

North-South Gradients in Adverse Birth Outcomes for First Nations and Others in Manitoba, Canada

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Abstract

Objective—to determine the relationship of north-south place of residence to adverse birth outcomes among First Nations and non-First Nations in Manitoba, Canada, a setting with universal health insurance.

Study Design—Live birth records (n=151,472) for the province of Manitoba, Canada 1991–2000 were analyzed, including 25,743 First Nations and 125,729 non-First Nations infants. North-south and rural-urban residence was determined for each birth through geocoding.

Results—Comparing First Nations to non-First Nations, crude rates in North (and South) were: 7.0% versus 8.4% (9.3% versus 7.5%) for preterm birth; 6.1% versus 8.4% (8.7% versus 10.0%) for small-for-gestational-age birth, 4.2% versus 6.5% (6.2% versus 5.7%) for low birth weight, and 20.6% versus 13.7% (17.0% versus 11.0%) for large-for-gestational-age birth; and mortality per 1000 - neonatal 3.2 versus 6.2 (3.8 versus 3.3), post-neonatal 6.4 versus 6.4 (5.8 versus 1.5), and infant 9.5 versus 12.6 (9.6 versus 4.8). Adjusting for observed maternal and infant characteristics and rural versus urban residence, the North was high risk for large-for-gestational-

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age birth for both First Nations and non-First Nations. First Nations' risk of preterm, small-for-gestational-age and low birth weight was lowest in the North, but for non-First Nations, the North was lower only for small-for-gestational-age. First Nations mortality indicators were similar North to South, but for non-First Nations, the North was high risk.

Conclusion—North-South place of residence does matter for adverse birth outcomes, but the effects may differ by ethnicity and could require different intervention strategies.

Keywords

North-south residence; First Nations; preterm birth; fetal growth; infant mortality; Aboriginal; North American Indian

INTRODUCTION

In many countries of the world, there has been a longstanding and substantial disparity in the health outcomes of Aboriginal people compared to the rest of the population [1, 2].

Aboriginal women are at particularly higher risk of adverse birth outcomes, with many studies demonstrating substantially elevated risks of outcomes such as preterm birth, low birth weight, neonatal, postneonatal and infant mortality, and sudden infant death syndrome (SIDS) [3–20]. Although absolute risk differences for adverse birth outcomes to Aboriginal compared to non-Aboriginal women have declined in Canada, the United States and Australia over the past twenty years, persistently high relative risks indicate continuing disparities [20].

The Canadian Constitution Act of 1982 recognizes three Aboriginal groups in Canada: First Nations (North American Indians), Inuit (“Eskimo”) and Métis (mixed First Nations and European heritage, with a distinctive culture) [21, 10]. “Registered Indians” (or “Status Indians”) refers to First Nations people entitled to treaty rights under Canada’s *Indian Act*, and to membership in a band community governed by an elected chief and band councillors.

In Canada, many reports show disparities in birth outcomes for Aboriginal women similar to international reports, with outcomes varying by Aboriginal group, by province and community. First Nations newborns in Canada have higher birth weights and greater likelihood of being large-for-gestational age [4, 6, 22–24], as well as higher rates of pre-term birth associated with potentially inadequate prenatal care and high levels of perceived stress [25]. Infant mortality estimates also show marked disparities, with First Nations at 1.5 to 2 times higher [3–5, 7–10], and Inuit at 2 to 5 times higher risk [3, 4] than non-Aboriginal Canadian infants, and the risk of preventable deaths due to causes such as SIDS and infection are much higher [26, 27].

Most of the population of the province of Manitoba, Canada resides in the southern part of the province, with over half (640,000) in the capital city of Winnipeg. Most tertiary care hospitals and specialist physicians are also located in the south, mainly in Winnipeg. Many northern remote Aboriginal communities are accessible only by airplane or winter road. Of the overall population, only 6% live in the northern part, compared to 39% of Registered Indians [28]. Of all Aboriginal people living in the province of Manitoba, 68% are First

Nations (64% Registered, 4% non-Registered), 32% are Métis, and 0.6% are Inuit or other [29].

In most studies to date, there has been a lack of information concerning possible community-level or area-level effects, which may hamper understanding of the gap in birth outcomes within and between Aboriginal and non-Aboriginal groups. Evidence suggests that community-level characteristics may be important for understanding these differentials, and that the effects may be independent of individual-level risk factors [5, 30–34]. This could be critical for policy and planning initiatives, since other evidence suggests that disproportionately fewer resources are spent to address the unmet needs of Aboriginal people [35].

This study explored the hypothesis that “place matters”: geographic-based characteristics in and of themselves may be important for First Nations birth outcomes even when other factors are taken into account, and geography itself may differentially impact birth outcomes among First Nations (the majority Aboriginal group in Manitoba) versus other ethnic groups. This would imply that to be most effective, perinatal health programs may need to be directed not only at the individual, but also at the community or geographic level. Our major focus is on north-south place of residence.

STUDY DESIGN

Based on the most recent linked live birth, stillbirth and infant death datasets of Statistics Canada, there were 161,557 total births registered in the province of Manitoba, Canada during the calendar years 1991 to 2000 inclusive. Stillbirth registrations in Manitoba did not ask for parental First Nations identification, so stillbirths could not be included in these analyses. Also, we excluded any live birth registrations missing birth weight, sex or gestational age, or having a gestational age less than 20 weeks or birth weight <500 grams, or without sufficient information to determine north-south place of residence, leaving 151,472 live births available for the analysis.

The linkage of the birth and infant death records was sponsored by the Canadian Perinatal Surveillance System (CPSS), part of the Public Health Agency of Canada’s ongoing initiative to strengthen health surveillance capacity through the Maternal and Infant Health Section. The birth and death registrations are collected by Canada’s provincial and territorial registries of vital statistics, while Statistics Canada acts as the custodian of the data.

Outcome (dependent) variables analyzed in this study included preterm birth (less than 37 weeks gestational age), small-for-gestational-age (<10th percentile in birth weight for gestational age, using Canadian fetal growth standards [36]), large-for-gestational-age (> 90th percentile), low birth weight (<2,500 grams), high birth weight (>4,000 grams), neonatal death (death from 0–27 days inclusive), post-neonatal death (death 28–364 days), and infant death (any death from 0–364 days).

Explanatory (independent) variables in this study included ethnicity (First Nations versus non-First Nations) and geographic area (North, North Transition, South Transition and South, as explained below). Analyses were controlled for individual-level characteristics,

including infant sex, maternal age, marital status, parity, multiple pregnancy (multiple birth versus singleton), and rural versus urban setting within each geographic area. 'Urban' was defined as residence in any census metropolitan area or census agglomeration (hence with a community population of at least 10,000), while residence in all other areas was defined as 'rural'.

Births were identified as First Nations or non-First Nations, dependent upon the self-identification on the birth registration by the mother, father or both. Of these, 25,743 of the records indicated First Nations, and 125,729 non-First Nations. Some First Nations people may not self-identify on the Manitoba live birth registry forms, resulting in these births being classified as non-First Nations. This would tend to reduce differences in birth outcomes between the two groups.

Geocoding of "place" was based on maternal residential postal codes on the birth registration forms, or municipality codes if the postal code was missing (only 3% of the records). Postal codes were converted to census geographic codes using Statistics Canada geocoding software [37], and then used to identify the maternal place of residence as North, North Transition, South Transition or South. These categories were based upon a unique Canadian area measure [38] taking account of various socio-geographic characteristics of Canadian communities (see Fig. 1). By ethnicity, the number of births for each geographic area were: North (4167 First Nations, 3042 non-First Nations); North Transition (6227 First Nations, 3136 non-First Nations); South Transition (5657 First Nations, 16,286 non-First Nations); and South (9092 First Nations, 103,265 non-First Nations) (see Table 1).

The large size of the birth cohort for Manitoba ($n=151,472$) allowed the study to have a power of over 90% (alpha error of 0.05) to detect a 10% difference in all primary outcomes comparing First Nations to non-First Nations births. All data management and analyses were conducted using Statistical Analysis System (SAS, version 9.1, SAS institute, Cary, NC, USA), version 9.1. Descriptive analyses of each outcome variable, bivariate analyses by ethnicity, and multivariate analyses using logistic regression to control for individual level factors when analyzing the effect of "place" were performed. SAS GLIMMIX macros for multilevel regression models [39] were used to allow for cluster-level random variation effects of intercorrelation at the geographic level. Chi-square tests were used to assess differences in rates. To determine trends in outcomes by geographic areas (North to North Transition to South Transition to South), the Cochran-Armitage trend test was used.

This study received ethical approval from the Research Ethics Board of Sainte-Justine Hospital, University of Montreal, as well as permission from the Manitoba First Nations Chiefs Health Committee for Manitoba-specific analyses.

RESULTS

Maternal and infant demographic characteristics by ethnicity and geography are presented in Table 1. For both First Nations and non-First Nations women, parity, maternal age, marital status and rural versus urban residence all varied significantly ($p<.05$) across the four

geographic areas of North, North Transition, South Transition and South, whereas infant sex and plurality (singleton versus multiple births) did not.

For First Nations women, demographic patterns differed from North to South. The North had a somewhat lower percentage of primiparas (27% versus 31%) and unmarried women (71% versus 83%), and a much higher percentage living in rural areas (80% versus 10%) compared to the South. Maternal age showed very little variation by geographic area, with the exception of the South Transition area, with a somewhat higher percentage less than 20 years of age (26%) and a somewhat lower percentage of mothers 20–34 years of age (69%), compared to the other three areas where around 24% were less than 20, and around 72% were 20–34. For non-First Nations women, similar geographic differences existed, with the North having a lower percentage of primiparas compared to the South (41% versus 44%) and a much higher percentage of rural dwellers (41% versus 21%). However, in contrast to First Nations, non-First Nations were more likely to give birth at age less than 20 years in the North compared to the South (12% versus 7%), and there was a much higher proportion of unmarried non-First Nations in the North compared to the South (41% versus 24%).

Table 2 presents the crude rates of adverse birth outcomes by ethnicity and by geographic area. For First Nations infants, geographic area made a difference for the rates of preterm birth, small-for-gestational-age, large-for-gestational-age and low birth weight. But geographic area did not make a difference for the rates of neonatal death, postneonatal death or infant death. First Nations babies were more likely to be born preterm, small-for-gestational-age or low birth weight, and less likely to be large-for-gestational-age as one transitioned from North to South (all trends statistically significant at the $p < .0001$ level).

In contrast, for non-First Nations infants, geographic area made a difference for the rates of all adverse birth outcomes. Non-First Nations infants were less likely to be preterm ($p < .03$), low birth weight ($p < .004$) or large-for-gestational-age ($p < .0001$) as one transitioned from North to South, but more likely to be small-for-gestational-age ($p < .0001$). The likelihood of neonatal death ($p < .0009$), postneonatal death ($p < .0001$) and overall infant death ($p < .0001$) decreased significantly from North to South.

Fig. (2). illustrates the differences in trends in crude adverse birth outcome rates for First Nations and non-First Nations by geographic area. Similar trends for both groups were evident in the rates of small-for-gestational-age and large-for-gestational-age, with small-for-gestational-age increasing and large-for-gestational-age decreasing from North to South. Opposite trends were seen for preterm births. The most striking difference was seen in neonatal and postneonatal death rates, where there was no evidence of a North-South trend for First Nations but a very strong trend for non-First Nations. For First Nations, the North was “healthier” as far as rates of preterm birth, small-for-gestational-age and low birth weight, with no elevated risk of neonatal, postneonatal or infant death from North to South. For non-First Nations, the North was “less healthy” compared to the South, with a higher likelihood of preterm birth, low birth weight, large-for-gestational-age, neonatal death, postneonatal death and infant death, and the North only showed a somewhat protective effect for small-for-gestational-age.

Some of the differences above may arise from differing demographics at the individual level, as noted previously in Table 1. Therefore, the multivariate analysis in Table 3 looks at adjusted odds ratios (aOR) of the adverse birth outcomes, after controlling for infant sex, maternal age, marital status, parity, multiple pregnancy, and rural versus urban setting, using the South area as the reference group (so, all aORs are in comparison to the South). After controlling for individual-level effects, many of the same trends noted in the crude rates persisted (Table 3). For First Nations infants, the North still showed a protective effect (aOR<1) for preterm, small-for-gestational-age and low birth weight compared to the South. However, the North showed an elevated likelihood of high birth weight and large-for-gestational-age. There was no statistically significant difference in mortality rates (neonatal, postneonatal or infant death) comparing the North to the South. For non-First Nations infants, after controlling for individual-level effects, the North was protective for small-for-gestational-age, but the lower risk of preterm and low birth weight was no longer statistically significant. The North also showed an elevated likelihood of high birth weight and large-for-gestational-age (similar to the First Nations patterns). For non-First Nations, the North was very high risk for mortality, with neonatal, postneonatal and infant death rates all elevated compared to the South, at roughly twice the likelihood of death.

Table 4 summarizes findings from other tables, by isolating the two areas of “North” and “South” to illustrate maximal differences. Crude rate ratios (RR) for adverse birth outcomes, by geographic area and ethnicity, are shown within ethnic group (First Nations, non-First Nations) for North to South, and between ethnic groups within the two geographical areas (North, South). For example, the North presents a higher risk for First Nations compared to the South for large-for-gestational-age and high birth weight, but lower risk for preterm, small-for-gestational-age and low birth weight births, and similar for mortality. In contrast, the North was high risk for non-First Nations compared to the South for large-for-gestational-age and high birth weight as well as for all mortality (neonatal, post-neonatal, infant), lower risk for small-for-gestational-age, but similar risk for preterm and low birth weight births.

DISCUSSION

Limitations

In this study, it is important to point out a major limitation – the limited number of variables available for analyses of individual-level risk factors for adverse birth outcomes. Using only the Manitoba vital statistics birth registration information available, many individual-level factors that may have impact on the observed outcomes were not available for analyses, such as maternal education and income, smoking status, ingestion of alcohol during pregnancy, complications of pregnancy, or access to prenatal care. These may mediate the various relationships observed in the comparisons of First Nations versus non-First Nations and across geographic areas [40]. Therefore, our results require further in-depth study to incorporate these factors in examining geographical differences. Potential data sources for future such studies could include linkage of survey data, or universal data collected during pregnancy, with universal healthcare and vital statistics data sources, such as may be available at the Manitoba Centre for Health Policy at the University of Manitoba.

Main Findings

Does “place” make a difference? Place, as indicated by the four North-South areas, was a strong predictor of adverse birth outcomes for both First Nations and non-First Nations (see Table 4). However, some of these outcomes trended differently for the different groups, so the advisability of both ethnicity and area-specific program planning should be considered.

Three trends in crude and adjusted birth outcomes that showed similarities with both First Nations and non-First Nations were for small-for-gestational-age, large-for-gestational-age and high birth weight, with both groups showing the lowest small-for-gestational-age rates and the highest large-for-gestational-age and high birth weight rates in the North. Despite these similar trends by locality for both groups, non-First Nations had higher small-for-gestational-age rates within every geographic area compared to First Nations. In contrast, First Nations women were about 50% more likely to have a large-for-gestational-age birth compared to non-First Nations, and much more likely to have a high birth weight birth, in every geographic area. This was not unexpected, given the high rates of diabetes in the First Nations population of Manitoba [28], and its relationship to large-for-gestational-age [41]. It also highlights the importance of careful prenatal monitoring of the mother, and of postnatal care of the large-for-gestational-age neonate [41].

For preterm and low birth weight rates, the trends by geographic area differed between First Nations and non-First Nations. For First Nations, preterm and low birth weight rates were highest in the South. Moreover, First Nations infants in the South were 24% more likely to be preterm compared to non-First Nations infants in the same area. Although the crude rates of preterm and low birth weight birth were highest in the North for non-First Nations, this difference disappeared after controlling for demographic differences. Heaman *et al.* [25] found that First Nations women were much less likely to receive adequate prenatal care, and more likely to experience stress compared with non-First Nations women. This experience of stress is not surprising, given that First Nations women living in urban areas commonly face adverse social determinants of health including poverty, inadequate housing, and heading lone parent households [42]. Stress in turn may increase the risk of preterm delivery through increased corticotropin-releasing hormone secretion or cytokine production [43]. Smoking has also been associated with preterm and low birth weight births, but smoking cessation programs for pregnant women have proven useful [44]. Thus programs that address the underlying social determinants of health, psychosocial stress factors and smoking cessation for First Nations, particularly for those living in southern urban environments, may be key to the success of any intervention designed to reduce preterm births.

Mortality rates showed the most striking differences by geographic area and between ethnic groups. Among First Nations, the rates of neonatal death, post-neonatal death and infant death were similar from North to South, and this similarity persisted in adjusted models. However, among non-First Nations, the crude rates of neonatal death (6.4 versus 3.3), post-neonatal death (6.4 versus 1.5) and infant death (12.6 versus 4.8 per 1000) were highly elevated in the North compared to the South, and this effect was also maintained in the multivariate regression analysis. “North” was a definite risk factor for mortality-related adverse birth outcomes for non-First Nations, but not for First Nations. That being said,

comparing the actual crude rates between the two ethnic groups shows another compelling difference – First Nations neonatal (0–27 days) death rates in the North (3.2 per 1000) were similar to those of First Nations (3.8 per 1000) and non-First Nations (3.3 per 1000) in the South. However, for neonatal mortality, babies born to non-First Nation women living in the North were at almost double the risk of all other groups and geographic areas (6.2 per 1000). In contrast, the post-neonatal death rate (28–364 days) showed a different picture, with First Nations and non-First Nations babies in the North experiencing similar post-neonatal death rates (6.4 per 1000), but in the South First Nations babies had about 4 times the rate compared to non-First Nations babies (5.8 versus 1.5 per 1000). These two death rates combined give the infant mortality rate. So the infant mortality rate comparisons showed lower rates for First Nations compared to non-First Nations in the North (9.5 versus 12.6 per 1000 – 33% higher for non-First Nations), but higher in the South (double at 9.6 versus 4.8 deaths per 1000).

It has been noted that the very high risk of post-neonatal death among First Nations is mainly due to SIDS and to respiratory infections [26, 27]. Intervention strategies that could potentially reduce these risks include: culturally appropriate back-to-sleep campaigns to avoid prone sleeping positions and thus reduce SIDS [45]; more widespread immunization of First Nations infants to reduce the gap in immunization rates between First Nations and others [28]; efforts to increase the safety of living conditions; and community strategies to increase breastfeeding rates. Previous research has indicated that homes in Manitoba First Nations communities may have high levels of fungi, bacteria and air particulates that are associated with SIDS [26]. As well, smoking rates have been shown to be higher in First Nations groups [27, 46, 47]. Attention must also be paid to the underlying social determinants of health, including poverty and inadequate housing [46]. Concerted efforts to increase the safety of homes and decrease smoking rates may help reduce post-neonatal mortality. Exclusive breastfeeding for at least six months has been associated with up to a 50% reduction in SIDS [48], as well as a reduction in infection [49] and rehospitalization [50]. Efforts to increase breastfeeding rates at the community level have been highly effective in one First Nations setting [51], and may be particularly important in decreasing the risk of post-neonatal mortality.

What is truly advantageous, not just in terms of relative risks but also in terms of absolutely lower rates adverse birth outcomes? For non-First Nations, living in more urban settings (the South) was associated with only one ‘adverse’ outcome – higher risk of small-for-gestational-age. The more urban setting showed lower risks of large-for-gestational-age and substantially lower risks of neonatal, postneonatal or infant death for non-First Nations. Such urban-associated advantage was absent for First Nations. For First Nations, living in a more rural or northern setting (the North) was associated with lower risks of preterm, low birth weight and small-for-gestational-age, as well as lower risk of neonatal death. But this advantage was offset by the higher risk of large-for-gestational-age and high birth weight for First Nations in the North.

SYNOPSIS

North-south place of residence does matter for adverse birth outcomes, and the impact may differ for First Nations versus other populations. Such lessons could be transferred to practice in the various settings to reduce adverse birth outcomes.

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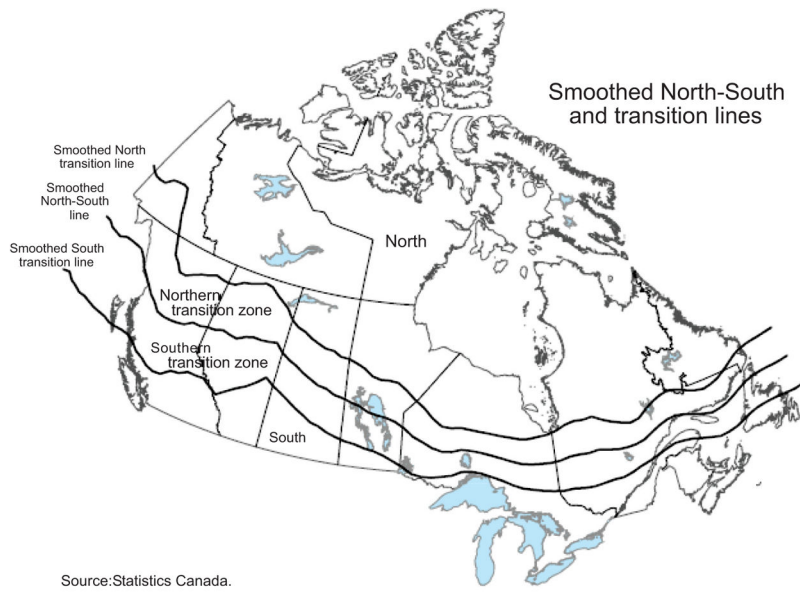


Fig. 1. North, North Transition, South Transition and South Areas of Canada (from http://www41.statcan.ca/2006/3119/htm/ceb3119_001_3-eng.htm).

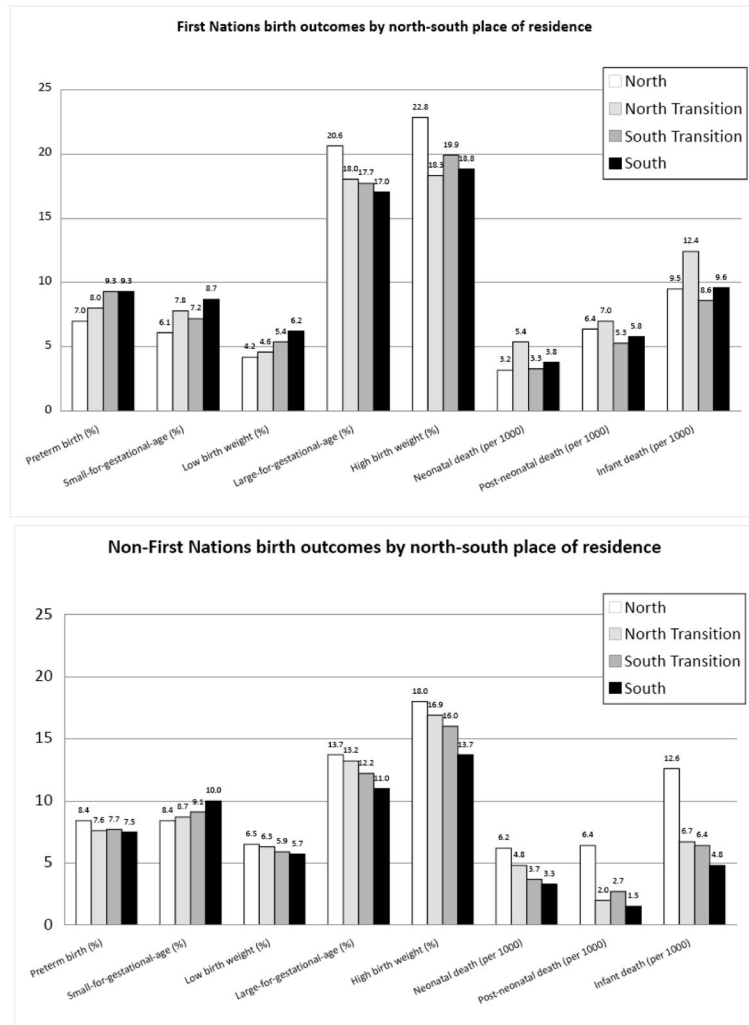


Fig. 2. Crude rates of adverse birth outcomes for first nations and non-first nations by north-south place of residence, manitoba, 1991–2000.

Table 1

Maternal Characteristics According to North-South Place of Residence for First Nations and Non-First Nations Live Births in Manitoba, 1991–2000

Characteristic* (%)	North-South Area of Residence			P Value Test for the Difference
	North	North Transition	South	
First Nations, N	4,167	6,227	9,092	
Infant sex, male	49.6	51.7	51.4	0.16
Multiple birth	1.8	1.7	2.0	0.51
Primiparous	26.9	27.5	30.6	<0.0001
Maternal age (y)				0.02
<20	23.8	24.0	23.6	
20–34	71.4	71.5	71.6	
35	4.8	4.6	4.9	
Unmarried	71.1	61.9	83.4	<0.0001
Rural	80.1	100.0	10.0	<0.0001
Non-First Nations, N	3,042	3,136	103,265	
Infant sex, male	50.0	52.3	51.4	0.36
Multiple birth	1.9	2.1	2.3	0.23
Primiparous	40.7	38.2	44.0	<0.0001
Maternal age (y)				<0.0001
<20	12.2	15.2	6.7	
20–34	81.8	78.3	81.5	
35	6.0	6.4	11.8	
Unmarried	41.2	44.1	24.0	<0.0001
Rural	40.8	100.0	21.1	<0.0001

* Results are presented as % in column except for N.

Table 2

Crude Rates of Adverse Birth Outcomes for First Nations and Non-First Nations by North-South Place of Residence, Manitoba, 1991–2000

Outcome	North-South Area*				p-Value in Tests for	
	North	North Transition	South Transition	South	Difference	Trend [§]
First Nations, N	4,167	6,227	5,657	9,092		
Births, %						
Preterm	7.0	8.0	9.3	9.3	<0.0001	<0.0001
Small-for-gestational-age	6.1	7.8	7.2	8.7	<0.0001	<0.0001
Low birth weight	4.2	4.6	5.4	6.2	<0.0001	<0.0001
High birth weight	22.8	18.3	19.9	18.8	<0.0001	<0.0001
Large-for-gestational-age	20.6	18.0	17.7	17.0	<0.0001	<0.0001
Deaths, per 1000						
Neonatal	3.2	5.4	3.3	3.8	0.15	0.69
Postneonatal	6.4	7.0	5.3	5.8	0.62	0.41
Infant	9.5	12.4	8.6	9.6	0.13	0.37
Non-First Nations, N	3,042	3,136	16,286	103,265		
Births, %						
Preterm	8.4	7.6	7.7	7.5	0.12	0.03
Small-for-gestational-age	8.4	8.7	9.1	10.0	<0.0001	<0.0001
Low birth weight	6.5	6.3	5.9	5.7	0.04	0.004
High birth weight	18.0	16.9	16.0	13.7	<0.0001	<0.0001
Large-for-gestational-age	13.7	13.2	12.2	11.0	<0.0001	<0.0001
Deaths, per 1000						
Neonatal	6.2	4.8	3.7	3.3	0.007	0.001
Postneonatal	6.4	2.0	2.7	1.5	<0.0001	<0.0001
Infant	12.6	6.7	6.4	4.8	<0.0001	<0.0001

* Results are presented as rates unless otherwise stated

Table 3

Adjusted Odds Ratios (OR) of Adverse Birth Outcomes for First Nations and non-First Nations by North-South Place of Residence, Manitoba, 1991–2000

Outcome	Adjusted OR (95% CI) [§]		
	North	North Transition	South Transition
First Nations			
<i>Births</i>			
Preterm	0.62 (0.53, 0.72) *	0.85 (0.75, 0.96) *	0.91 (0.81, 1.03)
Small-for-gestational-age	0.72 (0.62, 0.83) *	0.96 (0.85, 1.09)	0.83 (0.73, 0.94) *
Low birth weight	0.62 (0.52, 0.75) *	0.82 (0.71, 0.96) *	0.80 (0.68, 0.93) *
High birth weight	1.25 (1.14, 1.36) *	0.90 (0.83, 0.98) *	1.06 (0.97, 1.15)
Large-for-gestational-age	1.20 (1.10, 1.32) *	0.98 (0.90, 1.07)	1.00 (0.92, 1.10)
<i>Deaths</i>			
Neonatal	0.77 (0.39, 1.54)	1.59 (0.97, 2.63)	0.83 (0.45, 1.53)
Postneonatal	1.18 (0.74, 1.89)	1.30 (0.86, 1.96)	0.96 (0.61, 1.50)
Infant death	1.02 (0.69, 1.51)	1.41 (1.03, 1.94) *	0.91 (0.63, 1.31)
Non-First Nations			
<i>Births</i>			
Preterm	0.90 (0.78, 1.04)	1.12 (0.98, 1.28)	0.92 (0.86, 0.98) *
Small-for-gestational-age	0.76 (0.67, 0.87) *	0.81 (0.71, 0.92) *	0.87 (0.82, 0.92) *
Low birth weight	0.96 (0.82, 1.14)	1.17 (1.01, 1.36) *	0.90 (0.83, 0.98) *
High birth weight	1.43 (1.30, 1.57) *	1.30 (1.18, 1.43) *	1.19 (1.13, 1.24) *
Large-for-gestational-age	1.36 (1.23, 1.51) *	1.22 (1.10, 1.36) *	1.12 (1.06, 1.18) *
<i>Deaths</i>			
Neonatal	1.81 (1.12, 2.92) *	1.22 (0.70, 2.13)	0.98 (0.73, 1.32)
Postneonatal	2.14 (1.19, 3.88) *	0.81 (0.33, 1.98)	1.44 (1.01, 2.06) *
Infant death	1.94 (1.33, 2.81) *	1.07 (0.66, 1.72)	1.14 (0.91, 1.42)

[§]The adjusted ORs were controlled for infant sex, maternal age (<20, 20–34, 35+), marital status (married, not married), parity (primiparous or not), multiple pregnancy (singleton or multiple), and rural versus urban, using births in the South as the reference group in separate models for First Nations and non-First Nations.

* Statistically significant difference, $p < 0.05$.

Table 4

Does Place Matter? Crude Rate Ratios (RR) for Adverse Birth Outcomes, by Geographic Area (North versus South^{*}) and Ethnicity (First Nations versus non-First Nations), Manitoba, 1991–2000

Outcome	RR for North Compared to South [§]		RR for First Nations Compared to Non-First Nations [§]	
	First Nations	Non-First Nations	North	South
<i>Births</i>				
Preterm	<i>0.75</i>	1.12, NS	<i>0.83</i>	1.24
Small-for-gestational-age	<i>0.70</i>	<i>0.84</i>	<i>0.73</i>	<i>0.87</i>
Low-birth weight	<i>0.68</i>	1.14, NS	<i>0.65</i>	1.09
Large-for-gestational-age	1.21	1.25	1.50	1.55
High birth weight	1.21	1.31	1.27	1.37
<i>Deaths</i>				
Neonatal	0.84, NS	1.88	<i>0.52</i>	1.15
Postneonatal	1.10, NS	4.27	1.00, NS	3.87
Infant	0.99, NS	2.63	<i>0.75</i>	2.00

NS = not statistically significant crude rate differences (p>.05)

[§]Bolded numbers imply statistically significantly **elevated risk** (p<.05), italicized numbers imply statistically significant *reduced risk* (p<.05)

^{*}Results for North Transition and South Transition areas not shown (but available on request from the first author).