

A photograph of a woman with long blonde hair kissing a baby on the cheek. The baby is smiling and looking towards the camera. The image is slightly faded to allow text to be overlaid.

# **Alberta Reproductive Health Pregnancies & Births**

**Table Update  
2011**

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## 1 Executive Summary

### Pregnancies

#### Estimated Pregnancies

- The estimated pregnancy rate in 2001 was 63.5 (per 1,000 women 15-49). From 2002 to 2008, the rate increased yearly, from 64.2 in 2001 to 75.2 in 2008. The rate declined slightly, to 74.6, in 2009 and then declined further to 72.4 in 2010. In 2010, there were an estimated 69,286 pregnancies in Albertan women.

#### Spontaneous Abortions

- In 2001, the spontaneous abortion rate (per 1,000 women 15-49) was 5.3; it remained steady at 5.6 from 2002 to 2004. In 2005, the rate increased to 6.0 and rose to 6.7 in 2009, stabilizing at 6.6 in 2010. These rates, as expected, mirror pregnancy rates.
- The spontaneous abortion rate (per 100 estimated pregnancies) was more stable from 2001 to 2010, but did reach a decade-high rate of 9.1 in 2010. This trend may reflect increasing maternal age, because spontaneous abortions are more frequent among older mothers.

#### Induced Abortions

- The induced abortion rate (per 1,000 women aged 15-49) was 13.0 in 2010, similar to the 2007 to 2009 rates but higher than earlier years in the decade. As with spontaneous abortions, these trends reflect increased fertility rates during those years.
- Rates of induced abortion (per 100 estimated pregnancies) were lower in the second half of the decade than in the first half. In 2010, there were 18.1 induced abortions for every 100 estimated pregnancies in Alberta, compared with 19.5 in 2001.

### Deliveries

- The induction of labour rate peaked at 29.7 (per 100 deliveries) in 2003. In 2009, 27.2 out of every 100 hospital deliveries in Alberta involved labour induction. More than two thirds of these inductions were medical inductions; surgical or medical/surgical combined inductions were less common.
- The cesarean section rate was 27.8 (per 100 hospital deliveries) in 2009, representing 13,645 cesarean sections performed on Alberta mothers. The rate increased from 20.3 in 2000 to 27.7 in 2007, but was stable from 2007 to 2009.
- In 2009, 11.7 out of every 100 hospital deliveries involved vacuum extraction and 5.6 involved forceps extraction (5,722 and 2,766 hospital deliveries, respectively). These rates varied widely between regions.

### Maternal Age

- The average age of Albertan women giving birth in 2010 was 29.5 years, eight months older than the 2001 average of 28.8 years. The average was stable at 29.1 years from 2004 to 2007, and rose to 29.3 years in 2008. Average maternal age was highest in the two major centres (Calgary and Capital regions).

### Maternal Behaviours

- The 2008 maternal prenatal smoking rate was 17.2 (per 100 women delivering). In 2000, the rate was 23.5. This is a 27% decrease from 2000 to 2008. Rates vary widely across regions, with lowest maternal prenatal smoking rates in Calgary and Capital regions.

**Maternal Behaviours (continued)**

- Maternal prenatal alcohol consumption rates, on the other hand, showed an increasing trend, from 1.7 (per 100 women delivering) in 2001, to 2.6 in 2008. Rates were more than twice the provincial average in Chinook, David Thompson, and Peace Country regions.
- The high birth weight rate followed a similar trend, peaking at 12.9 (per 100 live births) in 2001, and decreasing to 10.4 in 2009, with stability from 2005 to 2008. There were 5,263 high birth weight babies born in Alberta in 2010, for a rate of 10.5.

**Births****Live Births**

- There were 50,185 live births in 2010, slightly lower than the highest number ever recorded in Alberta (51,057 in 2009).

**Fertility Rates**

- The general fertility rate (per 1,000 women 15-49) rose from 45.6 in 2001 to 55.0 in 2008, and declined slightly to 52.5 in 2010.
- The total fertility rate also peaked in 2008, at 1,931 (per 1,000 women 15-49); this rate was 1,783 in 2010. This represents an estimate of about 1.8 liveborn children on average per Albertan woman during her lifetime, up from about 1.7 in 2001.

**Birth Outcomes***Birth Weight*

- The small-for-gestational-age rate was 8.2 (per 100 live singleton births) in 2010, with 3,971 live singleton small-for-gestational-age babies born that year. Rates were higher between 2005 and 2010 than between 2001 and 2004.
- The 2010 low birth weight rate (per 100 live births) was 6.8 (3,412 low birth weight births). This rate increased from 6.1 in 2001, but was slightly lower than the 2006 peak of 7.0.
- The large-for-gestational-age rate decreased from 12.5 (per 100 live singleton births) in 2001 to 10.5 in 2009, with a period of stability from 2005 to 2008. In 2010, the rate was 10.6 (5,141 large-for-gestational-age births).

*Preterm Births*

- The preterm birth rate rose from a decade-low of 8.3 (per 100 live births) in 2001, to a peak of 9.1 2004 and 2005. The rate dipped to 8.4 in 2007 and increased to 8.7 (4,353 live preterm births) in 2010.

*Multiple Births*

- Almost all human births are singletons (one baby), but a small percentage of births are multiples (twins, triplets, etc.).
- There were 1,705 multiple live births in Alberta in 2010, for a rate of 3.4 (per 100 live births), up from 3.1 in 2001.

**Mortality***Stillbirths*

- The stillbirth rate was 7.1 (per 1,000 total births) in 2010. The stillbirth rate was lower between 2001 and 2003 than between 2004 and 2010.

*Neonatal Mortality*

- The neonatal mortality rate (per 1,000 live births) was 4.5 for 2001 to 2010 combined.

*Post-Neonatal Mortality*

- The post-neonatal mortality rate for 2001 to 2010 combined was 1.6 (per 1,000 live births).

*Infant Mortality*

- The infant mortality rate was 6.1 (per 1,000 live births) for 2001 to 2010 combined, representing 2,698 deaths of Albertan infants in that time period.

## 2 Introduction

Alberta Reproductive Health: Pregnancies and Births Table Update 2011 follows the Alberta Reproductive Health: Pregnancies and Births 2009 table update and the 2009 full report. This report is an update of selected indicators, based on data for the 10-year period from 2001 to 2010. Included are new Alberta data for 2010 for most indicators, and for both 2008 and 2009 for indicators from the Canadian Institute of Health Information Inpatient Files. New to this edition of the table update are estimated pregnancies data, spontaneous abortion data, maternal prenatal smoking and alcohol consumption data (up to 2008 only), and stillbirth data.

### Topic Areas

- Estimated pregnancies
- Spontaneous abortions
- Induced abortions
- Deliveries (labour inductions, cesarean sections, forceps deliveries, vacuum extractions)
- Maternal age
- Maternal prenatal behaviours (smoking, alcohol consumption)
- Live births
- Fertility rates
- Birth outcomes (birth weight categories, preterm birth, multiple births)
- Mortality (stillbirths, neonatal, post-neonatal, and infant deaths)

### Data Sources

- Vital Statistics Birth & Death Registration Files
- Canadian Institute of Health Information Inpatient Files
- Fee-for-Service Claims Files
- Alberta Health Care Insurance Plan Stakeholder Registration File
- Alberta Perinatal Health Program

### Methodology Notes

“Residence RHA” refers to the regional health authority in which the mother resided at the time of the relevant event. All analyses reflect December 2003 RHA boundaries, in effect until April 1, 2009, when the RHAs were replaced by Alberta Health Services. Provincial rates include Alberta residents with an ‘unknown’ RHA code. Only Alberta residents are included in analyses unless otherwise stated.

RHA 5 contains the city of Lloydminster, which is on the Alberta-Saskatchewan border. The hospital in Lloydminster is on the Saskatchewan side of the border, and births and services received at this hospital by Alberta residents are recorded in Saskatchewan’s administrative databases. These data are not included in this report. This means that a substantial portion (approximately one quarter) of births and services occurring to Alberta residents in RHA 5 are missing from the tables in this report. Interpretation of RHA 5 data should be carried out with caution. Of particular concern are measures in which the denominator is based on the population of RHA 5, rather than the number of births occurring in RHA 5. Even when the denominator is the number of births occurring in RHA 5, there is the opportunity for bias, as RHA 5 residents that have births at Lloydminster Hospital may be different from RHA 5 residents that have births within RHA 5.

Caution should always be exercised in interpreting rates based on small numbers. Data may have been combined across three-year periods (such as 2008 to 2010) in order to increase reliability of rates.

Populations used for the calculations of some rates are derived from the Alberta Health Care Insurance Plan Registration Files. Population figures used in calculations in this report are in Tables 20 and 21. All populations are by calendar year, and were based on mid-year estimates (June 30).

Beginning with April 2002 data, the coding system (for Hospital Inpatient Files and the Ambulatory Care Classification System files) for classification of diseases was the International Statistical Classification of Diseases and Related Health Problems Tenth Revision, Canada (ICD-10-CA) and the coding system for interventions was the Canadian Classification of Health Interventions (CCI). For data prior to April 2002, the International Classification of Disease – 9th Revision – Clinical Modification (ICD-9-CM)) codes were used for these databases (these codes are still used in the Fee-for-Service Claims files). Because the coding systems are different in the two time periods, there may be discrepancies between 2002 and later data and data for prior years. Comparisons of data coded with ICD-10-CA or CCI and those coded with ICD-9-CM should be undertaken with caution.

Reporting tends to improve with time, so time trends must be interpreted with caution for those datasets in which reporting variability is possible. There may also be regional differences in reporting and coding for those data that are acquired from the health regions.

There may be access issues that apply to more remote regions of the province, with some services being less available in those areas. Any known discrepancies in access should be taken into account when interpreting regional rates.

Population statistics cannot be applied to individuals. Not every member of a population will exhibit the characteristics that define the population.

Maternal prenatal smoking and alcohol consumption data were obtained from the Alberta Perinatal Health Program (APHP). There were small inaccuracies in previous extractions, which have been corrected here. Thus, the data reported here differ slightly from that reported in previous editions of this report. 2009 data were unavailable for both smoking and alcohol consumption, and 2001 data for alcohol consumption were excluded because they were incomplete.

In 2010, a review of extraction methodologies for some reproductive health indicators was undertaken. This review resulted in small adjustments to criteria used to extract indicators from the Fee-For-Service Claims files. The new criteria enable increased consistency in extraction across several indicators and across different branches of the Government of Alberta. Indicators affected include estimated pregnancies, induced abortions, spontaneous abortions, and deliveries (labour inductions, cesarean sections, forceps deliveries, vacuum extractions). Although the resulting changes in frequencies and rates are minimal, comparisons to previously published figures should be undertaken with this adjustment in mind. Appendix I contains details of codes used for data extraction.

Please refer to Alberta Reproductive Health: Pregnancies and Births Surveillance Report 2009 for definitions, descriptions of data sources, data limitations, further methodology notes, and background information on the data described here. The report can be found at <http://www.health.alberta.ca/documents/Reproductive-Health-2009.pdf>

Because of differences in definitions and dates of extracting data for analyses, the statistics in this report may not be the same as those previously published by Alberta Health and Wellness.

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Table 1 Selected Indicators for Pregnancies and Births, Alberta, 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Live Births	37,226	38,293	39,868	40,292	41,587	44,659	48,364	50,164	51,057	50,185
Estimated Pregnancy Rate (per 1,000 Women Age 15-49)	63.5	64.2	65.5	65.9	66.9	70.3	73.8	75.2	74.6	72.4
Spontaneous Abortion Rate (per 1,000 Women Age 15-49)	5.3	5.6	5.6	5.6	6.0	6.1	6.4	6.6	6.7	6.6
Spontaneous Abortion Rate (per 100 estimated pregnancies)	8.4	8.7	8.6	8.6	9.0	8.7	8.7	8.8	9.0	9.1
Induced Abortion Rate (per 1,000 Women Age 15-49)	12.3	12.3	12.2	12.4	11.8	12.6	13.0	13.2	13.2	13.0
Induced Abortion Rate (per 100 estimated pregnancies)	19.5	19.2	18.6	18.8	17.7	17.9	17.6	17.6	17.7	18.1
Total Labour Induction Rate <sup>1</sup> (per 100 Hospital Deliveries)	27.3	26.8	29.7	29.5	29.6	27.2	26.1	26.5	27.2	-
Cesarean Section Rate (per 100 Hospital Deliveries)	22.5	23.2	24.0	25.4	26.1	26.7	27.7	27.8	27.8	-
Mean Maternal Age at Delivery	28.8	28.9	29.0	29.1	29.1	29.1	29.1	29.3	29.3	29.5
Maternal Prenatal Smoking Rate (per 100 Women Delivering)	22.7	21.5	20.0	19.7	18.4	19.0	18.4	17.2	-	-
Maternal Prenatal Alcohol Consumption Rate (per 100 Women Delivering)	1.7	1.8	1.9	2.1	2.2	2.5	2.4	2.6	-	-
General Fertility Rate (per 1,000 Women Aged 15-49)	45.6	46.0	47.4	47.6	48.7	51.3	54.0	55.0	54.4	52.5
Total Fertility Rate (per 1,000 Women Aged 15-49)	1,670	1,687	1,736	1,740	1,777	1,855	1,923	1,931	1,872	1,783
Crude Birth Rate (per 1,000 Population)	12.3	12.4	12.7	12.7	12.9	13.5	14.2	14.4	14.1	13.5
Small for Gestational Age Rate (per 100 Live Singleton Births)	7.8	7.6	7.6	7.7	7.9	8.1	8.1	7.9	8.1	8.2
Low Birth Weight Rate (per 100 Live Births)	6.1	6.5	6.3	6.4	6.6	7.0	6.7	6.8	6.9	6.8
Large for Gestational Age Rate (per 100 Live Singleton Births)	12.5	12.1	11.9	11.9	11.1	11.1	11.0	11.0	10.5	10.6
High Birth Weight Rate (per 100 Live Births)	12.9	12.5	12.1	11.6	11.2	11.2	11.0	11.0	10.4	10.5
Preterm Birth Rate (per 100 Live Births)	8.3	8.6	8.8	9.1	9.1	8.9	8.4	8.6	8.8	8.7
Multiple Birth Rate (per 100 Live Births)	3.1	3.2	3.2	3.4	3.2	3.2	3.3	3.5	3.5	3.4
Stillbirth Rate (per 1,000 Total Births)	6.3	6.5	6.5	7.0	7.4	6.7	7.2	6.9	6.7	7.1
Neonatal Mortality Rate (per 1,000 Live Births)	3.9	5.2	4.9	4.4	5.0	4.0	4.6	4.6	4.2	4.5
Post-Neonatal Mortality Rate (per 1,000 Live Births)	1.7	2.0	1.8	1.3	1.7	1.6	1.4	1.7	1.3	1.4
Infant Mortality Rate (per 1,000 Live Births)	5.6	7.3	6.7	5.8	6.7	5.6	6.0	6.2	5.5	5.9

Sources: Vital Statistics, Birth and Death Files, Department of Government Services, April 2011 release.

Fee-for-Service Claims Files, Alberta Health and Wellness.

Canadian Institute of Health Information Inpatient Files, Alberta Health and Wellness.

Alberta Health Care Insurance Plan Registration File, Alberta Health and Wellness.

Alberta Perinatal Health Program, May 2010 release

Notes: 1. Labour inductions were under-reported from April 2002 to March 2003.

Data include Alberta residents only.

Data may differ from previously published data due to differences in definitions and dates of data extraction.



Table 2 Estimated Pregnancies and Rate by Year and Residence RHA, Alberta, 2001 to 2010

Estimated pregnancies	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	2,458	2,487	2,607	2,646	2,634	2,838	3,035	3,094	3,282	3,228
Palliser	1,587	1,617	1,650	1,662	1,770	1,808	2,062	1,989	2,098	1,907
Calgary	19,058	19,675	20,670	20,863	21,616	22,939	24,767	25,822	26,066	25,825
David Thompson	4,622	4,801	4,904	5,025	5,048	5,493	5,819	6,056	5,996	5,833
East Central	1,175	1,305	1,187	1,278	1,252	1,344	1,427	1,506	1,550	1,436
Capital	15,893	16,240	16,662	16,951	17,074	18,457	20,173	21,039	21,847	21,824
Aspen	3,090	3,172	3,135	3,120	3,137	3,404	3,564	3,634	3,739	3,731
Peace Country	2,425	2,485	2,581	2,620	2,785	2,979	3,075	3,171	3,178	3,129
Northern Lights	1,519	1,623	1,631	1,665	1,821	1,903	2,153	2,241	2,301	2,348
<b>Alberta</b>	<b>51,850</b>	<b>53,427</b>	<b>55,065</b>	<b>55,859</b>	<b>57,152</b>	<b>61,187</b>	<b>66,101</b>	<b>68,576</b>	<b>70,086</b>	<b>69,286</b>

Rate (per 1,000 women 15-49)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	65.6	66.4	69.4	70.3	70.0	75.0	78.7	79.0	82.1	79.3
Palliser	64.7	65.0	66.5	66.5	70.3	71.5	79.9	76.3	79.6	71.2
Calgary	63.2	63.5	65.8	65.6	67.0	69.4	72.8	74.2	72.5	70.4
David Thompson	64.4	65.8	66.7	67.8	67.7	72.7	75.0	77.1	75.2	72.5
East Central	45.0	49.5	45.1	48.8	47.8	51.4	53.3	55.6	56.6	52.2
Capital	61.8	62.1	63.0	63.8	63.8	67.9	71.9	73.6	74.0	72.4
Aspen	69.0	70.3	70.0	70.1	70.8	76.5	78.8	79.6	80.6	79.8
Peace Country	71.1	71.9	74.4	74.8	78.8	82.2	82.4	83.5	81.6	79.3
Northern Lights	83.0	84.3	81.4	80.8	86.4	88.3	94.4	93.7	90.6	88.0
<b>Alberta</b>	<b>63.5</b>	<b>64.2</b>	<b>65.5</b>	<b>65.9</b>	<b>66.9</b>	<b>70.3</b>	<b>73.8</b>	<b>75.2</b>	<b>74.6</b>	<b>72.4</b>

Source: Vital Statistics, Birth and Stillbirth Files, Service Alberta, April 2011 release.

Fee-for-Services Claims Files, Alberta Health and Wellness.

Alberta Health Care Insurance Plan Registration File, Alberta Health and Wellness.

Notes: Data include Alberta residents only.

Totals for age groups and RHAs include unknown ages or RHAs.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 3 Spontaneous Abortions and Rate by Year and Residence RHA, Alberta, 2001 to 2010

<b>Spontaneous abortions</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
Chinook	209	232	231	253	254	294	311	279	302	339
Palliser	142	157	170	169	199	184	199	212	230	199
Calgary	1,535	1,675	1,865	1,816	1,912	1,995	2,115	2,180	2,071	2,039
David Thompson	408	413	390	407	438	401	470	502	488	499
East Central	119	130	118	143	162	151	163	210	167	181
Capital	1,317	1,313	1,312	1,318	1,390	1,482	1,682	1,779	2,123	2,082
Aspen	262	297	260	250	248	297	299	318	344	375
Peace Country	211	250	241	277	328	301	277	292	326	319
Northern Lights	117	161	121	137	199	187	236	229	232	231
<b>Alberta</b>	<b>4,324</b>	<b>4,631</b>	<b>4,719</b>	<b>4,780</b>	<b>5,135</b>	<b>5,301</b>	<b>5,763</b>	<b>6,006</b>	<b>6,291</b>	<b>6,273</b>

<b>Rate (per 1,000 women 15-49)</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
Chinook	5.6	6.2	6.2	6.7	6.8	7.8	8.1	7.1	7.6	8.3
Palliser	5.8	6.3	6.8	6.8	7.9	7.3	7.7	8.1	8.7	7.4
Calgary	5.1	5.4	5.9	5.7	5.9	6.0	6.2	6.3	5.8	5.6
David Thompson	5.7	5.7	5.3	5.5	5.9	5.3	6.1	6.4	6.1	6.2
East Central	4.6	4.9	4.5	5.5	6.2	5.8	6.1	7.7	6.1	6.6
Capital	5.1	5.0	5.0	5.0	5.2	5.5	6.0	6.2	7.2	6.9
Aspen	5.9	6.6	5.8	5.6	5.6	6.7	6.6	7.0	7.4	8.0
Peace Country	6.2	7.2	6.9	7.9	9.3	8.3	7.4	7.7	8.4	8.1
Northern Lights	6.4	8.4	6.0	6.6	9.4	8.7	10.3	9.6	9.1	8.7
<b>Alberta</b>	<b>5.3</b>	<b>5.6</b>	<b>5.6</b>	<b>5.6</b>	<b>6.0</b>	<b>6.1</b>	<b>6.4</b>	<b>6.6</b>	<b>6.7</b>	<b>6.6</b>

<b>Rate (per 100 estimated pregnancies)</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
Chinook	8.5	9.3	8.9	9.6	9.7	10.4	10.3	9.0	9.2	10.5
Palliser	9.0	9.7	10.3	10.2	11.3	10.2	9.7	10.7	11.0	10.5
Calgary	8.1	8.5	9.0	8.7	8.9	8.7	8.6	8.5	8.0	7.9
David Thompson	8.8	8.6	8.0	8.1	8.7	7.3	8.1	8.3	8.2	8.6
East Central	10.2	10.0	9.9	11.2	13.0	11.2	11.5	14.0	10.8	12.6
Capital	8.3	8.1	7.9	7.8	8.2	8.0	8.4	8.5	9.8	9.6
Aspen	8.5	9.4	8.3	8.0	7.9	8.7	8.4	8.8	9.2	10.1
Peace Country	8.7	10.1	9.4	10.6	11.8	10.1	9.0	9.2	10.3	10.3
Northern Lights	7.7	9.9	7.4	8.3	11.0	9.8	11.0	10.2	10.1	9.9
<b>Alberta</b>	<b>8.4</b>	<b>8.7</b>	<b>8.6</b>	<b>8.6</b>	<b>9.0</b>	<b>8.7</b>	<b>8.7</b>	<b>8.8</b>	<b>9.0</b>	<b>9.1</b>

**Sources:** Vital Statistics, Birth File, Service Alberta, April 2011 release.  
Vital Statistics, Stillbirth File, Service Alberta, April 2011 release.  
Fee-for-Services Claims Files, Alberta Health and Wellness.  
Alberta Health Care Insurance Plan Registration File, Alberta Health and Wellness.

**Notes:** Totals for RHAs include unknown RHAs.  
Data include Alberta residents only.  
Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 4 Induced Abortions and Rates by Year and Residence RHA, Alberta, 2001 to 2010

Induced abortions	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	278	276	269	330	261	293	287	309	297	325
Palliser	207	225	218	209	209	248	268	244	262	237
Calgary	4,334	4,332	4,238	4,329	4,152	4,496	4,822	4,897	5,109	5,181
David Thompson	706	747	763	799	755	808	832	909	937	855
East Central	167	192	165	176	160	198	211	210	203	221
Capital	3,457	3,553	3,569	3,642	3,497	3,746	3,973	4,276	4,350	4,327
Aspen	411	455	473	456	482	507	541	522	535	572
Peace Country	292	301	293	370	368	368	405	404	384	428
Northern Lights	200	156	205	174	227	251	271	272	297	309
<b>Alberta</b>	<b>10,065</b>	<b>10,254</b>	<b>10,218</b>	<b>10,501</b>	<b>10,121</b>	<b>10,928</b>	<b>11,625</b>	<b>12,058</b>	<b>12,395</b>	<b>12,471</b>

Rate (per 1,000 women 15-49)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	7.4	7.4	7.2	8.8	6.9	7.7	7.4	7.9	7.4	8.0
Palliser	8.4	9.0	8.8	8.4	8.3	9.8	10.4	9.4	9.9	8.8
Calgary	14.4	14.0	13.5	13.6	12.9	13.6	14.2	14.1	14.2	14.1
David Thompson	9.8	10.2	10.4	10.8	10.1	10.7	10.7	11.6	11.7	10.6
East Central	6.4	7.3	6.3	6.7	6.1	7.6	7.9	7.7	7.4	8.0
Capital	13.5	13.6	13.5	13.7	13.1	13.8	14.2	14.9	14.7	14.4
Aspen	9.2	10.1	10.6	10.2	10.9	11.4	12.0	11.4	11.5	12.2
Peace Country	8.6	8.7	8.4	10.6	10.4	10.2	10.8	10.6	9.9	10.8
Northern Lights	10.9	8.1	10.2	8.4	10.8	11.6	11.9	11.4	11.7	11.6
<b>Alberta</b>	<b>12.3</b>	<b>12.3</b>	<b>12.2</b>	<b>12.4</b>	<b>11.8</b>	<b>12.6</b>	<b>13.0</b>	<b>13.2</b>	<b>13.2</b>	<b>13.0</b>

Rate (per 100 estimated pregnancies)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	11.3	11.1	10.3	12.5	9.9	10.3	9.5	10.0	9.1	10.1
Palliser	13.1	13.9	13.2	12.6	11.8	13.8	13.0	12.3	12.5	12.5
Calgary	22.8	22.1	20.5	20.8	19.2	19.6	19.5	19.0	19.7	20.1
David Thompson	15.3	15.6	15.6	15.9	15.0	14.7	14.3	15.0	15.7	14.7
East Central	14.2	14.8	13.9	13.8	12.8	14.7	14.8	14.0	13.2	15.4
Capital	21.8	21.9	21.5	21.5	20.5	20.3	19.7	20.4	20.0	19.9
Aspen	13.3	14.4	15.1	14.6	15.4	14.9	15.2	14.4	14.4	15.4
Peace Country	12.1	12.1	11.4	14.1	13.2	12.4	13.2	12.8	12.1	13.8
Northern Lights	13.2	9.6	12.6	10.5	12.5	13.2	12.6	12.2	12.9	13.2
<b>Alberta</b>	<b>19.5</b>	<b>19.2</b>	<b>18.6</b>	<b>18.8</b>	<b>17.7</b>	<b>17.9</b>	<b>17.6</b>	<b>17.6</b>	<b>17.7</b>	<b>18.1</b>

Sources: Vital Statistics, Birth and Stillbirth Files, Department of Government Services, April 2011 release.

Fee-for-Services Claims Files, Alberta Health and Wellness.

Alberta Health Care Insurance Plan Registration File, Alberta Health and Wellness.

Notes: Alberta totals include unknown RHAs.

Data include Alberta residents only.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 5 Labour Inductions and Rates by Residence RHA and Year, Alberta, 2007 to 2009

<u>2007</u>	Chinook	Palliser	Calgary	David Thompson	East Central	Capital	Aspen	Peace Country	Northern Lights	Alberta
Hospital deliveries	2,360	1,541	16,959	4,345	1,400	13,915	2,620	1,915	1,560	46,804
Total inductions <sup>1</sup>	608	247	4,804	1,045	412	3,544	665	491	341	12,205
Total inductions rate (per 100 hospital deliveries)	25.8	16.0	28.3	24.1	29.4	25.5	25.4	25.6	21.9	26.1
Medical inductions	520	83	2,150	774	226	2,256	442	395	250	7,116
Medical induction rate (per 100 hospital deliveries)	22.0	5.4	12.7	17.8	16.1	16.2	16.9	20.6	16.0	15.2
Surgical inductions	47	5	521	47	54	134	29	31	31	901
Surgical inductions rate (per 100 hospital deliveries)	2.0	0.3	3.1	1.1	3.9	1.0	1.1	1.6	2.0	1.9
Combined inductions	11	3	1,304	143	103	596	70	57	43	2,338
Combined inductions rate (per 100 hospital deliveries)	0.5	0.2	7.7	3.3	7.4	4.3	2.7	3.0	2.8	5.0

<u>2008</u>	Chinook	Palliser	Calgary	David Thompson	East Central	Capital	Aspen	Peace Country	Northern Lights	Alberta
Hospital deliveries	2,453	1,490	17,781	4,500	1,462	14,342	2,691	2,382	1,641	48,918
Total inductions <sup>1</sup>	588	280	4,900	1,058	404	3,862	692	702	427	12,955
Total inductions rate (per 100 hospital deliveries)	24.0	18.8	27.6	23.5	27.6	26.9	25.7	29.5	26.0	26.5
Medical inductions	506	80	2,238	726	251	2,473	472	391	304	7,462
Medical induction rate (per 100 hospital deliveries)	20.6	5.4	12.6	16.1	17.2	17.2	17.5	16.4	18.5	15.3
Surgical inductions	33	5	506	69	39	116	36	59	30	894
Surgical inductions rate (per 100 hospital deliveries)	1.3	0.3	2.8	1.5	2.7	0.8	1.3	2.5	1.8	1.8
Combined inductions	9	5	1,353	152	88	521	62	35	69	2,300
Combined inductions rate (per 100 hospital deliveries)	0.4	0.3	7.6	3.4	6.0	3.6	2.3	1.5	4.2	4.7

<u>2009</u>	Chinook	Palliser	Calgary	David Thompson	East Central	Capital	Aspen	Peace Country	Northern Lights	Alberta
Hospital deliveries	2,616	1,548	17,851	4,424	1,218	14,742	2,766	2,112	1,672	49,099
Total inductions <sup>1</sup>	586	275	5,140	1,088	331	4,195	694	523	453	13,338
Total inductions rate (per 100 hospital deliveries)	22.4	17.8	28.8	24.6	27.2	28.5	25.1	24.8	27.1	27.2
Medical inductions	513	186	2,825	811	244	3,273	569	382	351	9,178
Medical induction rate (per 100 hospital deliveries)	19.6	12.0	15.8	18.3	20.0	22.2	20.6	18.1	21.0	18.7
Surgical inductions	31	10	550	63	23	88	25	30	52	874
Surgical inductions rate (per 100 hospital deliveries)	1.2	0.6	3.1	1.4	1.9	0.6	0.9	1.4	3.1	1.8
Combined inductions	17	17	1,521	172	46	509	47	17	41	2,399
Combined inductions rate (per 100 hospital deliveries)	0.6	1.1	8.5	3.9	3.8	3.5	1.7	0.8	2.5	4.9

Source: Canadian Institute of Health Information Inpatient Files, Alberta Health and Wellness.

Notes: 1. From April 2003 onward, outpatient inductions were included in total inductions but were not categorized as medical, surgical, or combined. Consequently, "total inductions" is greater than the sum of medical, surgical, and combined.  
 Alberta totals include unknown RHAs.  
 Data include Alberta residents only.  
 Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 6 Cesarean Section, Forceps, and Vacuum Extraction Deliveries and Rates by Year and Residence RHA, Alberta, 2007 to 2009

<b>2007</b>	Chinook	Palliser	Calgary	David Thompson	East Central	Capital	Aspen	Peace Country	Northern Lights	Alberta
Hospital deliveries	2,360	1,541	16,959	4,345	1,400	13,915	2,620	1,915	1,560	46,804
Cesarean section cases	606	375	4,880	1,246	386	3,803	748	451	438	12,979
Cesarean section rate (per 100 hospital deliveries)	25.7	24.3	28.8	28.7	27.6	27.3	28.5	23.6	28.1	27.7
Forceps deliveries	127	22	760	252	119	1,115	83	34	118	2,641
Forceps delivery rate (per 100 hospital deliveries)	5.4	1.4	4.5	5.8	8.5	8.0	3.2	1.8	7.6	5.6
Vacuum extraction deliveries	169	122	3,008	189	156	988	253	175	305	5,394
Vacuum extraction rate (per 100 hospital deliveries)	7.2	7.9	17.7	4.3	11.1	7.1	9.7	9.1	19.6	11.5

<b>2008</b>	Chinook	Palliser	Calgary	David Thompson	East Central	Capital	Aspen	Peace Country	Northern Lights	Alberta
Hospital deliveries	2,453	1,490	17,781	4,500	1,462	14,342	2,691	2,382	1,641	48,918
Cesarean section cases	650	360	5,194	1,316	412	3,908	732	554	426	13,591
Cesarean section rate (per 100 hospital deliveries)	26.5	24.2	29.2	29.2	28.2	27.2	27.2	23.3	26.0	27.8
Forceps deliveries	127	21	804	281	116	1,141	107	69	140	2,818
Forceps delivery rate (per 100 hospital deliveries)	5.2	1.4	4.5	6.2	7.9	8.0	4.0	2.9	8.5	5.8
Vacuum extraction deliveries	183	141	3,294	253	133	974	247	241	335	5,818
Vacuum extraction rate (per 100 hospital deliveries)	7.5	9.5	18.5	5.6	9.1	6.8	9.2	10.1	20.4	11.9

<b>2009</b>	Chinook	Palliser	Calgary	David Thompson	East Central	Capital	Aspen	Peace Country	Northern Lights	Alberta
Hospital deliveries	2,616	1,548	17,851	4,424	1,218	14,742	2,766	2,112	1,672	49,099
Cesarean section cases	688	372	5,066	1,301	373	4,100	782	470	459	13,645
Cesarean section rate (per 100 hospital deliveries)	26.3	24.0	28.4	29.4	30.6	27.8	28.3	22.3	27.5	27.8
Forceps deliveries	133	17	796	292	77	1,198	109	42	96	2,766
Forceps delivery rate (per 100 hospital deliveries)	5.1	1.1	4.5	6.6	6.3	8.1	3.9	2.0	5.7	5.6
Vacuum extraction deliveries	176	149	3,219	234	141	970	311	213	291	5,722
Vacuum extraction rate (per 100 hospital deliveries)	6.7	9.6	18.0	5.3	11.6	6.6	11.2	10.1	17.4	11.7

Source: Canadian Institute of Health Information Inpatient Files, Alberta Health and Wellness.

Notes: Alberta totals include unknown RHAs.

Data include Alberta residents only.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 7 Mean Maternal Age by Residence RHA, Alberta, 2001 to 2010

Mean maternal age	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	27.6	27.7	27.7	27.8	27.9	27.8	27.6	27.8	27.8	28.0
Palliser	27.6	27.5	27.8	27.7	27.8	27.6	27.6	28.0	28.2	28.3
Calgary	30.0	30.0	30.2	30.2	30.4	30.4	30.4	30.5	30.6	30.8
David Thompson	27.4	27.7	27.5	27.7	27.6	27.5	27.7	27.8	27.8	28.1
East Central	28.5	28.6	28.3	28.4	28.3	28.5	28.0	28.0	28.2	28.3
Capital	29.1	29.1	29.3	29.3	29.3	29.4	29.4	29.5	29.6	29.8
Aspen	27.3	27.4	27.4	27.2	27.4	27.2	27.3	27.3	27.1	27.6
Peace Country	27.1	27.1	27.0	27.3	27.2	27.1	27.3	27.4	27.5	27.8
Northern Lights	27.1	26.9	27.4	27.3	27.3	27.6	27.5	27.6	27.7	27.8
Alberta	28.8	28.9	29.0	29.1	29.1	29.1	29.1	29.3	29.3	29.5

Source: Vital Statistics, Birth File, Department of Government Services, April 2011 release.

Notes: Data include Alberta residents only.

Alberta totals include unknown RHAs.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 8 Maternal Prenatal Smoking Cases and Rates by Year and Residence RHA, Alberta, 2000 to 2008

Maternal Prenatal Smoking Cases	2000	2001	2002	2003	2004	2005	2006	2007	2008
Chinook	414	421	367	369	387	389	447	496	487
Palliser	336	313	342	325	300	320	334	369	322
Calgary	2,291	2,139	2,084	1,996	1,990	1,886	2,067	2,024	2,118
David Thompson	1,054	1,034	1,070	1,068	1,048	1,009	1,128	1,178	1,171
East Central	246	230	249	246	285	260	259	283	306
Capital	2,248	2,348	2,265	2,099	2,074	2,038	2,317	2,385	2,356
Aspen	695	722	716	714	718	642	686	766	728
Peace Country	547	570	553	612	568	593	627	679	638
Northern Lights	354	345	342	299	332	282	322	373	328
<b>Alberta</b>	<b>8,230</b>	<b>8,208</b>	<b>8,030</b>	<b>7,780</b>	<b>7,754</b>	<b>7,487</b>	<b>8,267</b>	<b>8,643</b>	<b>8,484</b>

Rate (per 100 women delivering)	2000	2001	2002	2003	2004	2005	2006	2007	2008
Chinook	22.1	22.4	19.4	18.5	19.5	19.2	21.2	21.6	20.0
Palliser	28.5	26.8	29.0	26.7	24.4	24.7	25.8	24.3	22.3
Calgary	18.0	16.8	15.7	14.1	13.9	12.5	13.0	11.7	11.6
David Thompson	33.9	33.1	32.7	31.4	30.2	28.6	29.2	28.8	26.6
East Central	22.9	22.2	21.8	21.9	23.4	21.6	20.3	20.7	21.2
Capital	22.5	21.9	20.4	18.4	17.9	17.3	18.1	17.1	16.2
Aspen	32.7	32.5	31.6	31.8	32.6	29.4	30.3	31.6	27.9
Peace Country	31.6	30.9	30.2	31.6	30.4	29.7	28.7	30.0	26.9
Northern Lights	32.8	29.5	27.6	24.1	26.0	21.5	23.4	24.4	20.5
<b>Alberta</b>	<b>23.5</b>	<b>22.7</b>	<b>21.5</b>	<b>20.0</b>	<b>19.7</b>	<b>18.4</b>	<b>19.0</b>	<b>18.4</b>	<b>17.2</b>

Source: Alberta Perinatal Health Program, May 2010 release.

Notes: Data include only women with a completed Antenatal Risk Score on the Alberta Delivery Record.

Data include Alberta residents only.

Alberta totals include unknown RHAs.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 9 Maternal Prenatal Alcohol Consumption Cases and Rates by Year and Residence RHA, Alberta, 2001 to 2008

Maternal Prenatal Alcohol Consumption Cases	2001	2002	2003	2004	2005	2006	2007	2008
Chinook	77	80	90	78	112	144	148	161
Palliser	4	8	11	19	11	13	31	25
Calgary	132	161	152	187	186	253	249	314
David Thompson	141	153	165	203	199	216	225	235
East Central	13	8	17	12	20	22	23	22
Capital	119	128	140	179	164	204	247	231
Aspen	38	31	49	47	56	84	70	93
Peace Country	43	54	66	66	101	119	118	143
Northern Lights	41	34	38	47	37	43	36	38
<b>Alberta</b>	<b>617</b>	<b>658</b>	<b>735</b>	<b>843</b>	<b>898</b>	<b>1,108</b>	<b>1,147</b>	<b>1,262</b>

Rate (per 100 women delivering)	2001	2002	2003	2004	2005	2006	2007	2008
Chinook	4.1	4.2	4.5	3.9	5.5	6.8	6.4	6.6
Palliser	0.3	0.7	0.9	1.5	0.9	1.0	2.0	1.7
Calgary	1.0	1.2	1.1	1.3	1.2	1.6	1.4	1.7
David Thompson	4.5	4.7	4.9	5.9	5.6	5.6	5.5	5.3
East Central	1.3	0.7	1.5	1.0	1.7	1.7	1.7	1.5
Capital	1.1	1.2	1.2	1.5	1.4	1.6	1.8	1.6
Aspen	1.7	1.4	2.2	2.1	2.6	3.7	2.9	3.6
Peace Country	2.3	2.9	3.4	3.5	5.1	5.4	5.2	6.0
Northern Lights	3.5	2.7	3.1	3.7	2.8	3.1	2.4	2.4
<b>Alberta</b>	<b>1.7</b>	<b>1.8</b>	<b>1.9</b>	<b>2.1</b>	<b>2.2</b>	<b>2.5</b>	<b>2.4</b>	<b>2.6</b>

Source: Alberta Perinatal Health Program, May 2010 release.

Notes: Data include only women with a completed Antenatal Risk Score on the Alberta Delivery Record.

Data include Alberta residents only.

Alberta totals include unknown RHAs.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 10 Live Births, General Fertility Rate, Total Fertility Rate, and Crude Birth Rate by Year and Residence RHA, Alberta, 2001 to 2010

Live births	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	1,960	1,969	2,093	2,047	2,106	2,243	2,422	2,482	2,671	2,552
Palliser	1,230	1,226	1,258	1,278	1,349	1,364	1,579	1,526	1,597	1,461
Calgary	13,109	13,588	14,473	14,606	15,432	16,342	17,721	18,633	18,777	18,478
David Thompson	3,482	3,616	3,727	3,786	3,824	4,253	4,477	4,611	4,537	4,429
East Central	882	971	898	954	925	992	1,042	1,081	1,174	1,025
Capital	11,054	11,293	11,702	11,915	12,106	13,131	14,407	14,866	15,258	15,319
Aspen	2,404	2,408	2,386	2,396	2,386	2,583	2,704	2,774	2,839	2,756
Peace Country	1,907	1,921	2,037	1,959	2,075	2,298	2,377	2,464	2,450	2,370
Northern Lights	1,192	1,299	1,292	1,348	1,384	1,453	1,635	1,723	1,754	1,795
Alberta	37,226	38,293	39,868	40,292	41,587	44,659	48,364	50,164	51,057	50,185

General Fertility Rate (per 1,000 women 15-49)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	52.3	52.6	55.8	54.4	56.0	59.3	62.8	63.4	66.8	62.7
Palliser	50.2	49.3	50.7	51.1	53.6	53.9	61.2	58.5	60.6	54.6
Calgary	43.4	43.9	46.0	45.9	47.8	49.4	52.1	53.6	52.2	50.4
David Thompson	48.5	49.5	50.7	51.1	51.3	56.3	57.7	58.7	56.9	55.0
East Central	33.8	36.9	34.1	36.4	35.3	38.0	38.9	39.9	42.9	37.3
Capital	43.0	43.2	44.3	44.8	45.3	48.3	51.4	52.0	51.7	50.8
Aspen	53.7	53.4	53.3	53.8	53.9	58.0	59.7	60.8	61.2	59.0
Peace Country	55.9	55.5	58.7	55.9	58.7	63.4	63.7	64.9	62.9	60.0
Northern Lights	65.1	67.4	64.5	65.4	65.7	67.4	71.7	72.1	69.1	67.3
Alberta	45.6	46.0	47.4	47.6	48.7	51.3	54.0	55.0	54.4	52.5

Total Fertility Rate (per 1,000 women 15-49)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	1,947	1,954	2,052	1,990	2,049	2,149	2,222	2,216	2,278	2,113
Palliser	1,876	1,833	1,888	1,879	1,952	1,925	2,147	2,040	2,074	1,848
Calgary	1,544	1,564	1,639	1,637	1,703	1,747	1,816	1,845	1,769	1,684
David Thompson	1,848	1,893	1,938	1,941	1,942	2,087	2,101	2,106	1,999	1,909
East Central	1,355	1,483	1,369	1,454	1,413	1,491	1,499	1,526	1,589	1,364
Capital	1,574	1,580	1,616	1,638	1,648	1,741	1,824	1,817	1,766	1,713
Aspen	2,026	2,034	2,033	2,051	2,055	2,193	2,221	2,231	2,200	2,101
Peace Country	2,003	1,997	2,102	2,003	2,082	2,208	2,187	2,206	2,106	1,989
Northern Lights	2,247	2,329	2,222	2,249	2,242	2,286	2,386	2,377	2,243	2,151
Alberta	1,670	1,687	1,736	1,740	1,777	1,855	1,923	1,931	1,872	1,783

Crude Birth Rate (per 1,000 population)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	13.0	13.0	13.7	13.3	13.6	14.3	15.0	15.1	15.8	14.7
Palliser	12.8	12.5	12.8	12.8	13.4	13.3	15.0	14.2	14.6	13.0
Calgary	12.2	12.3	12.8	12.7	13.2	13.5	14.2	14.5	14.0	13.4
David Thompson	12.5	12.8	13.0	13.0	13.0	14.2	14.5	14.6	14.1	13.5
East Central	8.1	8.9	8.2	8.7	8.4	8.9	9.1	9.3	9.9	8.6
Capital	11.7	11.7	11.9	12.0	12.0	12.8	13.5	13.6	13.5	13.1
Aspen	13.8	13.7	13.5	13.6	13.5	14.6	14.9	15.1	15.1	14.5
Peace Country	14.9	14.8	15.5	14.7	15.3	16.5	16.6	16.9	16.3	15.4
Northern Lights	18.6	19.4	18.5	18.8	18.8	19.2	20.5	20.7	19.7	19.0
Alberta	12.3	12.4	12.7	12.7	12.9	13.5	14.2	14.4	14.1	13.5

Sources: Vital Statistics, Birth File, Department of Government Services, April 2011 release.  
Alberta Health Care Insurance Plan Registration File.

Notes: Data include Alberta residents only.

Alberta totals include unknown RHAs.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 11 Singleton Small-for-Gestational-Age Live Births and Rates by Year and Residence RHA, Alberta, 2001 to 2010

Singleton small-for-gestational-age live births	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	137	115	142	142	157	165	183	157	191	177
Palliser	105	98	102	95	117	118	121	133	119	123
Calgary	1,113	1,113	1,215	1,243	1,389	1,474	1,642	1,589	1,663	1,625
David Thompson	224	261	254	262	252	325	320	295	312	299
East Central	65	76	41	68	63	71	61	67	63	76
Capital	827	773	810	843	837	983	1,061	1,133	1,209	1,197
Aspen	162	149	137	164	143	153	157	202	170	192
Peace Country	121	140	133	121	137	141	137	136	170	163
Northern Lights	71	78	89	77	80	78	97	98	108	119
<b>Alberta</b>	<b>2,825</b>	<b>2,803</b>	<b>2,923</b>	<b>3,015</b>	<b>3,175</b>	<b>3,508</b>	<b>3,779</b>	<b>3,810</b>	<b>4,005</b>	<b>3,971</b>

Rate (per 100 singleton live births)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	7.2	6.0	7.0	7.2	7.7	7.6	7.8	6.5	7.4	7.2
Palliser	8.8	8.3	8.4	7.7	9.0	8.9	7.9	9.0	7.7	8.8
Calgary	8.8	8.5	8.7	8.8	9.3	9.3	9.6	8.9	9.2	9.2
David Thompson	6.6	7.5	7.0	7.2	6.9	7.9	7.3	6.6	7.1	7.0
East Central	7.6	8.0	4.7	7.4	7.1	7.4	6.0	6.4	5.6	7.6
Capital	7.7	7.0	7.1	7.3	7.2	7.7	7.6	7.9	8.2	8.1
Aspen	6.9	6.3	6.0	7.0	6.1	6.1	6.0	7.5	6.2	7.1
Peace Country	6.5	7.5	6.7	6.4	6.8	6.3	6.0	5.6	7.1	7.1
Northern Lights	6.1	6.2	7.1	5.8	5.9	5.5	6.2	5.9	6.3	6.8
<b>Alberta</b>	<b>7.8</b>	<b>7.6</b>	<b>7.6</b>	<b>7.7</b>	<b>7.9</b>	<b>8.1</b>	<b>8.1</b>	<b>7.9</b>	<b>8.1</b>	<b>8.2</b>

Source: Vital Statistics, Birth File, Department of Government Services, April 2011 release.

Notes: Data include Alberta residents only.

Alberta totals include unknown RHAs.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 12 Low Birth Weight Births and Rates by Year and Residence RHA, Alberta, 2001 to 2010

Low birth weight live births	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	114	99	111	111	112	146	141	131	163	154
Palliser	73	82	82	57	79	80	87	89	83	104
Calgary	873	992	990	1,046	1,133	1,222	1,291	1,420	1,448	1,422
David Thompson	215	229	204	214	238	307	277	267	287	297
East Central	57	65	66	73	63	65	46	74	68	62
Capital	669	722	753	774	837	920	1,002	1,065	1,076	998
Aspen	120	138	149	155	119	162	158	139	165	142
Peace Country	91	94	95	106	91	130	131	123	126	154
Northern Lights	53	65	67	53	56	77	85	93	106	79
<b>Alberta</b>	<b>2,265</b>	<b>2,486</b>	<b>2,517</b>	<b>2,589</b>	<b>2,728</b>	<b>3,109</b>	<b>3,218</b>	<b>3,402</b>	<b>3,522</b>	<b>3,412</b>

Rate (per 100 live births)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	5.8	5.0	5.3	5.4	5.3	6.5	5.8	5.3	6.1	6.0
Palliser	5.9	6.7	6.5	4.5	5.9	5.9	5.5	5.8	5.2	7.1
Calgary	6.7	7.3	6.8	7.2	7.3	7.5	7.3	7.6	7.7	7.7
David Thompson	6.2	6.3	5.5	5.7	6.2	7.2	6.2	5.8	6.3	6.7
East Central	6.5	6.7	7.3	7.7	6.8	6.6	4.4	6.8	5.8	6.0
Capital	6.1	6.4	6.4	6.5	6.9	7.0	7.0	7.2	7.1	6.5
Aspen	5.0	5.7	6.2	6.5	5.0	6.3	5.8	5.0	5.8	5.2
Peace Country	4.8	4.9	4.7	5.4	4.4	5.7	5.5	5.0	5.1	6.5
Northern Lights	4.4	5.0	5.2	3.9	4.0	5.3	5.2	5.4	6.0	4.4
<b>Alberta</b>	<b>6.1</b>	<b>6.5</b>	<b>6.3</b>	<b>6.4</b>	<b>6.6</b>	<b>7.0</b>	<b>6.7</b>	<b>6.8</b>	<b>6.9</b>	<b>6.8</b>

Source: Vital Statistics, Birth File, Department of Government Services, April 2011 release.

Notes: Data include Alberta residents only.

Alberta totals include unknown RHAs.

Data may differ from previously published data due to differences in definitions and dates of data extraction.



Table 13 Singleton Large-for-Gestational-Age Live Births and Rates by Year and Residence RHA, Alberta, 2001 to 2010

Singleton large-for-gestational-age live births	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	237	251	258	270	263	263	267	307	302	300
Palliser	142	143	139	127	134	167	160	163	149	141
Calgary	1,317	1,316	1,375	1,370	1,353	1,432	1,512	1,590	1,546	1,602
David Thompson	518	483	481	491	470	511	516	584	511	500
East Central	111	118	112	114	97	100	129	127	150	109
Capital	1,332	1,376	1,387	1,388	1,368	1,390	1,609	1,633	1,640	1,584
Aspen	348	364	360	357	320	372	384	359	351	354
Peace Country	305	259	299	294	273	338	321	337	307	302
Northern Lights	188	181	178	203	202	226	246	230	231	249
<b>Alberta</b>	<b>4,498</b>	<b>4,492</b>	<b>4,589</b>	<b>4,615</b>	<b>4,480</b>	<b>4,799</b>	<b>5,144</b>	<b>5,330</b>	<b>5,187</b>	<b>5,141</b>

Rate (per 100 singleton live births)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	12.5	13.2	12.6	13.6	12.9	12.1	11.4	12.7	11.6	12.1
Palliser	12.0	12.1	11.4	10.3	10.3	12.5	10.5	11.0	9.7	10.0
Calgary	10.4	10.0	9.9	9.7	9.0	9.1	8.8	8.9	8.6	9.0
David Thompson	15.3	13.9	13.3	13.4	12.8	12.4	11.8	13.1	11.6	11.7
East Central	13.0	12.4	12.9	12.5	11.0	10.4	12.6	12.2	13.2	10.9
Capital	12.4	12.5	12.2	12.1	11.7	11.0	11.6	11.4	11.2	10.7
Aspen	14.9	15.5	15.7	15.3	13.7	14.9	14.6	13.3	12.7	13.1
Peace Country	16.4	13.9	15.1	15.4	13.5	15.1	14.0	14.0	12.9	13.2
Northern Lights	16.0	14.5	14.2	15.3	14.9	15.9	15.7	13.8	13.6	14.2
<b>Alberta</b>	<b>12.5</b>	<b>12.1</b>	<b>11.9</b>	<b>11.9</b>	<b>11.1</b>	<b>11.1</b>	<b>11.0</b>	<b>11.0</b>	<b>10.5</b>	<b>10.6</b>

Source: Vital Statistics, Birth File, Department of Government Services, April 2011 release.

Notes: Data include Alberta residents only.

Alberta totals include unknown RHAs.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 14 High Birth Weight Births and Rates by Year and Residence RHA, Alberta, 2001 to 2010

High birth weight live births	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	269	286	282	264	278	285	303	332	322	327
Palliser	162	173	160	153	161	190	183	201	192	150
Calgary	1,414	1,387	1,490	1,380	1,442	1,480	1,507	1,613	1,530	1,629
David Thompson	553	509	490	527	480	527	546	601	529	531
East Central	110	123	120	105	104	120	128	141	138	110
Capital	1,371	1,395	1,408	1,359	1,360	1,407	1,673	1,638	1,668	1,582
Aspen	367	387	373	361	338	391	388	370	373	354
Peace Country	337	300	316	322	297	355	337	356	324	320
Northern Lights	212	212	195	213	197	228	253	274	229	260
<b>Alberta</b>	<b>4,796</b>	<b>4,773</b>	<b>4,834</b>	<b>4,684</b>	<b>4,657</b>	<b>4,983</b>	<b>5,318</b>	<b>5,526</b>	<b>5,305</b>	<b>5,263</b>

Rate (per 100 live births)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	13.7	14.5	13.5	12.9	13.2	12.7	12.5	13.4	12.1	12.8
Palliser	13.2	14.1	12.7	12.0	11.9	13.9	11.6	13.2	12.0	10.3
Calgary	10.8	10.2	10.3	9.4	9.3	9.1	8.5	8.7	8.1	8.8
David Thompson	15.9	14.1	13.1	13.9	12.6	12.4	12.2	13.0	11.7	12.0
East Central	12.5	12.7	13.4	11.0	11.2	12.1	12.3	13.0	11.8	10.7
Capital	12.4	12.4	12.0	11.4	11.2	10.7	11.6	11.0	10.9	10.3
Aspen	15.3	16.1	15.6	15.1	14.2	15.1	14.3	13.3	13.1	12.8
Peace Country	17.7	15.6	15.5	16.4	14.3	15.4	14.2	14.4	13.2	13.5
Northern Lights	17.8	16.3	15.1	15.8	14.2	15.7	15.5	15.9	13.1	14.5
<b>Alberta</b>	<b>12.9</b>	<b>12.5</b>	<b>12.1</b>	<b>11.6</b>	<b>11.2</b>	<b>11.2</b>	<b>11.0</b>	<b>11.0</b>	<b>10.4</b>	<b>10.5</b>

Source: Vital Statistics, Birth File, Department of Government Services, April 2011 release.

Notes: Data include Alberta residents only.

Alberta totals include unknown RHAs.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 15 Preterm Births and Rates by Year and Residence RHA, Alberta, 2001 to 2010

Preterm live births	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	142	135	161	169	147	196	176	197	195	192
Palliser	88	93	105	68	85	88	103	107	88	125
Calgary	1,126	1,243	1,349	1,383	1,509	1,511	1,599	1,675	1,728	1,677
David Thompson	278	299	279	319	350	359	355	377	383	392
East Central	82	84	99	86	90	92	66	94	105	92
Capital	986	1,024	1,095	1,177	1,179	1,202	1,242	1,373	1,432	1,353
Aspen	192	207	192	232	193	221	220	197	238	215
Peace Country	141	124	144	149	137	184	183	188	166	181
Northern Lights	73	90	97	82	91	104	114	119	155	126
<b>Alberta</b>	<b>3,108</b>	<b>3,300</b>	<b>3,521</b>	<b>3,666</b>	<b>3,781</b>	<b>3,957</b>	<b>4,058</b>	<b>4,328</b>	<b>4,490</b>	<b>4,353</b>

Rate (per 100 live births)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	7.2	6.9	7.7	8.3	7.0	8.7	7.3	7.9	7.3	7.5
Palliser	7.2	7.6	8.3	5.3	6.3	6.5	6.5	7.0	5.5	8.6
Calgary	8.6	9.1	9.3	9.5	9.8	9.2	9.0	9.0	9.2	9.1
David Thompson	8.0	8.3	7.5	8.4	9.2	8.4	7.9	8.2	8.4	8.9
East Central	9.3	8.7	11.0	9.0	9.7	9.3	6.3	8.7	8.9	9.0
Capital	8.9	9.1	9.4	9.9	9.7	9.2	8.6	9.2	9.4	8.8
Aspen	8.0	8.6	8.0	9.7	8.1	8.6	8.1	7.1	8.4	7.8
Peace Country	7.4	6.5	7.1	7.6	6.6	8.0	7.7	7.6	6.8	7.6
Northern Lights	6.1	6.9	7.5	6.1	6.6	7.2	7.0	6.9	8.8	7.0
<b>Alberta</b>	<b>8.3</b>	<b>8.6</b>	<b>8.8</b>	<b>9.1</b>	<b>9.1</b>	<b>8.9</b>	<b>8.4</b>	<b>8.6</b>	<b>8.8</b>	<b>8.7</b>

Source: Vital Statistics, Birth File, Department of Government Services, April 2011 release.

Notes: Data include Alberta residents only.

Alberta totals include unknown RHAs.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 16 Multiple Births and Rates by Year and Residence RHA, Alberta, 2001 to 2010

Multiple live births	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	66	62	53	64	62	76	80	65	75	79
Palliser	42	41	39	44	47	32	50	45	59	57
Calgary	452	468	529	494	478	551	580	683	700	722
David Thompson	96	140	107	127	151	126	114	153	131	162
East Central	29	22	32	40	40	34	21	39	41	28
Capital	322	319	347	444	418	446	511	561	572	481
Aspen	67	60	87	68	58	85	69	78	81	55
Peace Country	46	61	61	54	58	60	83	52	68	83
Northern Lights	20	48	39	24	26	32	66	57	51	38
<b>Alberta</b>	<b>1,140</b>	<b>1,221</b>	<b>1,294</b>	<b>1,359</b>	<b>1,338</b>	<b>1,442</b>	<b>1,574</b>	<b>1,733</b>	<b>1,778</b>	<b>1,705</b>

Rate (per 100 live births)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	3.4	3.1	2.5	3.1	2.9	3.4	3.3	2.6	2.8	3.1
Palliser	3.4	3.3	3.1	3.4	3.5	2.3	3.2	2.9	3.7	3.9
Calgary	3.4	3.4	3.7	3.4	3.1	3.4	3.3	3.7	3.7	3.9
David Thompson	2.8	3.9	2.9	3.4	3.9	3.0	2.5	3.3	2.9	3.7
East Central	3.3	2.3	3.6	4.2	4.3	3.4	2.0	3.6	3.5	2.7
Capital	2.9	2.8	3.0	3.7	3.5	3.4	3.5	3.8	3.7	3.1
Aspen	2.8	2.5	3.6	2.8	2.4	3.3	2.6	2.8	2.9	2.0
Peace Country	2.4	3.2	3.0	2.8	2.8	2.6	3.5	2.1	2.8	3.5
Northern Lights	1.7	3.7	3.0	1.8	1.9	2.2	4.0	3.3	2.9	2.1
<b>Alberta</b>	<b>3.1</b>	<b>3.2</b>	<b>3.2</b>	<b>3.4</b>	<b>3.2</b>	<b>3.2</b>	<b>3.3</b>	<b>3.5</b>	<b>3.5</b>	<b>3.4</b>

Source: Vital Statistics, Birth File, Department of Government Services, April 2011 release.

Notes: Data include Alberta residents only.

Alberta totals include unknown RHAs.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 17 Neonatal<sup>1</sup>, Post-Neonatal<sup>2</sup>, and Infant<sup>3</sup> Deaths and Rates by Year, Alberta, 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>Live births</b>	37,226	38,293	39,868	40,292	41,587	44,659	48,364	50,164	51,400	50,542
<b>Stillbirths</b>	235	249	260	286	309	299	349	348	343	357
<b>Stillbirth rate (per 1,000 total births)<sup>4</sup></b>	6.3	6.5	6.5	7.0	7.4	6.7	7.2	6.9	6.7	7.1
<b>Neonatal deaths</b>	144	200	195	179	209	177	221	229	213	226
<b>Neonatal mortality rate (per 1,000 live births)</b>	3.9	5.2	4.9	4.4	5.0	4.0	4.6	4.6	4.2	4.5
<b>Post-neonatal deaths</b>	65	78	71	54	70	73	70	84	68	72
<b>Post-neonatal mortality rate (per 1,000 live births)</b>	1.7	2.0	1.8	1.3	1.7	1.6	1.4	1.7	1.3	1.4
<b>Infant deaths</b>	209	278	266	233	279	250	291	313	281	298
<b>Infant mortality rate (per 1,000 live births)</b>	5.6	7.3	6.7	5.8	6.7	5.6	6.0	6.2	5.5	5.9

**Source:** Vital Statistics, Birth and Death Files, Department of Government Services, April 2011 release.

**Notes:** 1. Neonatal deaths refers to deaths of live born infants less than 28 full days after birth.

2. Post-neonatal deaths refers to deaths of children between 28 full days and one year of age.

3. Infant deaths refers to deaths of children under one year of age.

4. Total births = live births + stillbirths.

Data include Alberta residents only.

Alberta totals include unknown RHAs.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 18 Neonatal<sup>1</sup>, Post-Neonatal<sup>2</sup>, and Infant<sup>3</sup> Deaths and Rates by Residence RHA, Alberta, 2001 to 2010 Combined

	Chinook	Palliser	Calgary	David Thompson	East Central	Capital	Aspen	Peace Country	Northern Lights	Alberta
<b>Live births</b>	22,545	13,868	161,159	40,742	9,944	131,051	25,636	21,858	14,875	441,695
<b>Stillbirths</b>	135	94	1,049	328	69	921	186	135	118	3,035
<b>Stillbirth rate (per 1,000 total births)</b>	6.0	6.8	6.5	8.1	6.9	7.0	7.3	6.2	7.9	6.9
<b>Neonatal deaths</b>	97	62	609	206	63	660	121	92	73	1,993
<b>Neonatal mortality rate (per 1,000 live births)</b>	4.3	4.5	3.8	5.1	6.3	5.0	4.7	4.2	4.9	4.5
<b>Post-neonatal deaths</b>	34	24	220	90	17	189	61	41	29	705
<b>Post-neonatal mortality rate (per 1,000 live births)</b>	1.5	1.7	1.4	2.2	1.7	1.4	2.4	1.9	1.9	1.6
<b>Infant deaths</b>	131	86	829	296	80	849	182	133	102	2,698
<b>Infant mortality rate (per 1,000 live births)</b>	5.8	6.2	5.1	7.3	8.0	6.5	7.1	6.1	6.9	6.1

**Source:** Vital Statistics, Birth and Death Files, Department of Government Services, April 2011 release.

**Notes:** 1. Neonatal deaths refers to deaths of live born infants less than 28 full days after birth.

2. Post-neonatal deaths refers to deaths of children between 28 full days and one year of age.

3. Infant deaths refers to deaths of children under one year of age.

Data include Alberta residents only.

Alberta totals include unknown RHAs.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 19 Women 15 - 49 by Residence RHA, Alberta, 2001 to 2010

Residence RHA	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Chinook	37,453	37,469	37,538	37,637	37,621	37,820	38,573	39,159	39,972	40,727
Palliser	24,512	24,876	24,820	24,991	25,160	25,302	25,821	26,069	26,371	26,780
Calgary	301,784	309,686	314,359	318,119	322,633	330,679	340,332	347,886	359,562	366,778
David Thompson	71,785	72,983	73,541	74,145	74,570	75,569	77,632	78,555	79,777	80,457
East Central	26,088	26,345	26,308	26,207	26,172	26,136	26,778	27,099	27,373	27,507
Capital	256,989	261,592	264,438	265,829	267,430	271,912	280,518	286,046	295,396	301,275
Aspen	44,765	45,130	44,774	44,538	44,291	44,506	45,256	45,658	46,370	46,732
Peace Country	34,118	34,583	34,705	35,038	35,364	36,245	37,336	37,976	38,935	39,473
Northern Lights	18,304	19,263	20,028	20,611	21,073	21,548	22,802	23,913	25,391	26,684
Unknown	115	37	49	59	35	59	79	95	125	136
<b>Total Women 15-49</b>	<b>815,913</b>	<b>831,964</b>	<b>840,560</b>	<b>847,174</b>	<b>854,349</b>	<b>869,776</b>	<b>895,127</b>	<b>912,456</b>	<b>939,272</b>	<b>956,549</b>
<b>Alberta Population</b>	<b>3,022,891</b>	<b>3,086,646</b>	<b>3,134,337</b>	<b>3,179,036</b>	<b>3,222,191</b>	<b>3,298,028</b>	<b>3,407,742</b>	<b>3,495,300</b>	<b>3,617,554</b>	<b>3,716,220</b>

Source: Alberta Health Care Insurance Plan Registration File, Alberta Health and Wellness.

Notes: Data may differ from previously published data due to differences in definitions and dates of data extraction.

Table 20 Women 10 - 49 by Age Group, Alberta, 2001 to 2010

Age group	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
10-14	110,821	111,927	112,452	111,565	110,360	110,161	109,951	109,817	110,555	111,052
15-17	66,621	67,490	67,455	68,065	69,187	70,552	71,193	70,737	70,665	70,434
18-19	44,386	45,513	45,940	46,249	46,372	46,284	47,741	49,497	49,889	49,663
15-19	111,007	113,003	113,395	114,314	115,559	116,836	118,934	120,234	120,554	120,097
20-24	106,634	110,520	113,900	116,575	118,397	122,100	127,053	129,258	133,901	135,626
25-29	106,813	109,731	111,509	113,764	116,210	121,374	128,880	135,929	144,960	151,361
30-34	112,047	113,471	114,564	114,582	115,321	117,553	122,803	126,931	134,133	140,254
35-39	129,575	126,332	122,284	119,152	117,930	120,304	123,898	126,733	130,164	132,785
40-44	133,936	137,029	138,222	138,573	137,349	135,051	133,101	130,489	130,163	130,788
45-49	115,901	121,878	126,686	130,214	133,583	136,558	140,458	142,882	145,397	145,638
<b>Women aged 15 - 49</b>	<b>815,913</b>	<b>831,964</b>	<b>840,560</b>	<b>847,174</b>	<b>854,349</b>	<b>869,776</b>	<b>895,127</b>	<b>912,456</b>	<b>939,272</b>	<b>956,549</b>
<b>Women aged 10 - 49</b>	<b>926,734</b>	<b>943,891</b>	<b>953,012</b>	<b>958,739</b>	<b>964,709</b>	<b>979,937</b>	<b>1,005,078</b>	<b>1,022,273</b>	<b>1,049,827</b>	<b>1,067,601</b>
<b>Alberta Population</b>	<b>3,022,891</b>	<b>3,086,646</b>	<b>3,134,337</b>	<b>3,179,036</b>	<b>3,222,191</b>	<b>3,298,028</b>	<b>3,407,742</b>	<b>3,495,300</b>	<b>3,617,554</b>	<b>3,716,220</b>

Source: Alberta Health Care Insurance Plan Registration File, Alberta Health and Wellness.

Notes: Data may differ from previously published data due to differences in definitions and dates of data extraction.

## Appendix I

### Codes Used for Data Extraction

ICD-9-CM: International Classification of Disease – 9th Revision – Clinical Modification

ICD-10-CA: International Statistical Classification of Diseases and Related Health Problems Tenth Revision, Canada

CCI: Canadian Classification of Health Interventions

A number of contacts with the health care system can result from a single pregnancy.

Pregnancy-related events are counted as separate (i.e., different) pregnancies if they occur 44 or more weeks prior to a delivery date for an infant. Pregnancy-related events are counted as part of the same pregnancy if they occur less than 44 weeks prior to a delivery. Abortion-related events (spontaneous or induced) are counted as separate events if they occur 60 or more days apart, and as the same event if they occur less than 60 days apart.

*Where the symbol ^^ occurs, all codes with the given prefix were included*

#### **Spontaneous abortion, January 1997 to December 2010**

Fee-For-Service Claims diagnostic code

ICD-9-CM 634

#### **Induced abortion, January 1997 to December 2010, by year, maternal age group, and residence RHA**

Fee-For-Service Claims billing code

86.41, 87.0, 87.0A, 87.1, 87.21, 87.29A, 87.29B

#### **Induced abortion, January 1997 to March 2002, by facility type, facility region, and week of gestation**

Inpatient Hospital Separations and Ambulatory Care Classification System health service codes

86.41, 87.0, 87.0A, 87.1, 87.21

#### **Induced abortion, April 2002 to December 2010, by facility type, facility region, and week of gestation**

Inpatient Hospital Separations and Ambulatory Care Classification System diagnostic code

Medical abortion ICD-10-CA O04^^

Inpatient Hospital Separations and Ambulatory Care Classification System intervention codes:

Medical termination CCI 5CA88.^^

Surgical aspiration and curettage CCI 5CA89GA

Surgical dilatation and curettage CCI 5CA89GC

#### **Hospital delivery, January 1997 to December 2010**

Hospital Inpatient Files

Program Area as Main Patient Service code 51

**Induction of labour**

If a delivery was counted in “Combined Induction”, it was not counted in “Medical Induction” or “Surgical Induction” (i.e., these three categories are mutually exclusive).

From April 2002 to March 2003, inductions performed on outpatient bases were not captured, resulting in under-estimation of induction rates for this time period. From April 2003 onward, outpatient inductions were included in total inductions but were not categorized as medical, surgical, or combined. Consequently, "total inductions" is greater than the sum of medical, surgical, and combined from 2003 onward.

**Induction of labour, January 1997 to December 2001**

Hospital Inpatient Files procedure codes

Medical induction ICD-9-CM 73.4

Surgical induction ICD-9-CM 73.01, 73.1

Combined induction ICD-9-CM 73.4, and 73.01 or 73.1

**Induction of labour, January 2002 to March 2006**

Hospital Inpatient Files intervention codes

Medical induction CCI 5AC30AL, 5AC30AZ, 5AC30CA, 5AC30GU, 5AC30HA, 5AC30YA, 5AC30YB, 5AC30ZZ

Surgical induction CCI 5AC30AN, 5AC30AP, 5AC30CK

Combined induction One of CCI 5AC30AL, 5AC30AZ, 5AC30CA, 5AC30GU, 5AC30HA, 5AC30YA, 5AC30YB, 5AC30ZZ, and one of 5AC30AN, 5AC30AP, 5AC30CK

**Induction of labour, April 2006 to December 2010**

Hospital Inpatient Files intervention codes

Medical Induction CCI 5AC30AL-I2, 5AC30AZ, 5AC30CA-I2, 5AC30CA-Z9, 5AC30CK-A2, 5AC30CK-I2, 5AC30HA-I2, 5AC30YA-I2

Surgical Induction CCI 5AC30AN, 5AC30AP, 5AC30CK-BD, 5AC30CK-W6

Combined Induction One of CI 5AC30AL-I2, 5AC30AZ, 5AC30CA-I2, 5AC30CA-Z9, 5AC30CK-A2, 5AC30CK-I2, 5AC30HA-I2, 5AC30YA-I2, and one of CCI 5AC30AN, 5AC30AP, 5AC30CK-BD, 5AC30CK-W6

**Operative/assisted delivery, January 1997 to March 2002**

Hospital Inpatient Files procedure codes

Cesarean section and removal of fetus ICD-9-CM 74 (74.91 (hysterotomy to terminate pregnancy) was excluded).

Low forceps operation ICD-9-CM 72.0

Low forceps operation with episiotomy ICD-9-CM 72.1

Mid forceps operation ICD-9-CM 72.2

Mid forceps with episiotomy ICD-9-CM 72.21

Other mid forceps operation ICD-9-CM 72.29

High forceps operation ICD-9-CM 72.3

High forceps operation with episiotomy ICD-9-CM 72.31

Other high forceps operation ICD-9-CM 72.39

Vacuum extraction ICD-9-CM 72.7

Vacuum extraction with episiotomy ICD-9-CM 72.71

**Operative/assisted delivery, April 2002 to December 2010**

## Hospital Inpatient Files intervention codes

Forceps traction and rotation delivery CCI 5MD53.^, 5MD55.^, 5.MD.60.RG, 5.MD.60.JZ,  
5.MD.60.KC, 5.MD.60.RA, 5.MD.60.RE, 5.MD.60.JW, 5.MD.60.RG , 5.MD.60.CB,  
5.MD.60.CC, 5.MD.60.CD, 5.MD.60.CE, 5.MD.60.CF, 5.MD.60.CG

Vacuum traction delivery CCI 5MD54.^, 5MD55.^, 5.MD.60.RD, 5.MD.60.KA, 5.MD.60.KD,  
5.MD.60.RB, 5.MD.60.RF, 5.MD.60.JX, 5.MD.60.RH, 5.MD.60.CB, 5.MD.60.CC,  
5.MD.60.CD, 5.MD.60.CE, 5.MD.60.CF, 5.MD.60.CG

Combination of vacuum and forceps delivery CCI 5MD55.^

Cesarean section delivery CCI 5MD60.^

## Birth Weight Percentiles by Gestational Age for Live Births in Alberta Between 2000 and 2009

### Introduction

The following is an update of Alberta-based norms (Robertson, Svenson, and Kyle, 2002) for births occurring in Alberta between 2000 and 2009.

### Births data

In Alberta, there is a legal requirement to register the birth of a child (whether live or still) with Service Alberta's Vital Statistics office; as such, data for virtually all Alberta births are captured. The data recorded in the Alberta Vital Statistics Birth File includes (but is not limited to) birth weight, gestational age, gender, plurality (singleton, twin, or higher order multiple), and maternal age. The data were obtained primarily from this file.

Data were also obtained from Service Alberta's Vital Statistics Death and Stillbirth Files, and from the Alberta Health Care Insurance Plan Registration File and Hospital Inpatient Files.

### *Inclusions and exclusions*

Stillbirths were excluded from this study. Live births were excluded if gender, birth weight, gestational age, or maternal age were missing from the Vital Statistics database (0.03% of live births).

Also excluded were live births with maternal age less than 10 years (due to implausibility), gestational ages less than 21 weeks or greater than 43 weeks (due to very low frequencies; gestational ages below 21 weeks are also implausible for live births), multiple births of triplets, quadruplets, or higher plurality (due to very low frequencies and likelihood of different gestational age/birth weight distributions from singletons and twins), births to residents of Alberta occurring outside of Alberta (due to unavailability), and births within Alberta to non-residents of Alberta (this study is Alberta-resident based). In total, 1.3% of live births were excluded.

See Table 1 for details of number of exclusions in each category; note that the total number of excluded births is smaller than the sum of the categories of exclusions because some births belonged to more than one exclusion category.

### *Description of dataset*

There were 432,761 live births occurring between January 1, 2000 and December 31, 2009 in Alberta. The dataset contained records for 427,263 live births or 98.7% of live births in Alberta in the ten year time period; see Table 2 for frequency counts of female/male and singleton/twin births.

In this dataset, 48.8% of births were female, and 3.2% were twins. Preterm births (21 to 36 weeks gestation) comprised 8.6% of cases. Low birth weight (less than 2,500 grams) occurred in 6.4% of live births in this dataset.

Frequency distributions of birth weights for each week of gestational age for each gender were visually inspected. Distributions were noted to be generally similar in shape to the normal distribution, with few serious deviations. Skewness and kurtosis values and corresponding standard errors and z-scores were



computed for each week of gestational age, for the four combinations of female/male and singleton/twin. These appear in Tables 3 and 4.

Skewness and kurtosis both have an expected mean of 0 and values between -1 and 1 for normal distributions (Breakwell et al., 2006; Bulmer, 1979). Almost all skewness and kurtosis values fell within this range for our data; a few exceptions occurred at very low and very high gestational ages.

In general, skewness was highest and positive (with heavier tails at higher birth weights than at lower birth weights) at higher gestational ages (35 or 36 to 42 weeks) for singletons. For lower gestational age singleton births, skewness tended to be slightly negative (heavier tails at lower birth weights). For twin births, skewness was variable but slight in general.

Kurtosis values were generally positive for all groups, indicating slightly sharper peaks and heavier tails than the normal distribution, but the deviations from normal were not large. Kurtosis values were highest for singleton births with gestational ages 34 to 39 weeks.

### ***Crude percentile curves***

Percentiles (1, 3, 5, 10, 25, 50, 75, 90, 95, 97, and 99<sup>th</sup>) were calculated for the four combinations of female/male and singleton/twin births. Percentiles were defined using an empirical distribution function with averaging.

### ***Outliers***

The percentile curves were found to be affected by outliers at the highest percentiles (generally 95<sup>th</sup> and above) in lower gestational ages, resulting in non-smooth curves. Specifically, there were live births for which reported birth weights were much higher for a given gestational age than most other births at that gestational age. As an example, Figure 1 shows the crude percentile curves for female singleton live births. There were outliers in the highest (95<sup>th</sup> and above) percentiles at approximately 27 to 31 weeks gestational age. For male singletons, outliers occurred at similar gestational ages, but generally only the 99<sup>th</sup> percentile was affected (Figure 2).

This particular pattern of outliers has been documented previously in the development of birth weight norms (Robertson et al., 2002; Arbuckle, Wilkins, and Sherman, 1993). Varying hypotheses as to the genesis of these outliers have been put forward, and two plausible and testable hypotheses were examined.

The first hypothesis, based on personal correspondence with staff at the Alberta Perinatal Health Program, is the entry of the correct birth weight, but the incorrect entry of infant's gestational age in weeks with the maternal age in years. This is plausible because the gestational ages in weeks at which the outliers were most common (27 to 31 weeks) were also among the most common maternal ages in years (25 to 29 years).

We tested this hypothesis by identifying all records for which reported maternal age in years matched reported infant age in weeks. These records were expected to be a combination of the errors described above and correct records (in which the gestational age in weeks genuinely happened to be the same as maternal age in years). Amongst 1,939 outliers (defined as records with birth weights more than twice the interquartile range higher than the 75<sup>th</sup> percentile or lower than the 25<sup>th</sup> percentile), only 64 (3.3%) had gestational ages in weeks that matched the maternal age in years. While this was twice as high as the 1.6% of non-outliers with such a match, it still represented a very small percentage of the outliers and thus did not suffice as an explanation for most of the outliers.

A second hypothesis concerning data entry errors in the first digit of gestational age was also tested. The large majority of live births occurs within a few weeks of term (40 weeks); however, most birth weight outliers occurred between 27 and 31 weeks. It is possible that many of the outliers actually belonged in the 37 to 41 weeks gestation range (for which their birth weights would be much more appropriate) but that there were data entry errors in the first digit of the outliers (e.g., '27' was entered instead of '37'). To test this hypothesis, we compared the gestational age recorded in the Alberta Vital Statistics Birth File with the gestational age recorded for the same birth in the Hospital Inpatient Files, for both a sample of outliers and for a sample of all records.

Gestational ages differed between data sources in 8.7% of all records and in 26.1% of outliers. Thus, outliers were more likely to have a different (and therefore erroneous in at least one source) gestational age than were the records as a whole. However, the differences were not concentrated at 10 week intervals (only 2.4% of outliers fell into this category), as hypothesized above, and discrepancies only occurred in about one quarter of outliers. Thus, this hypothesis did not suffice as an explanation for most of the outliers.

### ***Final percentile curves***

Although we identified possible sources of error in the birth weights at 27 to 31 weeks gestation, it is not possible to determine which records were in fact erroneous and which were correct. Furthermore, the number of records potentially affected by the two possible error hypotheses above was not large enough to account for a meaningful proportion of the differences.

The possibility remains that the outliers observed at 27 to 31 weeks gestation are in fact correct observations and reflect biological processes of some kind. Evaluation of this hypothesis would require further investigation; however, based on the assumption that the extreme outliers were indeed errors of some kind, a second set of percentiles was calculated following Tukey's procedure of removing outliers that were more than twice the interquartile range higher than the 75<sup>th</sup> percentile or lower than the 25<sup>th</sup> percentile (Tukey, 1977). This procedure resulted in the removal of 1,939 (0.45%) outliers from the dataset, for a total of 425,324 observations used in the final percentile curves. The resulting final birth weight percentiles are in Tables 5 through 8, and percentile curves appear in Figures 3 through 6. Data for percentiles at 41 weeks gestation for both female and male twins are not presented due to low numbers of births (12 and 3, respectively).

### ***Differences over time***

Between 2000 and 2009, average birth weights for singletons and for female twins decreased slightly but consistently each year, with an overall decrease of about 50 grams over the time period. Birth weights for male twins did not show a consistent decrease. Average gestational ages also declined similarly.

The possibility that decreasing average gestational ages were associated with the decrease in average birth weights was examined using two approaches.

In the first approach, the effects of year and gestational age group were examined in a regression model and the effects were not found to interact with one another, suggesting that the decrease in average birth weights is not due primarily to the decreasing average gestational age. Mean birth weights for various groupings are shown in Tables 9, 10, and 11, and Figure 7.

In another approach to determine if the decreasing average birth weights were associated with the decreasing average gestational ages, the gestational age distributions were standardized. The year 2000 was arbitrarily chosen as the standard and the proportions of births at each of the gestational age weeks from 21 to 43 in the year 2000 were used as weights for those weeks for each of the years 2001 to 2009. The standardized mean birth weight for each year was then produced, allowing for a visual inspection of the decrease in average birth weights independent of changes in gestational age distribution from year to year. Results are shown in Figures 8 and 9.

Figure 8 (singletons) shows that there is still a decrease in average birth weights even after standardizing gestational age distributions, suggesting that the decreasing gestational ages contribute to the decreasing average birth weights for singletons but are not the only contributor. Figure 9 (twins) suggests that decreasing gestational ages do not appear to meaningfully contribute to the decreasing average birth weights.

Thus, Albertan babies were born slightly earlier and weighing slightly less in 2009 than they were in 2000. This trend could be the result of changes in the population of mothers (such as changes in their physical statures, in their overall health, in their risk factor behaviours, in their reproductive care choices, etc.), in the reproductive care practices affecting these mothers, or in any of the many other factors known to affect birth weight and gestational age. Given the strong association between birth weight and gestational age and birth outcomes, however, it will be important to monitor these trends and further investigate their underlying causes.

Incidentally, this finding is in contrast to an increasing trend in Albertan birth weight for 1985 to 1998 for term (38 to 42 weeks gestation) singletons found by Robertson et al. (2002; note that they reported a decreasing trend in birth weight for female twins and female singletons of 33 to 35 weeks gestation). Although the changes in birth weight are slight, it is of interest that the direction of the effect has changed from one decade to the next.

## Discussion

The percentile tables and figures presented here constitute current norms for the birth weights of Alberta liveborn infants. While the norms are similar to previous versions, they reflect the particular characteristics of, and ongoing changes in, the demographics and reproductive outcomes of Albertans. As such, they are the most appropriate percentiles for use with Albertan liveborns from 2000 onward.

The data demonstrated a slight decreasing trend in average birth weights over for male singletons 33 weeks and over, female singletons, and female twins, and a slight decreasing trend in mean gestational age over time for singletons. As such, the interpretation of small- and large-for-gestational-age status for an infant, and indeed of the validity of the concept of small- and large-for-gestational-age, must be tempered with a discussion of changes in the entire population.

The reader is reminded that these data are cross-sectional data for live births, and are not longitudinal growth curves for fetal development. These data are, however, quite appropriate for the determination of small- and large-for-gestational-age status of liveborn infants, as small- and large-for-gestational-age status is determined by 10<sup>th</sup> and 90<sup>th</sup> birth weight percentiles.

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Table 1 Live births 2000 to 2009 and Exclusions

<b>Live births</b>	
Before exclusions	432,761
After exclusions	427,263
Total excluded	5,498
Percent included in raw percentiles	98.7%
<b>Exclusions detail</b>	
Missing gender	5
Missing birth weight	5
Missing gestational age	13
Missing maternal age	94
Maternal age less than 10 years	3
Gestational age 1 to 21 weeks	254
Gestational age over 43 weeks	26
Triplets and higher pluralities	466
Non-Alberta residents	4,682

Table 2 Live Births by Sex and Plurality

	<b>Singleton</b>	<b>Twin</b>	<b>Total</b>
<b>Female</b>	201,789	6,772	208,561
<b>Male</b>	211,978	6,724	218,702
<b>Total</b>	413,767	13,496	427,263

Table 3 Number of Births, Skewness, and Kurtosis by Gestational Age and Sex, Singleton Live Births, Alberta, 2000 to 2009 Combined

Female							
Gestational age (weeks)	Number of births	Skewness			Kurtosis		
		Value	SE	Z	Value	SE	Z
21	92	0.17	0.26	0.65	-0.19	0.51	-0.38
22	95	-0.04	0.25	-0.17	0.47	0.50	0.95
23	74	-0.09	0.28	-0.32	0.33	0.56	0.58
24	97	0.27	0.25	1.10	-0.08	0.49	-0.17
25	110	-0.04	0.23	-0.19	-0.18	0.46	-0.39
26	136	-0.17	0.21	-0.81	0.75	0.41	1.80
27	161	-0.17	0.20	-0.86	-0.22	0.39	-0.56
28	189	0.13	0.18	0.71	0.33	0.36	0.91
29	213	-0.24	0.17	-1.39	0.31	0.34	0.91
30	266	-0.08	0.15	-0.50	0.68	0.31	2.23
31	388	0.20	0.13	1.63	0.36	0.25	1.42
32	591	0.20	0.10	1.96	0.34	0.20	1.67
33	793	-0.14	0.09	-1.59	0.15	0.17	0.88
34	1,582	0.05	0.06	0.77	0.42	0.12	3.39
35	2,618	0.17	0.05	3.49	0.36	0.10	3.74
36	5,757	0.18	0.03	5.61	0.13	0.06	1.98
37	12,575	0.21	0.02	9.54	0.20	0.04	4.52
38	33,324	0.19	0.01	14.13	0.12	0.03	4.61
39	51,752	0.21	0.01	19.21	0.08	0.02	3.75
40	59,580	0.19	0.01	18.80	0.03	0.02	1.60
41	29,865	0.20	0.01	13.86	-0.02	0.03	-0.73
42	1,482	0.21	0.06	3.38	0.01	0.13	0.10
43	49	-0.14	0.34	-0.40	-0.06	0.67	-0.09

Male							
Gestational age (weeks)	Number of births	Skewness			Kurtosis		
		Value	SE	Z	Value	SE	Z
21	90	0.43	0.26	1.65	0.18	0.51	0.35
22	135	-0.35	0.21	-1.65	0.09	0.42	0.21
23	104	0.17	0.24	0.70	0.71	0.48	1.47
24	114	0.10	0.23	0.42	0.26	0.46	0.57
25	113	-0.21	0.23	-0.92	-0.13	0.45	-0.28
26	170	0.10	0.19	0.56	1.06	0.37	2.82
27	192	-0.24	0.18	-1.37	0.76	0.35	2.16
28	197	-0.22	0.17	-1.28	0.16	0.35	0.45
29	243	-0.18	0.16	-1.12	0.07	0.32	0.24
30	348	0.09	0.13	0.71	0.40	0.26	1.53
31	471	-0.06	0.11	-0.49	0.30	0.23	1.30
32	710	0.00	0.09	-0.05	0.49	0.18	2.65
33	1,116	-0.05	0.07	-0.64	0.46	0.15	3.13
34	1,964	0.06	0.06	1.03	0.29	0.11	2.59
35	3,135	-0.01	0.04	-0.19	0.32	0.09	3.60
36	6,797	0.18	0.03	6.02	0.23	0.06	3.89
37	14,232	0.16	0.02	7.69	0.17	0.04	4.12
38	35,910	0.18	0.01	13.51	0.11	0.03	4.17
39	53,242	0.20	0.01	18.36	0.10	0.02	4.58
40	59,509	0.17	0.01	17.40	0.05	0.02	2.25
41	31,340	0.18	0.01	13.09	0.01	0.03	0.52
42	1,782	0.23	0.06	3.94	0.00	0.12	0.01
43	64	0.01	0.31	0.04	0.03	0.60	0.05

Table 4 Number of Births, Skewness, and Kurtosis by Gestational Age and Sex, Twin Live Births, Alberta, 2000 to 2009 Combined

Female							
Gestational age (weeks)	Number of births	Skewness			Kurtosis		
		Value	SE	Z	Value	SE	Z
21	25	0.64	0.46	1.38	-0.42	0.90	-0.47
22	22	-0.35	0.49	-0.72	-0.50	0.95	-0.52
23	33	0.82	0.43	1.93	0.43	0.83	0.52
24	24	0.12	0.47	0.26	0.57	0.92	0.62
25	34	-0.68	0.42	-1.62	2.13	0.82	2.60
26	40	0.07	0.37	0.19	-0.60	0.73	-0.82
27	41	0.36	0.38	0.95	1.15	0.74	1.55
28	59	-0.67	0.31	-2.16	0.31	0.61	0.50
29	97	-0.27	0.25	-1.08	0.09	0.49	0.18
30	118	-0.45	0.22	-2.02	0.08	0.44	0.19
31	161	-0.44	0.19	-2.30	0.68	0.38	1.78
32	310	-0.04	0.14	-0.30	0.18	0.28	0.65
33	337	-0.10	0.13	-0.76	0.06	0.27	0.24
34	578	0.01	0.10	0.06	0.14	0.20	0.69
35	748	-0.16	0.09	-1.83	-0.09	0.18	-0.51
36	1,146	0.13	0.07	1.83	-0.12	0.14	-0.80
37	1,678	0.15	0.06	2.50	0.12	0.12	1.01
38	1,072	0.17	0.07	2.21	0.07	0.15	0.50
39	200	-0.22	0.17	-1.30	0.50	0.34	1.45
40	37	0.50	0.39	1.30	-0.02	0.76	-0.02
41	12	0.72	0.64	1.13	1.25	1.23	1.02

Male							
Gestational age (weeks)	Number of births	Skewness			Kurtosis		
		Value	SE	Z	Value	SE	Z
21	25	-0.68	0.47	-1.45	-0.13	0.92	-0.14
22	20	-0.34	0.51	-0.67	-0.54	0.99	-0.55
23	25	-0.32	0.46	-0.69	0.21	0.90	0.23
24	45	-0.22	0.35	-0.62	-0.73	0.69	-1.05
25	30	-0.16	0.43	-0.36	-0.74	0.83	-0.89
26	50	-0.03	0.34	-0.10	0.82	0.66	1.24
27	61	-0.24	0.31	-0.78	0.43	0.60	0.71
28	72	-0.76	0.29	-2.67	0.56	0.57	0.98
29	81	-0.18	0.27	-0.66	0.04	0.53	0.07
30	132	-0.30	0.21	-1.41	0.36	0.42	0.85
31	165	-0.14	0.19	-0.73	0.28	0.38	0.74
32	276	-0.22	0.15	-1.51	0.17	0.30	0.58
33	352	-0.23	0.13	-1.77	0.09	0.26	0.36
34	553	-0.10	0.10	-0.93	-0.17	0.21	-0.82
35	734	-0.05	0.09	-0.54	0.12	0.18	0.69
36	1,164	0.05	0.07	0.72	-0.07	0.14	-0.46
37	1,643	0.09	0.06	1.52	-0.09	0.12	-0.76
38	1,091	0.18	0.07	2.44	0.25	0.15	1.72
39	164	0.02	0.19	0.13	-0.10	0.38	-0.27
40	38	0.17	0.39	0.44	0.16	0.76	0.22
41	3	-1.47	1.22	-1.20	.	.	.



Table 5 Percentiles for Birth Weight (in grams) by Gestational Age, Singleton Female Live Births with Outliers Removed, Alberta, 2000 to 2009

Gestational age (weeks)	Number of live births	Percentile										
		1	3	5	10	25	50	75	90	95	97	99
21	88	235	260	275	295	349	385	428	496	500	500	560
22	92	280	350	355	392	435	475	513	540	591	620	640
23	71	375	400	415	449	510	550	590	630	640	690	726
24	95	480	500	502	536	580	650	725	770	790	800	960
25	107	500	520	560	600	670	750	820	885	935	950	995
26	135	530	560	610	700	790	870	965	1,030	1,098	1,115	1,225
27	152	530	550	550	680	795	970	1,095	1,200	1,240	1,280	1,330
28	178	570	670	720	800	930	1,100	1,250	1,371	1,480	1,500	1,780
29	199	500	752	780	890	1,110	1,280	1,430	1,570	1,680	1,740	1,924
30	251	750	850	970	1,100	1,299	1,460	1,610	1,755	1,870	1,980	2,190
31	379	910	1,020	1,050	1,185	1,400	1,600	1,790	1,996	2,105	2,250	2,460
32	572	1,075	1,200	1,260	1,395	1,633	1,815	2,030	2,250	2,420	2,540	2,764
33	779	1,150	1,260	1,375	1,540	1,796	2,030	2,230	2,440	2,570	2,650	2,870
34	1,556	1,343	1,570	1,680	1,850	2,060	2,293	2,504	2,760	2,945	3,070	3,200
35	2,589	1,535	1,790	1,884	2,040	2,290	2,528	2,784	3,070	3,266	3,410	3,605
36	5,706	1,827	2,010	2,102	2,251	2,500	2,760	3,049	3,345	3,535	3,660	3,847
37	12,481	2,040	2,224	2,330	2,480	2,710	2,975	3,255	3,540	3,725	3,850	4,080
38	33,175	2,277	2,454	2,556	2,699	2,930	3,196	3,480	3,750	3,925	4,049	4,270
39	51,551	2,465	2,631	2,718	2,854	3,078	3,340	3,620	3,890	4,060	4,180	4,394
40	59,389	2,597	2,767	2,858	2,991	3,220	3,490	3,770	4,040	4,213	4,327	4,540
41	29,787	2,706	2,867	2,955	3,090	3,330	3,605	3,890	4,168	4,345	4,460	4,665
42	1,479	2,664	2,855	2,965	3,110	3,370	3,670	3,984	4,312	4,480	4,597	4,900
43	49	2,415	2,585	2,690	2,845	3,300	3,415	3,820	4,090	4,196	4,293	4,610

Table 6 Percentiles for Birth Weight (in grams) by Gestational Age, Singleton Male Live Births with Outliers Removed, Alberta, 2000 to 2009

Gestational age (weeks)	Number of live births	Percentile										
		1	3	5	10	25	50	75	90	95	97	99
21	87	244	310	320	340	380	420	480	535	570	620	640
22	132	280	320	332	363	448	496	546	594	635	636	670
23	98	400	415	467	490	540	585	640	674	714	745	830
24	110	460	480	490	548	620	700	760	806	870	910	976
25	112	530	557	575	640	730	765	848	910	950	966	970
26	166	500	530	650	725	804	910	1,010	1,090	1,130	1,180	1,430
27	188	520	640	690	790	940	1,040	1,178	1,260	1,370	1,400	1,569
28	193	520	580	680	830	970	1,170	1,300	1,450	1,540	1,570	1,702
29	236	700	790	860	930	1,133	1,290	1,460	1,575	1,650	1,700	1,860
30	337	800	920	980	1,090	1,300	1,500	1,640	1,815	1,960	2,100	2,260
31	459	920	1,020	1,100	1,250	1,490	1,700	1,883	2,080	2,227	2,290	2,545
32	698	1,095	1,240	1,310	1,442	1,720	1,910	2,140	2,305	2,470	2,646	2,826
33	1,101	1,260	1,395	1,489	1,695	1,915	2,135	2,345	2,560	2,700	2,820	3,045
34	1,930	1,470	1,610	1,725	1,890	2,155	2,381	2,614	2,850	3,055	3,170	3,355
35	3,097	1,600	1,775	1,920	2,120	2,363	2,610	2,866	3,130	3,307	3,418	3,627
36	6,742	1,880	2,069	2,180	2,350	2,600	2,858	3,145	3,437	3,622	3,785	4,000
37	14,146	2,105	2,295	2,400	2,557	2,801	3,079	3,365	3,650	3,838	3,960	4,195
38	35,735	2,370	2,556	2,650	2,805	3,047	3,320	3,610	3,890	4,070	4,195	4,420
39	53,035	2,550	2,737	2,830	2,970	3,207	3,480	3,760	4,040	4,220	4,345	4,557
40	59,341	2,690	2,870	2,962	3,105	3,350	3,629	3,920	4,200	4,373	4,489	4,719
41	31,257	2,800	2,980	3,079	3,220	3,470	3,750	4,055	4,345	4,525	4,645	4,860
42	1,777	2,820	3,026	3,136	3,260	3,533	3,840	4,156	4,480	4,650	4,790	5,048
43	61	2,750	2,995	3,180	3,250	3,430	3,690	3,977	4,060	4,284	4,389	4,600

Table 7 Percentiles for Birth Weight (in grams) by Gestational Age, Twin Female Live Births with Outliers Removed, Alberta, 2000 to 2009

Gestational age (weeks)	Number of live births	Percentile										
		1	3	5	10	25	50	75	90	95	97	99
21	25	225	225	260	280	315	358	471	540	575	575	575
22	22	340	340	355	362	417	458	480	510	530	538	538
23	30	445	445	460	470	500	520	550	621	627	635	635
24	24	486	486	512	550	598	645	675	730	730	815	815
25	31	284	284	440	570	612	670	770	830	900	940	940
26	40	510	590	595	675	705	805	935	1,020	1,045	1,050	1,130
27	39	570	690	690	720	855	950	1,050	1,150	1,260	1,260	1,440
28	59	450	640	650	720	940	1,090	1,234	1,310	1,350	1,440	1,470
29	96	630	760	790	910	1,060	1,234	1,340	1,505	1,557	1,618	1,730
30	118	650	840	860	933	1,160	1,325	1,490	1,600	1,640	1,690	1,760
31	160	830	910	1,070	1,215	1,420	1,559	1,733	1,869	1,915	1,990	2,120
32	308	1,060	1,220	1,295	1,338	1,560	1,738	1,932	2,070	2,140	2,200	2,489
33	335	1,140	1,310	1,400	1,520	1,703	1,920	2,110	2,260	2,360	2,485	2,581
34	576	1,350	1,515	1,565	1,700	1,900	2,080	2,280	2,445	2,560	2,630	2,844
35	747	1,460	1,630	1,720	1,835	2,060	2,290	2,500	2,660	2,792	2,859	2,980
36	1,142	1,784	1,879	1,938	2,062	2,255	2,485	2,695	2,910	3,072	3,132	3,285
37	1,668	1,853	2,030	2,121	2,220	2,425	2,635	2,869	3,084	3,225	3,340	3,510
38	1,069	2,008	2,165	2,239	2,352	2,555	2,790	3,010	3,246	3,390	3,490	3,665
39	199	1,817	2,220	2,280	2,444	2,700	2,930	3,160	3,350	3,470	3,650	3,767
40	37	2,245	2,555	2,555	2,590	2,795	2,974	3,210	3,735	3,800	3,800	3,808

Table 8 Percentiles for Birth Weight (in grams) by Gestational Age, Twin Male Live Births with Outliers Removed, Alberta, 2000 to 2009

Gestational age (weeks)	Number of live births	Percentile										
		1	3	5	10	25	50	75	90	95	97	99
21	24	330	330	350	355	406	453	480	500	510	520	520
22	20	372	372	381	398	452	491	535	566	576	580	580
23	25	340	340	410	450	494	560	610	690	710	720	720
24	45	430	500	500	520	620	670	780	820	830	840	870
25	30	530	530	580	600	670	716	797	840	870	880	880
26	50	410	550	650	680	780	874	990	1,070	1,200	1,220	1,260
27	61	600	790	820	844	910	1,050	1,124	1,180	1,240	1,320	1,390
28	70	660	690	800	845	1,050	1,190	1,260	1,320	1,440	1,460	1,500
29	80	900	1,010	1,045	1,090	1,260	1,388	1,475	1,591	1,630	1,670	1,890
30	129	910	940	980	1,120	1,323	1,415	1,590	1,720	1,750	1,820	1,940
31	162	1,160	1,219	1,260	1,356	1,560	1,700	1,800	1,930	2,020	2,108	2,260
32	269	1,160	1,280	1,310	1,460	1,645	1,830	1,990	2,130	2,230	2,300	2,478
33	350	1,236	1,407	1,516	1,618	1,823	2,004	2,170	2,340	2,445	2,512	2,620
34	550	1,435	1,570	1,660	1,763	2,000	2,205	2,422	2,634	2,730	2,821	2,925
35	732	1,555	1,690	1,763	1,895	2,128	2,369	2,576	2,760	2,930	3,070	3,190
36	1,162	1,790	1,920	2,001	2,112	2,325	2,560	2,770	3,005	3,119	3,219	3,362
37	1,639	1,955	2,110	2,190	2,310	2,520	2,770	3,007	3,240	3,375	3,456	3,645
38	1,087	2,075	2,240	2,335	2,468	2,666	2,888	3,127	3,346	3,505	3,625	3,805
39	164	1,895	2,210	2,375	2,451	2,700	2,965	3,257	3,500	3,620	3,875	3,950
40	37	2,473	2,515	2,515	2,790	2,955	3,220	3,315	3,543	3,764	3,764	3,974

Table 9 Mean Birth Weight (grams) by Sex and Plurality, Alberta, 2000 to 2009

Year	Singleton		Twin	
	Female	Male	Female	Male
2000	3,354	3,473	2,373	2,422
2001	3,358	3,477	2,375	2,472
2002	3,355	3,466	2,324	2,405
2003	3,346	3,462	2,368	2,386
2004	3,336	3,452	2,327	2,434
2005	3,330	3,431	2,340	2,459
2006	3,311	3,434	2,378	2,420
2007	3,319	3,434	2,337	2,459
2008	3,319	3,433	2,273	2,415
2009	3,304	3,425	2,325	2,408

Table 10 Mean Gestational Age (weeks) by Sex and Plurality, Alberta, 2000 to 2009

Year	Singleton		Twin	
	Male	Female	Male	Female
2000	39.02	39.11	35.33	35.47
2001	39.05	39.14	35.45	35.49
2002	38.98	39.08	35.17	35.24
2003	38.98	39.06	34.92	35.19
2004	38.93	39.00	35.06	35.18
2005	38.87	38.99	35.51	35.26
2006	38.87	38.93	35.23	35.53
2007	38.91	38.96	35.48	35.46
2008	38.88	38.95	35.11	35.05
2009	38.88	38.93	35.19	35.32

Table 11 Mean Birth Weight (grams) by Gestational Age Group and Sex, Live Births, Alberta, 2000 to 2009

Year	Singleton					
	Early preterm (<33 weeks)		Late preterm (33 to 36 weeks)		Term or later (37 to 43 weeks)	
	Male	Female	Male	Female	Male	Female
2000	1,330	1,274	2,737	2,638	3,551	3,420
2001	1,358	1,288	2,697	2,608	3,554	3,423
2002	1,309	1,310	2,710	2,607	3,547	3,420
2003	1,344	1,360	2,709	2,636	3,541	3,411
2004	1,390	1,297	2,712	2,619	3,533	3,402
2005	1,280	1,311	2,669	2,622	3,522	3,399
2006	1,379	1,264	2,656	2,549	3,517	3,382
2007	1,372	1,258	2,638	2,587	3,513	3,387
2008	1,366	1,254	2,643	2,563	3,512	3,386
2009	1,368	1,255	2,631	2,567	3,507	3,370

Year	Twin					
	Early preterm (<33 weeks)		Late preterm (33 to 36 weeks)		Term or later (37 to 43 weeks)	
	Male	Female	Male	Female	Male	Female
2000	1,319	1,403	2,355	2,242	2,817	2,761
2001	1,393	1,326	2,393	2,275	2,853	2,766
2002	1,313	1,255	2,359	2,280	2,831	2,692
2003	1,344	1,345	2,323	2,343	2,881	2,777
2004	1,351	1,249	2,432	2,291	2,846	2,721
2005	1,464	1,301	2,355	2,266	2,817	2,737
2006	1,384	1,434	2,365	2,323	2,827	2,698
2007	1,373	1,336	2,374	2,233	2,845	2,731
2008	1,347	1,274	2,340	2,264	2,845	2,689
2009	1,449	1,327	2,353	2,251	2,795	2,689

Figure 1 Crude Birth Weight Percentiles, Female Singleton Live Births, Alberta, 2000 to 2009 Combined

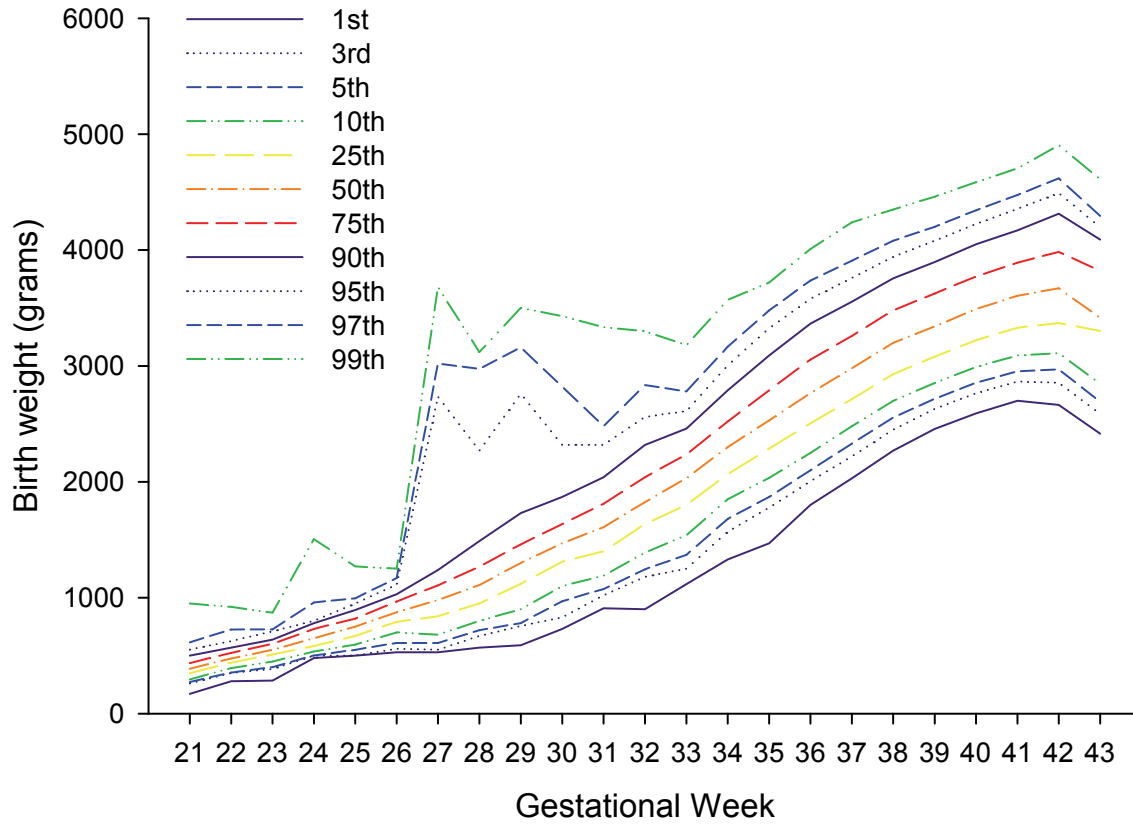


Figure 2 Crude Birth Weight Percentiles, Male Singleton Live Births, Alberta, 2000 to 2009 Combined

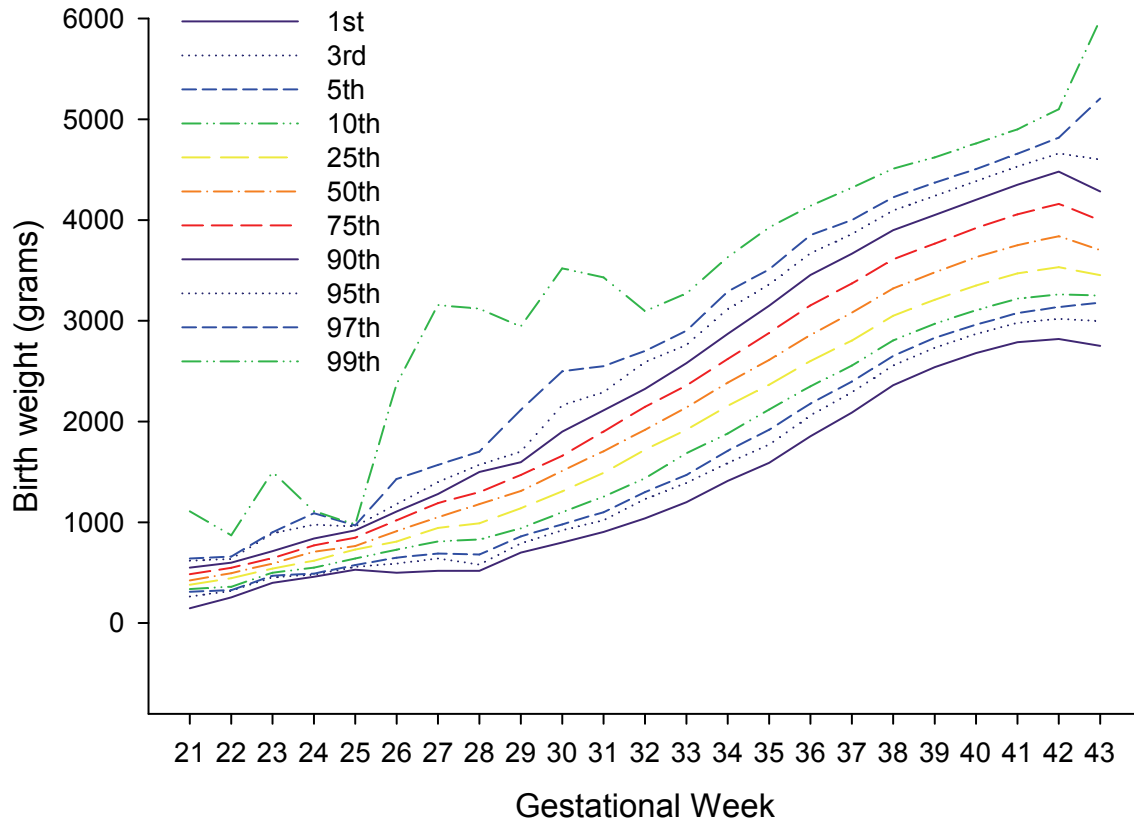


Figure 3 Birth Weight Percentiles, Female Singleton Live Births with Outliers Removed, Alberta, 2000 to 2009 Combined

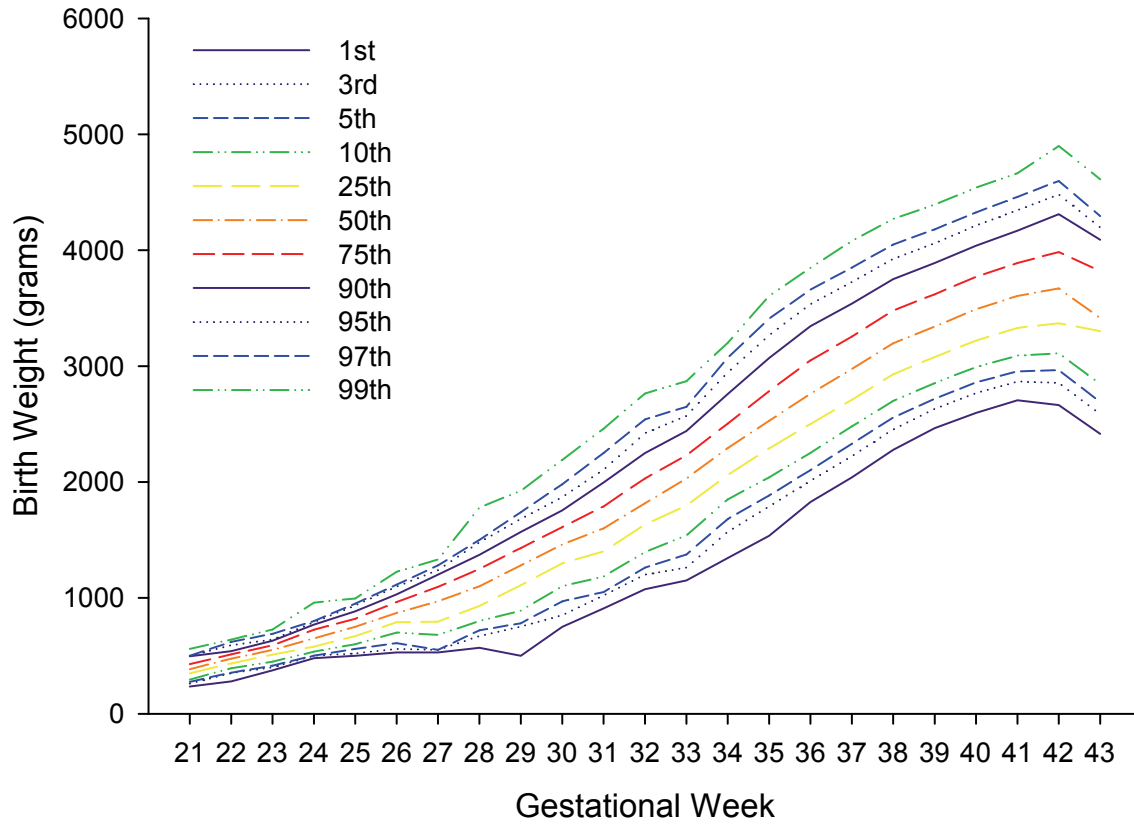


Figure 4 Birth Weight Percentiles, Male Singleton Live Births with Outliers Removed, Alberta, 2000 to 2009 Combined

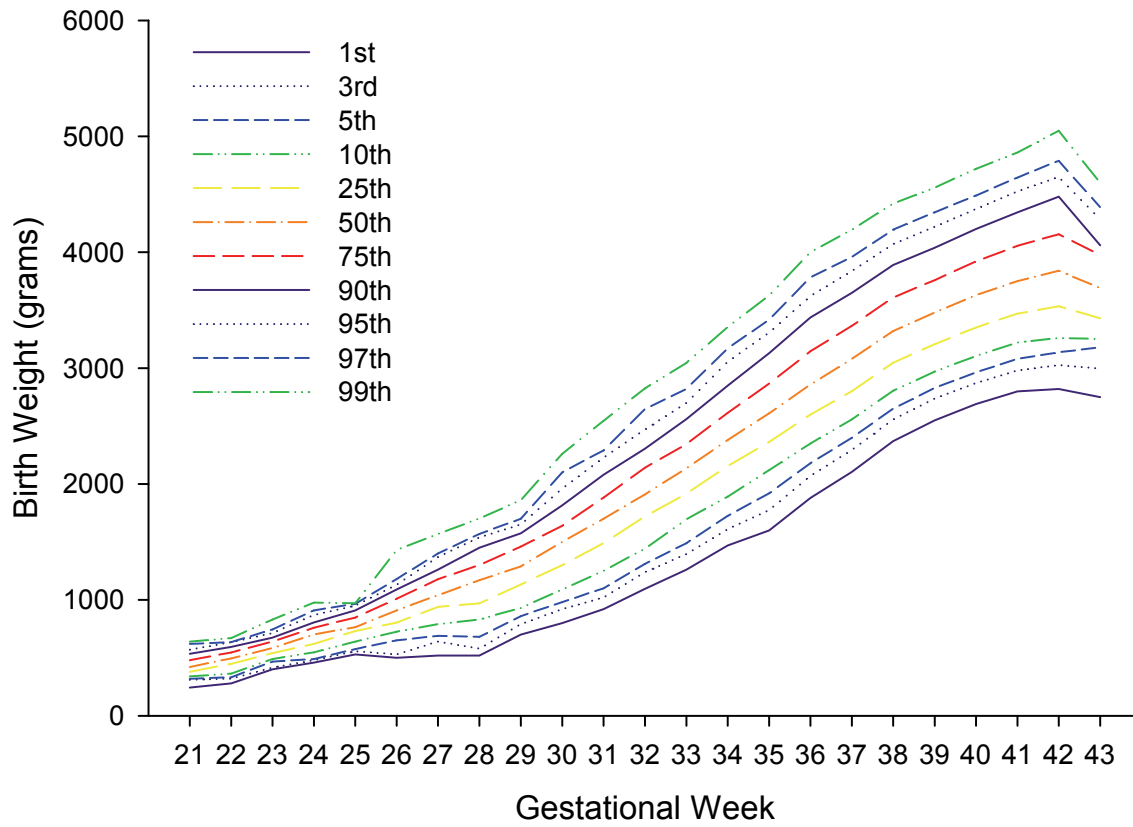


Figure 5 Birth Weight Percentiles, Female Twin Live Births with Outliers Removed, Alberta, 2000 to 2009 Combined

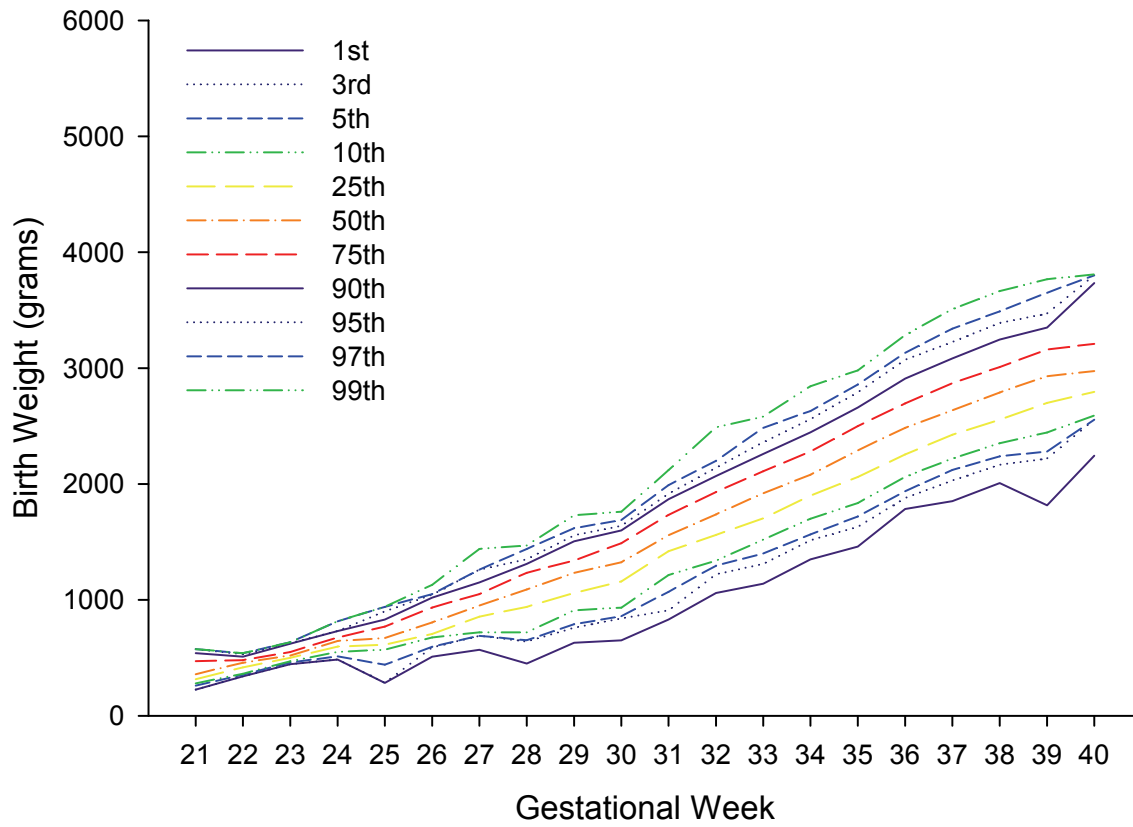




Figure 6 Birth Weight Percentiles, Male Twin Live Births with Outliers Removed, Alberta, 2000 to 2009 Combined

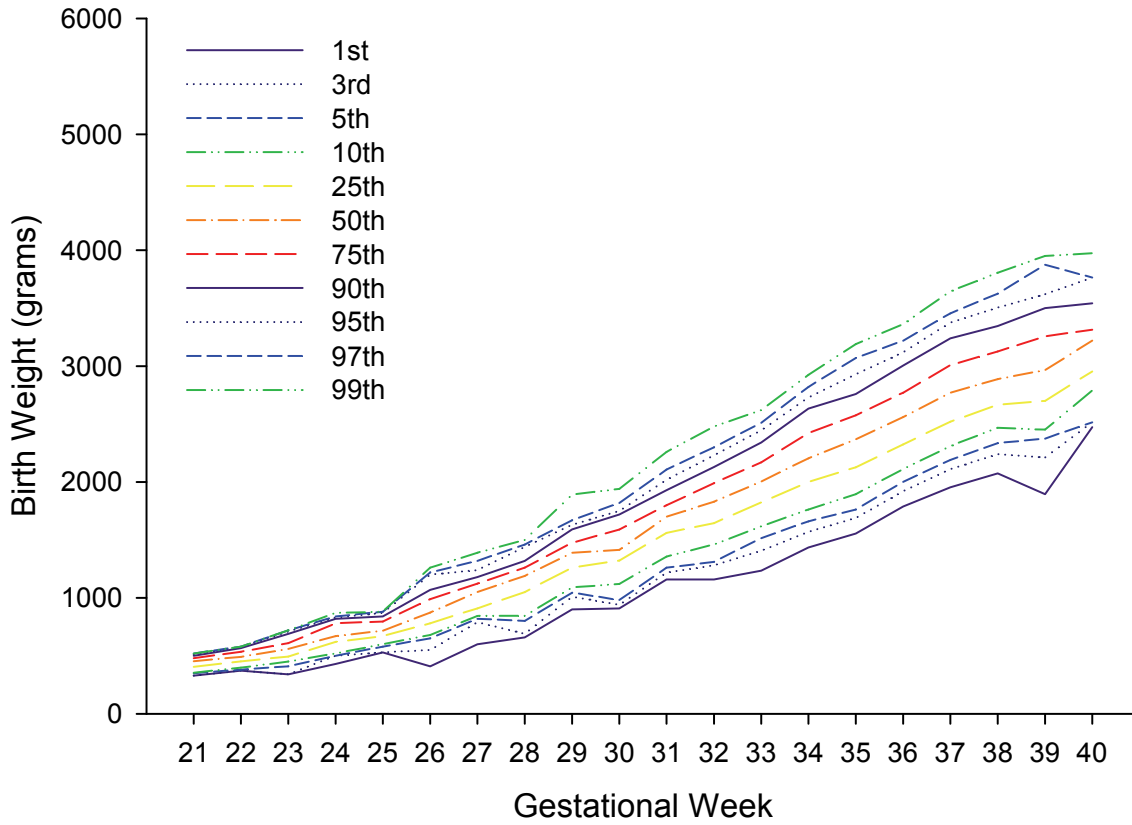


Figure 7 Mean Birth Weight, Sex by Plurality, Alberta, 2000 to 2009

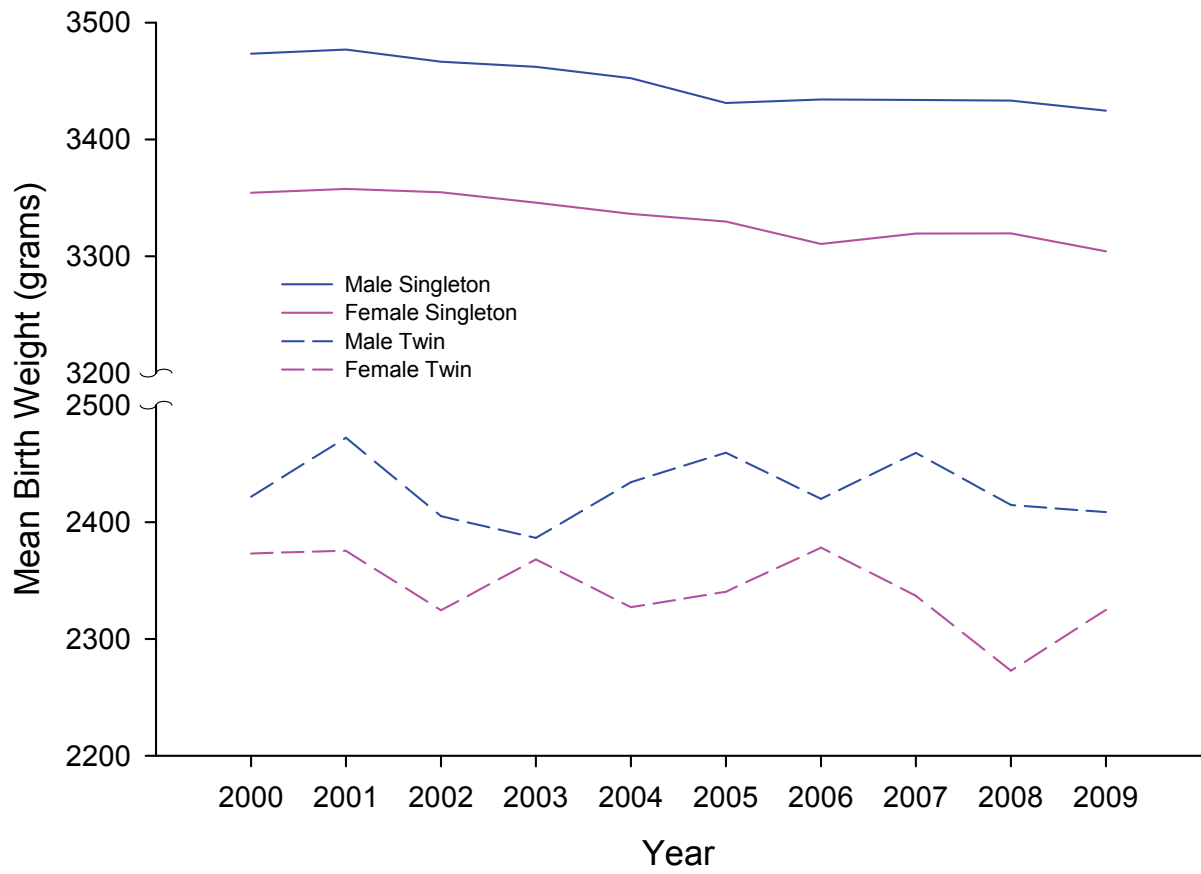


Figure 8. Mean Birth Weight, Gestational Age Standardized vs. Original Data, Singletons, Alberta, 2000 to 2009

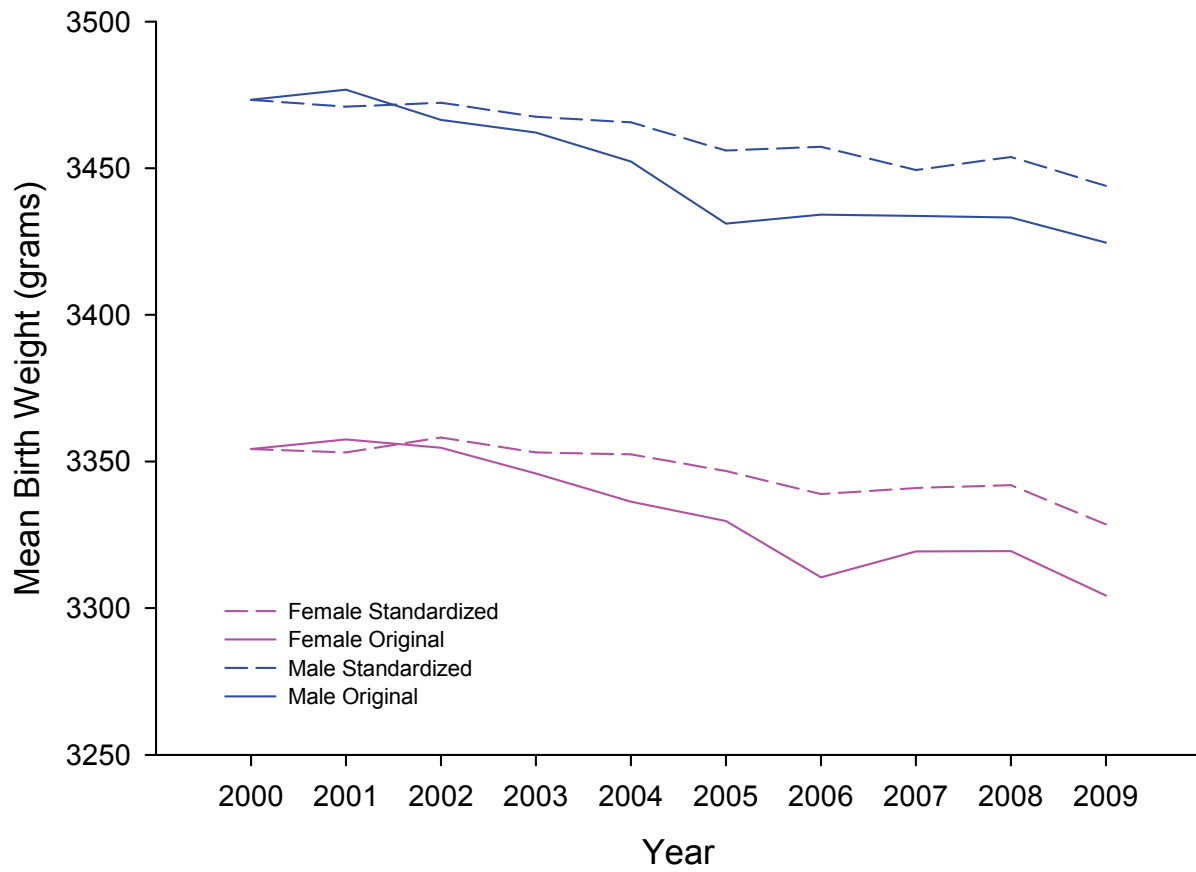
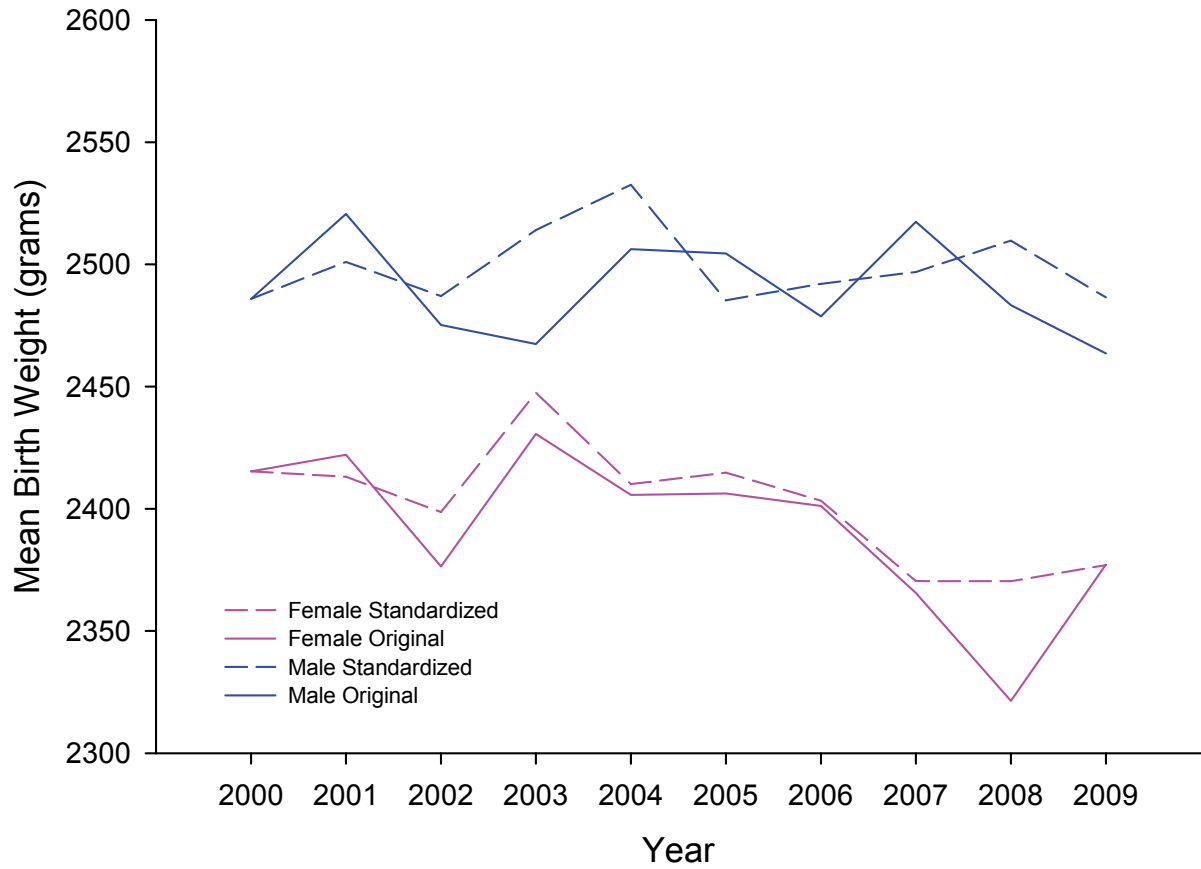


Figure 9. Mean Birth Weight, Gestational Age Standardized vs. Original Data, Twins, Alberta, 2000 to 2009



## Maternal and Infant Severe Morbidity Rates in Deliveries to Candidates for Vaginal Delivery

### Question

*How do the maternal and infant morbidity rates for deliveries to candidates for vaginal delivery who actually proceed to vaginal delivery differ from the morbidity rates for deliveries to candidates for vaginal delivery who instead proceed to cesarean section?*

In the current context, candidates for term vaginal delivery are those pregnant women who arrive at term in the absence of medical indication for cesarean.

Cesarean sections can occur on an emergency (intrapartum) basis or on an elective (planned in the antepartum period) basis. Emergency cesareans are medically indicated. Elective cesareans can be medically indicated or can be elected by patient or caregiver for non-medical reasons (e.g., maternal request, physician/facility availability, physician preference, etc.).

Anecdotal reports suggest that an increase in the rate of cesarean deliveries without maternal or fetal medical indication (“non-indicated cesareans”) is contributing to an increasing trend in the rate of cesarean delivery. Because cesarean section deliveries are major abdominal surgeries with significant post-operative morbidity rates, it is of interest whether non-indicated cesareans are contributing to an increased burden of morbidity for Alberta’s women and children.

The current study provides evidence that maternal morbidity rates are indeed higher in non-indicated cesareans than other selected categories of deliveries. In most (but not all) comparisons, these higher maternal morbidity rates are not accompanied by lower rates of infant morbidity but rather by higher rates of infant morbidity. Our analyses indicate that as many as 100 serious maternal morbidities and nearly 200 serious infant morbidities could be avoided in Alberta every year, in the absence of non-indicated cesareans.

### Background

Ideally, we would like to compare outcomes for non-indicated elective cesarean deliveries to outcomes for vaginal deliveries (i.e., Do morbidity rates associated with non-indicated elective cesareans differ from those associated with the vaginal deliveries these women might have progressed to?). Unfortunately, election for cesarean section is not coded in pregnancy- and birth-related databases in most jurisdictions, including Alberta. We must look instead at proxy measures for non-indicated elective cesareans.

Use of administrative data allows us to identify some medically-indicated cesareans. We can eliminate deliveries containing indications for emergency or planned cesarean, including medical conditions and labour complications. We can also eliminate deliveries with documented labour induction (labour induction does not occur in the case of a planned cesarean). Elimination of these deliveries results in what can be called a *best-available data* cohort for vaginal delivery (i.e., the best available data for indication were used) and allows us to claim, with a reasonable degree of confidence, to be studying deliveries among candidates for vaginal delivery. This method will of course fail to exclude those deliveries for which indication for cesarean was undocumented.

A conservative version of this method (the *conservative best-available data* method) limits the deliveries of interest to breech presentation deliveries only (excluding cephalic presentation deliveries). Most deliveries of babies presenting in breech position now occur by cesarean section, primarily due to physician preference and concomitant declining lack of expertise in breech deliveries, rather than due to medical indication. This tendency to deliver babies in breech position by cesarean section was influenced by widespread dissemination of the results of the Term Breech Trial (e.g., Hannah et al., 2000), which seemed to show that cesarean deliveries for breech births were safer. See Kotaska et al., 2009 for a critical analysis of the Term Breech Trial findings.

Limiting the cohort of interest to deliveries with no documented medical indications, no labour induction, and breech presentation is the most conservative approach to identifying deliveries in which there is no indication for cesarean section, reducing the risk of inclusion of undocumented indications even further than when cephalic deliveries are included. This will be referred to as the *conservative best-available data* cohort. Cesarean breech deliveries with no medical indications for cesarean and no labour induction are used as the proxy for non-indicated elective cesareans. One drawback of this approach is the relative rarity of cesarean breech deliveries with no medical indications for cesarean and no labour induction, reducing statistical power in comparisons involving this small group of deliveries.

In the two *best-available data* cohorts described above, included were all of the deliveries that, given all available information, were candidates for successful vaginal delivery. Some of these deliveries were indeed vaginal, and some were cesarean. Given the similarity of these two groups in terms of indications and absence of labour complications or induction, it can be assumed that outcome differences were largely (but certainly not entirely) a function of delivery method (rather than indication). In other words, the vaginal and cesarean groups were similar in indications for delivery, but differed in exposure to cesarean section, making differences in outcomes due to exposure to delivery method. This logic forms the basis of the design used in this project.

In the study described herein, outcomes for cesarean deliveries were compared to outcomes for vaginal deliveries, within the *best-available data* and *conservative best-available data* cohorts. Infant outcomes as well as maternal outcomes were considered. Comparisons similar (but not identical) to those other studies (described below) were also made.

## Methodology

An Alberta deliveries cohort was developed, consisting of all deliveries (N=570,944) of live infants in hospitals in Alberta between April 1, 1995 and March 31, 2009; these data were obtained from linkage between Service Alberta's Vital Statistics files and Alberta Health and Wellness' Hospital Inpatient files and Fee-for-Service Claims files.

The cohort of deliveries was then narrowed to those for which there was no documented indication for elective cesarean or poor infant outcome (i.e., a cohort of candidates for vaginal deliveries with expected good infant outcome). Note that analyses were based on deliveries, not on women (unlike some previous studies).

Deliveries excluded from analyses:

- 9,191 deliveries (1.6% of 570,944) to women with unknown health care numbers in the Vital Statistics files; health care numbers were needed to link to Hospital Inpatient Files and Fee-for-Service Claims files on the deliveries and infants.
- 71,301 deliveries (12.4%) belonging to categories known to be associated with increased need for cesarean deliveries and increased rates of poor infant outcomes, including multiple pregnancies (twins, triplets, or higher order), preterm (<37 weeks gestation) or post-term (>42 weeks gestation) deliveries, and deliveries of liveborns with subsequent diagnoses of congenital anomalies within one year of birth. These outcomes were determined via linkage to Service Alberta's Vital Statistics files.
- 4,659 deliveries (0.8%) to women with previous cesarean deliveries or previous uterine rupture (these women have a high likelihood of cesarean delivery), as determined from Hospital Inpatient files.
- 95,155 deliveries (16.7%) to women with possible medical indications for elective cesarean section (see list in Appendix I), as determined from Fee-for-Service Claims files.

Following the exclusion of the 180,306 deliveries (31.6% of the 570,944 deliveries) described above, a cohort of 390,638 deliveries remained (68.4% of all hospital deliveries of live infants over the 14 year time period).

Given all of the information available in the databases used, the deliveries in this cohort had no known indications for elective cesarean section. Up to the point of labour, they were (as well as can be identified from Inpatient Hospital and Vital Statistics files) candidates for vaginal delivery.

Deliveries in our cohort were divided into a total of 16 groups, based on the following mutually exclusive pairs of variables: vaginal or cesarean delivery (determined from Vital Statistics files), labour complications or not (labour complications are possible medical indications for emergency (intrapartum) cesarean section (these were captured from Hospital Inpatient files; see list of labour complications in Appendix II)), labour induction or not (these were captured from Hospital Inpatient files; labour induction codes used are listed in Appendix II), and breech or cephalic presentation during delivery (from Hospital Inpatient files).

#### *Outcome measures*

For mothers, morbidities captured were similar to those captured in Liu et al. (2007) with the addition of chronic pelvic pain from 90 to 365 days after delivery and postpartum depression diagnosis (see Appendix III for list of maternal outcomes). For infants, outcomes measured were similar to those used by the Canadian Perinatal Surveillance System in the Canadian Perinatal Health Report (Public Health Agency of Canada, 2008; see list of infant outcomes in Appendix IV).

Both maternal and infant morbidities were captured from the Hospital Inpatient files, with the exception of postpartum depression data, which were collected from the Hospital Inpatient files in addition to Alberta Health and Wellness' Fee-for-Service Claims and Ambulatory care files, because postpartum depression only rarely results in hospitalization, unlike the other severe morbidities studied in this report. Specified morbidities that were diagnosed within one year of delivery were included, with the exception of chronic pelvic pain, which was captured if diagnosed 90 to 365 days after delivery.

### *Other studies*

Other studies have used similar designs to look at related issues. Liu et al. (2007) studied maternal mortality and severe maternal morbidity in Canadian women. They selected a cohort of candidates for vaginal delivery: women for whom administrative data showed no evidence of indication for cesarean. Liu et al.'s methodology for selecting this cohort was the basis for the methodology in creating the cohort of candidates for vaginal delivery described in this report.

Liu et al. chose women with cesarean breech deliveries with no labour complications and no labour inductions (their "planned cesarean" group, which is the cesarean group in our *conservative best available cohort*) as a proxy for non-indicated cesareans. They compared this group of deliveries to all other deliveries among women with no evidence of indication for cesarean (their "planned vaginal" group).

Liu et al. found that their "planned cesarean" group had a significantly higher risk (adjusted odds ratio = 3.1) of several maternal morbidities than their "planned vaginal" group (along with a lower risk of hemorrhage requiring blood transfusion), after controlling for maternal age, year of delivery, province or territory of birth hospital, elderly primigravidity, and grand multiparity. It can be argued that their design involved an inappropriate comparison. The "planned vaginal" group was too heterogeneous, likely consisting of many deliveries other than planned vaginal deliveries. Rather than compare their "planned cesarean" group to all other deliveries, it would have been more appropriate to compare cesarean and vaginal breech deliveries with no labour complications and no labour inductions (as in the *conservative best-available data* cohort comparisons, and expanded to include cephalic deliveries in our *best-available data* cohort).

Declercq et al. (2007) also studied candidates for vaginal births: women with no prior cesareans and no documented prenatal risks of cesarean. They compared women with cephalic cesarean deliveries with no labour complications (their proxy for planned primary cesarean deliveries) to all other cephalic deliveries (their proxy for planned vaginal deliveries). They did not include data on labour induction. In their view, the type of delivery that was intended prior to the delivery actually occurring is what is of interest (i.e., this is an "intention to treat" model). Their rationale was that cephalic cesarean deliveries without labour complications were planned as cesareans, and that the other deliveries (all vaginal deliveries, and cesarean deliveries that followed labour complications) had been planned as vaginal deliveries.

Declercq et al. found that re-hospitalizations in the first 30 days after giving birth were more likely in the "planned primary cesarean" group than in the "planned vaginal" group (adjusted odds ratio = 2.3, after controlling for age, parity, and race/ethnicity). Leading causes of re-hospitalization were wound complications and infection.

### **Analyses**

Rates of overall maternal and infant morbidities (per 1,000 deliveries) were calculated for various groups and for the four comparisons described above (*best-available data* comparison, *conservative best-available data* comparison, non-indicated elective cesarean breech vs. all other deliveries (as in Liu et al., 2007), and cesarean no labour complications cephalic deliveries vs. all other cephalic deliveries (as in Declercq et al., 2007)). Rates for individual morbidity categories for the four comparisons were also calculated.



Differences between comparison groups were analyzed with logistic regression. These analyses controlled for the effects of maternal age, parity (number of live and still births the mother has had in her lifetime, including the current delivery), gestational age, and year of delivery (all determined by linkage to Vital Statistics data). Adjusted odds ratios were considered significant if their 95% confidence intervals did not contain 1.

A simulation was also run, in which all cesareans occurring in the groups of interest were assumed not to have occurred (e.g., a cesarean/no complications/no inductions delivery was modeled as a vaginal/no complications/no inductions delivery) and resulting morbidities were predicted. The predicted morbidities were subtracted from the actual morbidities in the groups of interest, resulting in a predicted difference in morbidities in the absence of cesarean section. Confidence intervals around these differences were calculated. The differences were intended to be an estimate of the real-world effect, in terms of number of excess morbidities resulting from non-indicated elective cesarean deliveries.

## Findings

Numbers and rates of maternal and infant severe morbidities by selected groups and the four comparisons are shown in Table 1. The overall rate of severe morbidity across all deliveries was 21.4 (per 1,000 deliveries) for mothers, and 212.1 for infants. Thus severe morbidities were much more likely to be reported for infants than for mothers. In all four comparisons, morbidity rates for mothers and for infants were higher in the selected cesarean deliveries than in the reference groups.

Table 2 provides the details of specific maternal morbidities amongst the four comparisons. Overall rates include all of the specified morbidities except for postpartum depression, which was considered separately. The rates of postpartum depression were the highest of all morbidities, ranging from 66.9 to 82.5 (per 1,000 deliveries) among the comparison groups. Obstetric-wound hematoma, hemorrhage, or infection was the next most common severe maternal morbidity, followed by major puerperal infection. The remainder of severe maternal morbidities occurred in fewer than three out of every 1,000 deliveries overall.

Severe infant morbidities are detailed in Table 3. Respiratory and cardiovascular disorders specific to the perinatal period were the most common of the infant morbidities, followed by haemorrhagic and haematological disorders of fetus and newborn, and birth trauma. Other morbidities occurred in fewer than 15 out of every 1,000 deliveries overall.

Odds ratios and confidence intervals for maternal morbidity comparisons appear in Table 4, and for infant morbidities in Table 5.

The *best-available data* comparison showed higher overall severe maternal morbidity rates (adjusted OR = 4.1, 95% CI 3.8 – 4.3) among non-indicated elective cesarean deliveries compared with non-indicated vaginal deliveries (the reference group). Odds ratios for individual morbidities were significantly above one (higher morbidity in non-indicated elective cesarean deliveries versus the reference group) for all but the three least common morbidities, for which the odds ratios were non-significant. The ratios were notably high for uterine rupture (adjusted OR = 25.5, 95% CI 14.1 – 46.2), obstetric-wound hematoma, hemorrhage, or infection (adjusted OR = 14.4, 95% CI 12.4 – 16.6), cardiac arrest (adjusted OR = 13.7, 95% CI 9.7 – 19.3), and in-hospital wound disruption (adjusted OR = 8.2, 95% CI 5.9 – 11.4). The odds ratio for postpartum depression was modest but significantly above one (adjusted OR = 1.2, 95% CI 1.1 – 1.6).

A similar pattern of odds ratios occurred in the severe infant mortality *best-available data* comparison, though the odds ratios were generally lower than in the maternal morbidity comparisons. The odds ratio for overall morbidity showed higher overall severe infant morbidity rates (adjusted OR = 1.5, 95% CI 1.5 – 1.6) among non-indicated elective cesarean deliveries compared with the reference group. The odds ratios for the individual morbidities were all significantly above one, with the exception of the odds ratio for birth trauma, which was significantly below one (adjusted OR = 0.8, 95% CI 0.8 – 0.9), indicating lower rates of birth trauma in the non-indicated elective cesarean deliveries compared to the reference group. This was true of birth trauma for all four comparisons.

The *conservative best-available data* comparison, of non-indicated elective cesarean breech deliveries with non-indicated vaginal breech deliveries (the reference group), showed that higher overall maternal morbidity was still found in the non-indicated elective cesarean breech deliveries (adjusted OR = 2.8, 95% CI 1.9 – 4.2) even in this most conservative of comparisons. The number of deliveries and morbidities in both of the groups was very small, resulting in low power for statistical comparisons. Nevertheless, in the two most common morbidities, odd ratios were significantly above one (obstetric-wound hematoma, hemorrhage, or infection (adjusted OR = 2.9, 95% CI 1.7 – 5.0), and major puerperal infection (adjusted OR = 4.2, 95% CI 1.3 – 13.4)). Other odds ratios for maternal morbidities were not significant in this comparison (note that odds ratios could not be calculated in cases where there were no morbidities in the reference group). As in the *best-available data* comparison, the odds ratio for postpartum depression was modest but significantly above one (adjusted OR = 1.1, 95% CI 1.1 – 1.2).

The only significant odds ratio in the *conservative best-available data* comparison for infant morbidities was the lower rate of birth trauma in the non-indicated elective cesarean deliveries compared to the reference group (adjusted OR = 0.5, 95% CI 0.3 – 0.8). The odds ratio for overall infant morbidity was not significant (adjusted OR = 1.1, 95% CI 1.0 – 1.3).

The comparison similar to Liu et al. (2007) (non-indicated elective cesarean breech deliveries compared to all other deliveries) was significant for overall severe maternal morbidity (adjusted OR = 2.2, 95% CI 2.0 – 2.5). Odds ratios were also significantly above one for obstetric-wound hematoma, hemorrhage, or infection, major puerperal infection, anesthetic or sedation complications, cardiac arrest, and in-hospital wound disruption. As with the *conservative best-available data* comparison, the number of deliveries was very small in the non-indicated elective cesarean breech group, reducing statistical power. The odds ratio for postpartum depression was non-significant (adjusted OR = 1.0, 95% CI 0.9 – 1.1).

Looking at newborn morbidity (which was not studied in Liu et al., 2007), higher overall maternal morbidity relative to the reference group was offset by decreased severe overall infant morbidity (adjusted OR = 0.8, 95% CI 0.8 – 0.9). The effect varied across individual morbidities, however. Respiratory and cardiovascular disorders specific to the perinatal period, birth trauma, other disturbances of the cerebral status of newborn, and infections specific to the perinatal period were all less common in the non-indicated elective cesarean breech group than in the reference group, while haemorrhagic and haematological disorders of fetus and newborn and feeding problems of the newborn—neonatal difficulty in feeding at breast were more common than in the reference group. The odds ratio for convulsions of newborn was not significantly different from one.

The comparison similar to Declercq et al. (2007), like the previous three comparisons, also resulted in an odds ratio significantly greater than one for overall severe maternal morbidity, when comparing cesarean no labour complications cephalic deliveries to all other cephalic deliveries (the reference group; adjusted OR = 2.5, 95% CI 2.3 – 2.6). Odds ratios for individual maternal morbidities were significant in all cases except for the two least common morbidities (obstetric shock and postpartum acute renal failure). As with the *best-available data* and *conservative best-available data* comparisons, the odds ratio for postpartum depression was modest but significantly above one (adjusted OR = 1.1, 95% CI 1.0 – 1.1).

For severe infant morbidities, the comparison similar to Declercq et al. (2007) resulted in an odds ratio significantly greater than one for overall infant morbidity when comparing cesarean no labour complications cephalic deliveries to all other cephalic deliveries (adjusted OR = 1.0, 95% CI 1.0 – 1.1). Haemorrhagic and haematological disorders of fetus and newborn and other disturbances of the cerebral status of newborn were significantly more likely in cesarean no labour complications cephalic deliveries, while respiratory and cardiovascular disorders specific to the perinatal period and birth trauma were more likely in the reference group.

Tables 6 and 7 contain the results of the simulations, in which models assuming no cesarean sections occurred were run, and resulting expected numbers of morbidities were compared to actual observed morbidities. The difference between the actual results and the simulation is the expected reduction in morbidities that would occur if no cesarean sections had been done in the groups containing cesarean sections.

As can be seen in Table 6, the *best-available data* and *conservative best-available data* comparisons lead to predicted reductions of 1,372 and 207 overall severe maternal morbidities, respectively, over the 14 year time period, while the Liu et al. and Declercq et al. comparisons result in predicted reductions of 183 and 964 severe overall morbidities, respectively, over this time period. The estimates (and the confidence intervals around them) give an idea of the magnitude of the findings in terms of actual outcomes. Reductions in severe maternal morbidities would result in a significant difference in the lives of many Albertan women (as many as 100 per year, according to the *best-available data* comparison) and their families, as well as substantial savings to the health care system. It is important to note that only severe morbidities were considered; presumably the reductions in less severe morbidities would be substantially larger.

In Table 7 are equivalent figures for infants, with predicted reductions of 2,685, 166, and 388 overall severe morbidities, respectively, the *best-available data* comparison, the *conservative best-available data* comparison, and the comparison similar to Declercq et al. (2007), while the comparison similar to Liu et al. (2007) resulted in predicted *increases* of 185 severe infant morbidities in the absence of cesarean sections in these groups (predicted increases in morbidities are represented by negative numbers in Tables 6 and 7).

## Interpretation

Using four different methods of comparison, two designed for this report and two modeled after previously-published reports, overall severe maternal morbidities were found to be higher in non-indicated elective cesarean deliveries relative to reference groups. For two specific severe maternal morbidities (obstetric-wound hematoma, hemorrhage, or infection, and major puerperal infection), this effect held up across all four comparisons. For three more severe maternal morbidities (anesthetic or sedation complications, cardiac arrest, and in-hospital wound disruption), the effect appeared in all but the most conservative comparison. Clearly, there is increased morbidity in non-indicated elective cesarean deliveries.

Some morbidities (such as obstetric wounds) result directly from the delivery itself; other morbidities (such as cardiac arrest or anesthetic complications) are likely mediated by other factors, both biological and procedural. It would be valuable to extend the current study and investigate such mediating factors, in order to enrich our understanding of the etiology of maternal severe morbidities and their relationships to mode of delivery.

In all but the comparison similar to Liu et al. (2007), the higher rates of severe maternal morbidity were accompanied not by decreased overall severe infant morbidity rates (as would be predicted by anecdotal reports of decisions to tradeoff increased maternal morbidity for reductions in infant morbidity), but rather by increased overall severe infant morbidity rates. Importantly, analysis of specific severe infant morbidities showed that patterns were variable across comparisons, with only haemorrhagic and haematological disorders of fetus and newborn showing consistently higher rates across the three comparisons in non-indicated elective cesarean deliveries (compared to the reference groups). Whether infant morbidities occurred as a direct result of the delivery itself (e.g., from laceration of the placenta or fetal injury during the cesarean section, from the presence or absence of the mechanical forces of vaginal delivery, etc.), or resulted from biological or procedural mediating factors, cannot be determined from the available data. Birth trauma was in fact consistently lower in non-indicated elective cesarean deliveries compared to reference groups, in all four comparisons. In the comparison similar to Liu et al. (2007), overall severe morbidity rates were indeed significantly lower in non-indicated elective cesarean deliveries than in all other deliveries, although the direction of the effect varied across specific morbidities.

Simulation data provided estimates of possible reductions in morbidity were non-indicated elective cesarean sections not to occur. While excess severe morbidity numbers were not extremely large, the burden on women, infants, their families, and the health care system is not insignificant. The increased burden of less severe morbidity is expected to be much greater, as well.

## Limitations

The current study is the result of a complex set of design decisions. There are many possible designs that could contribute to understanding of the question at hand, and even more possible modes of realizing those designs. Other designs and other implementations of the same designs may indeed lead to different results and interpretations because of the complexity of the measures used.

While an attempt was made to capture all relevant indications for cesarean section and for morbidities, it is possible that not all possible indicators were captured. Indeed, there may be disagreement among different practitioners or among different researchers as to which indicators are appropriate and which are not. The list of indicators and exclusions used in this study was based on previously published studies, but nevertheless was somewhat modified from previous studies and is consequently best described as a list thought to be appropriate by the authors of this paper after careful consideration, rather than as a definitive list determined by wide consensus. Other researchers may find different results by modification of the indicators used. Readers are encouraged to study the list of indicators to make their own determination of whether the indicators are appropriate.

A related issue is the exclusion of undocumented indications for cesarean or undocumented outcomes. Our analysis is based only on diagnosis and interventions coded in the source databases. It is entirely likely that some of the cesarean sections listed here as non-indicated were in fact indicated by some condition that was not documented in the patient's files, or in files not used as data sources here. While we expect that the number of such cases would be small, we expect that this did indeed occur in some instances. The inclusion of indicated cesareans in the non-indicated cohort could increase the number of cesarean-related morbidities in the non-indicated cohort, and therefore increase the likelihood of finding increased morbidity relative to reference groups.

The biological processes underlying the morbidities described in this paper have not been investigated, but they are nevertheless crucial to understanding the pattern of results. A valuable extension of this work would be to develop models that consider the underlying mechanisms behind the morbidities. Such an understanding could then lead to strategies to prevent or ameliorate adverse outcomes.

For some of the groups used in our comparisons, statistical power to detect differences was low due to small numbers of deliveries or morbidities in the groups. This was especially relevant in the *conservative best-available data* comparisons.

Finally, the appropriate perspective for understanding these data is at the level of population health, not at the level of individual health. Thus, while the data seem to indicate excess maternal and infant morbidity due to non-indicated elective cesareans at the population level, no such claim can be made at the individual level. The number of factors coming into play in an individual delivery is far larger and more complex than we have captured here. The results are best interpreted as suggesting consideration of whether non-indicated elective cesareans should be carried out within Alberta's population, not in the case of a given individual mother. A decision at the individual level would require consideration of all relevant factors, not just the findings presented here.

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**Appendix I****Maternal Medical Indications for Elective Cesarean Section**

<b>Description</b>	<b>ICD-9-CM</b>	<b>ICD-10</b>
Maternal cerebral hemorrhage	431.x - 434.x	I61-I66
Asthma	493.x	J45, J46
Antepartum bleeding, placental abruption, placenta previa	641.x, 656.0	O44
Hypertensive disorders	642.x, exc. 642.5, 642.6	O10-O16, exc. O14-O15
Severe hypertension (eclampsia and severe eclampsia)	642.5, 642.6	O14-O15
Preterm delivery	644.2	O60.0
Maternal renal abnormalities	646.2	O12.1
Genital herpes	054.x, 647.6	A60, B00, O98.4, O98.5
Maternal liver abnormalities	646.7	O26.6
Diabetes or abnormal glucose tolerance	648.0, 648.8	O24
Maternal thyroid abnormalities	648.1	E07.9
Maternal substance use	304.9, 648.3	F19.2, O99.3
Mental disorder	648.4	F53.8, F53.9, O99.3
Maternal congenital and other heart disease	648.5, 648.6	O99.4
Multiple gestation	651.x	O30, O31
Malpresentation	652.x, exc. 652.1, 652.5	O32, exc. O32.1, O32.4
Unengaged fetal head	652.5	O32.4
Maternal soft tissue disorder	654.0, 654.1, 654.4- 654.7	O34.0-O34.1, O34.3-O34.6
Uterine scar unrelated to cesarean delivery	654.9	O34.2, O34.8, O34.9
Congenital fetal CNS anomaly or chromosomal abnormality	655.0, 655.1	O35.0, O35.1
Isoimmunization	656.1, 656.2	O36.0, O36.1
Intrauterine fetal demise	656.4	O36.4
Intrauterine growth restriction	656.5	O36.5
Macrosomia	656.6	O36.6
Oligohydramnios	658.x	O41, O42, O75.5, O75.6
Polyhydramnios	657.x	O40
Ruptured membranes >24 hours	658.2	O42, O75.6
Chorioamnionitis	658.4	O41
Other maternal infection	659.2, 659.3	O75.2, O75.3
Maternal hypotension or obstetrical shock	669.1, 669.2	O75.1, O26.5
Pulmonary embolism	673.0, 673.1, 673.3, 673.8	O88.0-O88.3
Cesarean delivery <i>in a previous pregnancy</i>	654.2	O34.2, O75.7
Uterine rupture <i>in a previous pregnancy</i>	665.0, 665.1	O71.0-O71.1

## Appendix II

### Maternal Medical Indications for Emergency Cesarean Section (Labour Complications)

Description	ICD-9	ICD-10
Fetal distress	656.3	O68.0-O68.3
Prolapsed cord	663.0	O69.0
Dystocia		
Disproportion	653.x	O33
Obstructed labour	660.x	O64, O65, O66
Abnormality of forces of labour	661 (except 661.3)	O62 (except O62.3)
Long labour	662	O63

#### Labour induction codes

<b>January 1997 to December 2001</b>
Hospital Inpatient Files procedure codes
ICD-9-CM 73.4, 73.01, 73.1
<b>January 2002 to March 2006</b>
Hospital Inpatient Files intervention codes
CCI 5AC30AL, 5AC30AZ, 5AC30CA, 5AC30GU, 5AC30HA, 5AC30YA, 5AC30YB, 5AC30ZZ, 5AC30AN, 5AC30AP, 5AC30CK
<b>April 2006 to December 2009</b>
Hospital Inpatient Files intervention codes
CCI 5AC30AL-I2, 5AC30AZ, 5AC30CA-I2, 5AC30CA-Z9, 5AC30CK-A2, 5AC30CK-I2, 5AC30HA-I2, 5AC30YA-I2, CCI 5AC30AN, 5AC30AP, 5AC30CK-BD, 5AC30CK-W6



**Appendix III  
Maternal Outcome Measures**

Description	ICD-9-CM	ICD-10	CCP	ICD-9-CM	CCI	Notes
Overall severe morbidity	At least one from below (excluding postpartum depression)	At least one from below (excluding postpartum depression)				
Obstetric-wound hematoma, hemorrhage, or infection	674.3	O86.0, O90.2			5.PC.73.^	
Major puerperal infection	670	O85, O86.8, A34				
Anesthetic or sedation complications	668.0, 668.1, 668.2, 668.8, 668.9	O29, O74, O89				
Chronic pelvic pain (from 90 to 365 days post-delivery)	625.9, 789.0	N94.9, R10				
Cardiac arrest	669.4	O75.4				
In-hospital wound disruption	674.1, 674.2	O90.0, O90.1				
Uterine rupture	665.0, 665.1	O71.0, O71.1				
Any hysterectomy				68.4 to 68.9	1.RM.89.^, 1.RM.91.^	
Assisted ventilation or intubation				80.2, 80.3, 80.4	1.GZ.31.^	
Puerperal venous thromboembolism	671.4, 671.5, 671.9, 673.2	O87.1, O87.3, O87.9, O88.2, O22.5, O22.9				
Postpartum hemorrhage requiring transfusion	666.0, 666.1, 666.2, 666.3	O72.0, O72.1, O72.2, O72.3	13.62, 13.63, 10.01 to 10.05	99.0	1.LZ.19.^	Need diagnosis AND procedure code
Postpartum hemorrhage requiring hysterectomy	666.0, 666.1, 666.2, 666.3	O72.0, O72.1, O72.2, O72.3	13.03, 13.04	68.4 to 68.9	1.RM.89.^, 1.RM.91.^	Need diagnosis AND procedure code
Obstetric shock	669.1, 785.5, 998.0	O75.1, R57, T81.1				
Postpartum acute renal failure	669.3	O90.4				
Postpartum depression, January 1997 to March 2002: Fee-For-Service Claims, Inpatient Hospital Separations, and Ambulatory Care Classification System diagnostic codes ICD-9-CM 296.2-296.3, 311						
Postpartum depression, April 2002 to December 2009: Fee-For-Service Claims diagnostic Code ICD-9-CM 296.2-296.3, 311; Inpatient Hospital Separations and Ambulatory Care Classification System diagnostic code ICD-10-CA F32-F33, F53						

**Appendix IV**  
**Infant Outcome Measures**

<b>Description</b>	<b>ICD-9-CM</b>	<b>ICD-10</b>
Overall severe morbidity	At least one from below	At least one from below
Haemorrhagic and haematological disorders of fetus and newborn	772, 773, 774, 776/1-9, 778.0	P50- P61
Respiratory and cardiovascular disorders specific to the perinatal period	768/2-9, 747.0, 769, 770, 779.8	P20-P29
Birth trauma	767, 772.1, 772.2, 778.1	P10-P15
Feeding problems of newborn--neonatal difficulty in feeding at breast	779.3	P92.5
Other disturbances of the cerebral status of newborn	779.1, 779.2, 779.8	P91
Infections specific to the perinatal period	771	P35-P39
Convulsions of newborn	779.0	P90

Table 1. Number of deliveries, number of maternal and infant morbidities, and morbidity rates per 1,000 deliveries, by selected comparisons and groups.

	Number of deliveries	Deliveries with severe maternal morbidity*	Maternal morbidity rate per 1,000 deliveries	Deliveries with severe infant morbidity	Infant morbidity rate per 1,000 deliveries
Vaginal delivery	308,126	4,308	14.0	60,253	195.5
Labour complications	86,584	1,488	17.2	26,972	311.5
Labour induction	19,282	394	20.4	6,232	323.2
1. Breech	42	2	47.6	18	428.6
2. Cephalic	19,240	392	20.4	6,214	323.0
No Labour induction	67,302	1,094	16.3	20,740	308.2
3. Breech	187	6	32.1	81	433.2
4. Cephalic	67,115	1,088	16.2	20,659	307.8
No labour complications	221,542	2,820	12.7	33,281	150.2
Labour induction	36,033	589	16.3	6,181	171.5
5. Breech	120	1	8.3	35	291.7
6. Cephalic	35,913	588	16.4	6,146	171.1
No Labour induction	185,509	2,231	12.0	27,100	146.1
7. Breech	1,311	38	29.0	272	207.5
8. Cephalic	184,198	2,193	11.9	26,828	145.6
Cesarean delivery	82,512	4,056	49.2	22,590	273.8
Labour complications	37,314	2,085	55.9	12,518	335.5
Labour induction	11,082	609	55.0	3,748	338.2
9. Breech	68	4	58.8	19	279.4
10. Cephalic	11,014	605	54.9	3,729	338.6
No Labour induction	26,232	1,476	56.3	8,770	334.3
11. Breech	647	30	46.4	207	319.9
12. Cephalic	25,585	1,446	56.5	8,563	334.7
No labour complications	45,198	1,971	43.6	10,072	222.8
Labour induction	3,042	143	47.0	826	271.5
13. Breech	161	10	62.1	38	236.0
14. Cephalic	2,881	133	46.2	788	273.5
No Labour induction	42,156	1,828	43.4	9,246	219.3
15. Breech	7,185	344	47.9	1,613	224.5
16. Cephalic	34,971	1,484	42.4	7,633	218.3
<b>Best-available data comparison</b>					
Non-indicated elective cesarean deliveries (groups 15 & 16)	42,156	1,828	43.4	9,246	219.3
Non-indicated vaginal deliveries (groups 7 & 8)	185,509	2,231	12.0	27,100	146.1
<b>Conservative best-available data comparison</b>					
Non-indicated elective cesarean breech deliveries (group 15)	7,185	344	47.9	1,613	224.5
Non-indicated vaginal breech deliveries (group 7)	1,311	38	29.0	272	207.5
<b>Comparison similar to Liu et al. (2007)</b>					
Non-indicated elective cesarean breech deliveries (group 15)	7,185	344	47.9	1,613	224.5
All other deliveries (groups 1 to 14, 16)	383,453	8,020	20.9	81,230	211.8
<b>Comparison similar to Declercq et al. (2007)</b>					
Cesarean no labour complications cephalic deliveries (groups 14 & 16)	37,852	1,617	42.7	8,421	222.5
All other cephalic deliveries (groups 2, 4, 6, 8, 10, & 12)	343,065	6,312	18.4	72,139	210.3
All deliveries	390,638	8,364	21.4	82,843	212.1
Deliveries with labour complications	123,898	3,573	28.8	39,490	318.7
Deliveries with no labour complications	266,740	4,791	18.0	43,353	162.5
Deliveries with labour induction	69,439	1,735	25.0	16,987	244.6
Deliveries with no labour induction	321,199	6,629	20.6	65,856	205.0
Breech deliveries	9,721	435	44.7	2,283	234.9
Cephalic deliveries	380,917	7,929	20.8	80,560	211.5

\* Overall severe maternal morbidity includes all morbidities except postpartum depression.

Table 2. Rates (per 1,000 deliveries) and number of deliveries for severe maternal morbidities, for four comparisons and all deliveries.

	Best-available data comparison		Conservative best-available data comparison		Comparison similar to Liu et al. (2007)		Comparison similar to Declercq et al. (2007)		All deliveries
	Non-indicated cesarean deliveries	Non-indicated vaginal deliveries	Non-indicated cesarean breech deliveries	Non-indicated vaginal breech deliveries	Non-indicated elective cesarean breech deliveries	All other deliveries	Cesarean no labour complications cephalic deliveries	All other cephalic deliveries	
<b>Rates (per 1,000 deliveries)</b>									
Overall severe morbidity*	43.4	12.0	47.9	29.0	47.9	20.9	42.7	18.4	21.4
Obstetric-wound hematoma, hemorrhage, or infection	19.8	1.4	25.3	15.3	25.3	5.9	18.4	4.4	6.2
Major puerperal infection	7.0	3.9	8.4	3.8	8.4	5.3	6.9	5.1	5.4
Chronic pelvic pain (from 90 to 365 days post-delivery)	3.7	2.4	3.3	2.3	3.3	2.9	3.9	2.8	2.9
Anesthetic or sedation complications	4.5	1.5	5.0	1.5	5.0	2.5	4.5	2.3	2.5
Any hysterectomy	1.7	0.9	0.8	2.3	0.8	1.1	1.9	1.0	1.1
Cardiac arrest	3.4	0.3	2.9	3.1	2.9	1.1	3.5	0.8	1.1
Postpartum hemorrhage requiring transfusion	0.8	0.8	0.6	0.0	0.6	1.0	1.1	1.0	1.0
In-hospital wound disruption	2.7	0.3	2.9	1.5	2.9	0.9	2.5	0.8	1.0
Uterine rupture	1.8	0.1	0.4	0.0	0.4	0.6	2.1	0.5	0.6
Assisted ventilation/assisted intubation	1.1	0.3	0.8	0.0	0.8	0.6	1.3	0.5	0.6
Puerperal venous thromboembolism	1.1	0.4	0.7	2.3	0.7	0.6	1.2	0.5	0.6
Postpartum hemorrhage requiring hysterectomy	0.7	0.1	0.7	1.5	0.7	0.3	0.7	0.3	0.3
Obstetric shock	0.3	0.2	0.3	0.8	0.3	0.3	0.4	0.3	0.3
Postpartum acute renal failure	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Postpartum depression	81.7	66.9	74.9	72.5	74.9	74.2	82.5	73.3	74.2
<b>Number of deliveries</b>									
Total number of deliveries	42,156	185,509	7,185	1,311	7,185	383,453	37,852	343,065	390,638
Overall severe morbidity*	1,828	2,231	344	8,020	344	1,617	1,617	6,312	8,964
Obstetric-wound hematoma, hemorrhage, or infection	833	262	182	20	182	2,255	698	1,517	2,437
Major puerperal infection	296	727	60	5	60	2,043	262	1,765	2,103
Chronic pelvic pain (from 90 to 365 days post-delivery)	158	449	24	3	24	1,122	146	967	1,146
Anesthetic or sedation complications	191	276	36	2	36	955	170	777	991
Any hysterectomy	72	173	6	3	6	424	71	350	430
Cardiac arrest	144	47	21	4	21	406	132	265	427
Postpartum hemorrhage requiring transfusion	32	153	4	0	4	375	41	333	379
In-hospital wound disruption	113	61	21	2	21	356	94	258	377
Uterine rupture	75	14	3	0	3	240	80	159	243
Assisted ventilation/Assisted intubation	48	57	6	0	6	234	50	182	240
Puerperal venous thromboembolism	47	74	5	3	5	216	46	167	221
Postpartum hemorrhage requiring hysterectomy	29	22	5	2	5	117	27	88	122
Obstetric shock	14	44	2	1	2	119	14	104	121
Postpartum acute renal failure	1	4	0	0	0	18	3	15	18
Postpartum depression	3,444	12,414	538	95	538	28,458	3,124	25,152	28,996

\* Overall severe morbidity includes all morbidities except postpartum depression.

Table 3. Rates (per 1,000 deliveries) and number of deliveries for severe infant morbidities, for four comparisons and all deliveries.

	Best-available data comparison		Conservative best-available data comparison		Comparison similar to Liu et al. (2007)		Comparison similar to Declercq et al. (2007)		All deliveries
	Non-indicated elective cesarean deliveries	Non-indicated vaginal deliveries	Non-indicated elective cesarean breech deliveries	Non-indicated vaginal breech deliveries	Non-indicated elective cesarean breech deliveries	All other deliveries	Cesarean no labour complications cephalic deliveries	All other cephalic deliveries	
<b>Rates (per 1,000 deliveries)</b>									
Overall severe morbidity	219.3	146.1	224.5	207.5	224.5	211.8	222.5	210.3	212.1
Respiratory and cardiovascular disorders specific to the perinatal period	96.1	60.5	82.1	81.6	82.1	108.1	102.8	108.5	107.6
Haemorrhagic and haematological disorders of fetus and newborn	126.0	77.0	141.8	125.1	141.8	95.8	123.3	92.5	96.7
Birth trauma	15.3	17.4	13.1	20.6	13.1	32.3	17.1	34.0	31.9
Other disturbances of the cerebral status of newborn	11.7	11.8	9.0	9.9	9.0	13.5	15.6	13.3	13.4
Feeding problems of newborn--neonatal difficulty in feeding at breast	13.5	9.2	20.5	13.0	20.5	11.5	12.6	11.3	11.7
Infections specific to the perinatal period	7.4	6.5	4.6	9.9	4.6	8.4	8.3	8.4	8.3
Convulsions of newborn	1.5	0.7	1.0	0.8	1.0	1.4	1.7	1.4	1.4
<b>Number of deliveries</b>									
Total number of deliveries	42,156	185,509	7,185	1,311	7,185	383,453	37,852	343,065	390,638
Overall severe morbidity	9,246	27,100	1,613	272	1,613	81,230	8,421	72,139	82,843
Respiratory and cardiovascular disorders specific to the perinatal period	4,052	11,230	590	107	590	41,455	3,893	37,214	42,045
Haemorrhagic and haematological disorders of fetus and newborn	5,310	14,278	1,019	164	1,019	36,739	4,667	31,735	37,758
Birth trauma	647	3,231	94	27	94	12,377	648	11,667	12,471
Other disturbances of the cerebral status of newborn	492	2,192	65	13	65	5,188	590	4,557	5,253
Feeding problems of newborn--neonatal difficulty in feeding at breast	567	1,714	147	17	147	4,410	478	3,890	4,557
Infections specific to the perinatal period	311	1,197	33	13	33	3,215	313	2,869	3,248
Convulsions of newborn	64	136	7	1	7	556	65	484	563

Table 4. Adjusted odds ratios (OR (adj.)<sup>1</sup> and 95% confidence interval for OR, for severe maternal morbidities, for four comparisons.

	Best-available data comparison		Conservative best-available data comparison		Comparison similar to Liu et al. (2007)		Comparison similar to Declercq et al. (2007)	
	OR (adj.)	CI (95%)	OR (adj.)	CI (95%)	OR (adj.)	CI (95%)	OR (adj.)	CI (95%)
Overall severe morbidity*	<b>4.05</b>	3.79 4.33	<b>2.84</b>	1.90 4.24	<b>2.23</b>	1.99 2.50	<b>2.48</b>	2.34 2.63
Obstetric-wound hematoma, hemorrhage, or infection	<b>14.37</b>	12.43 16.61	<b>2.88</b>	1.67 4.99	<b>3.80</b>	3.24 4.45	<b>4.54</b>	4.13 4.99
Major puerperal infection	<b>2.16</b>	1.88 2.49	<b>4.17</b>	1.30 13.42	<b>1.57</b>	1.20 2.04	<b>1.51</b>	1.32 1.73
Chronic pelvic pain (from 90 to 365 days post-delivery)	<b>1.91</b>	1.58 2.31	1.38	0.41 4.71	1.20	0.79 1.81	<b>1.39</b>	1.17 1.67
Anesthetic or sedation complications	<b>2.89</b>	2.38 3.51	3.50	0.81 15.11	<b>1.79</b>	1.27 2.51	<b>1.98</b>	1.67 2.35
Any hysterectomy	<b>1.67</b>	1.25 2.23	0.58	0.11 3.16	0.95	0.42 2.15	<b>1.45</b>	1.12 1.89
Cardiac arrest	<b>13.66</b>	9.70 19.25	1.37	0.39 4.89	<b>2.19</b>	1.40 3.45	<b>4.64</b>	3.73 5.77
Postpartum hemorrhage requiring transfusion	1.38	0.93 2.05			0.68	0.25 1.82	<b>1.56</b>	1.12 2.18
In-hospital wound disruption	<b>8.21</b>	5.90 11.41	4.97	0.68 36.44	<b>2.77</b>	1.76 4.35	<b>4.33</b>	2.73 4.46
Uterine rupture	<b>25.52</b>	14.10 46.21			0.81	0.25 2.55	<b>3.43</b>	3.28 5.72
Assisted ventilation/assisted intubation	<b>3.71</b>	2.46 5.61			1.04	0.46 2.38	<b>2.40</b>	1.73 3.32
Puerperal venous thromboembolism	<b>2.72</b>	1.84 4.03	0.77	0.15 3.97	1.07	0.43 2.63	<b>2.24</b>	1.60 3.14
Postpartum hemorrhage requiring hysterectomy	<b>4.47</b>	2.48 8.07	0.29	0.06 1.54	1.73	0.69 4.37	<b>2.33</b>	1.49 3.66
Obstetric shock	1.79	0.95 3.37	0.32	0.03 3.74	0.99	0.24 4.08	1.48	0.84 2.62
Postpartum acute renal failure	2.43	0.27 22.12					2.50	0.70 8.88
Postpartum depression	<b>1.16</b>	1.11 1.57	<b>1.12</b>	1.08 1.22	<b>0.98</b>	0.89 1.07	<b>1.08</b>	1.04 1.12

1. Statistically significant adjusted odds ratios appear in bold.

\* Overall severe morbidity includes all morbidities except postpartum depression.

Table 5. Adjusted odds ratios (OR (adj.)<sup>1</sup> and 95% confidence interval for OR, for severe infant morbidities, for four comparisons.

	Best-available data comparison		Conservative best-available data comparison		Comparison similar to Liu et al. (2007)		Comparison similar to Declercq et al. (2007)	
	OR (adj.)	CI (95%)	OR (adj.)	CI (95%)	OR (adj.)	CI (95%)	OR (adj.)	CI (95%)
Overall severe morbidity	<b>1.53</b>	1.49 1.57	1.13	0.96 1.32	<b>0.81</b>	0.77 0.86	<b>1.04</b>	1.01 1.06
Respiratory and cardiovascular disorders specific to the perinatal period	<b>1.57</b>	1.51 1.64	1.06	0.84 1.34	<b>0.60</b>	0.55 0.66	<b>0.93</b>	0.90 0.97
Haemorrhagic and haematological disorders of fetus and newborn	<b>1.57</b>	1.52 1.63	1.21	0.99 1.47	<b>1.12</b>	1.05 1.20	<b>1.25</b>	1.21 1.29
Birth trauma	<b>0.82</b>	0.75 0.89	<b>0.50</b>	0.32 0.80	<b>0.30</b>	0.25 0.37	<b>0.51</b>	0.47 0.55
Other disturbances of the cerebral status of newborn	<b>1.17</b>	1.06 1.30	1.14	0.57 2.26	<b>0.56</b>	0.44 0.72	<b>1.41</b>	1.29 1.55
Feeding problems of newborn—neonatal difficulty in feeding at breast	<b>1.30</b>	1.17 1.43	1.49	0.84 2.64	<b>1.20</b>	1.01 1.42	<b>1.07</b>	0.97 1.18
Infections specific to the perinatal period	<b>1.21</b>	1.06 1.38	0.85	0.40 1.80	<b>0.48</b>	0.34 0.67	<b>1.02</b>	0.91 1.15
Convulsions of newborn	<b>2.04</b>	1.49 2.79	1.13	0.11 12.17	0.56	0.27 1.19	<b>1.23</b>	0.94 1.60

1. Statistically significant adjusted odds ratios appear in bold.

Table 6. Actual and simulated morbidity counts for severe maternal morbidities, with difference (actual - simulation) and 95% confidence interval of the difference, for four comparisons.

	Best-available data comparison				Conservative best-available data comparison			
	Actual	Simulation	Difference	Difference CI (95%)	Actual	Simulation	Difference	Difference CI (95%)
Overall severe morbidity*	4,059	2,687	1,372	1,299 - 1,445	382	175	207	179 - 235
Obstetric-wound hematoma, hemorrhage, or infection	1,095	319	776	721 - 831	202	90	112	91 - 133
Major puerperal infection	1,023	868	155	131 - 179	65	19	46	33 - 59
Chronic pelvic pain (from 90 to 365 days post-delivery)	607	530	77	60 - 94	27	8	8	2 - 14
Anesthetic or sedation complications	467	346	121	99 - 143	38	10	28	18 - 38
Any hysterectomy	245	215	30	19 - 41	9	13	-4	-8 - 0
Cardiac arrest	191	60	131	109 - 153	25	15	10	4 - 16
Postpartum hemorrhage requiring transfusion	185	177	8	2 - 14	4	0	4	0 - 8
In-hospital wound disruption	174	75	99	79 - 119	23	10	13	6 - 20
Uterine rupture	89	16	73	56 - 90	3	0	3	0 - 6
Assisted ventilation/assisted intubation	105	69	36	24 - 48	6	0	6	1 - 11
Puerperal venous thromboembolism	121	92	29	18 - 40	8	14	-6	-11 - -1
Postpartum hemorrhage requiring hysterectomy	51	29	22	13 - 31	7	21	-14	-21 - -7
Obstetric shock	58	51	7	2 - 12	3	11	-8	-14 - -2
Postpartum acute renal failure	5	5	0	0 - 0	0	0	0	0 - 0
Postpartum depression	15,858	15,403	455	413 - 497	633	633	0	0 - 0
	<b>Comparison similar to Liu et al. (2007)</b>				<b>Comparison similar to Declercq et al. (2007)</b>			
Overall severe morbidity*	8,364	8,181	183	156 - 210	7,929	6,965	964	903 - 1,025
Obstetric-wound hematoma, hemorrhage, or infection	2,437	2,313	124	102 - 146	2,215	282	1,933	1,847 - 2,019
Major puerperal infection	2,103	2,080	23	14 - 32	2,027	1,939	88	70 - 106
Chronic pelvic pain (from 90 to 365 days post-delivery)	1,146	1,142	4	0 - 8	1,113	1,113	0	0 - 0
Anesthetic or sedation complications	991	975	16	8 - 24	947	862	85	67 - 103
Any hysterectomy	430	432	-2	-5 - 1	421	395	26	16 - 36
Cardiac arrest	427	415	12	5 - 19	397	292	105	85 - 125
Postpartum hemorrhage requiring transfusion	379	381	-2	-5 - 1	374	361	13	6 - 20
In-hospital wound disruption	377	364	13	6 - 20	352	282	70	54 - 86
Uterine rupture	243	244	-1	-3 - 1	239	177	62	47 - 77
Assisted ventilation/assisted intubation	240	239	1	-1 - 3	232	202	30	19 - 41
Puerperal venous thromboembolism	221	221	0	0 - 0	213	188	25	15 - 35
Postpartum hemorrhage requiring hysterectomy	122	120	2	-1 - 5	115	99	16	8 - 24
Obstetric shock	121	121	0	0 - 0	118	114	4	0 - 8
Postpartum acute renal failure	18	18	0	0 - 0	18	16	2	-1 - 5
Postpartum depression	28,996	29,016	-20	-29 - -11	28,276	28,051	225	196 - 254

\* Overall severe morbidity includes all morbidities except postpartum depression.

Table 7. Actual and simulated morbidity counts for severe infant morbidities, with difference (actual - simulation) and 95% confidence interval of the difference, for four comparisons.

	Best-available data comparison			Conservative best-available data comparison		
	Actual	Simulation	Difference (95%)	Actual	Simulation	Difference (95%)
Overall severe morbidity	36,346	33,661	2,685	1,885	1,719	166
Respiratory and cardiovascular disorders specific to the perinatal period	15,282	13,880	1,402	697	706	-9
Haemorrhagic and haematological disorders of fetus and newborn	19,588	17,846	1,742	1,183	979	204
Birth trauma	3,878	4,025	-147	121	268	-147
Other disturbances of the cerebral status of newborn	2,684	2,622	62	78	85	-7
Feeding problems of newborn--neonatal difficulty in feeding at breast	2,281	2,149	132	164	107	57
Infections specific to the perinatal period	1,508	1,457	51	46	59	-13
Convulsions of newborn	200	168	32	8	8	0
Comparison similar to Liu et al. (2007)						
	Comparison similar to Liu et al. (2007)			Comparison similar to Declercq et al. (2007)		
	Actual	Simulation	Difference (95%)	Actual	Simulation	Difference (95%)
Overall severe morbidity	82,843	83,028	-185	80,560	80,172	388
Respiratory and cardiovascular disorders specific to the perinatal period	42,045	42,351	-306	41,107	41,241	-134
Haemorrhagic and haematological disorders of fetus and newborn	37,758	37,609	149	36,402	35,469	933
Birth trauma	12,471	12,665	-194	12,315	12,853	-538
Other disturbances of the cerebral status of newborn	5,253	5,296	-43	5,147	4,968	179
Feeding problems of newborn--neonatal difficulty in feeding at breast	4,557	4,527	30	4,368	4,307	61
Infections specific to the perinatal period	3,248	3,279	-31	3,182	3,170	12
Convulsions of newborn	563	568	-5	549	536	13