

Community Remoteness, Perinatal Outcomes and Infant Mortality among First Nations in Quebec

Spogmai Wassimi¹, Nancy G.L. Mchugh², Russell Wilkins^{3,4}, Maureen Heaman⁵, Patricia Martens⁶, Janet Smylie⁷, Fabienne Simonet¹, William D Fraser¹ and Zhong-Cheng Luo^{*,1}

¹Department of Obstetrics and Gynecology, Sainte-Justine Hospital, University of Montreal, Montreal, Canada

²First Nations of Quebec and Labrador Health and Social Services Commission, Wendake, Canada

³Health Analysis Division, Statistics Canada, Ottawa, Canada

⁴Department of Epidemiology and Community Medicine, University of Ottawa, Ottawa, Canada

⁵Faculty of Nursing, University of Manitoba, Winnipeg, Canada

⁶Manitoba Centre for Health Policy, Department of Community Health Sciences, University of Manitoba, Winnipeg, Canada

⁷Centre for Research on Inner City Health, St. Michael's Hospital, Department of Public Health Sciences, University of Toronto, Toronto, Canada

Abstract: *Objective:* Little is known about community remoteness in relation to birth outcomes among Indigenous populations. We assessed whether community remoteness matters for perinatal outcomes and infant mortality in Quebec First Nations communities.

Study Design: A retrospective cohort study of all births (n=11,033) to residents of First Nations communities in Quebec 1991-2000, using linked vital statistics data. First Nations communities were grouped by community remoteness into four zones from the least to most remote.

Results: Preterm birth rates declined progressively from the least remote (8.0%) to the most remote (5.7%) zones (p=0.002). In contrast, total fetal and infant mortality rose progressively from the least remote (10.4 per 1000) to the most remote (22.7 per 1000) zones (p<0.001). The excess infant mortality in the more remote zones was mainly due to higher rates of postneonatal mortality. Similar patterns were observed after adjusting for maternal age, education, parity and marital status. Substantially elevated risks in most remote communities remained for perinatal death (adjusted OR=2.1), postneonatal death (adjusted OR=2.7), and total fetal and infant death (adjusted OR=2.3).

Conclusion: Living in more remote First Nations communities was associated with a substantially higher risk of fetal and infant death, especially postneonatal death, despite a lower risk of preterm delivery. There is a need for more effective perinatal and infant care programs in more remote First Nations communities to reduce perinatal and infant mortality.

Keywords: Community remoteness, first nations, preterm birth, perinatal mortality, infant mortality.

INTRODUCTION

Birth outcomes and infant mortality are fundamental to a population's health, with long-term implications for families and societies. Birth outcomes and infant mortality are much worse in Indigenous compared to non-Indigenous populations even in developed countries like the United States, Australia and Canada [1-11]. The *Constitution Act* (1982) recognizes three groups of Aboriginal peoples in Canada: First Nations (North American Indians), Inuit and Métis. Data on Aboriginal birth outcomes in Canada are limited due

to the lack of Aboriginal birth identifiers on birth registrations in most provinces [6]. Available data suggest that fetal and infant mortality are significantly higher among Canadian First Nations and Inuit compared to non-Aboriginal populations [6-8,12]. First Nations (including Status Indians on reserve, status Indians off-reserve and non-status Indians) are the largest Aboriginal group in Canada. About half of the First Nations population of Canada lives in communities classified as "Indian reserves". Many of those First Nations reserves are located in relatively remote areas. Information about possible associations between community remoteness and birth outcomes could be important for developing targeted community maternal and infant health programs aimed at reducing adverse birth outcomes and infant mortality in Aboriginal communities. However, it remains unknown whether the degree of community remoteness may affect birth outcomes among First Nations.

*Address correspondence to this author at the Department of Obstetrics and Gynecology, Sainte-Justine Hospital, Bureau 4986, 3175, chemin Côte-Sainte-Catherine, Montreal, Quebec, H3T 1C5, Canada; Tel: 1-514-345-4931, Ext. 6706; Fax: 1-514-345-2195; E-mail: zhong-cheng.luo@recherche-ste-justine.qc.ca

Most health care's in Canada are covered by universal health insurance programs administered by the provinces and territories. The federal agency, Health Canada - First Nations, Inuit and Aboriginal Health, also plays a major role in the funding and delivery of health care services to on-reserve First Nations communities. It does so in partnerships with First Nations local governments, working towards increasing self-governance with respect to health care delivery. Health Canada funds community nursing stations to provide nursing services (including prenatal care) to on-reserve residents. The Quebec provincial government sponsors universal health insurance to cover basic health care costs of all residents. In practice, the degree of remoteness of First Nations communities is an important factor considered in the allocation of funds by federal governmental agencies for maintaining essential social and health care service programs in on-reserve communities. To facilitate this process, the Federal Department of Indian and Northern Affairs Canada (INAC) has developed a scheme to classify all First Nations bands (reserves or communities) into four zones based on degree of remoteness [13]. Using this measure, we assessed the impact of community remoteness in relation to perinatal outcomes and infant mortality in Quebec First Nations communities.

STUDY DESIGN

Subjects

We conducted a retrospective cohort study of all births to residents of First Nations reserves in Quebec, 1991-2000, using Statistics Canada's linked stillbirth, live birth and infant death data files. The validity of the Canadian linked vital data has been well documented [14]. The study was restricted to Quebec because it is the only large Canadian province with maternal education available on birth registrations thus allowing adjustment for this important indicator of socioeconomic status. The study was approved by the research ethics board of Sainte-Justine Hospital of the University of Montreal, and the First Nations of Quebec and Labrador Health and Social Services Commission.

Identification of First Nations Reserves

Births to residents of First Nations reserves were identified based on maternal residential postal codes reported on birth registrations. A list of postal codes used for the 40 First Nations reserves (one postal code for each reserve) in Quebec was obtained and verified by contacting a local person on each reserve. A total of 11,845 births were recorded to residents of the areas covered by those postal codes, including 11,033 births after exclusion of births with missing values for our analytical variables. In a preliminary analysis, we only considered births to First Nations mother tongue as births to on-reserve First Nations residents, but the total number of on-reserve First Nations births ($n=4,088$) was much lower than expected. This is due to the fact that over 40% First Nations people in Quebec no longer speak a First Nation mother tongue, according to the 2001 Census. We therefore decided to present the main results for all births ($n=11,033$) to residents of these First Nations communities (identified by postal codes). In addition, we conducted sensitivity analyses to examine whether similar results could be observed using alternative classification rules based on maternal mother tongue and/or the uniqueness of the postal code to a First Nation community. For the alternative classification,

we considered all births to residents of areas with postal codes unique to First Nations reserves as First Nations births, because these reserves are relatively isolated from other communities, with over 90% of their residents being First Nations according to self-identification in the 2001 Census. In areas with postal codes shared by a First Nation reserve and an adjacent other community, we only considered births to women whose mother tongue was a First Nation language as births to First Nations on reserve. Based on those alternative rules, a total of 7,791 births were identified as First Nations on-reserve in a sub-group analysis.

Determination of the Degree of Community Remoteness

We defined community remoteness according to the First Nations band classification manual developed by Indian and Northern Affairs Canada (INAC), which was motivated by the need to create an index of "difficulty to deliver services" to help with the allocation of funds in support of various on-reserve social service programs [13]. The INAC classification groups all First Nations bands into four zones according to the existence of year-round access roads, distance to the nearest service center, and climatic factors. Zone 1 has year-round road access and is within 50 km of the nearest service center. Zone 2 has year-round road access and is between 50 and 350 km from the nearest service center. Zone 3 has year-round road access and is over 350 km from the nearest service center. Zone 4 has no year-round access to a service center, regardless of distance, and as a result, experiences higher costs and greater inconvenience. A service center is a community where First Nations people living on-reserve can have access to social services and supplies. Local health care centers are often located in those communities. Thus the INAC zone is taken as a measure of the degree of community remoteness. The INAC zone classification is only available for and applicable to on-reserve First Nations communities in Canada. There were no statistically significant differences or trends in the proportions of communities with unique postal codes across the four INAC zones, but the percentages of births to First Nations mother tongue women trended higher in more remote zones (Appendix 1). As far as we know, variations in First Nations birth outcomes and infant mortality rates across INAC zones have not previously been reported.

Maternal and Pregnancy Characteristics

Available maternal and pregnancy characteristics included maternal age (<20, 20-29, 30-34, ≥ 35 years), education (<11 years, 11 years (completed high school in Quebec), ≥ 12 years (some college or higher)), marital status (single, common law union, married), parity (primiparous, multiparous), plurality (singleton, plural), infant sex (male, female), gestational age (in completed weeks), and birth weight (in grams).

Outcomes and Analyses

Perinatal and infant outcomes examined included preterm birth (gestational age <37 completed weeks), small-for-gestational-age birth (SGA, <10th percentile, based on the Canadian fetal growth standard [15], low birth weight (LBW, <2500 g), high birth weight (HBW, >4000 g), large-for-gestational-age birth (LGA, >90th percentile), stillbirth (fetal deaths ≥ 20 weeks), neonatal death (0-27 days), perina-

tal death (stillbirth + neonatal death), postneonatal death (28-364 days), infant death (neonatal death + postneonatal death), and fetal and infant death (stillbirth + infant death). Causes of infant death were investigated according to the classification of the International Collaborative Effort on Perinatal and Infant Mortality [16], based on International Classification of Diseases (ICD)-9 codes for deaths in 1991-1999 or ICD-10 codes for deaths in 2000-2001. The causes of death included congenital anomalies, immaturity-related conditions, asphyxia, sudden infant death syndrome (SIDS), infection, external causes, and other causes. Analyses of SIDS were restricted to the postneonatal period because SIDS is very rare during the neonatal period [17], and over 95% of the SIDS cases in our study occurred in the postneonatal period.

Chi-square tests for differences and Cochran-Armitage tests for trends were used to assess the differences and trends in outcome rates across the four categories of community remoteness (INAC zones). Crude and adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were calculated for assessing whether the associations could be explained by the differences in observed characteristics (maternal age, parity, education and marital status, plurality and infant sex). The least isolated communities (INAC zone 1) served as the reference group. Adjusted ORs were calculated using multi-level logistic regression models. All data management and analyses were carried out using SAS for Windows, Version 9.0 (SAS Institute: Cary, North Carolina).

RESULTS

There were significant differences in maternal characteristics across the four categories of community remoteness (Table 1). First Nations mothers from the least remote communities (INAC zone 1) were mostly likely to be primiparous, but least likely to be a teenager (<20 y) or to have not completed high school. In the other three more remote zones (INAC zone 2-4), about one in four First Nations births was

to a teenage mother, and the majority of mothers had not completed high school. First Nations women from both the most and least remote zones were more likely to be single.

Preterm birth rates were progressively lower, but fetal and infant mortality rates were progressively higher from the least remote to the most remote zones (Table 2, Fig. 1). The higher rates of fetal and infant mortality in more remote zones were largely due to higher rates of stillbirth (3.5 per 1000 higher) and postneonatal mortality (5.1 per 1000 higher). Postneonatal mortality rates were particularly high in the more remote zones 3 (8.1 per 1000) and 4 (9.1 per 1000), which was more than double the rates in less remote zones 1 and 2 (2.8 per 1000 for both). Cause-specific infant mortality analyses showed that postnatal SIDS was the only cause-specific category of infant death showing a statistically significantly higher rate in the most remote zone (4.9 per 1000, versus 1.0 per 1000 in the least remote zone, RR=4.9), although cause-specific infant death due to other cause categories generally showed higher rates in more remote zones. Stillbirth, neonatal and perinatal death rates were all highest in the most remote zone, but the differences across the four zones were not statistically significant. Rates of LBW and SGA births were highest in the least remote zone, while the differences among the other three more remote zones were small. Rates of LGA and HBW births were >15% in all zones, and substantially higher in the middle two zones (2 and 3).

We also compared outcome rates by birth weight- and gestational age-specific groupings (results not shown in details). Not unexpectedly, perinatal and infant mortality rates were significantly higher comparing preterm versus term infants, LBW versus normal birth weight (2500-3999 g) infants, or SGA versus birth weight appropriate for gestational age (10th -90th percentile, AGA) groupings of infants in the study cohort. The risk ratios in those comparisons ranged from 3.6 to 16.6.

Table 1. Maternal and Birth Characteristics among First Nations by Community Remoteness (INAC zone[§]) in Quebec, 1991-2000

Characteristics (%)	Community remoteness (INAC zone) [§]				P-value * in tests for differences
	Least remote Zone 1 (n=5089)	Zone 2 (n=2511)	Zone 3 (n=1981)	Most remote Zone 4 (n=1452)	
Male births	51.7	51.9	51.8	52.8	0.90
Multiple births	2.4	2.1	2.1	1.5	0.38
Mothers primiparous	37.8	33.6	30.2	31.3	<0.0001
Maternal age (y)					<0.0001
<20	14.0	23.1	24.9	21.3	
20-29	57.7	58.1	57.6	57.6	
30-34	20.4	14.3	12.0	16.0	
≥35	7.9	4.5	5.5	5.1	
Marital status					<0.0001
Single	28.3	18.8	23.9	28.4	
Common law union	44.2	39.3	30.5	35.7	
Married	27.5	41.9	45.6	35.9	
Maternal education					<0.0001
<Completed high school	33.2	64.2	64.9	54.1	
Completed high school	14.3	12.5	10.9	13.3	
≥Some college	52.6	23.3	24.2	32.6	

[§]INAC zone is a degree of remoteness measure developed by Indian and Northern Affairs Canada (INAC) to classify First Nations communities (reserves) into four zones from least remote (zone 1) to most remote (zone 4).

*Two-sided P values in Chi-square tests for differences across the four INAC zones.

Table 2. Crude Rates of Adverse Birth Outcomes and Infant Mortality among First Nations by Community Remoteness (INAC zone)[§] in Quebec, 1991-2000

Outcome	Least remote Zone 1 (n=5089)	Zone 2 (n=2511)	Zone 3 (n=1981)	Most remote Zone 4 (n=1452)	P value*, tests for differences	P value*, tests for trends
Births, %						
Preterm	8.0	7.5	6.8	5.7	0.0197	0.0019
Small-for-gestational-age	6.9	4.2	3.7	4.8	<0.0001	<0.0001
Low birth weight	5.3	3.4	4.4	3.4	0.0002	0.0010
High birth weight	16.5	28.6	29.1	24.7	<0.0001	<0.0001
Large-for-gestational-age	15.4	28.2	29.3	24.8	<0.0001	<0.0001
Deaths, per 1,000						
Perinatal death	7.7	10.8	8.1	13.8	0.1351	0.0820
Stillbirth	4.1	6.0	5.6	7.6	0.4034	0.1111
Neonatal death	3.6	4.8	2.5	6.2	0.3160	0.4119
Postneonatal death	2.8	2.8	8.1	9.1	0.0007	0.0001
Infant death	6.3	7.6	10.7	15.3	0.0076	0.0008
Fetal and infant death	10.4	13.5	16.2	22.7	0.0035	0.0003

[§]INAC zone is a degree of remoteness measure developed by Indian and Northern Affairs Canada (INAC) to classify First Nations communities (reserves) into four zones from least remote (zone 1) to most remote (zone 4).

* P values in Chi-Square tests for differences and Cochran-Armitage Trend Tests.

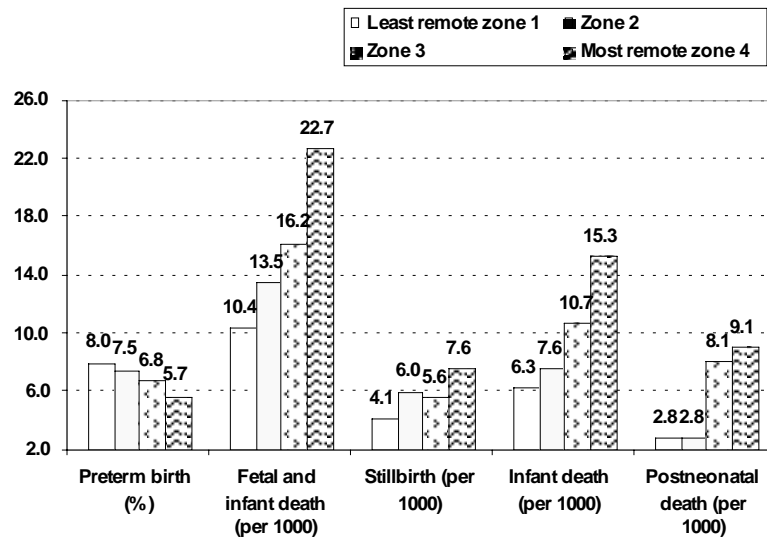


Fig. (1). Crude Rates of Adverse Birth Outcomes and Infant Mortality among First Nations by Community Remoteness (INAC zone)[§] in Quebec, 1991-2000. INAC Zone Is a Measure of Degree of Remoteness Developed by Indian and Northern Affairs Canada (INAC) to Classify First Nations Communities (Reserves) into Four Zones from Least Remote (Zone 1) to Most Remote (Zone 4).

Across the community remoteness zones, crude and adjusted ORs showed a similar pattern for all outcomes examined (Table 3). Both crude and adjusted ORs indicated lower risks of preterm birth but higher risks of fetal and infant death in more remote zones. Crude and adjusted ORs were very similar for preterm, SGA, LGA, LBW or HBW births. The adjusted ORs for infant death were also similar to the crude ORs comparing zones 2, 3 and 4 to the least remote zone 1. There was a trend towards higher crude and adjusted ORs for infant death, postneonatal death, and total fetal and infant death with increasing community remoteness ($P < 0.01$), although the adjusted ORs were statistically significant only for the most remote zone 4. After the adjustments, the risk of perinatal death remained almost doubled (adjusted OR=2.1), and the risk of postneonatal death remained almost tripled (adjusted OR=2.7), for infants from the most remote zone 4. The risk of postneonatal death remained more than doubled (adjusted OR=2.3) for infants from the remote zone 3.

In sensitivity analyses, we observed generally similar result patterns when using the alternative, more restrictive classification (Appendix 2). There were progressively lower preterm birth rates but higher fetal and infant mortality rates in more remote zones. The rates of LBW and SGA births remained highest in the least remote communities (zone 1). Comparing the most remote (zone 4) to the least remote (zone 1) communities, infant mortality (RR=2.4) and total fetal and infant mortality (RR=2.1) more than doubled, and postneonatal mortality (RR=2.8) almost tripled.

DISCUSSION

Major Findings

To our knowledge, our study is the first report on variations in preterm birth and fetal and infant mortality rates by the degree of community remoteness among Aboriginal communities. We found that living in more remote communities was associated with lower rates of preterm birth, but

Table 3. Crude and Adjusted Odds Ratios (OR) of Adverse Birth Outcomes and Infant Mortality among First Nations by Community Remoteness (INAC zone[§]) in Quebec, 1991-2000

Outcome	INAC Zone 2		INAC Zone 3		INAC Zone 4 (most remote)	
	Crude OR 95% CI	Adjusted OR [#] 95% CI	Crude OR 95% CI	Adjusted OR [#] 95% CI	Crude OR 95% CI	Adjusted OR [#] 95% CI
Births						
Preterm	0.93 (0.78, 1.18)	1.05 (0.86, 1.29)	0.84 (0.69, 1.03)*	0.81 (0.65, 1.02)	0.70 (0.55, 0.89)*	0.65 (0.50, 0.86)*
Small-for-gestational-age	0.59 (0.47, 0.74)*	0.50 (0.38, 0.65)*	0.51 (0.40, 0.67)*	0.55 (0.41, 0.73)*	0.68 (0.52, 0.89)*	0.68 (0.51, 0.93)*
Low birth weight	0.63 (0.49, 0.81)*	0.74 (0.56, 0.98)*	0.82 (0.64, 1.05)	0.98 (0.72, 1.33)	0.62 (0.46, 0.85)*	0.61 (0.43, 0.86)*
High birth weight	2.03 (1.81, 2.27)*	2.13 (1.87, 2.43)*	2.08 (1.84, 2.35)*	2.04 (1.78, 2.34)*	1.66 (1.45, 1.91)*	1.67 (1.44, 1.95)*
Large-for-gestational-age	2.35 (2.04, 2.70)*	2.22 (1.95, 2.54)*	2.28 (2.02, 2.58)*	2.15 (1.87, 2.47)*	1.82 (1.58, 2.09)*	1.82 (1.56, 2.13)*
Deaths						
Perinatal death	1.58 (0.86, 2.90)	1.66 (0.91, 3.05)	1.05 (0.59, 1.89)	0.91 (0.43, 1.94)	1.81 (1.05, 3.11)*	2.13 (1.15, 3.96)*
Stillbirth	1.47 (0.66, 3.28)	1.65 (0.71, 3.85)	1.35 (0.65, 2.80)	0.90 (0.31, 2.56)	1.84 (0.89, 3.83)	1.91 (0.79, 4.62)
Neonatal death	1.74 (0.69, 4.38)	1.69 (0.71, 4.00)	0.71 (0.26, 1.93)	0.95 (0.33, 2.75)	1.76 (0.79, 3.93)	2.38 (0.99, 5.66)
Postneonatal death	0.87 (0.32, 2.32)	1.02 (0.39, 2.69)	2.95 (1.44, 6.06)*	2.33 (1.03, 5.29)*	3.30 (1.55, 7.03)*	2.71 (1.17, 6.27)*
Infant death	1.24 (0.64, 2.41)	1.32 (0.69, 2.50)	1.70 (0.98, 2.95)	1.66 (0.89, 3.12)	2.44 (1.41, 4.21)*	2.54 (1.39, 4.64)*
Fetal and infant death	1.30 (0.85, 2.01)	1.41 (0.84, 2.36)	1.56 (1.00, 2.43)*	1.40 (0.82, 2.39)	2.21 (1.43, 3.43)*	2.32 (1.41, 3.82)*

[§]INAC zone is a measure of degree of remoteness developed by Indian and Northern Affairs Canada (INAC) to classify First Nations communities (reserves) into four zones from least remote (zone 1) to most remote (zone 4). The INAC zone 1 (least remote) served as the reference in calculating the crude and adjusted ORs.

[#]The ORs were adjusted for maternal age (<20, 20-29, 30-34, ≥35 years), education (<complete high school, completed high school, and some college or higher), marital status (single, common-law union, married), parity (primiparous, multiparous), plurality (singleton, multiple) and infant sex (boy, girl).

*P<0.05.

higher fetal and infant mortality rates among First Nations communities in Quebec. However, other birth outcomes did not show a monotonic pattern. Of particular concern were the high rates of perinatal and infant mortality. The rates of perinatal, infant and postneonatal mortality in the most remote zone 4 (communities with no year-round road access to a service center) were particularly high (adjusted OR=2.1, 2.5, and 2.7, respectively), indicating needs for more effective programs of perinatal and infant care (especially in the postneonatal period) in remote Aboriginal communities.

Comparisons with Previous Studies

Several studies have examined the association between the degree of remoteness and birth outcomes in the general population of some regions in developed countries [18-23]. Most studies reported that remoteness was associated with an elevated risk of adverse birth outcomes, but no or reverse associations were also observed in other studies in developed countries [18-23]. It is unclear whether these differential findings could be explained by the variable measures of remoteness, or by true differential associations in different regions due to different socioeconomic and health care context associated with remoteness. However, none of these studies focused on Aboriginal communities which are most often affected by remoteness.

A recent study in Western Australia observed somewhat higher Aboriginal infant mortality rates in "remote" versus "rural" areas, although the study did not address the degree of remoteness or other birth outcomes [3]. In contrast, we observed a risk gradient in fetal and infant mortality rates but a reverse risk gradient in preterm birth rates by the degree of community remoteness among Quebec First Nations communities. Limited or no access to year-round roads or the mere dependence on air transport for treatment of perinatal complications could in themselves be a cause of some adverse perinatal and infant outcomes in remote communities. The differences in living conditions and lifestyles may also partly explain the remoteness-associated disparities in birth outcomes.

The observed high prevalence of macrosomic births is consistent with previous findings demonstrating a high prevalence of macrosomia in some Quebec First Nations Cree communities [24,25]. Variations in rates of macrosomic birth across the four zones were not monotonic, since the highest rates were in the middle two zones. The causes of such variations are unknown and warrant further investigation.

SIDS is a leading cause of infant death among Indigenous infants in the United States, Australia and Canada [3-7,11,26]. As far as we know, no previous studies have examined variations in SIDS by community remoteness of Indigenous communities. We found that within the First Nations communities of Quebec, SIDS was substantially (4.9 times) more frequent in remote communities (zone 4). This finding is unlikely to be explained by differences in the ascertainment of SIDS, because the comparisons were within on-reserve communities with probably similar registration practices, and because unexplained deaths are required by law to be investigated by a coroner. Our findings underline the stresses and challenges remote Aboriginal communities face to reduce fetal and infant mortality, especially postneonatal mortality. More effective programs to promote "back-to-sleep" and safe sleep environments (including avoidance of bed-sharing, or infants sleeping with adults) in infant care, increasing breastfeeding rates and reducing maternal smoking and exposure to environmental tobacco smoke could help to reduce SIDS [27-30] in remote communities. There is evidence from Indigenous communities in Australia and New Zealand that SIDS prevention programs need to be specifically tailored for Indigenous populations in order to be effective [31].

Limitations

We had information on only a limited number of variables, but no information on many potential effect mediators such as maternal or paternal smoking, alcohol use and gestational complications. More studies are needed to understand the causal mediators of the observed differences in birth out-

comes. Our findings are based on births occurring to residents of Quebec First Nations communities. We do not assume that these findings are necessarily applicable to other regions of Canada or elsewhere.

There is a possibility that the lower rates of preterm birth observed in more remote areas could be due to under-reporting of extremely preterm births. If so, this could result in artificially lower rates of early fetal or neonatal deaths in more remote communities. Alternatively, there could be a true modest protective effect of lower preterm birth rates in more remote communities associated with more traditional life styles and family support. There is a need to further investigate the causes and prevention of preterm birth in more urban First Nations communities.

Because some postal codes were shared between reserve and non-reserve communities (generally in less remote areas), we undoubtedly misclassified some non-First Nations births as First Nations births in such areas. However, we did conduct sensitivity analyses and showed that similar result patterns when an alternative classification method (with additional restrictions based on mother tongue) was applied. Also, our comparisons of interest were across various re-

moteness categories of First Nations communities, rather than comparisons of First Nations versus non-First Nations.

SYNOPSIS

Living in more remote First Nations communities was associated with a substantially higher risk of fetal and infant death, especially postneonatal death, indicating a need for more effective perinatal and infant care programs, as well as improvement in the underlying social determinants of health in such communities.

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Appendix 1. Numbers of First Nations Communities with Unique Postal Codes and Percentages of Births to Women of First Nations Mother Tongue by Community Remoteness (INAC zone[§]) in Quebec, 1991-2000

	Least remote Zone 1	Zone 2	Zone 3	Most remote Zone 4	P value*, test for differences	P value*, tests for trends
Communities						
Total, N	18	10	6	6		
With unique postal code, N	10	4	4	2		
%	56	40	67	33	0.67	0.56
Births						
Total, N	5089	2511	1981	1452		
First Nations Mother tongue, N	897	1255	1266	790		
%	18	50	64	54	<0.0001	<0.0001

[§]INAC zone is a measure of degree of community remoteness developed by Indian and Northern Affairs Canada to classify First Nations communities (reserves) into four zones from least remote (zone 1) to most remote (zone 4).

*Two-sided P values in Chi-square tests for differences and Cochran-Armitage tests for trends across the four INAC zones.

Appendix 2. Crude Rates of Adverse Birth Outcomes and Infant Mortality among First Nations by Community Remoteness (INAC zone[§]) in Quebec, 1991-2000

Outcome	Least remote Zone 1 (n=3051)	Zone 2 (n=1765)	Zone 3 (n=1896)	Most remote Zone 4 (n=1079)	P value*, test for differences	P value*, tests for trends
Births, %						
Preterm	8.2	7.9	6.7	5.2	0.005	0.0006
Small-for-gestational-age	6.3	3.1	3.4	4.3	<0.0001	<0.0001
Low birth weight	5.0	3.2	4.3	2.9	0.003	0.009
High birth weight	17.6	31.4	29.9	25.0	<0.0001	<0.0001
Large-for-gestational-age	16.5	31.6	29.9	26.3	<0.0001	<0.0001
Deaths, per 1,000						
Perinatal death	7.2	11.3	7.4	12.0	0.27	0.31
Stillbirth	4.3	6.2	4.7	6.5	0.73	0.48
Neonatal death	3.0	5.1	2.6	5.6	0.39	0.46
Postneonatal death	4.0	3.4	8.5	11.3	0.01	0.003
Infant death	6.9	8.6	11.1	16.8	0.03	0.005
Fetal and infant death	11.2	14.8	15.8	23.3	0.04	0.007

[§]INAC zone is a measure of degree of community remoteness developed by Indian and Northern Affairs Canada to classify First Nations communities (reserves) into four zones from least remote (zone 1) to most remote (zone 4). The results presented here were based on an alternative classification method where births in communities with non-unique postal codes were restricted to those with First Nations mother tongue. Please see the Methods for interpretation of the differences in the method of identification of births in First Nations communities compared to the results presented in Table 2.

*Two-sided P values in Chi-square tests for differences and Cochran-Armitage tests for trends across the four INAC zones.

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