

Primary birthing attendants and birth outcomes in remote Inuit communities—a natural “experiment” in Nunavik, Canada

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Abstract

Background—There is a lack of data on the safety of midwife-led maternity care in remote or indigenous communities. In a *de facto* natural “experiment”, birth outcomes were assessed by primary birthing attendant in two sets of remote Inuit communities.

Methods—A geocoding-based retrospective birth cohort study in 14 Inuit communities of Nunavik, Canada, 1989–2000: primary birth attendants were Inuit midwives in the Hudson Bay (1529 Inuit births) vs western physicians in Ungava Bay communities (1197 Inuit births). The primary outcome was perinatal death. Secondary outcomes included stillbirth, neonatal death, post-neonatal death, preterm, small-for-gestational-age and low birthweight birth. Multilevel logistic regression was used to obtain the adjusted odds ratios (aOR) controlling for maternal age, marital status, parity, education, infant sex and plurality, community size and community-level random effects.

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Competing interests: None.

Ethics approval: The study was approved by the research ethics board of Sainte-Justine Hospital, University of Montreal, and the Nunavik Nutrition and Health Committee.

Results—The aORs (95% confidence interval) for perinatal death comparing the Hudson Bay vs Ungava Bay communities were 1.29 (0.63 to 2.64) for all Inuit births and 1.13 (0.48 to 2.47) for Inuit births at 28 weeks of gestation. There were no statistically significant differences in the crude or adjusted risks of any of the outcomes examined.

Conclusion—Risks of perinatal death were somewhat but not significantly higher in the Hudson Bay communities with midwife-led maternity care compared with the Ungava Bay communities with physician-led maternity care. These findings are inconclusive, although the results excluding extremely preterm births are more reassuring concerning the safety of midwife-led maternity care in remote indigenous communities.

Although increasing evidence suggests that midwife-led maternity care may be a safe alternative for deliveries in low-risk pregnancies,^{1–8} entrenched concerns remain about its safety and effectiveness, as evidenced by the reluctant or slow adoption of such practices in many places.⁹ Such concerns are more critical in remote settings because, if something goes wrong and evacuation to a tertiary care centre is called for, then the remoteness of the setting may delay timely treatment including surgical intervention. On the other hand, midwife-led maternity care could be a preferable option in remote areas because of the constant challenge of recruiting and retaining qualified physicians.¹⁰ There remains a lack of data on whether midwife-led maternity care may be a safe alternative to physician-led maternity care in remote or indigenous communities where such a model of accessible maternity care may be most wanted.

Nunavik is a vast region comprising over 500 000 square kilometres of tundra, one of the four predominantly Inuit-inhabited regions in Canada, and the only one where Inuit births could be identified through mother tongue on the birth registration. Nunavik is home to 14 small Inuit communities scattered along two coasts (see the map at http://www.nunavik-tourism.com/files/PDFs/printable-map_en.pdf):¹¹ seven westerly communities on the Hudson Bay and Hudson Strait coast (Kuujuarapik, Umiujaq, Inukjuak, Puvirnituq, Akulivik, Ivujivik and Salluit, hereafter referred to as the Hudson Bay communities) and seven easterly communities on the Ungava Bay and Hudson Strait coast (Kangiarsuaq, Quaqtaq, Kangirsuk, Aupaluk, Tasiujaq, Kuujuuaq and Kangiarsualujuaq, hereafter referred to as the Ungava Bay communities). The total population of Nunavik (including a small number of non-indigenous people) was 8000 in 1991, 8900 in 1996 and 9700 in 2001.¹² All 14 Nunavik communities are isolated fly-in-only communities without road connections between communities or to southern towns and cities. Despite many similarities, the two sets of remote communities adopted distinct practices with regard to primary birthing attendants. Midwives became the primary birthing attendants in the Hudson Bay communities after the first birthing centre was opened in Puvirnituq in 1986.^{12, 13} Midwives accounted for about 73% of all deliveries in the Hudson Bay communities during the period 1989–2000.¹² In contrast, in the Ungava Bay communities, western physicians remained the primary birthing attendants, and they accounted for about 95% of deliveries during the period 1989–2000.¹² This contrast between the two sets of communities creates a natural *de facto* “experiment” for assessing birth outcomes in remote indigenous communities by primary birthing attendants: midwife-led maternity care in the seven Hudson Bay communities vs physician-led maternity care in the seven Ungava Bay communities.

In the Hudson Bay communities, midwives lead perinatal care and risk screening in close collaboration with local nurses and physicians. High-risk pregnancies are referred to physicians or obstetricians; if caesarean section or tertiary care is expected to be necessary, births are planned in an obstetric hospital in Montreal. Midwives offer prenatal care (including supervision of village nurses providing prenatal consultations in communities), case management, low-risk delivery and postpartum care, primarily in the Inuit language (Inuktitut).¹³ New student midwives are trained through apprenticeship learning. Birthing is usually attended by two midwives in the birthing centres. A physician is on call to assist the delivery or arrange medical evacuation to an obstetrics hospital if needed. Flying time to Montreal, the most frequent evacuation destination, is 4–8 hours, depending on the weather. In the Ungava Bay communities, physicians in Tulattavik Hospital (Kuujjuaq) were responsible for providing most maternity care, and for arranging medical evacuation if tertiary care was expected or considered necessary. The primary service languages of the physicians are French and English.

METHODS

Data

We conducted a retrospective birth cohort study using Statistics Canada's linked live birth, infant death and stillbirth data for the period 1989–2000. We excluded births with missing data on birth weight or gestational age, and births of extremely low reported birthweight (<500 g) or gestational age (<20 weeks). The validity of the Canadian linked vital data has been well documented.¹⁴ We used data for the period 1989–2000 because those were the most recent years for which Inuit births in Quebec (the province where Nunavik is located) could be identified by maternal mother tongue in Statistics Canada's linked vital data files, and because midwives have accounted for over 70% of births in the Hudson Bay communities since 1989.¹² The study was approved by the research ethics board of Sainte-Justine Hospital, University of Montreal, and the Nunavik Nutrition and Health Committee. Informed consent was not sought from individual participants because the study was based on anonymised linked birth data.

Geocoding the maternal place of residence

Based on geocoding the maternal place of residence on birth registrations (determined from postal codes, or from municipality codes if postal codes were unavailable (<5%)), a total of 3359 births were identified to residents of Nunavik during the study period. We excluded 633 births (19%) to non-Inuit mother tongue women (French, English or other), leaving 2726 (81%) births to Inuit mother tongue (“Inuktitut”, “Inuttitut”, “Eskimo dialect”) women in the final study sample. The Inuit language remains the mother tongue for most Inuit; 86% of all self-identified Inuit in Quebec reported an Inuit mother tongue in the most recent 2006 census, and the proportion is likely to be higher for Inuit living in Nunavik. We restricted the analyses to births to Inuit mother tongue women because: (1) Inuit pregnant women were the target patients of the midwife-led maternity care programme in the Hudson Bay communities; (2) non-Inuit mother tongue women are apt to be non-indigenous migrants working temporarily in Nunavik and likely to return south for maternity care (although they may deliver locally).

Outcomes

The primary outcome was perinatal death, defined as stillbirth (fetal deaths ≥ 20 weeks and ≥ 500 g) plus neonatal death (died during 0–27 days of postnatal life), because this is arguably the most important indicator of the quality of perinatal and maternity care. Also, the perinatal mortality indicator would not have been affected by registration variability of extremely preterm or extremely low weight births at the borderline of viability,¹⁵ as there may be variable individual judgements by midwives and physicians which could result in a death being registered as either a stillbirth or an early neonatal death. We further examined perinatal mortality restricted to births at gestational age ≥ 28 weeks. We also examined the components of perinatal mortality (stillbirth, neonatal death) and other birth outcomes available in the linked birth data that might be related to the quality of perinatal care, including preterm birth (<37 completed weeks of gestation), small-for-gestational-age (SGA, <10 th percentile, based on the Canadian fetal growth standards¹⁶) or low birthweight (<2500 g) birth, post-neonatal death (28–364 days) and total infant mortality (death 0–364 days). Although post-neonatal death is strongly associated with socioeconomic conditions and quality of infant care, its perinatal origin is also well documented,^{17, 18} and Inuit midwives may continue to interact with the mothers during the post-neonatal period. Causes of infant death were investigated according to the classification of the International Collaborative Effort on Perinatal and Infant Mortality,¹⁹ based on International Classification of Diseases (ICD)-9 codes for deaths in 1991–1999 or ICD-10 codes for deaths in 2000–2001. The cause categories included congenital conditions, immaturity-related conditions, asphyxia, sudden infant death syndrome (SIDS), infection, external causes, other specific conditions and remaining causes.

Statistical analysis

Crude rates of adverse birth outcomes were compared for births to Inuit women of the Hudson Bay vs the Ungava Bay communities. Adjusted odds ratios (aOR) and 95% confidence intervals (CI) were estimated in hierarchical logistic regression models controlling for available individual and community-level characteristics. The individual-level characteristics included maternal age (<20 , 20–34, ≥ 35 years), education (<11 years, 11 years (high school graduation in Quebec), ≥ 12 years (at least some post-secondary education)), marital status (single, common law union, married), parity (primiparous or not), infant sex (boy, girl) and plurality (singleton, multiple). The community-level factors included primary birth attendant (midwives in Hudson Bay, physicians in Ungava Bay), community size (population <1000 , ≥ 1000) and community-level random effects. We dichotomised community size at the 1000 population cut-off because the communities with ≥ 1000 population are where the Nunavik social and health care service centres are located. Most Nunavik communities (11 out of 14) had a population <1000 persons based on the 1996 census (the middle year of the study period). All data analyses were carried out using SAS, version 9.1; the multilevel logistic regression models were done using the SAS Glimmix macro.

RESULTS

The maternal characteristics of Inuit mothers were similar in the Hudson Bay and Ungava Bay communities, except for a higher proportion of primiparous mothers in the Hudson Bay communities (table 1). There was a lower proportion of single mothers (neither married nor in common law unions) but a higher proportion of mothers in common law unions in the Hudson Bay communities compared with the Ungava Bay communities. About three out of five births were to mothers who had not completed high school (11 years in Quebec) in both the Hudson and Ungava Bay communities.

There were no statistically significant differences in the crude rates of perinatal death and other observed birth outcomes comparing the Hudson Bay communities where midwives were the primary birthing attendants vs the Ungava Bay communities where physicians were the primary birthing attendants (table 2). For all births, the perinatal mortality rate was non-significantly higher for Inuit residents of the Hudson Bay communities (14.4 per 1000) vs the Ungava Bay communities (10.9 per 1000). A non-significantly higher neonatal mortality rate was also observed for Inuit residents of the Hudson Bay communities (8.6 per 1000) compared with the Ungava Bay communities (5.0 per 1000), but stillbirth rates were almost identical. When the analyses were restricted to births at gestational age ≥ 28 weeks, the differences in perinatal or neonatal mortality remained not statistically significant and were even smaller. The incidence of extremely preterm births (<28 weeks) was non-significantly higher for residents of the Hudson Bay (6.5 per 1000) vs Ungava Bay (4.2 per 1000) communities. Births under 28 weeks of gestation accounted for 54% of neonatal deaths in the Hudson Bay communities vs 33% in the Ungava Bay communities. Perinatal and infant mortality rates for Inuit residents of both the Hudson Bay and the Ungava Bay communities were much higher than those observed for the majority French mother tongue births in Quebec during the same period, which were 6.9 per 1000 for perinatal mortality and 4.7 per 1000 for infant mortality ($p < 0.0001$, data not shown).

There were no statistically significant differences in any cause-specific infant mortality rates (congenital anomalies, asphyxia, immaturity-related, SIDS, infections or other causes) comparing births to residents of the Hudson Bay vs the Ungava Bay communities (detailed results not shown). Rates of preterm, SGA or LBW birth, perinatal death, stillbirth, neonatal death, postnatal death and cause-specific infant mortality were all not significantly different comparing smaller (population <1000) vs larger (population ≥ 1000) communities (detailed data not shown).

The adjusted odds ratios for all adverse birth outcomes controlling for individual (maternal age, parity, marital status, education, infant sex, plurality) and community characteristics (community size, community-level random effects) showed a similar pattern to that for the crude rates (table 3): no statistically significant differences, but somewhat higher odds of perinatal, neonatal and post-neonatal death comparing residents of the Hudson vs Ungava Bay communities. The aORs (95% CI) comparing the Hudson vs Ungava Bay communities were 1.29 (0.39 to 2.41) for perinatal death, 0.97 (0.39 to 2.41) for stillbirth, 1.60 (0.59 to 4.39) for neonatal death, and 1.22 (0.58 to 2.56) for post-neonatal death respectively. When the analyses were restricted to births ≥ 28 weeks of gestation, the aORs (95% CI) were 1.13

(0.48 to 2.47) for perinatal death, 0.98 (0.36 to 2.62) for stillbirth and 1.30 (0.39 to 4.34) for neonatal death respectively.

DISCUSSION

Main findings and interpretations

We observed somewhat but not statistically significantly higher risks of perinatal death in Inuit births comparing communities where midwives vs physicians were the primary birthing attendants. Because of limited power due to the relatively small number of births in these communities (see Limitations), our results are inconclusive concerning the safety of midwives vs physicians as the primary birthing attendants in remote Inuit communities. However, it is reassuring that the aOR for perinatal death was closer to 1 (aOR = 1.13) when the analysis was restricted to births \geq 28 weeks of gestation. The non-significantly higher risk of perinatal death in the Hudson Bay communities (aOR = 1.29) could be partly explained by a higher rate of extremely preterm (<28 weeks) births, which were unlikely to be related to the quality of maternity care. Nevertheless, our data also point to the need for ongoing monitoring and audits of adverse birth outcomes.

Although there have been many studies examining the disparities comparing indigenous vs non-indigenous birth outcomes,^{20–24} data have been scarce on the effects of community-level factors among indigenous communities on their birth outcomes. Canadian population-based surveillance data on Inuit birth outcomes are absent at the national level due to the lack of an Inuit birth identifier in most regions.^{22, 25} Even though there may be a problem of under-reporting of adverse birth outcomes among Inuit women in the currently available data,²² previous studies have consistently revealed much higher risks of stillbirth, preterm birth and infant mortality among Inuit vs their non-indigenous counterparts in Canada.^{22, 26–28} In our study, perinatal and infant mortality rates were all substantially (1.6–4.8 times) higher for births to Inuit mother tongue women in both the Hudson and Ungava Bay communities compared with the majority French mother tongue women in Quebec. Such disparities indicate a need to improve the quality of perinatal and infant care as well as to address the broader and more fundamental social and environmental determinants of health in northern aboriginal communities such as maternal education, housing and other socioeconomic conditions.²⁹

The Hudson Bay communities' midwife-led maternity care programme offering services in the Inuit language to Inuit women in their own communities may be a more accessible and culturally appropriate model of care, which may help care providers to better understand and meet the needs of pregnant Inuit women. Such a model may be helpful in improving Inuit birth outcomes in remote communities, and may help to bridge the gap between western medicine and indigenous knowledge. However, there remains a lack of rigorous scientific data on the safety of midwife-led maternity care in remote indigenous communities. Our study may have contributed an important piece of quantitative evidence concerning perinatal mortality, but other quantitative and qualitative evidence on maternal and neonatal morbidities also needs to be evaluated and taken into consideration for devising policies to improve perinatal outcomes in northern aboriginal communities.

Bringing back births to remote indigenous communities may bring vitality and other social and community benefits not assessed in the present study, although safety should be a key concern. According to the Society of Obstetrics and Gynecologists of Canada, the Hudson Bay communities' midwife-led maternity care programme could be considered as a model for other maternity care programmes in remote communities,³⁰ although there is a need for comprehensive qualitative research data.³¹ Previous evaluation reports of the Hudson Bay programme were based on birth centres' internal audit data and mostly compared outcomes before and after the introduction of midwife-led maternity care in those same communities.^{30, 32–35} However, no previous reports have assessed whether the key safety indicators of the quality of prenatal and maternity care—perinatal death, stillbirth and neonatal death rates—were statistically significantly different or not. Further, as high-risk pregnancies were transferred (before labour for high-risk pregnancies) or evacuated (emergency) to tertiary care hospitals in Montreal, their delivery outcomes may not have been captured in reports based on the local birth centres' internal audit data. The main finding of those previous evaluations was a lower frequency of obstetric interventions (such as caesarean section) associated with the midwife-led maternity care programme in the Hudson Bay communities. In contrast, our study was based on comprehensive, mortality-linked perinatal data which included delivery outcomes for Inuit women evacuated south out of Nunavik. Transfers south to a tertiary obstetric centre were known to be much more common for births to residents of the Ungava Bay communities—28% vs 9.4% for the Hudson Bay communities in 1995–96¹²—although we did not have data on whether a particular birth was a transfer south or not. We speculate that one reason for the much higher transfer rate in the Ungava communities could be the relative inexperience of maternity care physicians there because of high rates of staff turnover. It is unknown whether more transfers to a tertiary care centre may have accounted for the non-significantly lower rates of perinatal and neonatal death in the Ungava Bay communities. In any case, enhanced perinatal care capacity seems to be needed in both the Hudson and Ungava Bay communities, perhaps through improved continuing training programmes and policies of northern work retention bonuses for retaining experienced staff.

In addition to birth outcomes, other indicators could also be important in evaluating midwife-led maternity care programmes in northern aboriginal communities, such as rates of maternal and neonatal morbidities, obstetric interventions, service accessibility, cultural acceptability, satisfaction and costs. Further studies would be needed to address such concerns.

Strengths and limitations

Because this study was based on linked vital events according to the usual place of residence of the mother, our study data included the outcomes of cases referred, transferred or evacuated to tertiary care hospitals, which are a crucial part of assessing the midwife-led maternity care programme. These events were incompletely ascertained in previous assessments of the midwife-led maternity care programme based on the birth centres' internal audit data. No previous studies have compared perinatal mortality rates in the two sets of Inuit communities.

We are aware of some limitations to our study. First, our study had limited power to detect moderate differences in rare outcomes given the relatively small number of births in these remote communities. To reach a power of 80% at an alpha error of 5% for detecting a 30% difference (the observed risk ratio = 1.3) in perinatal death with a baseline rate of 12 per 1000 in Nunavik, we would need a sample size of about 16 000 births, which would require several more decades of data, but such data may lose relevance because of the extremely long time span. Continuing ongoing monitoring of fetal, infant and maternal outcomes is strongly recommended, including thorough and timely investigation of each fatal event, so that any problems can be identified and corrective action taken years before conventional statistical analysis could even detect a problem as ‘significant’. Second, we had information on only a limited number of maternal and infant variables, but no information on other potential confounders or effect mediators such as maternal smoking and family income. However, because of the *de facto* natural experiment nature of the study, these unobserved characteristics were likely to be similar in the Hudson Bay and Ungava Bay communities. Further, we observed no evidence of confounding for perinatal death by sociodemographic characteristics such as maternal age and education. We had no data on neonatal morbidity, maternal morbidity or mortality. Further studies are needed to assess other infant and maternal outcomes for a more comprehensive picture.

Our preliminary results from this natural “experiment” are inconclusive concerning the safety of midwife-led maternity care in remote Inuit communities. However, the results excluding extremely preterm births appear more reassuring. Nevertheless, because of our study’s limited power to detect moderate differences in perinatal mortality as statistically significant, we strongly recommend ongoing monitoring and periodic audits of adverse birth outcomes, including maternal and neonatal morbidities, by regional review committees.

What is already known on this subject

- Increasing evidence suggests that midwife-led maternity care may be a safe alternative for deliveries in low-risk pregnancies, but concerns remain about its safety, particularly in remote settings.
- There is a lack of data on the safety of midwife-led maternity care in remote or indigenous communities where such a model of accessible maternity care may be most wanted.

What this study adds

In Nunavik, a remote and predominantly Inuit-inhabited region of northern Canada, risks of perinatal death were somewhat but not significantly higher in the Hudson Bay communities where Inuit midwives served as the primary birthing attendants compared with the Ungava Bay communities where western physicians served as the primary birthing attendants. Excluding births, <28 weeks, the risks of perinatal death were more similar.

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Table 1

Characteristics of births to Inuit residents in the Hudson Bay communities where midwives were the primary birthing attendants, and the Ungava Bay communities where physicians were the primary birthing attendants, Nunavik, 1989–2000

	Hudson Bay	Ungava Bay	p Value *
All births, N	1529	1197	
Infant sex, male %	53.1	50.7	0.21
Multiple birth, %	1.4	1.8	0.51
Mothers primiparous, %	36.0	29.7	0.0006
Maternal age (years), %			0.18
<20	26.6	24.0	
20–34	69.2	72.4	
35	4.3	3.6	
Marital status, %			0.05
Single	39.1	43.1	
Common law union	41.0	36.6	
Married	19.9	20.3	
Maternal education, %			0.17
<11 years	61.5	64.6	
11 years (completed high school)	15.8	16.1	
12 years (some college or higher)	22.7	19.3	

* p Values in χ^2 tests for differences between the two sets of communities.

Table 2

Crude risks of adverse birth outcomes among births to Inuit residents in the Hudson Bay communities where midwives were the primary birthing attendants vs the Ungava Bay communities where physicians were the primary birthing attendants, Nunavik, 1989–2000

	Hudson Bay	Ungava Bay	Crude RR* (95% CI)
	N; Rate (95% CI)	N; Rate (95% CI)	
N (all births)	1529	1197	
For all births			
Preterm birth, %	157; 10.3 (8.7 to 11.8)	129; 10.8 (9.0 to 12.5)	0.95 (0.76 to 1.19)
SGA birth, %	94; 6.1 (4.9 to 7.4)	65; 5.4 (4.1 to 6.7)	1.13 (0.83 to 1.54)
LBW birth, %	81; 5.3 (4.2 to 6.4)	72; 6.0 (4.7 to 7.4)	0.88 (0.65 to 1.20)
Perinatal death, per 1000	22; 14.4 (8.4 to 20.4)	13; 10.9 (5.0 to 16.7)	1.32 (0.67 to 2.62)
Stillbirth, per 1000	9; 5.9 (2.1 to 9.7)	7; 5.8 (1.5 to 10.2)	1.01 (0.38 to 2.69)
Neonatal death, per 1000	13; 8.6 (3.9 to 13.2)	6; 5.0 (1.0 to 9.1)	1.70 (0.65 to 4.45)
Post-neonatal death, per 1000	21; 13.9 (8.0 to 19.9)	13; 11.0 (5.0 to 16.9)	1.27 (0.64 to 2.52)
Infant death, per 1000	34; 22.4 (14.9 to 29.8)	19; 16.0 (8.8 to 23.1)	1.40 (0.80 to 2.44)
For births \geq 28 weeks			
Perinatal death, per 1000	14; 9.2 (4.4 to 14.0)	10; 8.4 (3.2 to 13.6)	1.10 (0.49 to 2.46)
Stillbirth, per 1000	8; 5.3 (1.6 to 8.9)	6; 5.0 (1.0 to 9.1)	1.05 (0.36 to 3.01)
Neonatal death, per 1000	6; 4.0 (0.8 to 7.1)	4; 3.4 (0.1 to 6.7)	1.18 (0.33 to 4.16)

LBW, low birthweight (<2500 g); SGA, small-for-gestational-age (<10th percentile); RR, risk ratio; CI, confidence interval.

* All crude RRs were non-significant ($p > 0.05$).

Table 3

Crude and adjusted odds ratios of adverse birth outcomes among births to Inuit residents in the Hudson Bay communities where midwives were the primary birthing attendants vs the Ungava Bay communities where physicians were the primary birthing attendants, Nunavik, 1989–2000

Outcome	Crude OR (95% CI)	Adjusted OR* (95% CI)
For all births		
Preterm birth	0.95 (0.74 to 1.21)	0.94 (0.73 to 1.20)
SGA birth	1.14 (0.82 to 1.58)	1.48 (0.82 to 2.68)
LBW birth	0.87 (0.63 to 1.21)	0.85 (0.61 to 1.18)
Perinatal death	1.33 (0.67 to 2.65)	1.29 (0.63 to 2.64)
Stillbirth	1.01 (0.37 to 2.71)	0.97 (0.39 to 2.41)
Neonatal death	1.70 (0.65 to 4.49)	1.60 (0.59 to 4.39)
Post-neonatal death	1.27 (0.63 to 2.55)	1.22 (0.58 to 2.56)
Infant death	1.41 (0.80 to 2.48)	1.34 (0.75 to 2.40)
For births ≥ 28 weeks		
Perinatal death	1.10 (0.49 to 2.48)	1.13 (0.48 to 2.67)
Stillbirth	1.05 (0.36 to 3.02)	0.98 (0.36 to 2.62)
Neonatal death	1.18 (0.33 to 4.18)	1.30 (0.39 to 4.34)

OR, odds ratio; CI, confidence interval; LBW, low birthweight (<2500 g); SGA, small-for-gestational-age (<10th percentile).

* The odds ratios (ORs) from multilevel logistic regression models adjusting for maternal age (<20, 20–34, ≥ 35 years), education (<completed high school, completed high school (11 years) and ≥ some college), marital status (single, common law union, married), parity (primiparous or not), infant sex (boy, girl), plurality (singleton, multiple), community size (population <1000, ≥ 1000) and community-level random effects.