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ORIGINAL PAPER

Rising Disparities in Severe Adverse Birth Outcomes Among Haitians in Québec, Canada, 1981–2006

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Abstract Perinatal health data for Haitians are scant. We evaluated adverse birth outcomes for Haitians in Québec, Canada. We analyzed 2,124,909 live births from 1981 to 2006. Haitian ethnicity was assessed using maternal birth country (Haiti, other Caribbean country, other foreign country, Canada) and home language (Creole, French/English but Creole mother tongue, French/English, other). Associations between ethnicity and preterm birth (PTB), low birth weight (LBW), and small-for-gestational-age (SGA) birth were calculated. Adverse birth outcomes were more common among mothers with Haitian ethnicity. Relative to Canadian-born mothers, odds for Haitian-born mothers were 4 times greater for extreme PTB ($\leq$27 weeks), twice greater for very PTB (28–31 weeks), and 25% higher for moderate PTB (32–36 weeks). Patterns were similar for SGA birth and severe cases of LBW. Despite overall decreases LBW and SGA birth, relative and absolute inequalities increased over time. Perinatal health inequalities are increasing for Haitian-born mothers.

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Introduction

The perinatal health status of Haitians is poorly understood. Haiti is the most disadvantaged country in the Americas [1, 2], and data suggest that important inequalities in perinatal health may be present [3]. However, existing information is limited by data quality and a clear picture of perinatal health for Haitians is not available. Even less is known about the perinatal health of the substantial numbers of Haitians who emigrated over recent decades, including a large community in the province of Québec, Canada. The majority (96%) of Haitians in Canada reside in Québec, where French is an official language just as in Haiti [4]. Population and public health research has not yet examined this ethnic group despite evidence that significant inequalities may be present for minorities in Canada [5, 6].

Among immigrant live births in Québec, Haiti is presently the most represented country [7]. Some research suggests that Caribbean migrants as a whole may have worse birth outcomes relative to native-born populations [8, 9]. There is also evidence that low birth weight (LBW) is greater among Caribbean-born than Canadian-born mothers in Québec [10]. It is not known, however, whether these patterns may be driven by Haitian ethnicity because the birth country analyses performed thus far examined the aggregate of Caribbean countries.

Furthermore, no research has evaluated adverse birth outcomes for Haitians over time. Such studies are needed for health policy, especially in the context of increasing ethnic and socioeconomic inequalities in perinatal health

observed in other research [11–14]. There is also evidence that inequalities in perinatal health may be greater for more severe adverse birth outcomes [11]. Achieving an understanding of patterns both over time and according to outcome severity is important to guide health policy to better target ethnic inequalities in perinatal health.

Our objective was to determine the relationship between Haitian ethnicity and adverse birth outcomes (preterm, birth weight, fetal growth) in Québec, and to evaluate modifying effects over time according to outcome severity. Québec is the only province in Canada to collect detailed information relating to ethnicity on birth certificates (maternal country of birth, language spoken at home, and mother tongue).

Methods

Data and Variables

Singleton live born infants from the Québec birth file were extracted for a 25-year period spanning 1981–2006 (N = 2,143,134). The file is compiled from birth registration certificates and the ascertainment of births is complete [15].

Gestational age (in completed weeks) and birth weight (in grams) are available in the birth file. Births missing both gestational age and birth weight data were excluded (n = 7,501, 0.4%). Preterm birth (PTB) was examined for three severity categories based on gestational age at birth: (1) *extreme* PTB, ≤27 weeks; (2) *very* PTB, 28–31 weeks; and (3) *moderate* PTB, 32–36 weeks [11, 16]. Gestational age estimates in Québec are ultrasound-based, which are more precise than estimates based on recall of last menstruation period [17], especially when ethnicity is being evaluated [18]. However, ultrasound may not have been fully implemented in the 1980s.

Birth weight was examined for very (<1,500 g) and moderate (1,500–2,499 g) LBW [19, 20]. Analyses of LBW included all gestational ages (not only term births), to ensure a sufficient number of cases were in the very LBW category. Furthermore, in previous research the relationship between birth country and LBW was similar whether or not premature births were included [7].

Fetal growth was assessed using small-for-gestational-age (SGA) births, defined as birth weight less than the 10th percentile for gestational age and sex [21]. Births < 26 and > 43 weeks were not considered because no SGA classification was available [21]. Ethnic-specific growth curves were not available [22]. After exclusion of births missing outcome data, the final sample included 2,124,909 cases for analyses of PTB; 2,131,175 for LBW; and 2,114,520 for SGA birth.

Haitian ethnicity was identified using maternal country of birth (Haiti, other Caribbean country, other foreign country, Canada, unknown) and language spoken at home (Creole, French or English with Creole mother tongue, French or English, other foreign language, unknown). Creole and French are the two official languages of Haiti, with Creole typically the mother tongue and French more commonly taught at school. French was not considered an indicator of Haitian ethnicity, however, because French-speaking individuals in Québec are the majority making it impossible to identify Haitians from this language category. French and English were instead examined together because they are the two official languages of Canada. Mothers with French or English home language but Creole mother tongue were considered separately because they may represent Haitians who are relatively more integrated in (or acculturated to) Québec society [15].

Available covariates included maternal age (<20, 20–24, 25–29, 30–34, ≥35 years, unknown), education (no high school diploma, high school diploma, postsecondary, some university or more, unknown), marital status (legally married, or not), parity (0, 1, 2+ previous deliveries, unknown), and infant sex (male, female). Previous studies have identified these variables as potential confounders of the relation between ethnicity and adverse birth outcomes [23, 24]. Cohabitation was not considered as these data were not collected in the 1980s. Period was assessed for five intervals (1981–1985, 1986–1990, 1991–1995, 1996–2000, 2001–2006).

Statistical Analysis

Multivariate logistic regression was used to calculate odds ratios (OR) and 95% confidence intervals (CI) to evaluate the association between ethnicity and adverse birth outcomes. Models were initially run for each indicator of ethnicity alone, then adjusted for both ethnicity indicators, and finally adjusted for maternal age, education, marital status, parity, infant sex and period. SGA birth accounts for sex by definition, hence these models were not sex-adjusted.

For PTB and LBW, multivariate polytomous logistic regression was used to assess the influence of ethnicity on severity, using term births (≥37 weeks) and normal weights (≥2,500 g) as the reference. For SGA birth, separate models were estimated for preterm (gestational age 26–36 weeks) and term infants (37–43 weeks) on the basis of known misclassification of SGA status before term [25]. Differential effects over time were assessed in models run for periods separately. The difference in the prevalence of adverse birth outcomes between Haitians and the referent Canadian population was calculated for each period, adjusted for maternal age, education, marital status, parity

and infant sex [26]. Final models were re-run excluding extreme birth outcomes (gestational age less than 20 weeks, n = 312; birth weight less than 500 g, n = 1,027) to assess robustness. Analyses were performed using SAS 9.1 (SAS Institute Inc, Cary, North Carolina).

Results

Over the 25-year period, 1.5% of infants were born to mothers who had migrated from Haiti, 0.3% to mothers who spoke Creole at home, and 0.4% to mothers currently using French/English at home but who had Creole as their mother tongue. Among Haitian-born mothers, 17.9% spoke Creole at home and 25.3% spoke French/English but had Creole as their mother tongue (Table 1). The majority of mothers speaking Creole at home (92.7%) or French/English with Creole as the mother tongue (94.2%) were Haitian-born.

Without considering severity of adverse birth outcomes, PTB, LBW and SGA birth were all more common among Haitian-born mothers (8.5, 7.3, and 12.6%, respectively) compared with Canadian-born mothers (5.8, 4.9 and 11.5%, respectively, Table 2). Similarly, PTB, LBW and SGA birth were more common among mothers using Creole at home (9.0, 7.8, and 12.9%, respectively) and those speaking French/English at home but with Creole mother tongue (8.0, 6.6, and 12.1%, respectively) compared with mothers speaking French/English at home (5.8, 4.9, and 11.5%, respectively).

Mothers with Haitian ethnicity had relatively higher proportions of severe adverse birth outcomes compared with Canadian-born and French/English speaking mothers (Table 3). Relative to Canadian-born mothers, Haitian-born mothers had higher proportions of PTB, LBW and SGA birth for all severity categories, without considering period. This general finding was also present for mothers speaking Creole at home compared with French/English speakers, and to a lesser extent, for those speaking French/English but with Creole as the mother tongue.

When period was considered, extreme and moderate PTB proportions (but not very PTB) tended to increase over time both for mothers of Haitian and Canadian origin. However, the increase between 1981–1985 and 2001–2006 was larger for mothers speaking Creole at home (0.2–1.7% for extreme, and 5.0–9.1% for moderate PTB) compared with French/English speakers (0.2–0.3% for extreme, and 4.4–5.5% for moderate PTB). Similar patterns were present

Table 1 Descriptive characteristics according to maternal country of birth, singletons, Québec, 1981–2006

	Country of birth			
	Haiti (%)	Other Caribbean (%)	Other foreign (%)	Canada (%)
Language spoken at home				
Creole	17.9	0.1	0.1	0.0
French/English, Creole mother tongue	25.3	0.2	0.1	0.0
Other language	0.3	10.8	39.5	1.6
French/English	55.2	87.1	56.0	96.7
Age				
<20 years	3.4	6.0	2.2	4.5
20–24 years	15.7	20.7	15.3	22.9
25–29 years	28.6	30.7	32.4	39.4
30–34 years	30.2	26.4	32.1	24.9
≥35 years	22.2	16.1	18.1	8.3
Education				
No high school diploma	30.3	23.1	17.8	14.7
High school diploma	13.3	18.3	9.8	12.4
Postsecondary	21.2	25.9	20.8	28.5
Some university or more	28.6	25.6	43.0	39.3
Period				
1981–1985	17.8	22.6	14.3	21.4
1986–1990	19.8	20.6	15.9	20.9
1991–1995	21.5	23.1	18.1	21.2
1996–2000	19.7	17.3	20.6	17.2
2001–2006	21.2	16.4	31.2	19.3
Total N	31,663	10,681	230,692	1,841,396

Table 2 Characteristics of mothers according to adverse birth outcomes, singletons, Québec, 1981–2006

	Preterm (%)	Low birth weight (%)	Small-for-gestational-age (%)	N*
Country of birth				
Haiti	8.5	7.3	12.6	31,663
Other Caribbean country	8.8	7.2	13.3	10,681
Other foreign country	5.5	4.4	10.6	230,692
Canada	5.8	4.9	11.5	1,841,396
Language spoken at home				
Creole	9.0	7.8	12.9	6122
French/English, Creole mother tongue	8.0	6.6	12.1	8521
Other language	5.8	4.5	10.5	128,357
French/English	5.8	4.9	11.5	1,953,386
Age				
<20 years	8.0	7.1	15.0	91,459
20–24 years	6.2	5.4	13.6	468,269
25–29 years	5.4	4.5	11.1	821,607
30–34 years	5.5	4.4	9.9	552,186
≥35 years	6.8	5.5	10.2	207,047
Education				
No high school diploma	7.1	7.0	15.9	328,550
High school diploma	6.4	5.8	13.6	258,720
Postsecondary	5.6	4.9	12.3	587,335
Some university or more	5.0	3.6	8.5	843,323
Legally married				
Yes	5.1	4.3	10.7	1,231,234
No	6.8	5.8	12.4	909,511
Previous deliveries				
None	6.5	5.8	13.9	974,433
1	5.0	4.0	9.5	754,673
2+	5.7	4.4	9.1	408,260
Infant sex				
Male	6.2	4.5	11.3	1,100,001
Female	5.5	5.4	11.5	1,040,744
Period				
1981–1985	5.1	5.5	15.6	437,052
1986–1990	5.6	5.2	13.1	433,782
1991–1995	5.9	4.8	10.9	453,077
1996–2000	6.3	4.7	9.2	376,833
2001–2006	6.3	4.3	8.1	440,001
Total	5.8	4.9	11.4	2,140,745

* May not total due to missing data

for French/English speakers with Creole mother tongue and for Haitian-born relative to Canadian-born mothers.

Patterns over time were somewhat different for LBW and SGA birth. The proportion moderate LBW decreased over time for mothers of Canadian ethnicity, but not for those of Haitian ethnicity except for French/English speakers with Creole mother tongue. For very LBW, however, proportions increased for Haitian mothers, while remaining relatively stable for those of Canadian ethnicity. Proportions of term SGA birth decreased over time for all mothers, but the absolute decrease was larger for those of Canadian ethnicity. Preterm SGA birth proportions tended to decrease over time mainly for mothers of Canadian ethnicity; proportions actually increased by 5.3% for mothers speaking Creole at home and by 0.5% for Haitian-born mothers (no clear pattern was apparent for French/English speakers with Creole mother tongue).

Without considering severity, mothers of Haitian ethnicity had a higher likelihood of all three adverse birth outcomes in unadjusted models (Table 4). In models

Table 3 Proportion of adverse birth outcomes according to ethnicity indicator and period, Québec, 1981–2006

	Preterm (%)			Low birth weight (%)		Small-for-gestational-age (%)		N
	Extreme (≤27 weeks)	Very (28–31 weeks)	Moderate (32–36 weeks)	Very (<1,500 g)	Moderate (1,500–2,499 g)	Preterm (26–36 weeks)	Term (37–43 weeks)	
*Country of birth**								
Haiti								
All years	1.1	0.9	6.5	2.0	5.3	13.4	12.6	31,663
1981–1985	0.6	0.8	5.5	1.2	5.5	14.2	14.5	5,635
1986–1990	0.9	0.9	5.9	1.5	4.8	10.9	13.6	6,270
1991–1995	1.0	0.8	6.4	1.9	5.2	13.2	12.6	6,821
1996–2000	1.5	1.1	7.1	2.5	5.5	13.6	11.0	6,229
2001–2006	1.5	1.0	7.3	2.5	5.6	14.8	11.3	6,708
Canada								
All years	0.3	0.5	5.1	0.6	4.3	10.7	11.5	1,841,396
1981–1985	0.2	0.5	4.4	0.6	4.9	12.9	16.0	394,666
1986–1990	0.2	0.5	4.9	0.6	4.6	11.9	13.2	385,103
1991–1995	0.3	0.4	5.2	0.6	4.2	11.0	10.8	391,079
1996–2000	0.3	0.5	5.6	0.7	3.9	9.5	9.1	315,968
2001–2006	0.3	0.4	5.6	0.7	3.6	8.4	7.8	354,580
*Language spoken at home**								
Creole								
All years	1.4	1.0	6.6	2.4	5.5	13.8	12.8	6,122
1981–1985	0.2	0.9	5.0	0.7	5.4	9.8	14.2	686
1986–1990	1.0	0.8	5.1	1.7	4.9	14.3	14.1	1,072
1991–1995	1.3	0.7	5.7	2.1	5.5	13.9	12.8	1,833
1996–2000	2.3	1.6	7.5	3.7	6.0	14.2	12.6	1,286
2001–2006	1.7	1.0	9.1	2.8	5.5	14.2	11.1	1,245
French/English, Creole mother tongue								
All years	0.9	0.8	6.4	1.6	5.0	15.1	11.9	8,521
1981–1985	0.5	0.9	5.0	1.2	5.5	13.8	15.3	933
1986–1990	0.4	1.0	5.3	1.2	5.0	16.2	14.0	1,161
1991–1995	0.7	0.7	6.7	1.6	5.1	17.2	11.5	1,656
1996–2000	0.9	0.6	7.0	1.6	5.0	16.8	11.7	2,202
2001–2006	1.4	0.9	6.6	2.0	4.6	12.4	10.2	2,569
French/English								
All years	0.3	0.5	5.1	0.6	4.2	10.7	11.6	1,953,386
1981–1985	0.2	0.5	4.4	0.7	4.9	12.8	15.9	409,526
1986–1990	0.3	0.5	4.9	0.6	4.6	11.9	13.3	402,450
1991–1995	0.3	0.4	5.2	0.6	4.2	11.0	10.9	410,110
1996–2000	0.3	0.4	5.5	0.7	3.9	9.5	9.2	341,122
2001–2006	0.3	0.4	5.5	0.7	3.6	8.7	8.0	390,178

* Not all country and language categories are shown

adjusted for both language and country of birth, Haitian-born mothers primarily had higher odds of adverse birth outcomes relative to Canadian-born mothers (ORs for language were in large part attenuated). Fully-adjusted models resulted in associations that for Haitian- relative to Canadian-born mothers were strongest for PTB [OR 1.44; 95% CI 1.36, 1.52] and LBW [OR 1.42; 95% CI 1.34, 1.50], followed by SGA birth [OR 1.09; 95% CI 1.05, 1.14]. Similar patterns were observed for mothers originating from other Caribbean countries, but not for those from other foreign countries where associations were much weaker (LBW) or reversed (PTB).

Table 4 Odds ratios (OR) and 95% confidence intervals (CI) for the associations between ethnicity indicators and adverse birth outcomes, singletons, Québec, 1981–2006

	Unadjusted OR [95% CI]	Partially adjusted OR [95% CI]*	Fully adjusted OR [95% CI]**
Preterm birth			
Country of birth			
Haiti	1.50 [1.45, 1.57]	1.49 [1.41, 1.57]	1.44 [1.36, 1.52]
Other Caribbean country	1.56 [1.46, 1.67]	1.55 [1.45, 1.66]	1.48 [1.38, 1.58]
Other foreign country	0.94 [0.93, 0.96]	0.92 [0.90, 0.94]	0.96 [0.94, 0.98]
Canada (reference)	1	1	1
Language spoken at home			
Creole	1.61 [1.47, 1.75]	1.11 [1.01, 1.23]	1.04 [0.94, 1.15]
French/English, Creole mother tongue	1.42 [1.32, 1.54]	0.98 [0.89, 1.08]	0.92 [0.84, 1.01]
Other language	1.00 [0.98, 1.03]	1.06 [1.03, 1.09]	1.00 [0.97, 1.03]
French/English (reference)	1	1	1
Low birth weight			
Country of birth			
Haiti	1.52 [1.46, 1.59]	1.52 [1.44, 1.61]	1.42 [1.34, 1.50]
Other Caribbean country	1.50 [1.40, 1.62]	1.51 [1.40, 1.62]	1.39 [1.29, 1.50]
Other foreign country	0.90 [0.88, 0.92]	0.90 [0.88, 0.92]	1.03 [1.00, 1.06]
Canada (reference)	1	1	1
Language spoken at home			
Creole	1.66 [1.51, 1.82]	1.12 [1.01, 1.25]	1.06 [0.95, 1.18]
French/English, Creole mother tongue	1.37 [1.26, 1.50]	0.92 [0.83, 1.02]	0.92 [0.83, 1.02]
Other language	0.92 [0.89, 0.94]	0.98 [0.95, 1.01]	0.90 [0.87, 0.93]
French/English (reference)	1	1	1
Small-for-gestational age birth			
Country of birth			
Haiti	1.11 [1.08, 1.15]	1.12 [1.07, 1.17]	1.09 [1.05, 1.14]
Other Caribbean country	1.18 [1.11, 1.25]	1.19 [1.12, 1.26]	1.14 [1.08, 1.21]
Other foreign country	0.91 [0.90, 0.93]	0.94 [0.92, 0.95]	1.15 [1.13, 1.17]
Canada (reference)	1	1	1
Language spoken at home			
Creole	1.14 [1.06, 1.23]	1.03 [0.94, 1.12]	1.03 [0.94, 1.12]
French/English, Creole mother tongue	1.06 [1.00, 1.14]	0.96 [0.89, 1.03]	1.05 [0.97, 1.14]
Other language	0.90 [0.89, 0.92]	0.94 [0.92, 0.96]	0.87 [0.85, 0.89]
French/English (reference)	1	1	1

* Adjusted for both country of birth and language spoken at home

** Adjusted for country of birth, language spoken at home, age, education, marital status, previous deliveries, infant sex (except for small-for-gestational-age birth), and period

Associations for Haitian- relative to Canadian-born mothers were of even stronger magnitude for more severe outcomes (Table 5). This was particularly true for extreme PTB, very PTB and very LBW where the odds were, respectively, 4 times, 2 times, and 2.8 times higher for Haitian- relative to Canadian-born mothers (in contrast, the odds for moderate PTB and moderate LBW were only 25 and 19% higher, respectively). Furthermore, mothers speaking Creole at home had 28% higher odds of extreme PTB and 25% higher odds of very LBW relative to those speaking French–English at home. Exclusion of births < 20 weeks and <500 g did not affect results for extreme PTB or very LBW.

For most outcomes, a general pattern of increasing inequalities over time tended to be present for Haitian- relative to Canadian-born mothers. On a relative or ratio-based scale (Fig. 1), the magnitude of the increase was greater for very LBW (ORs rose from 1.74 in 1981–1985 to 4.09 in 2001–2006) than for moderate LBW (ORs rose from 1.02 in 1981–1985 to 1.80 in 2001–2006). Although

Table 5 Odds ratios and 95% confidence intervals for the associations between ethnicity indicators and adverse birth outcomes according to severity, singletons, Québec, 1981–2006*

	Preterm birth			Low birth weight		Small-for-gestational-age birth	
	Extreme (≤27 weeks)	Very (28–31 weeks)	Moderate (32–36 weeks)	Very (<1,500 g)	Moderate (1,500–2,499 g)	Preterm 26–36 weeks	Term 37–43 weeks
Country of birth							
Haiti	3.99 [3.45, 4.61]	1.99 [1.70, 2.31]	1.25 [1.18, 1.33]	2.84 [2.55, 3.16]	1.20 [1.13, 1.28]	1.17 [1.00, 1.36]	1.09 [1.04, 1.14]
Other Caribbean country	3.49 [2.85, 4.26]	1.90 [1.56, 2.33]	1.33 [1.24, 1.44]	2.63 [2.27, 3.04]	1.20 [1.11, 1.31]	1.12 [0.92, 1.38]	1.14 [1.08, 1.22]
Other foreign country	1.17 [1.06, 1.28]	1.01 [0.93, 1.09]	0.94 [0.92, 0.97]	1.07 [1.01, 1.14]	1.02 [1.00, 1.05]	1.05 [0.97, 1.13]	1.15 [1.13, 1.17]
Canada (reference)	1	1	1	1	1	1	1
Language spoken at home							
Creole	1.28 [0.99, 1.65]	1.09 [0.81, 1.46]	0.99 [0.88, 1.11]	1.25 [1.03, 1.52]	0.99 [0.88, 1.13]	1.15 [0.86, 1.53]	1.02 [0.93, 1.11]
French/English, Creole mother tongue	0.78 [0.60, 1.02]	0.87 [0.65, 1.15]	0.95 [0.86, 1.05]	0.86 [0.71, 1.05]	0.94 [0.84, 1.06]	1.33 [1.03, 1.72]	1.03 [0.94, 1.11]
Other language	0.92 [0.81, 1.03]	1.21 [1.10, 1.32]	0.99 [0.96, 1.02]	1.02 [0.94, 1.10]	0.88 [0.85, 0.91]	0.86 [0.78, 0.95]	0.86 [0.84, 0.88]
French/English (reference)	1	1	1	1	1	1	1

* Adjusted for country of birth, language spoken at home, age, education, marital status, previous deliveries, infant sex (except for small-for-gestational-age birth), and period

the change was not statistically significant for extreme and very PTB, ORs were nonetheless higher in later periods (ORs for moderate PTB were stable). ORs also tended to rise for preterm and term SGA birth. On an absolute or difference-based scale (Fig. 2), patterns in the prevalence percentage difference between Haitian- and Canadian-born mothers were similar to those of ORs. Associations did not change over time for mothers speaking Creole at home or for those speaking French/English with Creole mother tongue, nor did they change significantly for other languages, Caribbean- or other foreign-born mothers (results not shown).

Discussion

To our knowledge, this study is the first to examine population-based adverse birth outcomes over time (25 years) for Haitians living outside their native country. We found that PTB, LBW and SGA birth were more prevalent in Haitian compared with non-Haitian mothers residing in Québec. Relative disparities between Haitian- and Canadian-born mothers were larger for more severe outcomes, especially PTB and LBW. Associations were particularly strong for extreme PTB where adjusted odds were nearly 4 times higher for Haitian- compared with Canadian-born mothers. Furthermore, both relative and absolute inequalities increased over time particularly for LBW (very and moderate cases) and term SGA birth. Associations were stronger using country of birth as the indicator of Haitian ethnicity than language.

Scant research has evaluated perinatal health inequalities between Haitians and other populations. In Florida, there is evidence that infant mortality, PTB, LBW and birth defects are disproportionately greater among Haitians [27, 28]. In Québec, where 96% of Haitians in Canada are found [4], there has been an effort to document cardiovascular and infectious disease risk factors [29, 30]. A larger body of evidence has documented perinatal health inequalities for US ethnic groups especially Blacks and Hispanics [31–35], but also for other minorities including Arabs and native populations [36, 37]. Findings tend to vary across ethnic groups, with US Blacks having the poorest outcomes [32] and Arabs relatively favourable outcomes relative to non-Hispanic Whites [36]. Black-White disparities may also be larger for more severe outcomes such as very PTB and very LBW [19]. However, less research has evaluated trends in ethnic-based inequalities over time. Although there is evidence that Black-White disparities in PTB have been stable in the US since the 1990s [20], disparities between ethnic groups in New Zealand may be increasing [38]. For SGA birth, Black-White disparities in the US were stable for term SGA birth

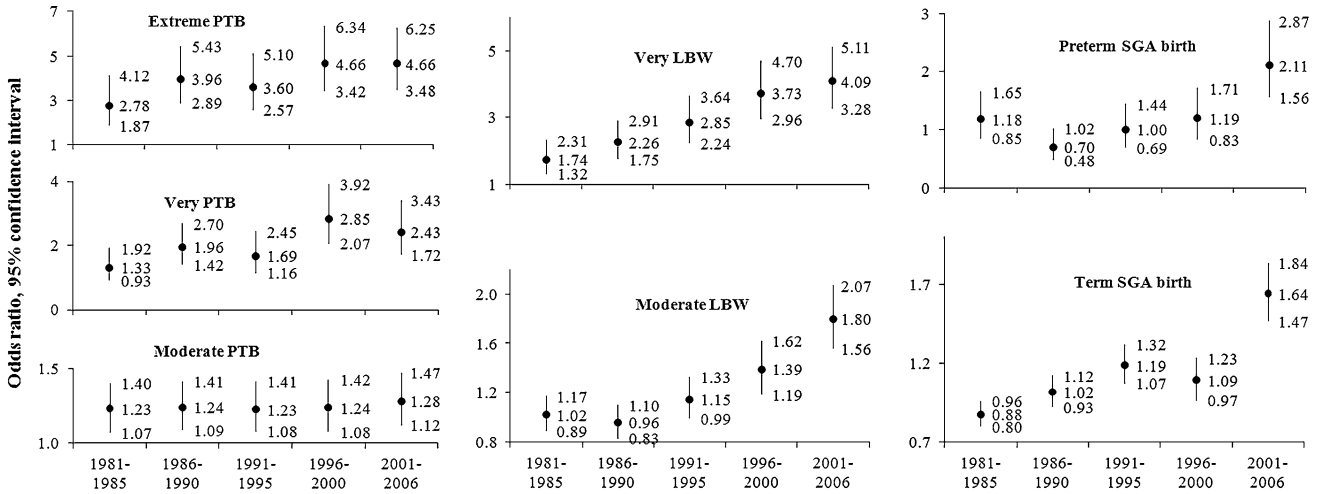

Fig. 1 Likelihood of adverse birth outcomes according to severity for Haitian- relative to Canadian-born mothers over time, Québec, 1981–2006*. *PTB* preterm birth, *LBW* low birth weight, *SGA* small-for-gestational-age. *Adjusted for country of birth, language spoken at home, age, education, marital status, previous deliveries, and (except for SGA birth) infant sex

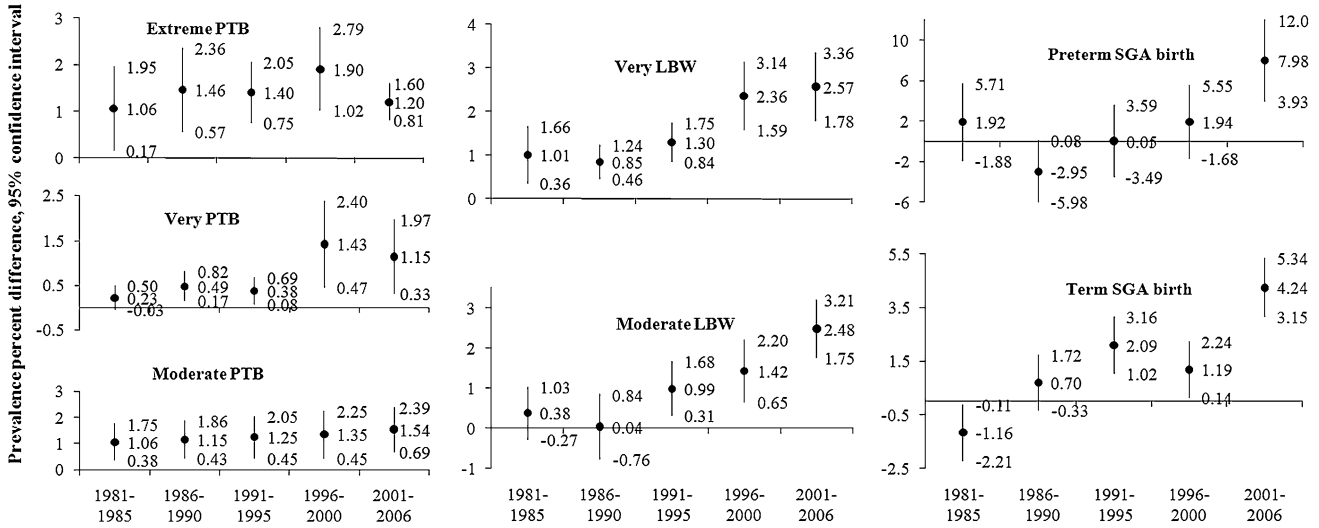

Fig. 2 Prevalence percentage difference between Haitian- and Canadian-born mothers for adverse birth outcomes according to severity, Québec, 1981–2006*. *PTB* preterm birth, *LBW* low birth weight, *SGA* small-for-gestational-age. *Adjusted for country of birth, language spoken at home, age, education, marital status, previous deliveries, and (except for SGA birth) infant sex

but increased for preterm SGA birth during the latter half of the last century [39, 40]. Even fewer studies have evaluated migration-based disparities in perinatal health over time. While it has been established (though findings are not consistent)[8, 41] that birth outcomes are better among migrants, we were unable to identify any studies evaluating patterns over time. The literature is also unclear whether immigrant birth outcomes vary according to severity. This is concerning because we found that relative and absolute disparities increased over time for Haitian- relative to Canadian-born mothers, particularly for LBW and SGA birth including severe cases. These findings should also be interpreted in light of the overall decreased prevalence of LBW and SGA birth over time, which may result in greater ORs due to smaller denominators, but this issue did not affect prevalence differences.

In our data, maternal country of birth was more strongly associated with adverse birth outcomes than was language. Though this suggests that Haitian immigrants per se may be more susceptible to adverse birth outcomes than Canadian-born Haitians, it should be realised that fewer mothers reported Creole as their language, lowering precision for this variable. Furthermore, Creole speakers may only represent a fraction of Haitians since many may be French-speakers who are impossible to identify in our data. Furthermore, French-speaking Haitians wishing to move to Québec are more likely to immigrate successfully than are Creole speakers as their socioeconomic status is generally

higher. Our results for immigration should nonetheless be interpreted in light of the possibility that country of birth reflects an immigration effect rather than an ethnicity effect. However, foreign-born mothers from other non-Caribbean countries tended to have much weaker associations than did Haitian-born mothers for most birth outcomes, with the exception of term SGA birth (associations were protective for moderate PTB). Associations also increased over time for Haitian- relative to Canadian born mothers without doing so for other foreign-born mothers, including Caribbean-born mothers. Thus, it is not clear that the associations observed for Haitian-born mothers (which were greater than those of other foreign-born mothers) were entirely due to immigration processes. Secular trends could reflect waves of immigration with different sociodemographic profiles, or political factors.

What might explain the patterns we observed? A body of evidence has established that perceived racial discrimination, widely experienced by Blacks [42] including those that are foreign-born [43], is associated with PTB and LBW [44]. Financial insecurity may be a contributing factor. Socioeconomic data indicate that unemployment and poverty may be common among Québec Haitians [45]. This is concerning because socioeconomic status is a well-recognised determinant of perinatal health [11, 46]. This problem may be compounded by the cultural practice of sending money back to Haiti to support kin [28, 47]. Furthermore, race, immigration, socioeconomic status and pregnancy outcomes are closely related and complex interactions may exist [7, 48]. Though we accounted for education, interaction could not be assessed due to limited power. Haitian immigrants also tend to have high rates of depression and post-traumatic stress [49]. Domestic violence is prevalent among Haitians [28, 50], and is another factor that may influence adverse birth outcomes. We did not have data on such potential explanatory factors, and it is possible that changes in their distribution over time might explain the patterns we observed. Racial differences related to genetic factors are unlikely to explain our findings since the increase in disparities occurred over a relatively short time period.

Limitations of this study included our inability to account for characteristics not recorded in the birth file, including behavioural factors like tobacco use or diet. However, smoking is relatively uncommon among Haitians and is unlikely to account for our findings [51, 52]. Furthermore, research suggests that smoking only explains a small part of perinatal health disparities [53]. We could not account for time since immigration, or for births clustered within mothers or relatives. There may be under-reporting of country of birth and language on birth certificates as women may make false statements. We evaluated births over a 25-year period, and do not know whether changes in the recording of variables occurred over time. For example, live births with extreme low birth weight may not have been recorded in the 1980s when survival was expected to be low and efforts to save such newborns may have been fewer. However, this problem would affect associations only if the practice was differential between Haitians and non-Haitians, which is unlikely. Last, generalizability to Haitians living in other communities is not known.

This study showed that perinatal health inequalities are present between Haitians and non-Haitians in large Canadian province, and that disparities are not only larger for more extreme birth outcomes but are increasing over time. Haitian people in Canada may be a particularly vulnerable group at risk of poor health outcomes [6]. More effort is needed to evaluate the health status of Haitian populations and other minorities to determine whether disparities are present for other health outcomes. Public health policy and prevention programs should account for minorities who may be more vulnerable than the mainstream population.

References

1. Chelala C, Canépa M. The challenge of Haiti. Health: a right for all. Pan American Health Organization, 2009, p. 1–23. Available from: http://www.paho.org/english/d/csu/TheChallengeofHaiti.pdf.
2. United Nations. Human Development Report 2009 Haiti. The Human Development Index -going beyond income. United Nations Development Programme, 2009. Available from: http://hdrstats.undp.org/en/countries/country_fact_sheets/cty_fs_HTI.html.
3. United Nations Children's Fund (UNICEF). The State of the World's Children 2009. Maternal and Newborn Health. New York, UNICEF, 2008, p. 1–160. Available from: http://www.unicef.org/sowc09/docs/SOWC09-FullReport-EN.pdf.
4. Bastien A. Haitians in Montreal: demographic and spatial evolution. Cah Que Demogr. 1985;14(2):241–57.
5. Frohlich KL, Ross N, Richmond C. Health disparities in Canada today: some evidence and a theoretical framework. Health Policy. 2006;79(2–3):132–43.
6. Rodney P, Copeland E. The health status of black Canadians: do aggregated racial and ethnic variables hide health disparities? J Health Care Poor Underserved. 2009;20(3):817–23.
7. Auger N, Luo ZC, Platt RW, Daniel M. Do mother's education and foreign born status interact to influence birth outcomes? Clarifying the epidemiological paradox and the healthy migrant effect. J Epidemiol Community Health. 2008;62(5):402–9.
8. Urquia ML, Glazier RH, Blondel B, et al. International migration and adverse birth outcomes: role of ethnicity, region of origin and destination. J Epidemiol Community Health. 2010;64(3):243–51.
9. Carballo M, Divino JJ, Zeric D. Migration and health in the European Union. Trop Med Int Health. 1998;3(12):936–44.
10. Moore S, Daniel M, Auger N. Socioeconomic disparities in low birth weight outcomes according to maternal birthplace in Quebec, Canada. Ethn Health. 2009;14(1):61–74.
11. Auger N, Roncarolo F, Harper S. Increasing educational inequality in preterm birth in Québec, Canada, 1981–2006. J Epidemiol Community Health 2010; in press. doi:10.1136/jech.2009.102350.
12. Demissie K, Rhoads GG, Ananth CV, et al. Trends in preterm birth and neonatal mortality among blacks and whites in the

United States from 1989 to 1997. Am J Epidemiol. 2001;154(4):307–15.
13. Glinianaia SV, Rankin J, Pless-Mulloli T, Pearce MS, Charlton M, Parker L. Temporal changes in key maternal and fetal factors affecting birth outcomes: a 32-year population-based study in an industrial city. BMC Pregnancy Childbirth. 2008;8:39.
14. Matijasevich A, Victora CG, Barros AJ, et al. Widening ethnic disparities in infant mortality in southern Brazil: comparison of 3 birth cohorts. Am J Public Health. 2008;98(4):692–8.
15. Auger N, Daniel M, Moore S. Sex ratio patterns according to Asian ethnicity in Quebec, 1981–2004. Eur J Epidemiol. 2009;24(1):17–24.
16. Moutquin JM. Classification and heterogeneity of preterm birth. BJOG. 2003;110(Suppl 20):30–3.
17. Dietz PM, England LJ, Callaghan WM, Pearl M, Wier ML, Kharrazi M. A comparison of LMP-based and ultrasound-based estimates of gestational age using linked California livebirth and prenatal screening records. Paediatr Perinat Epidemiol. 2007;21(2):62–71.
18. Wingate MS, Alexander GR, Buekens P, Vahratian A. Comparison of gestational age classifications: date of last menstrual period vs. clinical estimate. Ann Epidemiol. 2007;17(6):425–30.
19. Kramer MR, Hogue CR. What causes racial disparities in very preterm birth? A biosocial perspective. Epidemiol Rev. 2009;31:84–98.
20. Miranda ML, Maxson P, Edwards S. Environmental contributions to disparities in pregnancy outcomes. Epidemiol Rev. 2009;31:67–83.
21. Kramer MS, Platt RW, Wen SW, et al. A new and improved population-based Canadian reference for birth weight for gestational age. Pediatrics. 2001;108(2):E35.
22. Kierans WJ, Joseph KS, Luo ZC, Platt R, Wilkins R, Kramer MS. Does one size fit all? The case for ethnic-specific standards of fetal growth. BMC Pregnancy Childbirth. 2008;8:1.
23. Messer LC, Vinikoor LC, Laraia BA, et al. Socioeconomic domains and associations with preterm birth. Soc Sci Med. 2008;67(8):1247–57.
24. Wiles NJ, Peters TJ, Leon DA, Lewis G. Birth weight and psychological distress at age 45–51 years: results from the Aberdeen Children of the 1950 s cohort study. Br J Psychiatry. 2005;187:21–8.
25. Hutcheon JA, Platt RW. The missing data problem in birth weight percentiles and thresholds for "small-for-gestational-age". Am J Epidemiol. 2008;167(7):786–92.
26. Spiegelman D, Hertzmark E. Easy SAS calculations for risk or prevalence ratios and differences. Am J Epidemiol. 2005;162(3):199–200.
27. Beckerman A. Birth defects as an indicator of the health status of Haitian women and their children. J Health Soc Policy. 2006;22(1):93–109.
28. Fordyce L. Social and clinical risk assessment among pregnant Haitian women in South Florida. J Midwifery Womens Health. 2009;54(6):477–82.
29. Adrien A, Leaune V, Remis RS, et al. Migration and HIV: an epidemiological study of Montrealers of Haitian origin. Int J STD AIDS. 1999;10(4):237–42.
30. Desilets MC, Garrel D, Couillard C, et al. Ethnic differences in body composition and other markers of cardiovascular disease risk: study in matched Haitian and White subjects from Quebec. Obesity (Silver Spring). 2006;14(6):1019–27.
31. Howard DL, Marshall SS, Kaufman JS, Savitz DA. Variations in low birth weight and preterm delivery among blacks in relation to ancestry and nativity: New York City, 1998–2002. Pediatrics. 2006;118(5):e1399–405.
32. Kramer MR, Hogue CR. Place matters: variation in the black/white very preterm birth rate across U.S. metropolitan areas, 2002–2004. Public Health Rep. 2008;123(5):576–85.
33. Reagan PB, Salsberry PJ. Race and ethnic differences in determinants of preterm birth in the USA: broadening the social context. Soc Sci Med. 2005;60(10):2217–28.
34. Stein CR, Savitz DA, Janevic T, et al. Maternal ethnic ancestry and adverse perinatal outcomes in New York City. Am J Obstet Gynecol. 2009;201(6):584–9.
35. Kleinman JC, Kessel SS. Racial differences in low birth weight. Trends and risk factors. N Engl J Med. 1987;317(12):749–53.
36. El-Sayed AM, Galea S. Explaining the low risk of preterm birth among arab americans in the United States: an analysis of 617451 births. Pediatrics. 2009;123(3):e438–45.
37. Schempf AH, Mendola P, Hamilton BE, Hayes DK, Makuc DM. Perinatal outcomes for Asian, Native Hawaiian, and other Pacific Islander mothers of single and multiple race/ethnicity: California and Hawaii, 2003–2005. Am J Public Health. 2010;100(5):877–87.
38. Craig ED, Mantell CD, Ekeroma AJ, Stewart AW, Mitchell EA. Ethnicity and birth outcome: New Zealand trends 1980–2001. Part 1. Introduction, methods, results and overview. Aust N Z J Obstet Gynaecol. 2004;44(6):530–6.
39. Ananth CV, Demissie K, Kramer MS, Vintzileos AM. Small-for-gestational-age births among black and white women: temporal trends in the United States. Am J Public Health. 2003;93(4):577–9.
40. Ananth CV, Balasubramanian B, Demissie K, Kinzler WL. Small-for-gestational-age births in the United States: an age-period-cohort analysis. Epidemiology. 2004;15(1):28–35.
41. Bollini P, Pampallona S, Wanner P, Kupelnick B. Pregnancy outcome of migrant women and integration policy: a systematic review of the international literature. Soc Sci Med. 2009;68(3):452–61.
42. Clark R, Anderson NB, Clark VR, Williams DR. Racism as a stressor for African Americans. A biopsychosocial model. Am Psychol. 1999;54(10):805–16.
43. Dominguez TP, Strong EF, Krieger N, Gillman MW, Rich-Edwards JW. Differences in the self-reported racism experiences of US-born and foreign-born Black pregnant women. Soc Sci Med. 2009;69(2):258–65.
44. Mustillo S, Krieger N, Gunderson EP, Sidney S, McCreath H, Kiefe CI. Self-reported experiences of racial discrimination and Black-White differences in preterm and low-birthweight deliveries: the CARDIA Study. Am J Public Health. 2004;94(12):2125–31.
45. Icart JC. Haïtiens. L'Encyclopédie Canadienne, 2010. Available from: http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=F1ARTF0009391.
46. Beard JR, Lincoln D, Donoghue D, et al. Socioeconomic and maternal determinants of small-for-gestational age births: patterns of increasing disparity. Acta Obstet Gynecol Scand. 2009;88(5):575–83.
47. Olivier D. Les transferts d'argent, «une rivière d'or qui descend sur Haïti». AlterPresse, 2010. Available from: http://www.alterpresse.org/spip.php?article5741#auteur_bas12.
48. Savitz DA, Kaufman JS, Dole N, Siega-Riz AM, Thorp JM Jr, Kaczor DT. Poverty, education, race, and pregnancy outcome. Ethn Dis. 2004;14(3):322–9.
49. Fawzi MC, Betancourt TS, Marcelin L, et al. Depression, post-traumatic stress disorder among Haitian immigrant students: implications for access to mental health services, educational programming. BMC Public Health. 2009;9:482.
50. Latta RE, Goodman LA. Considering the interplay of cultural context and service provision in intimate partner violence: the case of Haitian immigrant women. Violence Against Women. 2005;11(11):1441–64.
51. O'Loughlin J, Maximova K, Tan Y, Gray-Donald K. Lifestyle risk factors for chronic disease across family origin among adults

in multiethnic, low-income, urban neighborhoods. Ethn Dis. 2007;17(4):657–63.
52. Taylor KL, Kerner JF, Gold KF, Mandelblatt JS. Ever vs never smoking among an urban, multiethnic sample of Haitian-, Caribbean-, and US-born blacks. Prev Med. 1997;26(6):855–65.
53. Morgen CS, Bjork C, Andersen PK, Mortensen LH, Nybo Andersen AM. Socioeconomic position and the risk of preterm birth–a study within the Danish National Birth Cohort. Int J Epidemiol. 2008;37(5):1109–20.