provinces/territories where gestational age information was available on the newborn chart: Newfoundland and Labrador, Ontario, Manitoba, Saskatchewan, British Columbia and Nunavut. Only typical patients were included (that is, patients who received a course of treatment in a single institution and were discharged; excludes stillbirths, transfers and patients who stayed longer than the expected length of stay).

This analysis was limited to newborns with known birth weight, gestational age and length of stay.

Sources

Discharge Abstract Database, 2005–2006, and Canadian MIS Database, 2005–2006, Canadian Institute for Health Information.

As previously discussed, low birth weight (LBW) is a result of preterm birth or intrauterine growth restriction. These two distinct causes of LBW have different short- and long-term consequences. As such, the health care costs are expected to be different for an LBW newborn who is preterm compared to an LBW newborn who is SGA. In addition, newborns who are not LBW (born with a birth weight 2,500 grams or more) but who are born too early (preterm) or SGA may have higher risks of poor neonatal outcomes compared to other non-LBW babies.

Preterm infants are at increased risk of a range of poor neonatal outcomes, including respiratory distress syndrome, gastrointestinal complications and infections.[24, 179] The high rates of morbidity arising from preterm birth leads to increased health care costs due to the use of specialized equipment, longer length of hospital stay and increased health care personnel resources.[176] According to CIHI data, in 2005–2006, the average hospital cost for typical singleton newborns was approximately nine times higher for newborns born at less than 37 weeks of gestation compared to full-term infants (Table 3). Average hospital cost and length of stay increased with decreasing gestational age. Singleton newborns born at extremely preterm gestational ages (less than 28 weeks) had the highest average cost ($84,235) and stayed in the hospital an average of 40 times longer than singletons born at full-term.

The hospital cost associated with a preterm multiple-birth baby was approximately seven times higher than the average cost for a full-term multiple-birth baby (Table 3). As well, the average hospital cost for multiples was consistently higher than singletons for each gestational age category. This may reflect the increased likelihood of preterm birth, SGA birth and medical interventions among multiple births.[180]

Table 3

Average Hospital Costs and Length of Stay (LOS) for “Typical” Newborns by Multiple Birth and Gestational Age Category,* 2005–2006

As gestational age decreased, average hospital cost and length of stay increased. The average cost for multiples was consistently higher than for singletons for each gestational age category.

Multiple Birth Status by Preterm Status	Total	Typical Babies				Atypical Babies	
	No. Babies	No. Typical Babies	% Typical	Average Cost ($)	Average LOS (Days)	No. Atypical Babies	% Atypical
Singletons							
Full Term (≥37 Weeks)	**189,750**	**185,249**	**97.6**	**1,050**	**2.1**	**4,501**	**2.4**
Any Preterm (<37 Weeks)	**13,005**	**10,304**	**79.2**	**9,233**	**10.0**	**2,701**	**20.8**
Late Preterm (34–36 Weeks)	9,716	8,714	89.7	5,047	5.8	1,002	10.3
Moderate Preterm (32–33 Weeks)	1,428	987	69.1	19,463	21.2	441	30.9
Very Preterm (28–31 Weeks)	1,099	465	42.3	43,718	42.6	634	57.7
Extremely Preterm (<28 Weeks)	762	138	18.1	84,235	83.1	624	81.9
Total	**202,755**	**195,553**	**96.4**	**1,482**	**2.5**	**7,202**	**3.6**
Multiples							
Full Term (≥37 Weeks)	**2,742**	**2,625**	**95.7**	**1,871**	**3.5**	**117**	**4.3**
Any Preterm (<37 Weeks)	**3,623**	**2,569**	**70.9**	**12,479**	**13.8**	**1,054**	**29.1**
Late Preterm (34–36 Weeks)	2,370	2,035	85.9	6,494	8.0	335	14.1
Moderate Preterm (32–33 Weeks)	571	327	57.3	21,388	23.5	244	42.7
Very Preterm (28–31 Weeks)	418	159	38.0	47,318	46.0	259	62.0
Extremely Preterm (<28 Weeks)	264	48	18.2	90,123	91.0	216	81.8
Total	**6,365**	**5,194**	**81.6**	**7,118**	**8.6**	**1,171**	**18.4**

Notes

* This analysis was limited to live births discharged from an acute care facility located in provinces/territories where gestational age information was available on the newborn chart: Newfoundland and Labrador, Ontario, Manitoba, Saskatchewan, British Columbia and Nunavut. Only typical patients were included (that is, patients who received a course of treatment in a single institution and were discharged; excludes stillbirths, transfers and patients who stayed longer than the expected length of stay).

This analysis was limited to newborns with known gestational age, birth weight, length of stay and multiple birth status.

Sources

Discharge Abstract Database, 2005–2006, and Canadian MIS Database, 2005–2006, Canadian Institute for Health Information.

In 2005–2006, the average hospital cost for all SGA infants (which excludes multiple births) was $2,297—a figure which is approximately 1.6 times higher than the average hospital cost for non-SGA infants (Table 4). The poorer health outcomes and subsequent costs associated with SGA babies may vary depending on the underlying mechanism and timing of growth restriction onset. Babies who are growth restricted are at increased risk of fetal distress during labour[16, 181] and have higher rates of C-section deliveries and inductions of labour.[42] However, costs for these interventions were not captured since this analysis did not include maternal costs.

Table 4

Average Hospital Cost and Length of Stay (LOS) for "Typical" Singleton Newborns by Small-for-Gestational-Age (SGA) Status and Gestational Age Category,* 2005–2006

A newborn can be born both preterm and SGA. In this analysis (which excludes multiple births) SGA/preterm babies had almost twice the average hospital cost of normal-growth preterm newborns. This suggests that poor growth is an additional risk for poor neonatal outcomes beyond that caused by preterm birth.[182] The higher average cost observed for each gestational age category for SGA infants compared to non-SGA infants may be explained by the increased complexity and severity of the medical problems faced by SGA infants compared to those who had normal growth during pregnancy.[183]

SGA Status by Preterm Status	Total	Typical Babies				Atypical Babies	
	No. Babies	No. Typical Babies	% Typical	Average Cost ($)	Average LOS (Days)	No. Atypical Babies	% Atypical
Not SGA							
Full Term (≥37 Weeks)	**173,806**	**169,831**	**97.7**	**1,011**	**2.1**	**3,975**	**2.3**
Any Preterm (<37 Weeks)	**11,718**	**9,397**	**80.2**	**8,558**	**9.5**	**2,321**	**19.8**
Late Preterm (34–36 Weeks)	8,778	7,924	90.3	4,383	5.3	854	9.7
Moderate Preterm (32–33 Weeks)	1,307	912	69.8	18,571	20.3	395	30.2
Very Preterm (28–31 Weeks)	1,006	434	43.1	41,347	42.0	572	56.9
Extremely Preterm (<28 Weeks)	627	127	20.3	85,103	84.4	500	79.7
Total	**185,524**	**179,228**	**96.6**	**1,407**	**2.5**	**6,296**	**3.4**
SGA							
Full Term (≥37 Weeks)	**15,920**	**15,396**	**96.7**	**1,479**	**2.4**	**524**	**3.3**
Any Preterm (<37 Weeks)	**1,215**	**903**	**74.3**	**16,244**	**15.0**	**312**	**25.7**
Late Preterm (34–36 Weeks)	938	790	84.2	11,704	11.2	148	15.8
Moderate Preterm (32–33 Weeks)	120	75	62.5	30,309	31.7	45	37.5
Very Preterm (28–31 Weeks)	93	31	33.3	76,907	52.1	62	66.7
Extremely Preterm (<28 Weeks)	64	7	10.9	109,286	99.0	57	89.1
Total	**17,135**	**16,299**	**95.1**	**2,297**	**3.1**	**836**	**4.9**

Notes

* This analysis was limited to singleton live births discharged from an acute care facility located in provinces/territories where gestational age information was available on the newborn chart: Newfoundland and Labrador, Ontario, Manitoba, Saskatchewan, British Columbia and Nunavut. Only typical patients were included (that is, patients who received a course of treatment in a single institution and were discharged; excludes stillbirths, transfers and patients who stayed longer than the expected length of stay).

This analysis was limited to singleton newborns with known birth weight, length of stay and sex, with gestational age between 22 and 43 weeks.

Sources

Discharge Abstract Database, 2005–2006, and Canadian MIS Database, 2005–2006, Canadian Institute for Health Information.

In contrast to the comparison of SGA and non-SGA babies by gestational age category, non-SGA newborns had a higher average in-hospital cost in each birth weight category compared to SGA newborns (see Table 5; analyses exclude multiple births). This likely reflects the fact that a non-SGA baby is of low birth weight because it is born preterm, compared to an SGA baby who is of low birth weight but may, in fact, be born at full term. For example, in 2005–2006, almost all (96.9%) typical non-SGA babies who were LBW were born preterm, compared to only one-quarter (24.5%) of SGA babies. This suggests that birth weight and being born preterm are important determinants of hospital costs.

Table 5

Average Hospital Cost and Length of Stay (LOS) for "Typical" Singleton Newborns by Small-for-Gestational-Age (SGA) Status and Birth Weight Category,* 2005–2006

Typical non-SGA newborns have a higher average in-hospital cost in each birth weight category compared to SGA newborns. However, these non-SGA groups also represent a higher proportion of preterm births at each birth weight level. These data suggest that SGA status on its own—classified at the 10th percentile—is not a strong predictor of hospital resource use and that hospital costs are largely driven by low birth weight and preterm birth.

SGA Status by Birthweight	Total	Typical Babies					Atypical Babies	
	No. Babies	% Preterm Typical	No. Typical Babies	% Typical	Average Cost ($)	Average LOS (Days)	No. Atypical Babies	% Atypical
Not SGA								
≥2,500 g	**180,288**	**3.4**	**175,658**	**97.4**	**1,074**	**2.2**	**4,630**	**2.6**
<2,500 g	**5,236**	**96.9**	**3,570**	**68.2**	**17,791**	**18.0**	**1,666**	**31.8**
2,000–2,499 g	3,037	95.8	2,596	85.5	9,655	9.7	441	14.5
1,500–1,999 g	1,041	100.0	629	60.4	24,153	25.3	412	39.6
1,000–1,499 g	617	100.0	247	40.0	53,661	56.2	370	60.0
750–999 g	265	100.0	72	27.2	94,925	87.4	193	72.8
<750 g	276	100.0	26	9.4	121,817	116.5	250	90.6
Total	**185,524**	**5.2**	**179,228**	**96.6**	**1,407**	**2.5**	**6,296**	**3.4**
SGA								
≥2,500 g	**12,991**	**0.0**	**12,607**	**97.0**	**1,052**	**2.1**	**384**	**3.0**
<2,500 g	**4,144**	**24.5**	**3,692**	**89.1**	**6,550**	**6.5**	**452**	**10.9**
2,000–2,499 g	3,138	12.0	2,993	95.4	3,218	3.8	145	4.6
1,500–1,999 g	652	76.2	530	81.3	14,896	13.0	122	18.7
1,000–1,499 g	221	80.4	138	62.4	28,138	26.3	83	37.6
750–999 g	48	100.0	17	35.4	73,119	53.9	31	64.6
<750 g	85	92.9	14	16.5	109,258	79.6	71	83.5
Total	**17,135**	**5.5**	**16,299**	**95.1**	**2,297**	**3.1**	**836**	**4.9**

Notes

* This analysis was limited to singleton live births discharged from an acute care facility located in provinces/territories where gestational age information was available on the newborn chart: Newfoundland and Labrador, Ontario, Manitoba, Saskatchewan, British Columbia and Nunavut. Only typical patients were included (that is, patients who received a course of treatment in a single institution and were discharged; excludes stillbirths, transfers and patients who stayed longer than the expected length of stay).

This analysis was limited to singleton newborns with known birth weight, length of stay and sex, with gestational age between 22 and 43 weeks.

Sources

Discharge Abstract Database, 2005–2006, and Canadian MIS Database, 2005–2006, Canadian Institute for Health Information.

Hospital Cost Data at CIHI

CIHI collects information on hospital costs and other health expenditures in order to monitor health care spending.

The cost estimates provided in this report provide a snapshot of the hospital costs for typical preterm and SGA babies during the initial stay in the hospital where they were born. The financial information presented in these analyses was obtained from the Canadian MIS (Management Information Systems) Database (CMDB). This database contains financial and statistical information from hospitals across Canada. The patient groups used in the costing analysis come from CIHI's newly redeveloped case mix methodology, CMG+, which is used to aggregate acute care inpatients with similar clinical and resource utilization characteristics into Case Mix Groups (CMGs). These groups are then used to measure Resource Intensity Weights (RIWs), which are relative values that describe the expected resource consumption of the average patient within a CMG. Hospital spending is assigned using patient-specific RIWs and Cost per Weighted Case data, which are calculated and updated annually from the CMDB.

Two reports recently released by CIHI, *The Costs of Hospital Stays: Why Costs Vary* and *The Cost of Acute Care Hospital Stays by Medical Condition in Canada: 2004–2005*, demonstrate how particular patient groupings/case mix methodology (CMG+) can be used to determine relative costs in acute care inpatient hospitals. The costs associated with infant and maternal care were also examined previously. Using an earlier form of CIHI grouping methodology, *Giving Birth in Canada: The Costs* (released by CIHI in 2006) provided information on hospital costs as well as some of the physician and community costs associated with maternity and neonatal care.

For more information on the health spending databases maintained by CIHI and for a listing of other health spending reports, please refer to www.cihi.ca.

Chapter 4

Putting It All Together

The previous chapters demonstrated the importance of several factors in explaining the chances/odds of delivering a preterm or small-for-gestational-age (SGA) baby. However, many of these factors are related to one another. For example, older women are more likely to have a comorbid condition such as diabetes or hypertension when they give birth to a preterm or SGA baby—in this case we do not know if the increased association is due to older age or these medical conditions. These factors can have their own independent effect on the chances of having a preterm or SGA baby, but they can also influence each other's effect on perinatal outcomes. That is, the effect of one factor may differ after adjusting for the effect of the others. For these reasons, it is important to look at all these factors together, rather than in isolation.

To accomplish this, we conducted two separate analyses (using logistic regression models) to examine the chances of having either a preterm or an SGA baby. The set of factors that we investigated in these models was limited to those previously explored in this report. By exploring these factors, we determined their relative importance in explaining the odds or chance of delivering a preterm or SGA baby after taking all the other factors into consideration. It is important to note, however, that other factors not captured in CIHI's Discharge Abstract Database are also associated with the chances of giving birth to a preterm or SGA baby. For example, studies have shown that smoking, nutrition, ethnicity and the use of assisted reproductive technologies increase the likelihood of these outcomes.[14–16]

What Is an Odds Ratio?

An odds ratio indicates the strength of the association between a factor and an outcome[184]—for example, maternal hypertension and preterm birth. An odds ratio is also a way of comparing the likelihood of an outcome for multiple groups. For instance, let's take preterm birth as the outcome. Using singleton babies as the reference group, let's suppose the odds ratio for multiple birth babies is 1. This means that the outcome (for example, preterm birth) is equally likely for both a singleton baby as well as a multiple-birth baby. If the number is *greater than 1*, the outcome is *more likely* for multiples. If it is *less than 1*, multiples are *less likely* to experience the outcome in question.[184]

Our data show that when babies born to mothers with both hypertension and diabetes are compared to those without these conditions, the odds ratio for preterm birth is 5.9. This means that babies born to mothers with both of these conditions are, on average, about six times more likely to be born preterm compared with babies born to mothers without these conditions.

Confidence intervals tell us how precise the estimate is and help to determine whether differences between groups are statistically significant. A 95% confidence interval provides a range within which the true value falls 19 times out of 20. For example, the odds ratio for being born preterm was 1.4 for babies with three or more older siblings relative to those with only one or two older siblings. The 95% confidence interval associated with this odds ratio was 1.3 to 1.5. Because 1.0 is outside the confidence interval of 1.3 to 1.5, this association is statistically significant, based on our study sample.

What Matters Most

Figures 14 and 15 show the adjusted odds ratios for each factor in explaining the chances of giving birth to a preterm or SGA baby. In these figures, the circles show the odds ratios or estimated increases in odds relative to others—for example, babies of mothers age 35 or older relative to those age 20 to 34—taking into account the effect of other factors considered in the model. The odds ratios are estimated to be accurate to within the range indicated by the horizontal bars 19 times out of 20 (that is, the 95% confidence intervals).

Figure 14 shows that a multiple birth was the most important factor associated with preterm birth. All else being equal, multiples were almost 17 times more likely than singletons to be born preterm. Maternal hypertension and diabetes were the next most important factors, with pre-existing conditions more strongly associated with preterm delivery than conditions that occur for the first time during the pregnancy. Mothers with a previous preterm delivery were more than four times more likely to deliver another preterm baby. In addition to adjusting for provincial/territorial variation, other factors that were significantly associated with preterm births included maternal age (teenage and older mothers), parity (first-time mothers and high-parity women), socio-economic status (low neighbourhood income quintiles) and the sex of the baby (males).

Mode of delivery (Caesarean section, induction) was also significantly associated with a preterm delivery. However, it should be noted that the relationship between mode of delivery and preterm birth may actually reflect complications necessitating these interventions. For example, in Chapter 3 we noted that interventions performed before 37 weeks of gestation are most likely performed to improve health outcomes for the baby and the mother if there are observed complications with the pregnancy, such as hypertensive disorders, fetal growth restriction or compromise, and premature rupture of membranes. As such, although not explicitly included in the model, mode of delivery may also be representative of left-over hazards associated with unmeasured complications.

Neighbourhood income is also significantly associated with preterm birth. However, the effect of low neighbourhood income may have been stronger if maternal diabetes and hypertension, as well as maternal age (specifically, teenage mothers), had not been included in the model. This is because teenage mothers and maternal comorbid conditions are more prevalent in low-income neighbourhoods. Nonetheless, the odds ratios presented in this model illustrate the effect of low neighbourhood income, even after adjusting for these other aspects of low neighbourhood income (for example, maternal age and comorbidities).

Our analyses also found that babies born preterm were less likely to be born via induction. This may reflect the conditions under which a preterm birth occurs, as well as obstetrical practice. Our data suggest that inductions are not usually carried out before 37 weeks of gestation—when delivery is indicated prior to 37 weeks, Caesarean sections are more often performed. Although living in an urban or rural area was also associated with preterm birth, it had no impact on the likelihood of delivering a preterm baby when other factors were taken into consideration.

Figure 14

Factors Associated With Preterm Birth,* 2006–2007

Notes

* This analysis was limited to residents of Ontario, Manitoba, Saskatchewan, Alberta and the territories, as parity and previous preterm delivery information from other provinces was unavailable. Analyses were adjusted for all associated factors shown above, as well as province/territory of residence.

† This effect was determined by excluding first-time mothers and re-running the analyses with previous preterm delivery in the model.

This analysis was limited to live births discharged from an acute care facility that were linked to mothers in the Discharge Abstract Database with known gestational age and associated factor information.

Urban/rural area of living was removed due to non-significance in the model.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Figure 15 shows that, in general, the factors that we investigated had a smaller association with SGA births compared to preterm births. However, although the effect of these factors was small, many were statistically significant. For example, maternal hypertension was the most important factor associated with an SGA birth. All else being equal, babies whose mother had pre-existing hypertension were 1.8 times more likely to be SGA compared to babies born to mothers without hypertension or diabetes. This association was slightly smaller if the mother had gestational hypertension (odds ratio of 1.7). First-time mothers were 1.6 times more likely to give birth to an SGA baby compared to those who had previously delivered one or two babies. Babies born to mothers living in low-income neighbourhoods (quintile 1) were 1.5 times more likely to be SGA than babies born to mothers in the highest neighbourhood income quintile. Other factors that were significantly associated with an SGA birth were living in an urban area and having a delivery that required induction. As with the preterm birth model, care must be taken in interpreting the mode of delivery effect, as it may also represent unmeasured complications necessitating these medical interventions. In contrast to the results for the preterm birth model, mothers who had some form of diabetes were less likely to deliver an SGA baby. This may be because diabetes tends to increase fetal growth and is more likely to result in large rather than small babies.

Figure 15

Factors Associated With Small-for-Gestational-Age Birth,* 2006–2007

Notes

* This analysis was limited to residents of Ontario, Manitoba, Saskatchewan, Alberta and the territories, as parity information from other provinces was unavailable. Analyses were adjusted for all associated factors shown above, as well as province/territory of residence.

This analysis was limited to live singleton births discharged from an acute care facility that were linked to mothers in the Discharge Abstract Database with known birth weight, sex and associated factor information, with gestational age between 22 and 43 weeks.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

The factors investigated in this report were those available in CIHI's Discharge Abstract Database (DAD). Other potentially important factors such as ethnicity and smoking were not examined. The smaller odds ratios seen in the SGA analysis may indicate that DAD data contain factors that are more strongly associated with preterm births compared to SGA births. Furthermore, our analyses suggest that social factors are more significantly associated with SGA, given that neighbourhood income quintile and urban/rural residence have larger effects on the odds of an SGA birth compared to a preterm birth. Although we were not able to examine the independent impact of several important social factors, neighbourhood income may be a marker for some of these factors, such as poor living environments, smoking, alcohol and drug use, poor nutrition and poor access to prenatal care.[32, 55, 57–60] Conversely, biological factors appear to have more influence on preterm births, as shown by the higher odds ratios for multiple gestations, maternal comorbidities and maternal age.

While multiple births and maternal comorbidities were associated with the greatest chances/odds, it is important to note that multiple births only represent 3.0% of all births in Canada, while maternal hypertension occurs in 6.2% of births and maternal diabetes in 5.1%. In contrast, while the odds ratios associated with other factors may be small, these factors may be quite prevalent. For example, first-time mothers account for 44.7% of all births in Canada. Please refer to Appendix B for the provincial/territorial distributions of these factors.

Conclusion

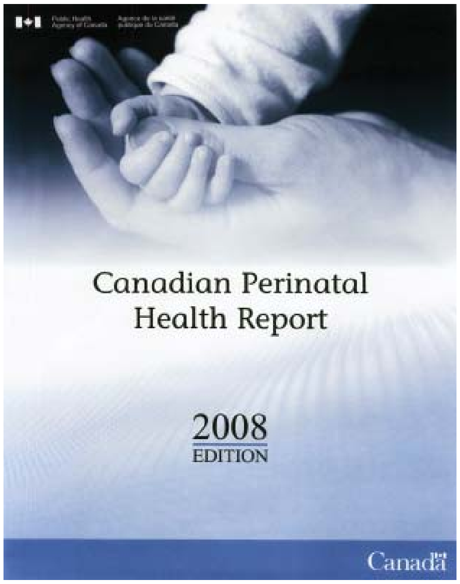
This report presents the pan-Canadian preterm birth and small-for-gestational-age (SGA) rates in 2006–2007, and shows how these rates varied by province/territory. In that period, approximately 8.1% of all discharged births from hospital were preterm and 8.3% were SGA—representing more than 54,000 births in Canada. We examined selected factors associated with preterm and SGA births, including the distribution of these factors across the country as well as their relationship with preterm and SGA births.

Although not an exhaustive list, we found that among the factors examined, multiple births and maternal hypertension and diabetes were the most important factors associated with preterm birth. As well, we found that maternal hypertension, parity (specifically, first-time mothers) and low neighbourhood income were the most important factors in predicting an SGA birth. Biological factors such as multiple gestations, maternal comorbidities and maternal age played a greater role in preterm birth compared to SGA births, while social factors such as neighbourhood income quintile and urban/rural residence were more highly associated with SGA births. Other important factors associated with these birth outcomes included previous preterm deliveries and mode of delivery (Caesarean sections, inductions), which may actually be a marker for the complications that necessitated medical intervention. While the magnitude of the odds ratio is important to consider, it is equally important to consider the prevalence of these factors among all births. For example, while multiple births accounted for only 3% of all births, first-born babies made up almost half of all births and older mothers (35 years and older) made up almost one-fifth of all births, indicating that these latter factors may be equally important.

The average costs incurred in the hospital in which a baby was born varied according to birth weight, multiple birth status and gestational age. In general, the average cost and length of stay increased sharply as birth weight decreased, and multiple-birth babies cost more than singletons. Babies who were born preterm and/or SGA incurred more costs than babies who were neither. In general, birth weight and gestational age were found to be important determinants of in-hospital costs.

Preterm and SGA births are important to examine as they account for a high proportion of perinatal morbidity and mortality.[16, 24] A greater understanding of the factors and population characteristics related to preterm birth and SGA could help to reduce the risk of mortality and morbidity associated with these outcomes. It would also help to inform health care planning and decision-making in obstetrical practice. The recent increases in preterm birth rates were largely attributed to an increase in medically indicated early delivery and, to a lesser extent, increasing maternal age, the use of assisted reproductive technologies and multiple births.[14, 31, 35] Due to advances in obstetrical intervention and neonatal care,[30] the increase in preterm births was actually accompanied by a decline in perinatal mortality and serious neonatal morbidity.[50, 158, 159] Nevertheless, due to their increased mortality, morbidity and associated health care costs, preterm and SGA babies are an important dimension in the emerging picture of maternity and neonatal care across the country.

Further information on Canadian perinatal health indicators is available through the Canadian Perinatal Surveillance System (CPSS), which is part of Health Canada's initiative to strengthen national health surveillance capacity. The CPSS monitors and reports on perinatal health determinants and outcomes through an ongoing cycle of data collection and acquisition, expert analysis and interpretation, and communication. Recently, the CPSS released its *Canadian Perinatal Health Report 2008*, which includes information on 29 perinatal health indicators on determinants and outcomes of maternal, fetal and infant health. Statistics for each indicator consist mainly of temporal trends at the national level and provincial/territorial comparisons for the most recent year for which data are available. It can be downloaded free of charge from the following link: http://www.phac-aspc.gc.ca/publicat/2008/cphr-rspc.



What We Know

- In 2006–2007, the Canadian in-hospital preterm birth and SGA rates were approximately 8.1% and 8.3%, respectively, accounting for more than 54,000 live births combined.
- The degree to which preterm and SGA births are associated with maternal age, parity, diabetes, hypertension, previous preterm deliveries, Caesarean sections, inductions, neighbourhood income quintile, urban/rural residence and multiple births across Canada in 2006–2007 was examined in this report. The provincial/territorial distribution of these factors is presented in Appendix B.
- Among the associated factors available in CIHI's Discharge Abstract Database, biological factors such as multiple gestation, maternal hypertension and diabetes were most highly associated with preterm babies.
- Social factors such as neighbourhood income quintile and urban/rural status were more highly associated with SGA than with preterm births. However, biological factors such as maternal hypertension and being a first-time mother were also important.
- Birth weight and being born preterm were strong determinants of in-hospital costs—as birth weight and gestational age decreased, average in-hospital costs increased.

What We Don't Know

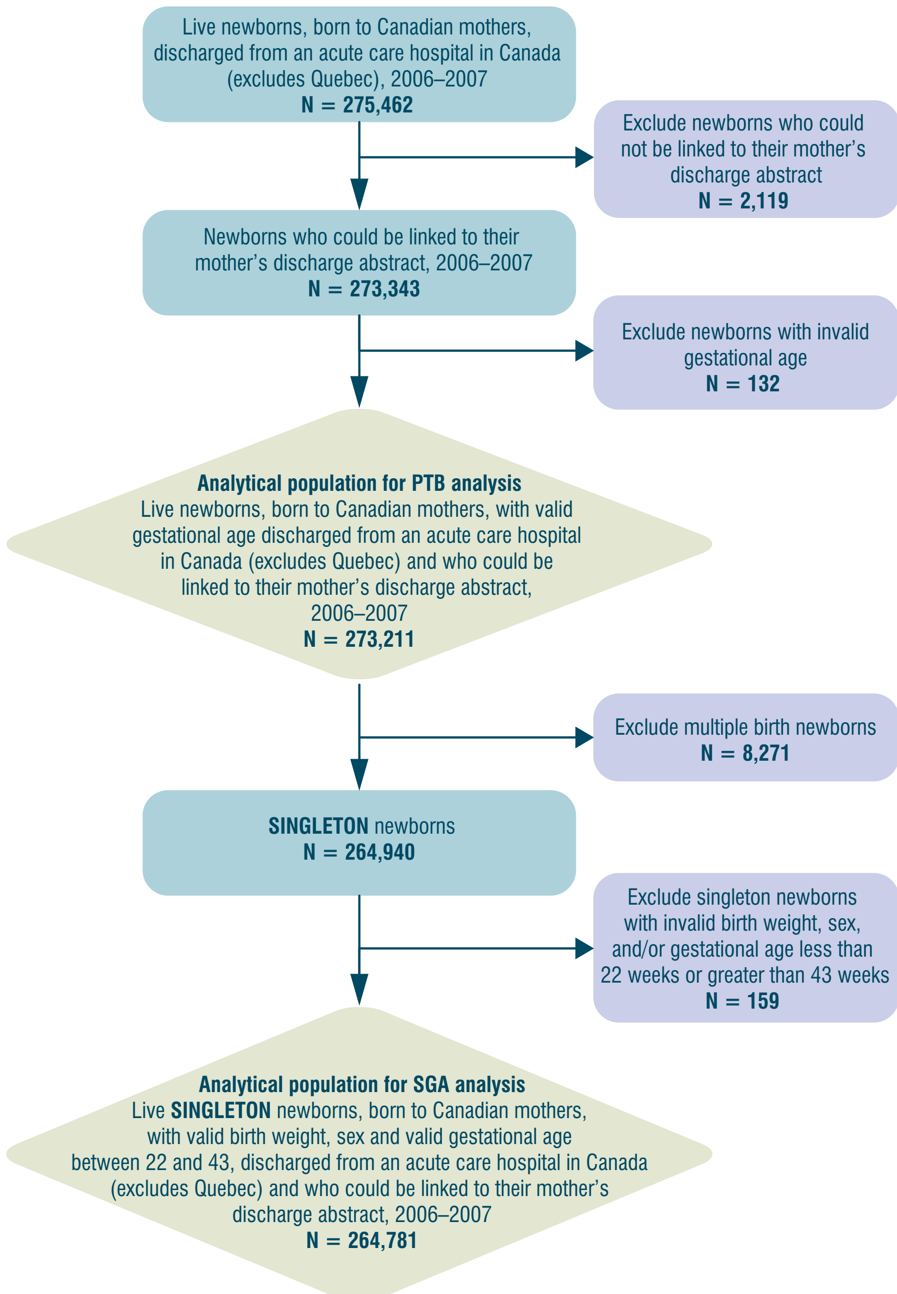
- What are the preterm and SGA rates among home births? What is the distribution and degree of association of the selected factors for home births?
- What proportion of women is induced before they are admitted to hospital? Where do these inductions occur (for example, physician's office)?
- What is the degree of association and distribution of other factors such as maternal nutrition, ethnicity, smoking and substance use, poor prenatal care and other maternal medical conditions not examined in this report on these birth outcomes?
- What is the degree of association of assisted reproductive technologies (ARTs) for preterm and SGA births? To what extent are ARTs being used across Canada?
- What are the total initial episode of care costs for preterm and SGA babies (for example, including transfers)? What are the long-term in-hospital and out-of-hospital costs of caring for these babies?
- Have increasing preterm birth rates led to an increase in short-term and long-term morbidity?

General Notes

- Data for all in-hospital-based indicators were obtained from CIHI's 2006–2007 Discharge Abstract Database (DAD). All provinces and territories submit data to the DAD except for Quebec, which submits data to CIHI's Hospital Morbidity Database (HMDB). Quebec data for 2006–2007 were unavailable for inclusion in this publication and are excluded from all but the 2006–2007 PTB, SGA and LBW Canadian rates. For these statistics, Quebec data from Statistics Canada's Canadian Vital Statistics System were included to provide national estimates.
- The in-hospital cost information presented in this report was derived from DAD and the Canadian MIS Database (CMDB) for fiscal year 2005–2006. It is important to note that the results presented here reflect only the hospital costs among newborns who received treatment in the hospital in which they were born and discharged. As such, the estimates provided do not reflect the total costs for newborn care.
- In-hospital birth statistics are presented based on patients' places of residence, which may differ from the place of hospitalization. The Postal Code Conversion File plus (PCCF+)[17] from Statistics Canada was used to assign patients with a current postal code to their province/territory of residence and to assign urban/rural status and socio-economic status information using the 2001 census. Alternate methods were used to assign patients with a retired or incomplete postal code to their place of residence.
- All provinces and territories submitting to the DAD in 2006–2007 use the enhanced Canadian version of the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada (ICD-10-CA) and Canadian Classification of Health Interventions (CCI). Indicator definitions were based on these systems of coding diagnoses and interventions.
- Analyses of the in-hospital birth statistics and logistic regression models were based on a population of live newborns who were discharged from an acute care hospital and who could be linked to their mothers' abstracts in the DAD. Therefore, the unit of analysis in this report was babies, not mothers. Stillbirths were excluded from all analyses in this report. The small-for-gestational-age (SGA) analysis was limited to singleton babies only, since the standard to classify babies as SGA does not include multiple births. Where there was evidence of rate instability or small numbers, data were suppressed.

- It is important to note that the methodology used was developed specifically for this report, which had the objective of examining the relationship between selected factors and the occurrence of preterm and SGA babies. For this reason, the results presented in this report may differ from other CIHI publications that may have a different focus and/or use a different methodology.
- Please refer to the Technical Notes, which can be found online accompanying the electronic version of this report at www.cihi.ca, for diagnosis and procedure codes used to extract the data and detailed definitions.

Appendix A: Analytic Population for Preterm and Small-for-Gestational-Age Analyses



Source
Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Appendix B: Distribution of Factors by Province/Territory

Proportion of In-Hospital Births by Neighbourhood Income Quintile in Canada,* 2006–2007

Province/ Territory	Quintile 1 (Lowest)		Quintile 2		Quintile 3		Quintile 4		Quintile 5 (Highest)	
	Rate (%)	95% CI	Rate (%)	95% CI	Rate (%)	95% CI	Rate (%)	95% CI	Rate (%)	95% CI
N.L.	21.0	(19.8–22.3)	19.5	(18.3–20.7)	18.6	(17.4–19.8)	20.2	(19.0–21.5)	20.7	(19.4–21.9)
P.E.I.	23.2	(20.9–25.4)	19.5	(17.4–21.6)	18.0	(16.0–20.0)	20.0	(17.9–22.1)	19.4	(17.3–21.5)
N.S.	21.4	(20.5–22.2)	20.0	(19.1–20.9)	19.1	(18.2–19.9)	19.9	(19.1–20.8)	19.6	(18.8–20.5)
N.B.	20.1	(19.1–21.0)	19.5	(18.6–20.5)	19.6	(18.6–20.5)	20.0	(19.1–21.0)	20.8	(19.8–21.8)
Ont.	20.6	(20.4–20.9)	19.3	(19.1–19.5)	19.6	(19.4–19.8)	21.9	(21.7–22.1)	18.6	(18.4–18.8)
Man.	31.2	(30.4–32.0)	18.6	(17.9–19.2)	17.7	(17.0–18.3)	16.8	(16.2–17.4)	15.8	(15.2–16.4)
Sask.	29.4	(28.6–30.3)	19.9	(19.2–20.7)	18.0	(17.3–18.7)	16.3	(15.6–17.0)	16.3	(15.6–17.0)
Alta.	20.7	(20.4–21.1)	19.8	(19.4–20.2)	20.0	(19.6–20.4)	20.6	(20.2–20.9)	18.9	(18.5–19.3)
B.C.	21.5	(21.1–21.9)	21.3	(20.9–21.7)	20.0	(19.6–20.4)	20.3	(19.9–20.7)	16.9	(16.5–17.2)
Y.T.	18.4	(13.4–23.5)	21.9	(16.6–27.3)	26.3	(20.6–32.0)	15.8	(11.1–20.5)	17.5	(12.6–22.5)
N.W.T.	25.6	(22.3–28.9)	20.8	(17.7–23.9)	19.8	(16.7–22.8)	21.0	(17.9–24.0)	12.9	(10.3–15.4)
Nun.	25.9	(22.6–29.1)	20.7	(17.7–23.7)	19.3	(16.4–22.2)	14.1	(11.5–16.6)	20.0	(17.1–23.0)
Canada*	**21.8**	**(21.6–21.9)**	**19.7**	**(19.6–19.9)**	**19.5**	**(19.4–19.7)**	**20.8**	**(20.6–20.9)**	**18.2**	**(18.1–18.4)**

Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication and were excluded from the 2006–2007 Canadian rate.

This analysis was limited to live births discharged from an acute care facility with known gestational age that could be linked to the mothers' abstracts, where the mothers were assigned to a neighbourhood income quintile.

Income data were based on the 2001 census from Statistics Canada, as 2006 census income data were not available at the time of analysis. More details are provided in the accompanying Technical Notes at www.cihi.ca.

Results are presented for the mothers' place of residence, rather than the location of the facility where hospitalization occurred.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Proportion of In-Hospital Births by Urban/Rural Place of Residence in Canada,* 2006–2007

Province/ Territory	Urban		Rural	
	Rate (%)	95% CI	Rate (%)	95% CI
N.L.	57.6	(56.1–59.0)	42.4	(41.0–43.9)
P.E.I.	58.8	(56.2–61.4)	41.2	(38.6–43.8)
N.S.	67.9	(66.9–68.9)	32.1	(31.1–33.1)
N.B.	57.6	(56.5–58.8)	42.4	(41.2–43.5)
Ont.	89.6	(89.5–89.8)	10.4	(10.2–10.5)
Man.	61.1	(60.3–61.9)	38.9	(38.1–39.7)
Sask.	59.3	(58.4–60.2)	40.7	(39.8–41.6)
Alta.	76.2	(75.8–76.6)	23.8	(23.4–24.2)
B.C.	87.9	(87.6–88.2)	12.1	(11.8–12.4)
Y.T.	77.6	(73.1–82.1)	22.4	(17.9–26.9)
N.W.T.	43.1	(39.5–46.7)	56.9	(53.3–60.5)
Nun.	†	†	100.0	(100.0–100.0)
Canada*	**81.7**	**(81.6–81.9)**	**18.3**	**(18.1–18.4)**

Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication and were excluded from the 2006–2007 Canadian rate.

† All Nunavut residents were assigned to rural status.

This analysis was limited to live births discharged from an acute care facility with known gestational age that could be linked to the mothers' abstracts, where the mothers were assigned to an urban/rural residence. More details are provided in the accompanying Technical Notes at www.cihi.ca.

Results are presented for the mothers' place of residence, rather than the location of the facility where hospitalization occurred.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Proportion of In-Hospital Births by Maternal Age in Canada,* 2006–2007

Province/ Territory	<20 Years		20–34 Years		35+ Years	
	Rate (%)	95% CI	Rate (%)	95% CI	Rate (%)	95% CI
N.L.	5.3	(4.6–5.9)	80.5	(79.3–81.7)	14.2	(13.2–15.3)
P.E.I.	4.7	(3.6–5.8)	79.6	(77.5–81.7)	15.7	(13.8–17.6)
N.S.	5.8	(5.3–6.3)	79.1	(78.3–80.0)	15.1	(14.3–15.8)
N.B.	6.0	(5.4–6.5)	82.0	(81.1–82.9)	12.0	(11.2–12.8)
Ont.	3.7	(3.6–3.8)	75.7	(75.5–76.0)	20.5	(20.3–20.8)
Man.	9.1	(8.6–9.6)	77.5	(76.8–78.2)	13.4	(12.8–14.0)
Sask.	10.3	(9.8–10.9)	79.5	(78.8–80.2)	10.2	(9.6–10.7)
Alta.	5.2	(5.0–5.4)	79.9	(79.5–80.2)	14.9	(14.6–15.3)
B.C.	3.6	(3.5–3.8)	74.2	(73.8–74.6)	22.2	(21.8–22.6)
Y.T.	4.8	(2.5–7.1)	77.0	(72.5–81.5)	18.2	(14.1–22.3)
N.W.T.	11.2	(9.0–13.5)	74.6	(71.4–77.7)	14.2	(11.7–16.7)
Nun.	22.7	(19.7–25.8)	71.0	(67.8–74.3)	6.2	(4.5–8.0)
Canada*	**4.8**	**(4.7–4.8)**	**76.8**	**(76.6–77.0)**	**18.4**	**(18.3–18.6)**

Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication and were excluded from the 2006–2007 Canadian rate.

This analysis was limited to live births discharged from an acute care facility with known gestational age and associated factor information that could be linked to the mothers' abstracts. More details are provided in the accompanying Technical Notes at www.cihi.ca.

Results are presented for the mothers' place of residence, rather than the location of the facility where hospitalization occurred.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Proportion of In-Hospital Births by Multiple Birth Status in Canada,* 2006–2007

Province/ Territory	Singleton		Any Multiple		Twin	
	Rate (%)	95% CI	Rate (%)	95% CI	Rate (%)	95% CI
N.L.	97.3	(96.9–97.8)	2.7	(2.2–3.1)	2.5	(2.0–2.9)
P.E.I.	96.8	(95.9–97.7)	3.2	(2.3–4.1)	3.2	(2.3–4.1)
N.S.	97.2	(96.9–97.6)	2.8	(2.4–3.1)	2.7	(2.3–3.0)
N.B.	97.2	(96.9–97.6)	2.8	(2.4–3.1)	2.7	(2.4–3.1)
Ont.	96.9	(96.8–97.0)	3.1	(3.0–3.2)	3.0	(2.9–3.1)
Man.	97.3	(97.0–97.6)	2.7	(2.4–3.0)	2.6	(2.3–2.8)
Sask.	97.4	(97.1–97.6)	2.6	(2.4–2.9)	2.6	(2.3–2.9)
Alta.	96.9	(96.8–97.1)	3.1	(2.9–3.2)	3.0	(2.9–3.2)
B.C.	96.9	(96.7–97.1)	3.1	(2.9–3.3)	3.0	(2.9–3.2)
Y.T.	97.0	(95.2–98.8)	3.0	(1.2–4.8)	3.0	(1.2–4.8)
N.W.T.	98.4	(97.5–99.3)	1.6	(0.7–2.5)	1.6	(0.7–2.5)
Nun.	98.1	(97.1–99.1)	1.9	(0.9–2.9)	1.9	(0.9–2.9)
Canada*	**97.0**	**(96.9–97.0)**	**3.0**	**(3.0–3.1)**	**2.9**	**(2.9–3.0)**

Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication and were excluded from the 2006–2007 Canadian rate.

This analysis was limited to live births discharged from an acute care facility with known gestational age and associated factor information that could be linked to the mothers' abstracts. More details are provided in the accompanying Technical Notes at www.cihi.ca.

Results are presented for the mothers' place of residence, rather than the location of the facility where hospitalization occurred.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Proportion of In-Hospital Births by Parity and Previous Preterm Delivery Status in Canada,* 2006–2007

Province/ Territory	Parity 0		Parity 1 or 2		Parity 3+		Previous Preterm Delivery	
	Rate (%)	95% CI	Rate (%)	95% CI	Rate (%)	95% CI	Rate (%)	95% CI
N.L.	Not Available							
P.E.I.	Not Available							
N.S.	Not Available							
N.B.	Not Available							
Ont.	45.7	(45.4–46.0)	48.4	(48.2–48.7)	5.9	(5.8–6.0)	6.8	(6.6–7.0)
Man.	40.4	(39.6–41.2)	45.7	(44.9–46.6)	13.8	(13.3–14.4)	8.8	(8.2–9.4)
Sask.	39.7	(38.9–40.6)	47.5	(46.6–48.4)	12.8	(12.2–13.3)	9.7	(9.0–10.3)
Alta.	44.5	(44.0–45.0)	47.3	(46.8–47.7)	8.2	(8.0–8.5)	9.2	(8.9–9.6)
B.C.	Not Available							
Y.T.	46.2	(40.9–51.6)	45.9	(40.6–51.3)	7.8	(4.9–10.7)	6.6	(3.0–10.3)
N.W.T.	38.9	(35.4–42.5)	45.8	(42.2–49.5)	15.2	(12.6–17.9)	9.5	(6.8–12.3)
Nun.	31.3	(27.9–34.7)	39.7	(36.2–43.3)	29.0	(25.7–32.3)	21.0	(17.5–24.6)
Canada*	**44.7**	**(44.4–44.9)**	**47.9**	**(47.7–48.1)**	**7.4**	**(7.3–7.6)**	**7.7**	**(7.6–7.9)**

Notes

* This analysis was limited to residents of Ontario, Manitoba, Saskatchewan, Alberta and the territories, as parity and previous preterm delivery information from other provinces was unavailable.

This analysis was limited to live births discharged from an acute care facility with known gestational age and associated factor information that could be linked to the mothers' abstracts. More details are provided in the accompanying Technical Notes at www.cihi.ca.

Results are presented for the mothers' place of residence, rather than the location of the facility where hospitalization occurred.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Proportion of In-Hospital Births by Maternal Diabetes Status in Canada,* 2006–2007

Province/ Territory	Any Diabetes‡		Pre-Existing Diabetes		Gestational Diabetes	
	Rate (%)	95% CI	Rate (%)	95% CI	Rate (%)	95% CI
N.L.	4.2	(3.6–4.8)	0.8	(0.5–1.1)	3.4	(2.9–3.9)
P.E.I.	2.4	(1.6–3.2)	†	†	1.8	(1.1–2.4)
N.S.	4.6	(4.2–5.1)	0.7	(0.6–0.9)	3.9	(3.5–4.3)
N.B.	4.3	(3.8–4.7)	0.7	(0.5–0.9)	3.6	(3.1–4.0)
Ont.	4.9	(4.8–5.0)	0.6	(0.6–0.7)	4.3	(4.2–4.4)
Man.	4.2	(3.9–4.5)	1.1	(0.9–1.2)	3.1	(2.9–3.4)
Sask.	4.1	(3.8–4.5)	0.8	(0.7–1.0)	3.3	(3.0–3.6)
Alta.	4.4	(4.2–4.6)	0.5	(0.5–0.6)	3.9	(3.7–4.0)
B.C.	7.6	(7.3–7.8)	0.4	(0.3–0.5)	7.1	(6.9–7.4)
Y.T.	4.8	(2.5–7.1)	†	†	4.5	(2.3–6.7)
N.W.T.	2.7	(1.5–3.9)	†	†	2.3	(1.2–3.4)
Nun.	0.9	(0.2–1.6)	†	†	0.8	(0.2–1.5)
Canada*	**5.1**	**(5.0–5.2)**	**0.6**	**(0.6–0.7)**	**4.5**	**(4.4–4.6)**

Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication and were excluded from the 2006–2007 Canadian rate.

† Data were suppressed due to rate instability.

‡ The any diabetes rate includes records with unspecified diabetes in addition to those with pre-existing and gestational diabetes.

This analysis was limited to live births discharged from an acute care facility with known gestational age and associated factor information that could be linked to the mothers' abstracts. More details are provided in the accompanying Technical Notes at www.cihi.ca.

Results are presented for the mothers' place of residence, rather than the location of the facility where hospitalization occurred.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Proportion of In-Hospital Births by Maternal Hypertension (HTN) Status in Canada,* 2006–2007

Province/ Territory	Any HTN‡		Pre-Existing HTN		Gestational HTN	
	Rate (%)	95% CI	Rate (%)	95% CI	Rate (%)	95% CI
N.L.	9.0	(8.2–9.9)	1.0	(0.7–1.3)	7.8	(7.0–8.6)
P.E.I.	7.2	(5.9–8.6)	†	†	6.5	(5.2–7.7)
N.S.	8.3	(7.7–8.9)	1.3	(1.0–1.5)	6.8	(6.3–7.3)
N.B.	8.1	(7.5–8.8)	1.0	(0.8–1.2)	6.9	(6.3–7.5)
Ont.	5.7	(5.6–5.9)	0.5	(0.5–0.5)	5.0	(4.9–5.1)
Man.	6.2	(5.8–6.6)	0.5	(0.4–0.6)	5.5	(5.1–5.9)
Sask.	5.6	(5.2–6.0)	0.4	(0.3–0.5)	4.9	(4.6–5.3)
Alta.	6.6	(6.4–6.8)	0.4	(0.4–0.5)	6.0	(5.8–6.2)
B.C.	6.0	(5.8–6.2)	0.7	(0.6–0.7)	5.0	(4.8–5.2)
Y.T.	6.3	(3.7–8.9)	†	†	6.0	(3.4–8.5)
N.W.T.	6.6	(4.8–8.4)	†	†	5.4	(3.8–7.0)
Nun.	7.7	(5.8–9.6)	†	†	6.5	(4.7–8.3)
Canada*	**6.2**	**(6.1–6.3)**	**0.6**	**(0.5–0.6)**	**5.4**	**(5.3–5.5)**

Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication and were excluded from the 2006–2007 Canadian rate.

† Data were suppressed due to rate instability.

‡ The any hypertension rate includes records with unspecified hypertension in addition to those with pre-existing and gestational hypertension.

This analysis was limited to live births discharged from an acute care facility with known gestational age and associated factor information that could be linked to the mothers' abstracts. More details are provided in the accompanying Technical Notes at www.cihi.ca.

Results are presented for the mothers' place of residence, rather than the location of the facility where hospitalization occurred.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Proportion of In-Hospital Births by Mode of Delivery Among Preterm Births in Canada,* 2006–2007

Province/ Territory	Non-Induced Vaginal		Caesarean Section Only		Any Induction	
	Rate (%)	95% CI	Rate (%)	95% CI	Rate (%)	95% CI
N.L.	44.9	(39.9–50.0)	38.2	(33.3–43.2)	16.8	(13.1–20.6)
P.E.I.	41.0	(31.4–50.6)	43.0	(33.3–52.7)	16.0	(8.8–23.2)
N.S.	46.3	(42.5–50.2)	33.5	(29.9–37.1)	20.2	(17.1–23.3)
N.B.	43.9	(39.4–48.3)	38.1	(33.8–42.4)	18.0	(14.6–21.4)
Ont.	45.9	(45.0–46.8)	39.6	(38.7–40.5)	14.5	(13.8–15.1)
Man.	45.9	(43.1–48.8)	32.9	(30.2–35.6)	21.2	(18.8–23.5)
Sask.	50.4	(47.2–53.6)	33.0	(30.0–36.0)	16.6	(14.2–18.9)
Alta.	42.3	(40.8–43.8)	37.4	(35.9–38.9)	20.3	(19.1–21.6)
B.C.	39.7	(38.0–41.5)	42.4	(40.7–44.1)	17.9	(16.5–19.2)
Y.T.	57.1	(38.8–75.5)	21.4	(6.2–36.6)	†	†
N.W.T.	34.0	(21.2–46.7)	41.5	(28.2–54.8)	†	†
Nun.	48.8	(37.8–59.7)	28.8	(18.8–38.7)	22.5	(13.3–31.7)
Canada*	**44.5**	**(43.8–45.1)**	**38.7**	**(38.1–39.3)**	**16.8**	**(16.3–17.3)**

Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication and were excluded from the 2006–2007 Canadian rate.

† Data were suppressed due to rate instability.

This analysis was limited to live births discharged from an acute care facility with known gestational age and associated factor information that could be linked to the mothers' abstracts. More details are provided in the accompanying Technical Notes at www.cihi.ca.

Results are presented for the mothers' place of residence, rather than the location of the facility where hospitalization occurred.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

Proportion of In-Hospital Births by Mode of Delivery Among Small-for-Gestational-Age Births in Canada,* 2006–2007

Province/ Territory	Non-Induced Vaginal		Caesarean Section Only		Any Induction	
	Rate (%)	95% CI	Rate (%)	95% CI	Rate (%)	95% CI
N.L.	47.4	(41.2–53.6)	27.3	(21.8–32.8)	25.3	(19.9–30.7)
P.E.I.	50.0	(39.9–60.1)	21.3	(13.0–29.6)	28.7	(19.6–37.9)
N.S.	52.2	(48.4–55.9)	21.2	(18.1–24.2)	26.7	(23.4–29.9)
N.B.	48.5	(44.5–52.6)	19.4	(16.2–22.6)	32.1	(28.3–35.9)
Ont.	56.0	(55.1–56.9)	22.3	(21.5–23.0)	21.7	(20.9–22.4)
Man.	62.6	(59.7–65.5)	18.8	(16.5–21.1)	18.6	(16.3–20.9)
Sask.	59.7	(56.4–63.0)	19.0	(16.4–21.7)	21.3	(18.5–24.1)
Alta.	51.6	(50.0–53.2)	21.2	(19.9–22.5)	27.2	(25.8–28.6)
B.C.	58.4	(56.7–60.2)	20.9	(19.5–22.4)	20.7	(19.2–22.1)
Y.T.	†	†	†	†	†	†
N.W.T.	75.6	(62.5–88.8)	†	†	†	†
Nun.	75.0	(62.8–87.3)	†	†	16.7	(6.1–27.2)
Canada*	**55.7**	**(55.0–56.3)**	**21.5**	**(21.0–22.1)**	**22.8**	**(22.2–23.3)**

Notes

* Quebec data for 2006–2007 were unavailable for inclusion in this publication and were excluded from the 2006–2007 Canadian rate.

† Data were suppressed due to rate instability.

This analysis was limited to live singleton births discharged from an acute care facility with known birth weight, sex and associated factor information, with a gestational age between 22 and 43 weeks, that could be linked to the mothers' abstracts. More details are provided in the accompanying Technical Notes at www.cihi.ca.

Results are presented for the mothers' place of residence, rather than the location of the facility where hospitalization occurred.

Source

Discharge Abstract Database, 2006–2007, Canadian Institute for Health Information.

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