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ORIGINAL ARTICLE

Stillbirth in an Anglophone minority of Canada

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Abstract
Objectives We assessed trends in stillbirth over time for Francophones and Anglophones of Quebec, a large Canadian province with publically funded health care and an English-speaking minority.
Methods We calculated stillbirth rates for Francophones and Anglophones, and estimated hazard ratios (HR) by decade from 1981 to 2010, adjusting for maternal characteristics. We analyzed temporal trends by gestational interval and cause of fetal death.
Results Stillbirth rates decreased in Quebec during the three decades, due to improved rates in Francophones. Rates decreased for Anglophones in 1991–2000, but increased in 2001–2010 at term, during the second trimester, and for most causes of fetal death. In the 2000s, the hazard of stillbirth for Anglophones was nearly the same as the hazard for Francophones in the 1980s (HR 0.93, 95 % confidence interval 0.82, 1.05).
Conclusions Stillbirth rates declined in both Francophones and Anglophones before the turn of the century, but increased thereafter for Anglophones, suggesting that linguistic inequalities in stillbirth may be emerging in Quebec. Linguistic status may be a useful marker for surveillance of inequalities in stillbirth.

Keywords Canada · Cultural deprivation · Fetal death · Language · Stillbirth · Trends

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Introduction

Anglophones in the Canadian province of Quebec are a minority in a majority Francophone population (Bouchard and Desmeules 2013), and their health status is surprisingly unclear. During the past three decades, perinatal health of Anglophones has deteriorated in Quebec, particularly fetal growth (Auger et al. 2012, 2013). A growing number of Anglophones are socioeconomically disadvantaged compared with Francophones (Lussier and Trempe 2012), and the lack of data on other perinatal outcomes is concerning. This is especially true for stillbirth, a pregnancy outcome that is more common in minorities (Flenady et al. 2011; Smith and Fretts 2007), and that is potentially preventable through health care (Bhutta et al. 2014; Flenady et al. 2011).

Stillbirth is gaining attention worldwide, but there is a paucity of data for minorities at risk (Lawn et al. 2011). The Anglophone minority in Quebec makes up 13.4 % of the population (Bouchard and Desmeules 2013), but a tendency to leave for other provinces is reducing their proportion even further (Corbeil et al. 2010; Floch and

Pocock 2008). Little is known on rates of stillbirth among Anglophones in Quebec, where health care is under provincial jurisdiction. Stillbirth rates decreased in Canada during past decades, but this improvement reflects the Anglophone majority in the rest of Canada and may not apply to Anglophones in Quebec. It is entirely plausible that stillbirth rates did not decrease for Anglophones in Quebec, or that the decline was more modest, considering the recent increase in fetal growth restriction (Auger et al. 2012, 2013) and socioeconomic disadvantage (Lussier and Trempe 2012) for this group.

In high-income countries, stillbirth rates are potential indicators of quality of health care (Flenady et al. 2011). Deficiencies in medical care are linked with ethnic inequalities in stillbirth in Europe (Malin and Gissler 2009; Reime et al. 2009). Linguistic inequalities may be exacerbated through communication barriers or other problems affecting access to care (Ackermann Rau et al. 2014; Temel et al. 2013). Suboptimal care could be more problematic in the third trimester, since stillbirth prevention is more feasible toward the end of pregnancy (Pattinson et al. 2011). Emergency obstetric care could potentially prevent stillbirths from obstetric complications such as placental abruption or cord prolapse (Bhutta et al. 2014). Thus, language-related problems in health care could have a greater impact later in gestation or for some causes of death.

The objectives of this study were twofold. We sought to (a) determine whether Anglophones contributed to the overall decrease in the rate of stillbirth over time in Quebec, and (b) evaluate differences in the gestational timing or causes of fetal death between Anglophones and Francophones. We hypothesized that stillbirth rates did not necessarily decrease for Quebec's Anglophones, and that linguistic inequalities were potentially greater later in gestation or for causes of death preventable through health care.

Methods

Data and study design

We analyzed the cohort of all singleton live births ($N = 2{,}482{,}364$) and stillbirths ($N = 10{,}287$) in the province of Quebec over three decades from 1981 through 2010, excluding abortions. We used information from birth registration certificates, which by law all residents must submit to the Quebec Health Ministry even if delivery occurs out of province. We therefore had complete coverage of births to residents of Quebec. Stillbirths in Quebec by definition must weigh 500 g to be registered; hence, analyses were limited to this cut-off.

Variables

Maternal mother tongue was used to code linguistic status. We used mother tongue rather than language spoken at home because the first language spoken may more closely reflect cultural exposures over the life course. Mother tongue is self-reported on birth certificates in Quebec. We identified Anglophones (English speakers), Francophones (French speakers), and Allophones (all remaining languages). We examined time trends for each decade since 1981 (i.e., 1981–1990, 1991–2000, 2001–2010). Narrower time periods were not used as stillbirth is rare. For minorities, Quebec regulations forbid reporting rates containing fewer than 10 events.

We included covariates recorded on birth registration certificates that potentially influenced the association between linguistic status and stillbirth over time. These included maternal age (<20, 20–34, ≥35 years), education (high school diploma or less, pre-university studies, university training), marital status (legally married, or not), and parity (0, 1, ≥2 previous deliveries, including stillbirths).

The main outcome measure was stillbirth, expressed dichotomously. We used a time-to-event design, with pregnancies followed retrospectively over gestational time until delivery of a stillborn or live born infant. To explore associations over the duration of pregnancy, we defined five gestational intervals, including <24, 24–27, 28–31, 32–36, and ≥37 weeks of gestation. We selected these intervals based on the natural history of stillbirth (Yudkin et al. 1987), and to ensure a sufficient number of stillbirths in each gestational interval. In Quebec, gestational age is determined by ultrasound before 20 weeks for most women (Public Health Agency of Canada 2009); however, menstrual dating may have been used more frequently in the 1980s than in recent years. Misclassification of gestational age was likely similar for Francophones and Anglophones.

We identified the leading cause of fetal death with International Classification of Disease (ICD) codes, using the 9th revision until 1999, and the 10th beginning in 2000. These included placental abruption (762.1; P02.1), amniotic sac/cervix/other placental causes (761.0–761.3; 762.0; 762.2; 762.6; P01.0–P01.3; P02.0; P02.2; P02.6; P02.7), cord compression/prolapse (762.4; 762.5; P02.4; P02.5), hypertension (760.0; P00.0), diabetes (775.0; 775.1; P70.0–P70.2), disorders related to fetal growth/malnutrition/short gestation (764; 765; P05; P07), congenital anomaly (740–759; Q00–Q99), unexplained causes (779.9; P95), and all remaining causes grouped in a last category (alphabetical codes pertain to ICD-10). In Quebec, cause of death is documented by physicians on stillbirth certificates, and is coded by the Statistics Institute of Quebec using the ICD. Autopsies were performed for 64.8 % of

Anglophones (95 % CI 61.6, 68.0), 69.7 % of Francophones (95 % CI 68.7, 70.7), and 56.6 % of Allophones (95 % CI 53.8, 59.5). Placental pathology and markers used in alternative classification systems were not available (Gordijn et al. 2009; Silver et al. 2007).

Missing data on mother tongue (2.3 %), maternal age (0.01 %), education (5.9 %), marital status (0.03 %), and gestational age (0.8 %) were imputed five times with multiple imputation, using the distribution of other covariates in the imputation model (Sterne et al. 2009).

Statistical analysis

We calculated stillbirth rates per 1000 total births. We used Cox proportional hazards regression to estimate hazard ratios (HR) and 95 % confidence intervals (CI) for the association between linguistic status and stillbirth, using gestational age in the time axis and censoring live births, a competing outcome. The proportional hazards assumption was verified using a mother tongue-by-gestational age interaction term. We also computed risk differences (RDs) on the absolute scale, using log-binomial models with an identity link. Estimates were adjusted for the added variance due to imputation (Sterne et al. 2009).

To determine whether Anglophones contributed to the overall decline in stillbirth (objective 1), we tested for changes in the HR of stillbirth over time using a mother tongue-by-period interaction term in a Cox regression model adjusted for maternal age, education, marital status, and parity. Subsequently, we estimated period-specific HRs for each language group relative to Francophones in 1981–1990. To ensure that fewer births to Anglophones over time were not responsible for the reduction in stillbirths, we used Kitagawa's method to decompose the decrease in the stillbirth rate between 1981–1990 and 2001–2010 (Kitagawa 1995). More specifically, we decomposed the absolute decrease in the overall stillbirth rate into two parts: (a) the component attributable to a change in the proportion of Anglophone births over time, versus (b) the component attributable to an actual decrease in the Anglophone stillbirth rate. Anglophones have been gradually leaving Quebec since the 1970s (Corbeil et al. 2010; Floch and Pocock 2008), potentially reducing the number of births in this population and their contribution to the overall stillbirth rate.

To evaluate differences in gestational age or causes of death between Anglophones and Francophones over time (objective 2), we computed stillbirth rates by gestational interval and by cause of death. For gestational age-specific rates, we used ongoing pregnancies (fetuses-at-risk) in the denominator, rather than the total number of deliveries. We did so because the number of preterm live births is very low, resulting in very small denominators and deceptively high stillbirth rates that are difficult to compare across groups due to bias (Auger et al. 2014a). We subsequently calculated gestational age-specific HRs for each interval and period using Cox regression models, with the risk period defined as the first week of each interval and births after the interval of interest censored. Cox regression uses a fetuses-at-risk approach (Platt et al. 2004). Similarly, we used Cox models to compute HRs for each cause and study period, censoring live births and stillbirths from all other causes.

We undertook sensitivity analyses in which we (a) excluded all births that were missing data ($N = 187{,}727$), and (b) added abortions to the category of congenital anomalies. There were 515 abortions reported on stillbirth certificates in Quebec, and it is plausible that a portion was performed because of congenital anomalies, or that some abortions were coded as congenital anomalies (Auger and Denis 2012).

Analyses were undertaken using SAS 9.2 (SAS Institute Inc., Cary, NC, USA). Ethical approval was waived the University of Montreal Hospital Centre, as the data were anonymous and the study conformed to the Tri-Council Policy Statement for ethical conduct of research involving humans in Canada.

Results

There were few differences in the rates of stillbirth between linguistic groups. Francophones had 4.12 (95 % CI 4.03, 4.21), Anglophones 4.31 (95 % CI 4.01, 4.62), and Allophones 4.02 (95 % CI 3.77, 4.26) stillbirths per 1000 births. However, stillbirth rates diverged over time for Francophones and Anglophones (Table 1). The rate for Francophones decreased steadily from 5.08 per 1,000 in 1981–1990 to 3.25 per 1,000 in 2001–2010. The rate for Anglophones decreased from 4.67 in 1981–1990 to 3.82 in 1991–2000, but then increased to 4.43 in 2001–2010. This trend contrasted with the overall decrease in the stillbirth rate for all groups combined, from 4.99 in 1981–1990 to 3.84 in 1991–2000 and 3.47 in 2001–2010 (per 1,000). Rates for Allophones were relatively stable.

Cox regression models suggested little difference in the hazard of stillbirth between Francophones and Anglophones overall (Table 2). However, a mother tongue-by-period interaction term was statistically significant, indicating that the association with stillbirth changed over time. For Francophones, HRs decreased steadily relative to 1981–1990. For Anglophones, HRs decreased in 1991–2000, but then reversed in 2001–2010. There was little change in HRs for Allophones over time. Risk differences yielded similar findings. Thus, these results suggest an improvement in the risk of stillbirth for

Table 1 Stillbirth rates over time according to maternal characteristic, Quebec, 1981–2010

	1981–1990		1991–2000		2001–2010	
	Total births (stillbirths)	Rate[a] (95 % confidence interval)	Total births (stillbirths)	Rate[a] (95 % confidence interval)	Total births (stillbirths)	Rate[a] (95 % confidence interval)
Mother tongue						
French	718,428 (3,488)	5.08 (4.92, 5.25)	645,834 (2,415)	3.84 (3.69, 3.99)	622,229 (2,289)	3.25 (3.10, 3.40)
English	72,787 (329)	4.67 (4.16, 5.19)	69,871 (274)	3.82 (3.36, 4.28)	69,248 (310)	4.43 (3.90, 4.97)
Allophone	78,121 (328)	4.34 (3.81, 4.86)	107,057 (411)	3.82 (3.43, 4.21)	109,077 (443)	3.99 (3.62, 4.37)
Maternal age (years)						
<20	38,759 (269)	6.95 (6.11, 7.78)	38,260 (179)	4.67 (3.98, 5.35)	24,941 (132)	5.29 (4.43, 6.27)
20–34	785,955 (3,701)	4.71 (4.56, 4.86)	703,262 (2,509)	3.57 (3.43, 3.71)	640,468 (2,038)	3.18 (3.05, 3.32)
≥35	53,662 (412)	7.67 (6.93, 8.41)	91,655 (510)	5.56 (5.08, 6.05)	115,689 (537)	4.64 (4.26, 5.05)
Maternal education						
High school	301,888 (1,791)	5.93 (5.61, 6.26)	223,697 (1,043)	4.66 (4.37, 4.96)	203,824 (871)	4.27 (3.99, 4.56)
Post secondary	317,024 (1,469)	4.63 (4.39, 4.88)	225,161 (888)	3.94 (3.64, 4.25)	104,780 (372)	3.55 (3.17, 3.94)
University	259,464 (1,122)	4.32 (3.97, 4.67)	384,319 (1,267)	3.30 (3.10, 3.49)	472,494 (1,464)	3.10 (2.93, 3.26)
Legally married						
Yes	644,626 (2,913)	4.52 (4.35, 4.69)	413,875 (1,479)	3.57 (3.39, 3.76)	306,658 (1,102)	3.59 (3.38, 3.81)
No	233,750 (1,469)	6.28 (5.96, 6.61)	419,302 (1,719)	4.10 (3.90, 4.30)	463,414 (1,629)	3.38 (3.22, 3.55)
Parity						
0	403,293 (2,551)	6.33 (6.08, 6.57)	370,730 (1,781)	4.80 (4.58, 5.03)	360,765 (1,434)	3.97 (3.77, 4.19)
1	307,694 (1,065)	3.46 (3.26, 3.68)	295,989 (800)	2.70 (2.52, 2.90)	275,827 (734)	2.66 (2.47, 2.86)
≥2	167,389 (766)	4.58 (4.26, 4.91)	166,458 (617)	3.71 (3.42, 4.01)	144,506 (539)	3.73 (3.42, 4.06)
Total	878,376 (4,382)	4.99 (4.84, 5.14)	833,177 (3,198)	3.84 (3.71, 3.97)	781,098 (2,707)	3.47 (3.34, 3.60)

[a] Per 1,000 total births

Francophones, recent increase in risk for Anglophones, and no change for Allophones.

Between the 1980s and 2000s, the overall stillbirth rate decreased by 1.52 per 1,000 (Table 3). In the 1990s, the stillbirth rate for Francophones declined by 1.24, and in the 2000s by 1.83 per 1,000. For Anglophones, the rate declined by 0.85 per 1,000 in the 1990s, but subsequently increased, leading to only 0.24 fewer stillbirths between the first and last study period. The stillbirth rate for Allophones decreased very little over time. These trends coincided with a lower share of births to Francophones, slightly greater share to Anglophones, and even greater share to Allophones over time. The decomposition analysis indicated that Anglophones had no impact whatsoever on the overall decrease in the stillbirth rate over time, from either changes in their rate or in their share of births. Francophones were the main contributors, primarily through a reduction in their rate of stillbirth in the 1990s, but also in the 2000s. The greater proportion of births to Allophones over time slightly offset the decrease in the stillbirth rate (i.e., the rate would have declined further had the proportion of Allophone births not increased).

When examined by gestational interval, rates of stillbirth for Francophones decreased over time for all gestational ages, with a sharper decline after 28 weeks of gestation (Table 4). For Anglophones, the increase in 2001–2010 was more pronounced before 28 weeks and after 37 weeks. The hazard of stillbirth for Anglophones was lower during the 1980s and 1990s for most gestational intervals, relative to Francophones. This reversed during the 2000s, when Anglophones began to have a higher hazard at every gestational interval. A similar pattern was present for Allophones, though the magnitude of HRs was lower. The small number of stillbirths, however, led to wide CIs with low precision.

In contrast with the 1980s and 1990s, HRs for most causes of stillbirth in 2001–2010 were elevated for Anglophones relative to Francophones, although CIs were again wide (Table 5). In the last period, HRs were highest for stillbirth due to fetal growth problems and congenital anomalies. Although the HR for Anglophones in the last period was high for diabetes, precision was very low. Allophones also had a high rate of stillbirth from diabetes in 2001–2010, with a HR of 3.37 relative to Francophones.

In sensitivity analyses, exclusion of births with missing data had no impact on the findings. Inclusion of abortions with congenital anomalies attenuated the strength of

Table 2 Association between mother tongue and stillbirth by period, Quebec, 1981–2010. Adjusted for maternal age, education, marital status, parity and period

	Hazard ratio (95 % confidence interval)	Risk difference (95 % confidence interval)
Mother tongue		
French	Ref	Ref
English	1.03 (0.95, 1.11)	0.11 (−0.20, 0.42)
Allophone	0.98 (0.92, 1.05)	−0.02 (−0.26, 0.23)
Mother tongue-by-period		
French		
1981–1990	Ref	Ref
1991–2000	0.81 (0.77, 0.86)	−1.09 (−1.32, −0.87)
2001–2010	0.70 (0.66, 0.75)	−1.60 (−1.83, −1.36)
English		
1981–1990	0.91 (0.81, 1.03)	−0.49 (−1.03, 0.04)
1991–2000	0.81 (0.71, 0.92)	−1.37 (−1.85, −0.90)
2001–2010	0.93 (0.82, 1.05)	−0.66 (−1.19, −0.14)
Allophone		
1981–1990	0.80 (0.70, 0.92)	−1.01 (−1.54, −0.47)
1991–2000	0.79 (0.71, 0.88)	−1.31 (−1.71, −0.91)
2001–2010	0.84 (0.76, 0.93)	−1.00 (−1.40, −0.59)
p value interaction	<0.0001	<0.0001

associations for Anglophones (HR 1.19; 95 % CI 0.92, 1.53) and Allophones (HR 1.20; 95 % CI 0.96, 1.50) relative to Francophones. The interaction term for mother tongue-by-gestational age suggested that hazards were proportional ($p = 0.5$).

Discussion

We evaluated linguistic inequality in stillbirth between Anglophones and Francophones of Quebec, and assessed changes over a 30-year period. We found that rates of stillbirth decreased for both groups in the 1980s and 1990s, but increased for Anglophones in the 2000s. Anglophones made no contribution to the decrease in stillbirth during the 30 years studied; Francophones were in large part responsible for the decrease. In addition, the inequalities in stillbirth that emerged between Anglophones and Francophones were more pronounced at term and before 28 weeks, and were present over a range of causes of fetal death. Inequality was not necessarily greater for causes more sensitive to medical care. It is therefore likely that the underlying reason for Anglophone-Francophone inequality in stillbirth in Quebec is multifactorial, involving social or cultural factors as well as health care. Overall, our findings illustrate the rapidity with which stillbirth inequality in minorities may change or even reverse, and highlight the importance of using indicators such as mother tongue to monitor inequality in stillbirth.

Stillbirth rates in most parts of the world have decreased over time (Cousens et al. 2011), although the improvement has been disproportionately low in some minorities. In the United States, stillbirth rates stand out for Blacks (MacDorman et al. 2012), and some evidence suggests that Black-White inequalities in stillbirth are increasing (Wingate and Barfield 2011). Overall, however, stillbirth rates in the different racial groups of the US have decreased (MacDorman et al. 2012), whereas rates have increased in Quebec's Anglophones.

Temporal trends in stillbirth for minorities in other parts of the world are more poorly understood. In Israel, rates of intrapartum stillbirth decreased over time, but more for Bedouins than Jews (Brailovschi et al. 2012), contrasting with Anglophones in Quebec where rates have increased. Minorities in countries such as Australia (Patterson et al. 2014), the Netherlands (Ravelli et al. 2011), and Canada (Auger et al. 2014b) have higher rates of stillbirth, but trends over time are not known. Information on time trends is also lacking for immigrant minorities in high-income countries, many of which have high rates of stillbirth (Gagnon et al. 2009; Gissler et al. 2009).

In Quebec, Anglophone stillbirth rates in the last decade increased predominantly after 37 and before 28 weeks of gestation. This contrasts with sharp declines in stillbirth after 28 weeks in the United States (MacDorman et al. 2012), and after 22 weeks in Norway (Sarfraz et al. 2011). There is some evidence that rates before 37 weeks of gestation are increasing in Blacks

Table 3 Decomposition of change in stillbirth rate over time, Quebec, 1981–2010

	French	English	Allophone	Total
Stillbirth rate[a]				
1981–1990	5.08	4.67	4.34	4.99
1991–2000	3.84	3.82	3.82	3.84
2001–2010	3.25	4.43	3.99	3.47
% Change in stillbirth rate				
1991–2000 vs. 1981–1990	−1.24	−0.85	−0.52	−1.15
2001–2010 vs. 1981–1990	−1.83	−0.24	−0.34	−1.52
Distribution of births[b]				
1981–1990	83.49	8.36	8.15	–
1991–2000	79.05	8.44	12.51	–
2001–2010	76.11	8.73	15.16	–
% Change in distribution				
1991–2000 vs. 1981–1990	−4.44	0.08	4.36	
2001–2010 vs. 1981–1990	−7.39	0.37	7.01	–
Decomposition				
1991–2000 vs. 1981–1990				
Contribution of change in stillbirth rate	−1.01	−0.07	−0.05	−1.13
Contribution of change in distribution of births	−0.20	0	0.18	−0.02
Total contribution	−1.21	−0.07	0.12	−1.15
2001–2010 vs. 1981–1990				
Contribution of change in stillbirth rate	−1.46	−0.02	−0.04	−1.52
Contribution of change in distribution of births	−0.31	0.02	0.29	0
Total contribution	−1.77	0	0.25	−1.52

[a] Per 1,000 total births

[b] Percentage of total births

(Wingate and Barfield 2011), but this finding remains to be verified using fetuses-at-risk. Blacks had higher rates at 20–23 weeks of gestation in a study that used fetuses-at-risk, but temporal trends were not examined (Willinger et al. 2009).

Prevention of stillbirth typically is more achievable later in gestation, when obstetric complications are easier to identify and manage (Flenady et al. 2011). The increase in stillbirth at term in Anglophones is particularly worrisome, especially if it relates to delays in recognizing clinical complications or treatment (Flenady et al. 2011). Accessing health care is increasingly challenging in Quebec. Current language spoken was not evaluated, but is correlated with mother tongue, and it is possible that communication barriers contributed to stillbirth rates, especially if Anglophones increasingly obtain care through French service providers. Alternatively, quality of care in the Anglophone sector may have changed over time. We could not perform chart audits, however, or obtain more detailed information on the circumstances surrounding Anglophone stillbirths.

During 2001–2010, Anglophones had higher stillbirth rates across a range of causes. Differences were larger for fetal growth and other placental disorders, problems related to placental dysfunction which are multifactorial. Interestingly, the increase in stillbirth due to fetal growth disorders coincided with a rise in fetal growth restriction of Anglophones (Auger et al. 2012, 2013). There was, however, little difference between Francophones and Anglophones in stillbirth due to hypertension, which aligns with the Unites States where Blacks have similar rates of preeclampsia as Whites (Carr et al. 2013). Evidence suggests that Blacks have more stillbirths from obstetric complications (including abruption) and infection (Stillbirth Collaborative Research Network Writing Group 2011). Although precision was low, Anglophones in the last period had a higher rate of stillbirth from cord complications. Rates from diabetes were low in both Francophones and Anglophones, which may be related to systematic screening. The increase in stillbirth due to congenital anomaly in Anglophones may relate to differences in pregnancy termination compared with Francophones

Table 4 Association between mother tongue and stillbirth by gestational interval, Quebec, 1981–2010

	Rate[a] (95 % confidence interval)			Hazard ratio[b] (95 % confidence interval)	
	French	English	Allophone	English vs. French	Allophone vs. French
Gestational age					
<24 weeks					
1981–1990	0.73 (0.67, 0.80)	0.70 (0.50, 0.90)	0.90 (0.68, 1.12)	0.94 (0.61, 1.44)	1.19 (0.81, 1.74)
1991–2000	0.59 (0.53, 0.65)	0.57 (0.39, 0.75)	0.51 (0.36, 0.66)	1.02 (0.71, 1.48)	0.87 (0.56, 1.35)
2001–2010	0.49 (0.43, 0.55)	0.69 (0.49, 0.89)	0.58 (0.43, 0.73)	1.38 (0.99, 1.92)	1.17 (0.85, 1.61)
24–27 weeks					
1981–1990	0.63 (0.57, 0.70)	0.58 (0.39, 0.75)	0.53 (0.32, 0.74)	0.94 (0.64, 1.38)	0.87 (0.56, 1.37)
1991–2000	0.54 (0.49, 0.60)	0.42 (0.26, 0.57)	0.44 (0.30, 0.59)	0.74 (0.50, 1.09)	0.75 (0.52, 1.08)
2001–2010	0.53 (0.47, 0.59)	0.71 (0.50, 0.93)	0.63 (0.48, 0.77)	1.26 (0.90, 1.76)	1.09 (0.82, 1.45)
28–31 weeks					
1981–1990	0.85 (0.79, 0.92)	0.77 (0.54, 0.99)	0.70 (0.45, 0.94)	0.89 (0.66, 1.20)	0.79 (0.55, 1.14)
1991–2000	0.57 (0.51, 0.63)	0.70 (0.50, 0.90)	0.56 (0.41, 0.71)	1.26 (0.92, 1.74)	0.98 (0.72, 1.33)
2001–2010	0.47 (0.41, 0.53)	0.63 (0.42, 0.85)	0.56 (0.42, 0.70)	1.29 (0.86, 1.94)	1.13 (0.82, 1.58)
32–36 weeks					
1981–1990	1.30 (1.21, 1.38)	1.34 (1.06, 1.63)	1.09 (0.81, 1.36)	1.03 (0.82, 1.29)	0.81 (0.62, 1.06)
1991–2000	0.94 (0.86, 1.01)	0.97 (0.73, 1.22)	1.05 (0.83, 1.26)	1.01 (0.77, 1.32)	1.04 (0.83, 1.32)
2001–2010	0.80 (0.72, 0.87)	1.03 (0.75, 1.31)	1.02 (0.82, 1.22)	1.21 (0.88, 1.66)	1.18 (0.92, 1.52)
≥37 weeks					
1981–1990	1.99 (1.88, 2.10)	1.68 (1.34, 2.03)	1.64 (1.30, 1.98)	0.80 (0.64, 0.99)	0.78 (0.62, 0.97)
1991–2000	1.37 (1.27, 1.46)	1.32 (1.04, 1.60)	1.45 (1.19, 1.70)	0.89 (0.71, 1.12)	0.96 (0.79, 1.17)
2001–2010	1.04 (0.96, 1.13)	1.47 (1.16, 1.78)	1.30 (1.08, 1.52)	1.25 (0.98, 1.58)	1.08 (0.87, 1.33)

[a] Per 1,000 ongoing pregnancies

[b] Adjusted for maternal age, education, marital status, and parity

over time. Sensitivity analyses in which we included abortions narrowed the difference between Anglophones and Francophones, suggesting that stillbirths due to congenital anomalies are probably underestimated in Francophones. It is not clear if the higher stillbirth rate in Allophones is linked with personal risk factors (Daoud et al. 2012), or underuse of antenatal care, a problem common among immigrants (Malin and Gissler 2009; Reime et al. 2009).

It is important to note that the quality of coding with the ICD is undetermined, and that misclassification of cause of death is probable. Infection is not captured with the ICD, which is limiting since infections are an important cause of death before 28 weeks of gestation (Smith and Fretts 2007; Stillbirth Collaborative Research Network Writing Group 2011). Coding for maternal preeclampsia with the ICD is prone to error (Geller et al. 2004). The rate of stillbirth from hypertension was low in our study compared with other research (Stillbirth Collaborative Research Network Writing Group 2011), suggesting misclassification. For cord complications and placental abruption, coding is presumably better since obstetric emergencies are easier to document. In addition, we did not know whether fetal death occurred antepartum or intrapartum. In developed countries, 9 % of stillbirths are intrapartum (Flenady et al. 2011).

We were limited by lack of data on maternal factors potentially related to the increase in stillbirth in Anglophones, including individual and area socioeconomic status. Although we adjusted for education, Anglophones increasingly are unemployed and of low income (Floch and Pocock 2008; Lussier and Trempe 2012). Interaction between mother tongue and education was not assessed and is an interesting topic for future research given changes in socioeconomic status over time. We did not have information on smoking, a risk factor for stillbirth (Flenady et al. 2011), and could not identify repeated stillbirths. Data on ethnicity and migration were also lacking. Migration of Anglophones to other provinces may have left a minority with lower social capital behind (Corbeil et al. 2010). However, the change in number of Anglophone births over time had little impact on the overall stillbirth rate. We evaluated maternal mother tongue but not language spoken at home, though these are correlated in Quebec.

Table 5 Association between mother tongue and stillbirth by cause of death, Quebec, 1981–2010

	Rate[a] (95 % confidence interval)			Hazard ratio[b] (95 % confidence interval)	
	French	English	Allophone	English vs. French	Allophone vs. French
Cause of death					
Placental abruption					
1981–1990	0.74 (0.68, 0.80)	1.10 (0.85, 1.34)	0.63 (0.41, 0.85)	1.49 (1.16, 1.90)	0.83 (0.58, 1.20)
1991–2000	0.51 (0.46, 0.56)	0.46 (0.28, 0.64)	0.60 (0.45, 0.76)	0.92 (0.61, 1.38)	1.14 (0.85, 1.52)
2001–2010	0.40 (0.35, 0.45)	0.54 (0.36, 0.73)	0.45 (0.33, 0.58)	1.35 (0.92, 1.98)	1.13 (0.81, 1.59)
Amniotic sac, cervix, other placental					
1981–1990	0.53 (0.48, 0.58)	0.41 (0.25, 0.57)	0.40 (0.25, 0.55)	0.77 (0.51, 1.15)	0.75 (0.51, 1.11)
1991–2000	0.34 (0.30, 0.39)	0.38 (0.23, 0.53)	0.47 (0.33, 0.60)	1.06 (0.69, 1.62)	1.24 (0.87, 1.77)
2001–2010	0.37 (0.32, 0.42)	0.54 (0.36, 0.71)	0.56 (0.42, 0.70)	1.32 (0.91, 1.92)	1.38 (1.01, 1.89)
Fetal growth					
1981–1990	0.44 (0.39, 0.48)	0.31 (0.17, 0.44)	0.28 (0.15, 0.40)	0.72 (0.45, 1.13)	0.67 (0.41, 1.08)
1991–2000	0.24 (0.20, 0.28)	0.25 (0.14, 0.37)	0.19 (0.10, 0.28)	1.05 (0.63, 1.74)	0.76 (0.44, 1.30)
2001–2010	0.15 (0.11, 0.18)	0.23 (0.11, 0.35)	0.11 (0.04, 0.17)	1.50 (0.78, 2.91)	0.70 (0.33, 1.48)
Hypertension					
1981–1990	0.13 (0.10, 0.15)	0.11 (0.04, 0.19)	0.20 (0.10, 0.31)	0.85 (0.41, 1.76)	1.46 (0.82, 2.59)
1991–2000	0.11 (0.09, 0.14)	0.11 (0.03, 0.19)	0.10 (0.03, 0.16)	1.05 (0.47, 2.32)	0.89 (0.43, 1.86)
2001–2010	0.14 (0.11, 0.17)	0.13 (0.04, 0.21)	0.12 (0.06, 0.18)	0.83 (0.40, 1.75)	0.79 (0.41, 1.51)
Diabetes					
1981–1990	0.07 (0.05, 0.09)	0.04 (−0.01, 0.09)	0.09 (0.02, 0.16)	0.52 (0.16, 1.68)	0.99 (0.22, 6.76)
1991–2000	0.02 (0.01, 0.04)	0.04 (−0.02, 0.09)	0.06 (0.01, 0.11)	1.22 (0.22, 6.76)	1.69 (0.55, 5.18)
2001–2010	0.05 (0.03, 0.06)	0.06 (0.00, 0.13)	0.12 (0.06, 0.19)	1.69 (0.56, 5.08)	3.37 (1.57, 7.21)
Cord compression, prolapse					
1981–1990	0.71 (0.65, 0.77)	0.86 (0.64, 1.07)	0.88 (0.66, 1.10)	1.16 (0.89, 1.51)	1.16 (0.89, 1.52)
1991–2000	0.45 (0.40, 0.51)	0.48 (0.31, 0.65)	0.54 (0.39, 0.68)	1.02 (0.69, 1.50)	1.13 (0.82, 1.54)
2001–2010	0.42 (0.37, 0.47)	0.63 (0.41, 0.84)	0.44 (0.31, 0.56)	1.29 (0.88, 1.90)	0.86 (0.61, 1.22)
Congenital anomaly					
1981–1990	0.75 (0.68, 0.81)	0.55 (0.37, 0.73)	0.36 (0.22, 0.50)	0.73 (0.52, 1.04)	0.47 (0.31, 0.72)
1991–2000	0.48 (0.43, 0.53)	0.49 (0.32, 0.65)	0.44 (0.31, 0.58)	1.01 (0.70, 1.46)	0.93 (0.64, 1.33)
2001–2010	0.45 (0.39, 0.51)	0.74 (0.53, 0.94)	0.75 (0.58, 0.92)	1.51 (1.07, 2.13)	1.54 (1.10, 2.14)
Other					
1981–1990	0.78 (0.71, 0.84)	0.58 (0.40, 0.76)	0.54 (0.37, 0.72)	0.71 (0.52, 0.99)	0.68 (0.48, 0.95)
1991–2000	0.65 (0.58, 0.71)	0.81 (0.60, 1.02)	0.54 (0.40, 0.69)	1.20 (0.90, 1.60)	0.78 (0.58, 1.06)
2001–2010	0.37 (0.32, 0.42)	0.49 (0.32, 0.66)	0.35 (0.24, 0.46)	1.18 (0.80, 1.75)	0.82 (0.56, 1.21)
Unexplained					
1981–1990	0.96 (0.88, 1.03)	0.72 (0.53, 0.92)	0.96 (0.73, 1.20)	0.74 (0.56, 0.98)	1.02 (0.79, 1.32)
1991–2000	1.04 (0.96, 1.12)	0.80 (0.58, 1.02)	0.88 (0.69, 1.06)	0.74 (0.55, 1.00)	0.80 (0.63, 1.02)
2001–2010	0.92 (0.84, 0.99)	1.09 (0.84, 1.33)	1.09 (0.90, 1.29)	1.11 (0.86, 1.43)	1.10 (0.89, 1.37)

[a] Per 1,000 total births

[b] Adjusted for maternal age, education, marital status, and parity

Stillbirth rates have increased in the Anglophone minority of Quebec. The increase occurred over a range of causes, and was greater at term and before 28 weeks of gestation. This contrasts with a consistent decline in stillbirth in the Francophone majority since the 1980s. The reason for the increase in Anglophone stillbirth is not clear, but may involve sociodemographic factors and health care utilization. Heightened vigilance of Anglophones in Quebec and targeted stillbirth prevention programs deserve scrutiny. Surveillance of perinatal health problems such as stillbirth should include novel indicators such as mother tongue to identify minorities at

risk, especially in countries containing multiple linguistic groups.

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