

Risks of adverse pregnancy outcomes among Inuit and North American Indian women in Quebec, 1985–97

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Summary

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We used Statistics Canada's linked stillbirth, live birth and infant death files to assess the risks of adverse pregnancy outcomes among Inuit and North American Indian vs. other ethnic women in Quebec, 1985–97 (1 125 462 singleton births). Mother tongue was used to define ethnicity, with the largest French language group as the reference. Main outcome measures are adjusted odds ratios (AOR) for preterm birth, small-for-gestational-age (SGA), stillbirth, neonatal and postneonatal death controlled for maternal age, education, marital status, parity, infant sex, community size, and community-level random effects using multilevel logit models.

Inuit women had higher risks of preterm birth (AOR = 1.49, 95% CI [1.25, 1.78]) and immaturity-related infant mortality (AOR = 3.03 [1.36, 6.74]), while Indian women did not. Infants of Inuit (AOR = 0.39 [0.31, 0.49]) and Indian (AOR = 0.27 [0.24, 0.31]) women had substantially lower risks of SGA. Elevated risks of stillbirth were observed among Indian women [AOR = 1.53 (1.09, 2.15)], and of postneonatal death among both Inuit (AOR = 4.45 [2.74, 7.22]) and Indian (AOR = 1.86 [1.28, 2.70]) infants. Both Inuit and Indian infants had much higher risks of sudden infant death syndrome (SIDS) and infection-related mortality. Although the absolute risks of adverse outcomes declined from 1985–87 to 1995–97, the relative disparities between aboriginal and non-aboriginal women changed little over this period. We conclude that Inuit and Indian women have different risk profiles for adverse pregnancy outcomes, and that prevention of preterm birth among Inuit women, and of SIDS and infection-related infant mortality in both aboriginal groups, are important targets for future research and intervention.

Introduction

Aboriginal women are at higher risks of adverse pregnancy outcomes in many countries.^{1–9} For instance, Australian aboriginal women have twice the risk of stillbirth as non-aboriginal women, and their live-born infants have a much higher risk of neonatal death in all States and Territories.¹ A significantly higher perinatal mortality has also been observed among Australian aboriginal women living in urban areas.² Birthweight-specific neonatal mortality for Alaskan natives, primarily of Inuit (Eskimo) ethnicity, is higher than for the non-natives.³ Urban American Indians and Alaskan natives have much higher risks of low birth-

weight and infant mortality than urban whites.⁴ The higher risks of adverse pregnancy outcomes among aboriginal women may be at least partly attributed to their disadvantaged socio-economic status.^{1–6,10–12}

Three aboriginal peoples are recognised constitutionally in Canada: North American Indian, Inuit, and Metis.⁵ Although most aboriginal peoples lived on reserves in the past, an increasing proportion (30–40%) now live in urban or peri-urban areas.^{5,13,14} Previous studies of pregnancy outcome among Canadian aboriginal women suffered from incomplete and/or poor quality data, because aboriginal births/deaths are difficult or impossible to identify in most provin-

cial vital records. The available evidence suggests that they experience a substantially higher infant mortality.^{13–19} Average infant mortality in 1986–90 was estimated to be 13.8 per 1000 live births among Indian infants and 16.3 per 1000 among Inuit infants, both much higher than the 7.3 per 1000 among all Canadian infants.¹⁹ In addition, aboriginal infants in Canada may have different characteristics from those in other countries. For example, in contrast to the lower birthweight among Australian aborigines,^{20,21} at least some groups of Canadian Indian infants have been reported to be heavier than non-aboriginal infants.^{22,23}

The risks of adverse pregnancy outcomes among Inuit and Indian vs. other ethnic women have not been adequately explored and compared. Thus, we carried out this study to assess this issue comprehensively in Quebec for the years 1985–97.

Subjects and methods

Statistics Canada's linked stillbirth, live birth, and infant death files

The study is based on Statistics Canada's most updated linked stillbirth, live birth and infant death registration files for all births in the province of Quebec, 1985–97. Complete linked data were not yet available for 1998 and more recent years.

The Quebec aboriginal population numbered about 63 000 in 1992, and comprised 7400 Inuit and 55 600 Indians (no Metis live in Quebec).¹⁶ A unique feature of the Quebec birth registrations is that maternal mother tongue – the first language spoken by the fetus'/infant's mother – is recorded by the parents, providing a proxy for the mother's ethnicity no matter where she resides, and was used to define ethnicity. Race/ethnicity is not requested on Quebec birth registrations. According to the Quebec vital statistics registry, many births to Inuit-speaking mothers in Northern Quebec villages had been miscoded to Indian, particularly during the earlier years of the study period. All births coded to Indian or other language groups which occurred in villages inhabited largely or primarily by Inuit were recoded from microfilm copies of the original records. Of the 949 such records checked, 624 were recoded to Inuit. Infants were grouped into five maternal language groups: French (the majority and reference group), English, Inuit (Inuktituk or Eskimo), Indian (including any of the many North American

Indian languages), and others. Maternal education levels were recorded in years of completed education and were grouped into four levels: 0–10, 11, 12–13 and ≥ 14 years, as a previous study found such a grouping to be highly associated with infant mortality.¹¹ Parity was defined as no. of pregnancies resulting in a live or stillbirth, including the index birth.

Causes of death are recorded on Canadian stillbirth and infant death registrations, and the underlying causes of death were categorised using the classification of the International Collaborative Effort (ICE) on Perinatal and Infant Mortality based on the International Classification of Diseases, Ninth Revision (ICD-9).²⁴ The causes of death categories include congenital conditions, immaturity-related conditions, asphyxia-related conditions, infections, sudden infant death syndromes (SIDS), external causes, other specific conditions, and remaining causes. These cause-of-death categories differ slightly from those used by others – for example, congenital conditions include conditions other than congenital anomalies and SIDS includes the ICD-9 codes 798, 799 and E913 (no death from code E913 was recorded in the sample). The 'classic' SIDS (ICD-9 code: 798.0) rate was also compared among different language women. Medical examiners investigate all suspected cases of SIDS in Quebec.

Community-level variables

The risks of adverse pregnancy outcomes may be associated not only with individual-level factors, but also with community size, as the size of a community strongly affects access to and quality of health care. The Census Metropolitan Area or Census Agglomeration (CMACA) code of the mother's place of residence was determined, based on her municipal code. The CMACA code was then used as the community identifier and entered as a community-level random effect variable in multilevel logit models. As Quebec municipal codes changed several times during the study period, a conversion file was first created to convert all codes to the 1996 standards. Excluding codes for non-residents of Quebec, 31 valid CMACA codes were generated, and all rural areas and small towns with a population < 10 000 were assigned the same CMACA code. The community size of each CMACA was determined from the 1996 Canadian census population figures and was categorised into five levels: ≥ 1 million, 500 000–999 999, 100 000–499 999, 10 000–99 999, and < 10 000.

Outcome measurements

Pregnancy outcomes studied include preterm birth, low birthweight, small-for-gestational-age (SGA), stillbirth, and infant (subdivided into neonatal and postneonatal) death. Low birthweight (LBW) was defined as birthweight < 2500 g, preterm birth as gestational age (GA) < 37 completed weeks, and SGA as birthweight below the 10th percentile of the recently published Canadian reference values based on infants born in 1994–96.²⁵ In Quebec, all live births are reported, and fetal deaths with birthweight \geq 500 g are reported as stillbirths. Neonatal, postneonatal, and infant mortality refer to deaths that occurred during 0–27, 28–364, and 0–364 days of life, respectively. The GA-specific stillbirth rate was computed as a true prospective rate, i.e. among all ongoing pregnancies at risk.²⁶ The fetal/perinatal death ratio was computed as the ratio of stillbirths to stillbirths plus early neonatal deaths (0–6 days of life), and was used to assess potential registration artifacts resulting from under-registration of stillbirths and/or live births, particularly at extremely low birthweights.²⁷ The neonatal/infant death ratio was computed to assess the relative frequency of neonatal death to postneonatal death. Pregnancy outcomes were compared for singletons among the five maternal language groups, and between two periods a decade apart: 1995–97 vs. 1985–87.

Statistical analyses

Means and standard deviations (SD) (for continuous variables) and frequencies and proportions (for discrete variables) were used to describe maternal characteristics and pregnancy outcomes. Analyses of variance and non-parametric rank tests were used to assess differences in continuous variables; because similar *P*-values were obtained in all analyses, the results presented are based on the parametric tests. Chi-square and likelihood chi-square tests were used to compare the differences in rates among groups. Multilevel logit models were used to estimate the ethnicity-associated adjusted odds ratios (AOR) of adverse pregnancy outcomes with 95% confidence intervals (CI), using the majority French language women as the reference group. The multilevel logit models included infant sex (girl vs. boy), parity (1 vs. \geq 2), maternal age (< 20, 20–34, \geq 35), education (four strata noted above), marital status (unmarried vs. mar-

ried), and community size (five strata noted above) as covariates, and allowing for community-level random effects. All data analyses were carried out using SAS software; multilevel logit analyses were performed using the GLIMMIX macro in SAS version 8.0.²⁸

Results

A total of 1 149 769 births (1 125 462 singletons) were registered in Quebec from 1985 to 1997. The multiple birth rate was lower among Indian (1.7%) and Inuit (1.7%) than among French (2.1%), English (2.3%) and other language (2.1%) women ($P < 0.001$) in 1985–97. The lower multiple birth rate was true for Indian women in both 1985–87 (1.6%) and 1995–97 (1.7%), while Inuit women actually had a non-significantly higher multiple birth rate (2.5%) than French women (2.0%) in 1985–87 ($P = 0.53$). All remaining analyses were restricted to singletons.

Of the 1 125 462 singletons, the numbers by maternal language were 905 565 French, 93 071 English, 2538 Inuit, 7817 Indian, 109 399 others (mostly immigrants of various mother tongues; we do not have the actual numbers of each of the 'other' language women), and 7072 missing. There were 1 120 559 live births, 4903 stillbirths (4.4 per 1000 total births), 5900 infant deaths (5.3 per 1000 live births), 66 248 preterm births (6.0%), 58 561 LBW (5.3%), and 131 758 SGA (12.0%).

Maternal age, education and marital status, and community size

Inuit and Indian mothers were much younger than non-aboriginal language mothers, and their proportion of adolescent mothers was much higher (Table 1). This proportion declined substantially among both Inuit and Indian women from 1985–87 to 1995–97 but remained fourfold higher than among French language women in 1995–97.

Inuit and Indian mothers had much lower educational attainment. The proportion of mothers with <11 years of education was fourfold higher among both Inuit and Indian than among French and English language women. Large disparities in maternal education remained between aboriginal and non-aboriginal women from 1985–87 to 1995–97.

The proportion of unmarried mothers was higher among Inuit and Indian than among non-aboriginal women. This proportion was much higher in 1995–97

	Maternal age and education					<i>P</i> ^a
	French	English	Inuit	Indian	Others	
1985–97 (n)	905 565	93 071	2538	7817	109 399	
Mother's age, mean/SD	27.5/4.7	28.7/5.2	23.6/5.4	23.8/5.6	28.9/5.1	<0.001
% of <20 years	4.3	4.5	26.4	25.3	2.7	<0.001
% of 20–34 years	88.3	82.1	69.8	70.1	83.1	
% of ≥35 years	7.4	13.3	3.8	4.6	14.2	
Education, mean/SD	13.1/2.8	13.4/3.0	9.6/2.4	9.5/2.4	12.4/3.6	<0.001
% of <11 years	15.0	11.1	67.2	69.5	24.4	<0.001
% of 11 years	11.6	19.3	14.6	12.2	14.1	
% of 12–13 years	34.3	27.0	13.3	12.7	25.6	
% of ≥14 years	39.1	42.6	4.9	5.5	35.9	
% of unmarried mothers	45.3	26.2	75.9	56.9	13.6	<0.001
1985–87 (n)	204 948	20 664	233	1758	17 919	
Mother's age, mean/SD	26.8/4.4	28.0/5.1	22.9/5.6	23.3/5.3	28.3/4.9	<0.001
% of <20 years	4.1	4.7	31.4	28.1	2.7	<0.001
% of 20–34 years	90.8	84.8	63.8	68.2	85.6	
% of ≥35 years	5.2	10.6	4.8	3.8	11.7	
Education, mean/SD	12.5/2.6	12.9/2.9	8.6/2.5	9.2/2.4	11.8/3.5	<0.001
% of <11 years	18.3	13.0	83.6	74.9	28.9	<0.001
% of 11 years	12.4	23.5	7.9	11.3	16.6	
% of 12–13 years	40.1	28.1	5.0	10.1	26.1	
% of ≥14 years	29.2	35.4	3.6	3.7	28.5	
% of unmarried mothers	29.6	20.5	70.1	49.9	9.9	<0.001
1995–97 (n)	190 127	20 078	738	1613	30 678	
Mother's age, mean/SD	28.0/5.1	29.4/5.4	24.0/5.4	24.3/5.9	29.4/5.2	<0.001
% of <20 years	4.9	4.3	22.2	23.6	2.7	<0.001
% of 20–34 years	84.7	78.7	73.7	70.2	80.5	
% of ≥35 years	10.4	17.0	4.1	6.1	16.7	
Education, mean/SD	13.6/3.0	13.8/3.1	9.8/2.2	9.8/2.4	12.7/3.6	<0.001
% of <11 years	13.5	9.7	66.4	66.6	22.5	<0.001
% of 11 years	11.4	15.3	14.9	11.8	12.0	
% of 12–13 years	26.1	25.0	13.9	14.3	25.0	
% of ≥14 years	49.0	50.0	4.8	7.4	40.5	
% of unmarried mothers	60.6	31.8	80.9	63.6	15.5	<0.001

^a*P*-values based on analyses of variance/chi-square tests for differences among the five language groups. There were 7072 singletons with maternal language missing, and sample sizes varied slightly for different variables.

than in 1985–87 for all language groups and almost doubled among French language women. Consequently, the disparities between Inuit and Indian vs. French language women were much smaller in 1995–97.

The numbers of singletons with known maternal language by community size (CS) were 573 672 (CS ≥ 1 million), 95 935 (CS 500 000–999 999), 65 275 (CS 100 000–499 999), 125 939 (CS 10 000–99 999) and 255 911 (CS < 10 000, rural and small towns). Much higher proportions of Inuit (95.0%) and Indian (83.3%) women lived in small communities (CS < 10 000) than

of French (25.9%), English (11.8%), and other language (1.9%) women (*P* < 0.001).

Birthweight and gestational age

Indian infants had heavier birthweight than French, English, Inuit, and other language infants, and Inuit women had shorter gestations than those in the other four language groups (Table 2). Inuit women had the highest preterm birth rate, while Indian women had the lowest LBW rate and the highest proportions of both birthweight > 4500 g and post-term birth

Table 1. Maternal age, education and marital status among French, English, Inuit, Indian, and other language women for 1 125 462 singleton births in Quebec, 1985–97

Table 2. Descriptive statistics of pregnancy outcomes among French, English, Inuit, Indian, and other language women for 1 125 462 singleton births in Quebec, 1985–97

Pregnancy outcomes	Maternal language										P ^a
	French		English		Inuit		Indian		Others		
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
1985–97 (n)	905 565		93 071		2538		7817		109 399		
BW (g), mean/SD	3336/546		3399/563		3420/573		3650/594		3346/536		<0.001
GA in weeks, mean/SD	39.1/1.9		39.1/1.9		38.6/2.2		39.0/1.8		39.1/1.8		<0.001
(n) % of BW > 4500 g	11 010	1.2	1 709	1.9	56	2.3	493	6.4	1 398	1.3	<0.001
(n) % of BW < 2500 g	47 804	5.3	4 449	4.8	127	5.1	220	2.9	5 125	4.7	<0.001
(n) % of GA < 37 weeks	53 705	6.0	5 294	5.9	249	10.1	427	5.5	5 838	5.5	<0.001
(n) % of GA > 42 weeks	22 905	2.6	2 431	2.7	47	1.9	268	3.5	2 377	2.2	<0.001
(n) % of SGA birth	109 191	12.3	9 148	10.2	146	6.0	340	4.5	12 020	11.4	<0.001
Stillbirth, n per 1000	3 792	4.2	340	3.7	18	7.1	52	6.7	352	3.2	<0.001
Infant death, n per 1000	4 679	5.2	474	5.1	58	23.0	65	8.4	509	4.7	<0.001
Neonatal death	3 219	3.6	296	3.2	28	11.1	21	2.7	341	3.1	<0.001
Postneonatal death	1 460	1.6	178	1.9	30	12.0	44	5.7	168	1.5	<0.001
1985–87 (n)	204 948		20 664		233		1758		17 919		
BW (g), mean/SD	3306/542		3381/557		3370/595		3596/603		3336/533		<0.001
GA in weeks, mean/SD	39.2/1.9		39.3/1.8		38.4/2.3		39.2/1.9		39.2/1.8		<0.001
(n) % of BW > 4500 g	2 174	1.1	333	1.6	9	3.9	94	5.4	233	1.3	<0.001
(n) % of BW < 2500 g	11 537	5.7	995	4.9	15	6.7	62	3.6	857	4.9	<0.001
(n) % of GA < 37 weeks	11 266	5.5	1 127	5.5	33	14.4	103	5.9	887	5.0	<0.001
(n) % of GA > 42 weeks	7 439	3.6	714	3.5	4	1.8	102	5.9	531	3.0	<0.01
(n) % of SGA birth	30 042	14.8	2 437	12.0	9	4.0	105	6.1	2 332	13.3	0.01
Stillbirth, n per 1000	997	4.9	78	3.8	7	30.0	12	6.8	70	3.9	<0.001
Infant death, n per 1000	1 231	6.0	120	5.8	9	39.8	17	9.7	80	4.5	<0.001
Neonatal death	864	4.2	81	3.9	5	22.1	7	4.0	55	3.1	<0.001
Postneonatal death	367	1.8	39	1.9	4	18.1	10	5.8	25	1.4	<0.001
1995–97 (n)	190 127		20 078		738		1613		30 678		
BW (g), mean/SD	3356/550		3411/570		3392/577		3684/611		3350/543		<0.001
GA in weeks, mean/SD	39.0/1.9		39.0/1.9		38.5/2.3		38.9/1.8		39.0/1.9		<0.001
(n) % of BW > 4500 g	2 463	1.3	421	2.1	12	1.7	110	6.9	409	1.3	<0.001
(n) % of BW < 2500 g	9 689	5.1	991	5.0	39	5.4	49	3.1	1 443	4.7	<0.001
(n) % of GA < 37 weeks	12 200	6.5	1 241	6.2	78	10.7	93	5.8	1 765	5.8	<0.001
(n) % of GA > 42 weeks	1 990	1.1	284	1.4	12	1.6	22	1.4	388	1.3	<0.001
(n) % of SGA birth	19 549	10.4	1 754	8.8	46	6.4	49	3.1	3 102	10.2	<0.001
Stillbirth, n per 1000	734	3.9	69	3.4	2	2.7	15	9.3	89	2.9	<0.001
Infant death, n per 1000	828	4.4	85	4.2	17	23.1	12	7.5	136	4.4	<0.001
Neonatal death	598	3.2	55	2.7	8	10.9	7	4.4	93	3.0	0.003
Postneonatal death	230	1.2	30	1.5	9	12.4	5	3.1	43	1.4	<0.001

BW, birthweight; GA, Gestational age; SGA, small-for-gestational-age.

^aP-values based on analyses of variance/chi-square tests for differences among the five language groups.

($P < 0.001$). The high preterm birth rate among Inuit women decreased from 1985–87 to 1995–97, but remained 60% higher than other language women in 1995–97. The proportion of SGA births was lower among both Inuit and Indian than among French, English, and other language women during both

1985–87 and 1995–97. The proportion of LBW was lowest among Indian infants in both 1985–87 and 1995–97.

Overall, the proportions of births with GA < 28 weeks and BW < 750 g increased from 3.4 and 2.2 per 1000, respectively, in 1985–87, to 4.3 and 2.8 per 1000

Table 3. Birthweight-specific neonatal, postneonatal and total infant mortality rates (per 1000 live births) by maternal language group for 1 125 462 singleton births in Quebec, 1985–97

Birthweight	Maternal language										P ^a
	French		English		Inuit		Indian		Others		
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
Neonatal death											
<500 g	293/321	912.8	36/39	888.9	0/0	–	0/1	–	41/47	872.3	–
500–999 g	829/1949	425.3	86/280	307.1	7/9	777.8	2/9	222.2	83/293	283.3	<0.001
1000–1499 g	325/3256	99.8	20/368	54.3	4/12	333.3	4/12	333.3	32/406	78.8	<0.001
1500–2499 g	572/39 841	14.4	41/3554	11.5	3/100	30.0	5/170	27.4	62/4173	14.9	0.16
2500–3499 g	794/499 794	1.6	67/47 079	1.4	5/1189	4.2	6/2670	2.2	77/61 242	1.3	0.06
3500–4499 g	270/339 040	0.8	24/38 831	0.6	5/1098	4.6	2/4312	0.5	26/40 348	0.6	0.01
≥4500 g	19/10 979	1.7	3/1707	1.8	0/56	–	0/492	–	5/1390	3.6	–
Postneonatal death											
<500 g	1/28	35.7	0/3	–	0/0	–	0/1	–	2/6	333.3	–
500–999 g	72/1120	64.3	20/194	103.1	1/2	500.0	0/7	–	11/210	52.4	–
1000–1499 g	85/2931	29.0	8/348	23.0	1/8	125.0	0/8	–	7/374	18.7	–
1500–2499 g	253/39 269	6.4	39/3513	11.1	4/97	41.2	2/165	12.1	36/4111	8.8	0.001
2500–3499 g	732/499 000	1.5	75/47 012	1.6	15/1184	12.7	15/2664	5.6	86/61 165	1.4	<0.001
3500–4499 g	297/338 770	0.9	29/38 807	0.7	8/1093	7.3	22/4310	5.1	23/40 322	0.6	<0.001
≥4500 g	4/10 960	0.4	0/1704	–	1/56	17.9	4/492	8.1	1/1385	0.7	–
Infant death											
<500 g	294/321	915.9	36/39	923.1	0/0	–	0/1	–	43/47	914.9	–
500–999 g	901/1949	462.3	106/280	378.6	8/9	888.9	2/9	222.2	94/293	320.8	<0.001
1000–1499 g	410/3256	125.9	28/368	76.1	5/12	416.7	4/12	333.3	39/406	96.1	<0.001
1500–2499 g	825/39 841	20.7	80/3554	22.5	7/100	70.0	7/170	41.2	98/4173	23.5	<0.01
2500–3499 g	1526/499 794	3.1	142/47 079	3.0	20/1189	16.8	21/2670	7.9	162/61 242	2.6	<0.001
3500–4499 g	567/339 040	1.7	53/38 831	1.4	13/1098	11.8	24/4312	5.6	49/40 348	1.2	<0.001
≥4500 g	23/10 979	2.1	3/1707	1.8	1/56	17.9	4/492	8.1	6/1390	4.3	0.07

^aP-values based on chi-square tests for differences among the five language groups.

–, Too few events in some subgroups to estimate a valid P-value.

in 1995–97 ($P < 0.001$). The proportion with BW < 750 g was non-significantly lower among Indian (1.4/1000) than among French (2.2/1000), English (2.4/1000), and Inuit (2.8/1000) women ($P = 0.41$). The proportion with GA < 28 weeks was much lower among Indian (2.2/1000) than among Inuit (8.1/1000), French (3.5/1000), English (4.1/1000), and other language (3.5/1000) women ($P < 0.001$). The proportion with BW < 1500 g was much lower among Indian (4.9/1000) than among French (8.1/1000), English (8.7/1000), and Inuit (9.3/1000) women ($P < 0.001$).

Stillbirth and infant mortality

The overall stillbirth and infant mortality rates were much higher among births to Inuit and Indian women than among births to French, English, and other language women (Table 2, $P < 0.001$). Reductions in still-

birth, neonatal and postneonatal mortality rates were generally observed in all language groups from 1985–87 to 1995–97, but the relative disparities between aboriginal and non-aboriginal women changed little over the decade. Surprisingly, the stillbirth rate increased significantly among Indian women from 1985–87 to 1995–97 ($P < 0.001$). The stillbirth rate among Inuit women was sixfold higher than among French language women in 1985–87 but paradoxically lower in 1995–97. Neonatal mortality was much higher among Inuit infants in both 1985–87 and 1995–97. Postneonatal mortality was much higher among both Inuit and Indian infants than among non-aboriginal infants during both 1985–87 and 1995–97. English and other language women had slightly lower stillbirth and neonatal mortality than French language women.

Fetal/perinatal death ratios were 25% lower among Inuit (0.43) than among French (0.59), English (0.59),

Table 4. Gestational-age-specific stillbirth risk (per 1000 ongoing pregnancies), neonatal and postneonatal mortality (per 1000 live births) rates by maternal language group for 1 125 462 singleton births in Quebec, 1985–97

Gestation	Maternal language										<i>P</i> ^b
	French		English		Inuit		Indian		Others		
	<i>n</i>	Rate	<i>n</i>	Rate	<i>n</i>	Rate	<i>n</i>	Rate	<i>n</i>	Rate	
Stillbirth^a											
<22 weeks	102/894 700	0.11	9/89 977	0.10	0/2474	–	0/7739	–	5/106 267	0.05	–
22–27 weeks	844/894 393	0.94	65/89 946	0.72	2/2474	0.81	8/7738	1.03	70/106 233	0.66	0.01
28–32 weeks	555/891 531	0.62	56/89 610	0.62	1/2454	0.41	8/7722	1.04	44/105 895	0.42	0.05
33–36 weeks	866/887 140	0.98	86/89 112	0.97	3/2434	1.23	10/7687	1.30	83/105 337	0.79	0.32
37–41 weeks	1220/840 995	1.45	105/84 683	1.24	11/2225	4.94	22/7312	3.10	120/100 429	1.20	<0.001
≥42 weeks	36/22 905	1.57	1/2431	0.41	0/47	–	1/268	3.73	4/2377	1.68	–
Neonatal death											
<22 weeks	195/205	951.2	21/22	954.5	0/0	–	0/0	–	29/29	1000.0	–
22–27 weeks	938/2018	464.8	105/271	387.5	14/18	777.8	1/8	125.0	86/268	320.9	<0.001
28–32 weeks	330/3836	86.0	21/442	47.5	2/19	105.3	7/27	259.3	33/514	64.2	<0.001
33–36 weeks	595/45 279	13.1	35/4343	8.1	5/206	24.3	3/365	8.2	53/4825	11.0	0.01
37–41 weeks	1080/816 870	1.3	95/82 147	1.2	6/2167	2.8	10/7022	1.4	117/97 932	1.2	0.19
≥42 weeks	46/22 869	2.0	6/2430	2.5	1/47	21.3	0/267	–	12/2373	5.1	0.03
Postneonatal death											
<22 weeks	0/10	–	0/1	–	0/0	–	0/0	–	0/0	–	–
22–27 weeks	62/1080	57.4	13/166	78.3	1/4	250.0	0/7	–	13/182	71.4	0.45
28–32 weeks	82/3506	23.4	12/421	28.5	2/17	117.6	0/20	–	61/481	12.5	0.10
33–36 weeks	203/44 684	4.5	29/4308	6.7	3/201	14.9	1/362	2.8	22/4772	4.6	0.15
37–41 weeks	1064/815 790	1.3	113/81 939	1.4	23/2161	10.6	41/7012	5.8	119/97 815	1.2	<0.001
≥42 weeks	30/22 803	1.3	3/2324	1.2	1/46	21.7	1/267	3.7	3/2361	1.3	0.34

^aProspective stillbirth rate using all ongoing pregnancies at risk as the denominator.

^b*P*-values based on chi-square tests for differences among the five maternal language groups.

–, Too few events in some subgroups to estimate a valid *P*-value.

and other (0.57) language women ($P = 0.02$). At 500–999 g, fetal/perinatal death ratios were much lower among Inuit (0%, 0/7) than among French (60.3%, 1152/1910), English (56.9%, 93/165), Indian (83.3%, 10/12), and other (56.9%, 95/167) language groups ($P < 0.01$). Neonatal/infant death ratios were 50% lower among Indian (0.32) than among French (0.69), English (0.62), and other (0.67) language infants ($P < 0.001$).

Birthweight- and gestational age-specific mortality

Table 3 compares birthweight-specific infant (neonatal and postneonatal) mortality by maternal language. Inuit and Indian infants had much higher birthweight-specific neonatal and postneonatal mortality in virtually all birthweight groups, but a surprisingly low neonatal mortality at 500–999 g was noted among Indian infants. Neonatal mortality rates at 1000–1499 g were threefold higher among both Inuit and Indian

than among French language infants. Postneonatal mortality rates at both LBW and normal birthweight were much higher among both Inuit and Indian infants.

Table 4 compares gestational age-specific stillbirth, neonatal and postneonatal mortality rates by maternal language. At term (37–41 weeks), the stillbirth rate was threefold higher among Inuit and twofold higher among Indian than among French language women. The neonatal mortality rate among Inuit infants was roughly twofold higher at 33–36 and 37–41 weeks. The neonatal mortality rate was much higher among Indian infants at 28–32 weeks but surprisingly low at 22–27 weeks. Postneonatal mortality at 37–41 weeks was roughly eightfold higher among the Inuit and fourfold higher among the Indian infants.

Adjusted odds ratios of adverse pregnancy outcomes

Table 5 presents the ethnicity-associated AORs of adverse pregnancy outcomes from multilevel logit

Pregnancy outcomes	Maternal language			
	English AOR [95% CI]	Inuit AOR [95% CI]	Indian AOR [95% CI]	Others AOR [95% CI]
1985–97				
Preterm birth	1.01 [0.97, 1.04]	1.49 [1.25, 1.78]	0.82 [0.73, 0.91]	0.94 [0.91, 0.97]
SGA	0.85 [0.83, 0.87]	0.39 [0.31, 0.49]	0.27 [0.24, 0.31]	0.93 [0.91, 0.96]
LBW	0.94 [0.91, 0.98]	0.81 [0.64, 1.03]	0.42 [0.36, 0.49]	0.90 [0.87, 0.94]
Stillbirth	0.96 [0.83, 1.11]	0.94 [0.40, 2.23]	1.53 [1.09, 2.15]	0.93 [0.81, 1.08]
Neonatal death	0.93 [0.82, 1.05]	1.63 [0.93, 2.87]	0.63 [0.41, 0.98]	0.90 [0.80, 1.03]
Postneonatal death	1.27 [1.06, 1.54]	4.45 [2.74, 7.22]	1.86 [1.28, 2.70]	1.05 [0.86, 1.28]
1985–87				
Preterm birth	1.01 [0.94, 1.08]	2.13 [1.23, 3.67]	0.91 [0.73, 1.15]	0.90 [0.83, 0.98]
SGA	0.82 [0.79, 0.87]	0.18 [0.07, 0.45]	0.31 [0.25, 0.38]	0.92 [0.88, 0.97]
LBW	0.90 [0.83, 0.97]	1.06 [0.54, 2.11]	0.47 [0.35, 0.64]	0.86 [0.79, 0.93]
Stillbirth	0.87 [0.65, 1.16]	7.19 [2.54, 20.36]	1.04 [0.48, 2.27]	0.99 [0.73, 1.34]
Neonatal death	0.89 [0.71, 1.11]	1.49 [0.27, 8.33]	0.71 [0.35, 1.45]	0.73 [0.56, 0.95]
Postneonatal death	1.13 [0.78, 1.65]	11.40 [3.84, 33.85]	2.07 [0.99, 4.30]	0.87 [0.54, 1.38]
1995–97				
Preterm birth	0.99 [0.93, 1.06]	1.19 [0.88, 1.61]	0.78 [0.62, 0.98]	0.91 [0.86, 0.97]
SGA	0.87 [0.82, 0.93]	0.55 [0.40, 0.77]	0.23 [0.17, 0.31]	1.00 [0.95, 1.05]
LBW	1.00 [0.93, 1.08]	0.68 [0.45, 1.03]	0.46 [0.34, 0.63]	0.93 [0.87, 1.00]
Stillbirth	0.88 [0.64, 1.21]	–	2.24 [1.23, 4.10]	0.84 [0.63, 1.12]
Neonatal death	0.96 [0.71, 1.32]	2.29 [0.90, 5.83]	1.28 [0.58, 2.82]	0.96 [0.73, 1.27]
Postneonatal death	1.57 [1.05, 2.34]	5.44 [2.74, 10.82]	1.28 [0.53, 3.12]	1.67 [1.14, 2.44]

LBW, low birthweight; SGA, small-for-gestational-age.

AOR were adjusted for infant sex, parity, maternal age, education and marital status, and community size and community-level random effects; the majority French language women were used as the reference group.

–, Too few events (two stillbirths among 738 Inuit births, apparent under-reporting) to estimate AOR.

analyses, including maternal age, education, marital status and parity, infant sex, and community size as covariates and allowing for community-level random effects. Inuit women remained at higher risk of preterm birth (AOR = 1.49, [95% CI 1.25, 1.78]) but lower risk of SGA (AOR = 0.39 [0.31, 0.49]). Indian women had much lower risks of SGA (AOR = 0.27 [0.24, 0.31]) and LBW (AOR = 0.42 [0.36, 0.49]). Higher risks of stillbirth were observed among Indian women (AOR = 1.53 [1.09, 2.15]), and of postneonatal death among both Inuit (AOR = 4.45 [2.74, 7.22]) and Indian (AOR = 1.86 [1.28, 2.70]) women. A much higher risk of stillbirth among Indian women was observed in 1995–97 (AOR = 2.24 [1.23, 4.10]) but not in 1985–87 (AOR = 1.04 [0.48, 2.27]). A much higher risk of stillbirth among Inuit women was observed in 1985–87 (AOR = 7.19 [2.54, 20.36]), but not in 1995–97. Inuit infants had a much higher risk of postneonatal death during both 1985–87 and 1995–97. The odds of neonatal death among Inuit and Indian infants were not significantly elevated after these adjustments. Similar

ethnicity-associated risks were observed when the analyses were restricted to residents of rural and small town areas.

Among other covariates observed in multilevel logit analyses, unmarried and less educated women had higher risks of preterm birth, SGA and LBW ($P < 0.01$). Much higher risks of stillbirth and neonatal death were observed among infants of unmarried, less educated, and older (≥ 35 years) women, and of postneonatal death among young (< 20 years), less educated, and unmarried women ($P < 0.01$). Infants from smaller communities had a much higher risk of neonatal death, but did not differ significantly in the risks of preterm birth, SGA and LBW.

Causes of stillbirth and infant death

The leading causes of stillbirth (4903 cases) were asphyxia (2004, 40.9%) and congenital conditions (667, 13.6%). 'Immaturity' was coded in 548 cases (11.2%), although 36% of them were caused by 'slow fetal

Table 5. Adjusted odds ratios (AOR) of adverse pregnancy outcomes by maternal language group from multilevel logit models for singleton births in Quebec, 1985–97

growth and fetal malnutrition' (ICD-9 code: 764). The risk of stillbirth resulting from congenital conditions was slightly higher among Indian women (0.9/1000) than among French (0.6/1000), English (0.6/1000), Inuit (0.4/1000), and other language (0.3/1000) women ($P = 0.03$).

The main causes of infant death (5880 cases) were congenital conditions (2409, 41.0%), immaturity (1427, 24.3%), asphyxia (555, 9.4%), SIDS (535, 9.1%), infection (308, 5.2%), and external causes (151, 2.6%). The risks of cause-specific infant death differed among aboriginal and non-aboriginal infants. Inuit infants had a much higher risk of infant death from immaturity-related conditions (6.3/1000) than Indian (0.9/1000), English (1.4/1000), French (1.2/1000), and other (1.0/1000) language infants ($P < 0.001$). The risk of infant death from congenital conditions did not differ significantly among French (2.2/1000), English (2.0/1000), Inuit (4.0/1000), Indian (1.8/1000), and other language (2.1/1000) infants ($P = 0.27$). The risk of SIDS was much higher among Inuit (6.0/1000) and Indian (2.6/1000) than among French (0.5/1000), English (0.4/1000), and other language (0.5/1000) infants ($P < 0.001$). The risk of 'classic' SIDS (ICD-9 code: 798.0, 501 cases) was also much higher among Inuit (6.0/1000) and Indian (2.4/1000) than among French (0.4/1000), English (0.4/1000), and other language (0.3/1000) infants ($P < 0.001$). The risk of infant death resulting from infections was also much higher among Inuit (2.8/1000) and Indian (2.1/1000) than among French (0.3/1000), English (0.3/1000), and other language (0.2/1000) infants ($P < 0.001$). The risk of infant death from external causes (ICD-9 codes: 260–363, 507, 800–999, E800–912, E914–999) did not differ significantly among the five language groups ($P = 0.67$).

After adjustment for maternal age, education, marital status, parity, infant sex, community size, and community-level random effects by multilevel logit models, Inuit infants remained at a much higher risk of immaturity-related infant death (AOR = 3.03 [1.36, 6.74]) and of SIDS (AOR = 5.46 [2.89, 10.33]) compared with French language infants. Indian infants also had a much higher risk of SIDS (AOR = 2.44 [1.50, 3.97]) but not of immaturity-related infant death (AOR = 0.54 [0.21, 1.34]). Similar elevated risks of SIDS among Inuit (AOR = 5.81 [3.03, 11.15]) and Indian (AOR = 2.41 [1.45, 4.01]) infants were observed when the analyses were restricted to postneonatal period (502 cases), or to 'classic' SIDS (501 cases). Both Inuit (AOR = 6.92

[3.76, 12.73]) and Indian (AOR = 4.83 [3.26, 7.15]) infants had much higher risks of infant death from infections. Within rural and small town areas, similar markedly elevated risks of immaturity-related death were observed among the Inuit, and of death from SIDS and infections among both Inuit and Indian infants.

The proportion of the excess risks $[(RR - 1) / RR * 100\%]$ of selected differential adverse outcomes among Inuit and Indian vs. French language women in 1985–97 after these adjustments was estimated by converting the AOR into relative risk (RR).²⁹ These proportions of the excess risks were 31% for preterm birth among Inuit, 34% for stillbirth among Indian, 39% for neonatal death among Inuit, 77% for postneonatal death among Inuit, 46% for postneonatal death among Indian, 67% for immaturity-related infant death among Inuit, 82% and 59% for SIDS among Inuit and Indian, and 86% and 79% for infant death from infections among Inuit and Indian infants, respectively.

Discussion

Strengths and weaknesses of the present study

Pregnancy outcome studies among Canadian aboriginal women have been hampered by incomplete and/or poor-quality data and the absence of population-based linked data on aboriginal births, infant deaths and stillbirths. A uniform identifier for race/ethnicity on birth registrations would greatly facilitate our capacity to assess ethnic/racial disparities among geographic regions and over time. We used the mother tongue, which has been recorded on Quebec birth registrations throughout the study period, to define ethnicity. Some Quebec aboriginal people have lost their native languages, however, and have adopted English or French as their first language. The aboriginal women defined by language probably represent the more traditionally and culturally preserved aboriginal peoples. Aboriginal women living in urban areas are more likely to have adopted French or English as their first language and therefore be misclassified by mother tongue, although such women are far less frequent in Quebec than in other Canadian provinces. English- or French-speaking aboriginal women were classified with the much larger French and English maternal language groups; their small relative numbers are unlikely to have significantly affected the results for these latter groups. Another limitation is the relatively

small numbers of some events, particularly for Inuit women. The large increase in Inuit births from 1985–87 to 1995–97 probably indicates less complete recording of mother tongue in birth registrations for Inuit in the earlier period.

The Quebec data used in our analyses are the most recent updated linked live birth, stillbirth, and infant death files. As in any population-based data, registration artifacts are of concern, including under-registration of stillbirths, live births, and early neonatal deaths and possible misclassification of live births who died in the first few days of life as stillbirths (particularly at extremely low birthweights).²⁶ Apparent under-reporting of early neonatal deaths among Indian births is strongly suggested by the low neonatal mortality at 500–999 g and 22–27 weeks. Under-reporting of stillbirths in Inuit fetuses near the borderline of viability may well explain the zero fetal/perinatal death ratio at 500–999 g. The very low stillbirth rate among Inuit women in 1995–97, and the relatively lower stillbirth risk among Indian women in 1985–87 vs. 1995–97, indicate probable under-reporting of stillbirth during these periods. Actual pregnancy outcomes among Inuit and Indian women are therefore likely to have been even worse than those recorded here.

Main findings and implications

Despite such under-reporting, we found that Inuit women had much higher risks of preterm birth and immaturity-related infant death, while Indian women did not. Both Inuit and Indian women had a lower risk of SGA and higher risks of stillbirth, neonatal and postneonatal death. There were much higher risks of infant death resulting from SIDS and infections among both Inuit and Indian infants. The relative disparities between aboriginal and non-aboriginal women changed little over a decade, although the absolute rate differences diminished substantially. The fact that these elevated mortality risks largely remained after controlling for maternal age, education, marital status, parity, infant sex, community size, and community-level random effects suggests that these disparities are at least partly related to their particular socio-cultural environments or other unknown factors related to aboriginal women and their communities. A large proportion of these excess risks of adverse outcomes was associated with their aboriginal status after these adjustments, and these risks deserve special attention from researchers and public health policy makers.

The lower risks of SGA or fetal growth restriction among both Inuit and Indian infants, and of LBW among Indian infants, are in contrast to the much higher risk of LBW in Australian aborigines^{20,21} and the slightly higher risk of LBW among Indian infants previously reported in British Columbia and Saskatchewan.^{30,31} Pregnancy outcomes in Inuit women bear some similarities to those in Australian aborigines, with much higher risks of preterm birth and immaturity-related death.^{20,21,32} The much higher risk of immaturity-related infant death among Inuit women is a special problem that was not observed among Indian women. Inuit women have heavier family responsibilities and much higher prevalence of smoking and drug use,³³ which may partly account for their much higher preterm birth rate.

Excess risks of neonatal mortality were observed among aboriginal infants both preterm and at term. These results suggest an urgent need to improve access to and quality of obstetric and neonatal care. The particularly high risks of postneonatal death among Inuit and Indian infants also suggest much room for improvement in living conditions and child health care^{34,35} for Quebec aboriginal populations. Prevention of SIDS and infection-related deaths among both Inuit and Indian infants would be likely to reduce their infant mortality substantially, and are important targets for future research and intervention.

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