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Comparison of maternal and newborn outcomes of Tibetan and Han Chinese delivering in Lhasa, Tibet

Suellen Miller¹, Carrie Tudor², Vanessa Thorsten³, Nyima⁴, Sonam⁵, Droyoung⁶, Linda Wright⁷, and Michael Varner⁸

¹ Bixby Center for Global Reproductive Health, Department of Obstetrics, Gynecology, and Reproductive Sciences, University of California, San Francisco, California ² Department of Obstetrics, Gynecology, and Reproductive Sciences, University of California, San Francisco, California ³ RTI International, Research Triangle Park, North Carolina, USA ⁴ Women's Division, Lhasa Municipal Hospital, Lhasa, TARPRC ⁵ Women's Division, Mentsikhang Traditional Tibetan Medicine and Astrology Hospital, Lhasa, TARPRC ⁶ Women's Division, Lhasa Maternal Child Health Hospital, Lhasa, TARPRC ⁷ Center for Research for Mothers and Children, National Institute of Child Health and Human Development, Bethesda, Maryland ⁸ Maternal Fetal Medicine, University of Utah School of Medicine, Salt Lake City, Utah, USA

Abstract

Aim—To compare maternal and neonatal outcomes of Tibetan and Han Chinese women delivering vaginally at high altitude (3650 meters) in Lhasa, Tibet Autonomous Region, People's Republic of China.

Method—Comparative analysis of data from a prospective observational study of Tibetan ($n = 938$) and Han Chinese ($n = 146$) women delivering at three hospitals between January 2004 and May 2005.

Results—Han Chinese women had higher rates of pre-eclampsia/gestational hypertension than Tibetan women, (10.3% vs 5.9%, $P = 0.04$). There was no difference in rates of postpartum hemorrhage between Tibetan and Han women (12.8% vs 17.1%, $P = 0.15$). Han newborns weighed significantly less than Tibetan newborns ($P < 0.01$), and were twice as likely to be small for gestational age, (24.5% vs 11.6%, $P < 0.01$). Tibetan newborns were less likely to have poor neonatal outcomes than Han newborns ($P < 0.01$).

Conclusion—In high altitude deliveries in Tibet, adverse outcomes were significantly more common among Han Chinese.

Keywords

gestational hypertension; high altitude; low birthweight; postpartum hemorrhage; pre-eclampsia; small for gestational age; Tibet

Introduction

Little research has been conducted on maternal and neonatal outcomes in the Tibet Autonomous Region (TAR), People's Republic of China (PRC), elevation 3650 meters. It has been documented elsewhere^{1–4} that pregnant women residing and delivering at high altitude

have higher rates of pre-eclampsia (PE) and gestational hypertension (GH) than women at low altitude. The negative effects of PE/GH on neonatal outcomes are well documented.^{2,5} Research has demonstrated that low birthweight is more common in newborns born at high altitude than at low altitude.^{2,6–12} Small studies have compared outcomes between newborns of Tibetans, who have resided at high altitude for generations, and Han Chinese, who have immigrated to Tibet more recently. In these studies, Tibetan newborns weighed 300 g to 530 g more than Han Chinese newborns born at altitudes between 3000 to 3800 meters, suggesting that extremely long multi-generational residence at high altitude may modify the effects of altitude on pregnancy outcomes.^{7,13}

We hypothesized that because of the multi-generational acclimatization to the lower content of oxygen at high altitude, that native-born Tibetans would have better maternal and newborn outcomes than would non-Tibetan born Han Chinese delivering in Lhasa, Tibet. Specifically we expected higher rates of PE/GH among Han Chinese women delivering, and higher rates of low birthweights among Han Chinese newborns. Further we hypothesized that Tibetan newborns would weigh more than Han Chinese newborns. In this paper we compare maternal and neonatal outcomes using data from a prospective observational study in three hospitals in Lhasa, TAR, among 1084 Tibetan and Han Chinese mothers and newborns.¹⁴

Methods

Study sites and participants

Between January 2004 and May 2005 data were collected on all women delivering vaginally at the three study hospitals: the Mentzikhang Hospital, the Lhasa Municipal Hospital and the Lhasa Maternal and Child Health Hospital. Eligibility criteria included a singleton intrauterine pregnancy of at least 28 weeks gestation. Women who had multiple gestations or delivered by Cesarean section were excluded from the study. There were no maternal age exclusions.

Definitions specific to this study

Pre-eclampsia (PE) and *gestational hypertension* (GH) were combined due to lack of recorded proteinuria levels. We defined PE/GH as two readings in a seated position of a systolic blood pressure (BP) ≥ 140 mmHg or a diastolic blood pressure (BP) ≥ 90 mmHg taken on admission to the hospital and one hour postpartum. *Postpartum hemorrhage* (PPH) was defined as measured blood loss ≥ 500 mL and *severe postpartum hemorrhage* was defined as measured blood loss ≥ 1000 mL. Post-partum blood loss was measured in the blood collection drape for one hour following the delivery of the placenta. *Maternal complication* was defined as the presence of at least one of the following: PE/GH, PPH, infection and/or other major maternal complication.

A woman was considered to have had *prenatal care* if she had at least one visit to a health care provider during this pregnancy for reasons related to the pregnancy. *Gestational age* was determined preferentially by an ultrasound performed in the first half of pregnancy. If no early ultrasound report was available, *gestational age* was calculated from the first day of the woman's last menstrual period, or, if not known, by measuring her fundal height. Term newborns, 37–41 weeks gestation, were considered to be *small for gestational age* (SGA) if their birthweight was less than the 10th percentile for their gestational age adjusted for sex, based on the 1963 Lubchenco growth curves.¹⁵ *Low Apgar* was < 7 at 5 min. *Low birthweight* (LBW) was defined as newborn birthweight < 2500 g; newborns with birth-weight < 1500 g were considered *very low birthweight* (VLBW).¹⁶ *Early neonatal death* was defined as the death of a live born baby before discharge. SGA, LBW, stillbirth and early neonatal death prior to discharge were combined into one composite variable, *poor neonatal outcome*.

Data collection

The Institutional Review Boards (IRB) of the participating US-based institutions (the University of Utah, the University of California, San Francisco, and RTI International) and the Tibetan IRB at the Mentzikhong Hospital approved this observational study; informed consent was not required.

Trained clinician data collectors (nurses, nurse-midwives, and physicians) at the three study hospitals collected data on basic demographics, labor and delivery progress and complications, medications used before, during and following delivery, measured post-partum blood loss, and maternal and neonatal outcomes. All women were asked to self identify their ethnicity. All data were recorded on a standardized data collection form developed by US and Tibetan researchers.

All forms were reviewed for accuracy by hospital study staff before being submitted to the research office for data entry. All data were entered into Epi Info version 3.2 and 3.3¹⁷ and transmitted electronically using BLAST¹⁸ to the Global Network Data Coordinating Center (DCC) at RTI International, North Carolina, USA, for final analysis.

Statistical analysis

The DCC transferred the data to SAS version 9.0 for data analysis.¹⁹ Descriptive statistics were generated for participant demographics, health care received during delivery and postpartum, and maternal and newborn outcomes by ethnicity. Continuous variables were categorized based on the distribution of the data and clinical relevance. Relationships between categorical variables were evaluated by examining cross-tabulations, odds ratios, χ^2 tests and Fisher's exact tests. Similarly, relationships between continuous variables were evaluated by examining means, standard deviations, and quartiles. Differences in means by ethnicity were compared using the pooled method of *t*-test in cases with equal variances and the Satterthwaite method was used in cases with unequal variances. A reduced alpha level of 0.01 was adopted when assessing statistical significance to partially correct for multiple comparisons.

A multivariate logistic regression was used to analyze the association between maternal characteristics and SGA, coded as a binary variable. The maternal characteristics included as independent variables were age (years), parity, ethnicity (Tibetan [reference group] and Han Chinese), prenatal care, and PE/GH. The model was a good fit (Deviance $P = 0.20$, Pearson $P = 0.12$). Model adjusted χ^2 test results were considered significant at the alpha equals 0.01 to correct for multiple comparisons.

Results

Maternal

Of the 1121 consecutive women who delivered vaginally in the three study hospitals over a 17 month period, there were 938 (83.7%) Tibetan, 146 (13%) Han Chinese and 37 (3.3%) women of 'other ethnicity' enrolled. This analysis only compares maternal and neonatal outcomes between the 938 (86.5%) Tibetan and 146 (13.5%) Han Chinese women, a total of 1084 women. Maternal characteristics are described in Table 1. The majority of all participants reported having had at least one prenatal visit during this pregnancy. A higher percentage of Tibetan women had at least one prenatal visit than Han Chinese women ($P < 0.001$).

There were no maternal deaths; however, 217 (20.0%) women experienced at least one maternal complication. The overall complication rates were not significantly different between Tibetan and Han Chinese women (18.9% vs 27.4%, $P = 0.02$) at the alpha = 0.01 level. There was a higher incidence of PE/GH in Han Chinese women ($n = 15$, 10.3%) compared to Tibetan

women ($n = 55$, 5.9%) odds ratio (OR) 1.85 (1.01, 3.33). Han women who had PE/GH were more likely to have a poor neonatal outcome adjusted OR 2.15 (0.55, 8.41), to have a newborn who was SGA adjusted OR 1.47 (0.26, 7.65), or LBW adjusted OR 4.57, (1.04, 20.49) than Tibetan women who had PE/GH.

Tibetan women had a significantly higher rate of episiotomies than Han Chinese women (unadjusted $P < 0.01$). The rates of perineal and cervical tears were similar between the groups. One hundred and twenty-two (11.3%) women experienced PPH and 23 (2.1%) experienced severe PPH. There was no significant difference between Tibetan and Han Chinese women in either the rate of PPH or in the mean measured post-partum blood loss.

Newborns—There were 27 perinatal deaths ($n = 18$ early neonatal deaths, $n = 9$ stillbirths). Han newborns were significantly more likely to have any complication than Tibetan newborns OR 2.14 (1.4, 3.2). Mean gestational age and birthweight by ethnicity are detailed in Table 2. Approximately 9.7% of all newborns were LBW. Han Chinese newborns were nearly three times as likely to be LBW compared to Tibetan newborns (7.7% vs 22.6%, $P < 0.01$) and more than twice as likely to be SGA (25.0% vs 11.7%, $P < 0.01$). Newborns whose mothers had prenatal care were less likely to be LBW OR 0.40 (0.26, 0.61). However, Han Chinese newborns were more likely to be LBW even if their mothers had prenatal care OR 3.64 (2.0, 6.7).

Of newborns born at term, Han Chinese newborns were four times more likely to be LBW than Tibetan term newborns OR 4.3 (2.5, 7.4). Han Chinese newborns were twice as likely to have a poor neonatal outcome than Tibetan newborns OR 2.16 (1.44, 3.23).

Logistic regressions were performed to examine the relationship between SGA and ethnicity, using SGA as the dependent variable (Table 3), and the composite poor neonatal outcome variable and ethnicity, using poor neonatal outcome as the dependent variable (Table 4). After adjusting for multiple potential confounders including maternal age, ethnicity, prenatal care, parity, gravidity and PE/GH, only Han Chinese ethnicity and lack of prenatal care were significantly associated with having a SGA newborn or a poor neonatal outcome.

Discussion

Han Chinese women had higher rates of pre-eclampsia/gestational hypertension than Tibetan women, (10.3% vs 5.9%, $P = 0.04$). There was no significant difference in rates of postpartum hemorrhage between Tibetan and Han Chinese women (12.8% vs 17.1%, $P = 0.15$). Han Chinese newborns weighed significantly less than Tibetan newborns ($P < 0.01$), and were twice as likely to be small for gestational age, (24.5% vs 11.6%, $P < 0.01$). Han Chinese newborns were significantly more likely to have poor neonatal outcomes than Tibetan newborns ($P < 0.01$). Thus we found, as we had hypothesized, that in high altitude deliveries in Tibet, adverse outcomes were significantly more common among Han Chinese.

Previous reports document that women delivering at high altitude have higher rates of PE/GH than women delivering at low altitude.^{1–3,20} In a study, conducted in Colorado, researchers found that women residing and delivering at 3100 m had a higher rate of pre-eclampsia than women delivering at 1260 m, 16% compared to 3% respectively.¹ A similar study in Bolivia looking at PE/GH at 3600 m and 300 m also found higher rates of PE/GH at 3600 m (17.6%) compared to 300 m (11.4%).² In this study Han Chinese women had higher rates of PE/GH (10.3%) compared to Tibetan women (5.9%). This finding suggests that the impact of altitude on the development of PE/GH may be modified by extremely long term residence at high altitude.

An independent relationship between altitude and lower birthweight has been documented in numerous studies.^{1,2,6–13,21} Xiong and Fraser found that the mean birthweight among Han Chinese newborns in low altitude Suzhou, China (221 m) was 3229 g²² compared to 2798 g in this high altitude sample; a difference of 431 g. These findings are consistent with the observation that mean birthweight decreases by approximately 100 g per 1000 m of elevation gain.²³ Yip also found that birthweight at high altitude is reduced by up to 10% from birthweight at low altitudes.⁸ For the past two decades, Chinese infants born at lower altitudes have had a mean birthweight of 3180 g; this is, respectively, 171 g and 382 g more than the Tibetan and Han Chinese newborns in this study.²⁴

Two smaller research studies, with sample sizes of 452 (Han Chinese 75, Tibetan 377)⁷ and 30 (15 Han Chinese and 15 Tibetan),^{7,13} that have compared neonatal outcomes at high altitude, found that Han Chinese newborns weighed less than Tibetan newborns. In our study of 1084 deliveries, we have demonstrated not only that they were smaller, but that Han Chinese newborns were three times as likely to be LBW compared to Tibetan newborns, and more than twice as likely to be SGA. The latter relationship persisted after adjustment for a variety of maternal factors. These findings again suggest a modifying influence of very long multi-generational residence at high altitude. A 2007 report comparing Andean native populations with descendants of European or mixed ancestry dwelling at 3600 m in Bolivia²⁵ likewise found similar differences in birthweights. Various rationales have been given to explain these differences. One was that genetically mediated differences in O₂ transport explained the ethnic differences in size,^{20,21} recent improvements in measurement have however, rendered this explanation unlikely.²⁵ Current theories are that increased substrate delivery (greater blood flow), placental transport, or the fetoplacental utilization of substrate may explain the differences.²⁵

These data showed no difference between the mean gestational age of Tibetan and Han Chinese newborns (39.4 weeks compared to 39.2 weeks respectively). This is similar to other studies conducted at high altitude in Tibet, Colorado, and South America^{1,2,4,7,8,12,13} and confirms that the decrease in birthweight seen in Han Chinese newborns born at high altitude in Tibet is more likely a result of intrauterine growth restriction than prematurity.

The combined rate of PPH in this study at high altitude and where expectant management of the third stage of labor was practiced, was 13.4% and is similar to findings from a recent randomized controlled clinical trial, at low altitude in India, which compared misoprostol to placebo in preventing PPH.²⁶ Although not statistically higher, the rate of PPH among Han Chinese women was 17%, which is higher than rates seen in much of the published work on reported PPH rates among women receiving expectant management of the third stage of labor.

The researchers do not know why fewer Han Chinese women accessed any prenatal care during pregnancy than Tibetan women. Based on the significantly poorer outcomes among Han Chinese newborns, this is an issue to be explored in future research and may have important policy implications.

Limitations

The major limitation of this study is that we did not collect detailed residency histories, so we are unable to determine how long Han Chinese women in this study have been living at high altitude in the TAR. In addition, the sample of women was restricted to those who delivered vaginally in three Lhasa city hospitals. Therefore, the researchers are not able to generalize the findings to women who delivered by Cesarean or delivered at other Lhasa hospitals, at lower level health facilities, or at home. Women delivering in Lhasa hospitals may be more educated and may be better nourished than women delivering at home or in rural villages. The sample size was determined as part of a pilot study prior to a randomized controlled trial (clinical trials

#NCT00147420) and no a priori sample size determinations were made. Because of this, and because the number of Han Chinese women is much smaller than the number of Tibetan women, other differences between the two ethnicities may exist that were not captured by this analysis. However, this difference in numbers of Tibetan and Han Chinese women does reflect the current population distribution in Lhasa.²⁷

The Lubchenco curves were chosen as a reference standard because they represent the only available moderate-elevation birthweight gestational age curve. The data used to construct these curves are dated (collected in the 1950s and 1960s), and based on patients of different ethnic backgrounds than either the Han Chinese or Tibetan women in this study. These limitations notwithstanding, we believe that the Lubchenco data still represent the best potential comparative data.

The researchers are unable to comment regarding the underlying physiological mechanisms contributing to the outcomes. Specifically lacking is information on maternal proteinuria. Since protein urinalysis and pre-existing history of hypertension were not routinely recorded, it is not clear whether patients had GH only, or PE.

Our definition of prenatal care as having had at least one visit may inflate the numbers of women who appeared to be attending antenatal visits, and also limits our ability to discuss the possible effects of increased PNC on neonatal outcomes. Newborns whose mothers had prenatal care were significantly less likely to be LBW; however, Han Chinese newborns were more likely to be LBW even if their mothers had prenatal care. Since any of the women could have only had one prenatal visit, the interpretation of the effect of prenatal care on LBW is impossible to make.

The use of the composite variable, SGA, LBW, stillbirth, and neonatal death combined as a composite variable also limits our ability to discuss the various relationships between the individual outcomes and any individual predictor variable, including ethnicity.

Conclusions

The findings that there were no differences in PPH between Tibetan and Han Chinese women or between Tibetan women delivering at altitude and of previously recorded rates of PPH among women of a variety of ethnicities at sea level may indicate no association between PPH and altitude. These findings also add to the available published reports on the apparent increased prevalence of PE/GH in both Tibetan and Han Chinese women delivering at high altitude. Moreover, these findings of a higher incidence of LBW and SGA Han Chinese newborns than Tibetan newborns and increased rates of neonatal complications in Han Chinese newborns adds to the current knowledge of differences between Tibetan and Han Chinese women and their newborns delivering at high altitude. Generational residence at high altitude may be protective, but is not a modifiable factor and the high rates of perinatal mortality in both groups may indicate that access and utilization of high quality prenatal care with special attention to monitoring BP, weight gain, and fetal growth should be made available for all pregnant women in the TAR.

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Table 1

Maternal clinical characteristics and complications by ethnicity of 1084 women delivering vaginally in-hospital in Lhasa, Tibet Autonomous Region, People's Republic of China, Jan 2004–May 2005

Variable	Ethnicity		Total n (%)	P-value [*]
	Tibetan n (%)	Han Chinese n (%)		
Total enrolled	938 (86.5)	146 (13.5)	1084	
Age (years) [†]	26.6 (4.5)	27.8 (4.7)	26.8 (4.5)	< 0.01
Parity [†]	0.4 (0.9)	0.7 (0.7)	0.5 (0.8)	< 0.01
Gravida [†]	1.7 (1.1)	2.5 (1.3)	1.8 (1.1)	< 0.01
Prenatal care	772 (82.3)	86 (58.9)	858 (79.2)	< 0.01
Maternal Complication [‡]	177 (18.9)	40 (27.4)	217 (20.0)	0.02
PE/GH [§]	55 (5.9)	15 (10.3)	70 (6.4)	0.04
Episiotomy	507 (54.1)	36 (24.7)	543 (50.1)	< 0.01
Perineal tear	173 (18.4)	28 (19.2)	201 (18.5)	0.83
Cervical tear	72 (7.7)	8 (5.5)	80 (7.4)	0.35
Blood loss (mL) [†]	279.6 (205.4)	301.1 (235.7)	282.5 (209.8)	0.30
PPH [¶]	120 (12.8)	25 (17.1)	145 (13.4)	0.15
Length of 3rd stage of labor (min) [†]	7.3 (3.3)	7.2 (4.7)	7.3 (3.5)	0.79

* Relationships between continuous variables and ethnicity were tested using a Pooled *t*-test, or in cases with unequal variances the Satterthwaite method was used. Relationships between categorical variables and ethnicity were tested using an unadjusted χ^2 test or Fisher's Exact Test where appropriate.

[†] Mean (standard deviation [SD]).

[‡] Some women had more than one maternal complication.

[§] PE/GH was defined as two readings in a seated position of a systolic BP ≥ 140 mmHg or a diastolic BP ≥ 90 mmHg as taken on admission to the hospital and one hour postpartum. Because proteinuria was not routinely recorded, PE and GH have been grouped together for the purposes of this analysis.

[¶] Defined as measured blood loss ≥ 500 mL. GH, gestational hypertension; PE, pre-eclampsia; PPH, Postpartum hemorrhage.

Table 2

Characteristics of stillborn and live born infants by ethnicity ($n = 1084$) delivered vaginally in-hospital in Lhasa, Tibet Autonomous Region, People's Republic of China, Jan 2004–May 2005

Variable	Ethnicity		Total n (%)	P -value *
	Tibetan n (%)	Han Chinese n (%)		
Total enrolled	938 (86.5)	146 (13.5)	1084	
Neonatal outcome				
Live birth, alive at discharge	914 (97.4)	143 (97.9)	1057 (97.5)	
Death prior to discharge	17 (1.8)	1 (0.7)	18 (1.7)	
Stillbirth	7 (0.8)	2 (1.4)	9 (0.8)	
Sex				
Male	473 (50.4)	78 (53.4)	551 (50.8)	0.49
Female	465 (49.6)	68 (46.6)	533 (49.2)	
Mean gestational age (wks) [†]	39.4 (1.7)	39.1 (1.8)	39.4 (1.7)	0.05
Categorized gestational age (wks)				
< 37 (pre-term)	36 (3.8)	5 (3.4)	41 (3.8)	
37–41 (term)	873 (93.1)	137 (93.8)	1010 (93.2)	
≥ 42 (post-term)	29 (3.1)	4 (2.8)	33 (3.0)	
Mean birthweight (grams) [‡]	3038.7 (448.9)	2797.5 (459.1)	3006.2 (457.5)	< 0.01
Categorized birthweight (grams)				
< 1500	5 (0.5)	1 (0.7)	6 (0.6)	
1500–2499	67 (7.2)	32 (21.9)	99 (9.1)	< 0.01
2500–3499	710 (75.7)	103 (70.5)	813 (75.0)	
≥ 3500	156 (16.6)	10 (6.9)	166 (15.3)	
Newborn complications	145 (15.5)	41 (28.1)	186 (17.2)	< 0.01
Apgar score < 7 at 5 min [§]	35 (3.8)	5 (3.5)	40 (3.7)	0.91
SGA [§]	104 (11.7)	35 (25.0)	139 (13.5)	< 0.01
Poor neonatal outcome [¶]	165 (17.6)	46 (31.5)	211 (19.5)	< 0.01

* Relationships between continuous variables and ethnicity were tested using a Pooled t-test or in cases with unequal variances the Satterthwaite method was used. Relationships between categorical variables and ethnicity were tested using an unadjusted χ^2 test or Fisher's Exact Test where appropriate.

[†] Mean (SD).

[‡] Apgar score provided for live births only ($n = 1075$).

[§] SGA for babies born at gestational ages 37–42 weeks ($n = 1031$).

[¶] Poor neonatal outcome is present for babies who were small for gestational age, low birthweight, stillborn, died before discharge, had a 5 min Apgar of less than 4, or were transferred to another hospital after delivery. SGA, small for gestational age.

Table 3

Adjusted risk factors for small for gestational age newborns delivered vaginally ($n = 1031$) in-hospital in Lhasa, Tibet Autonomous Region, People's Republic of China, Jan 2004–May 2005

Variable	Small for gestational age		Adjusted OR (95% CI) [†]	P-value [*]
	Yes ($n = 139$) n (%)	No ($n = 892$) n (%)		
Age [†]	27.4 (5.1)	26.7 (4.4)	1.02 (0.98, 1.07)	0.38
Parity [†]	0.6 (0.9)	0.4 (0.8)	0.99 (0.78, 1.26)	0.96
Ethnicity				
Tibetan	104 (74.8)	787 (88.2)	1.0	
Han Chinese	35 (25.2)	105 (11.8)	2.15 (1.36, 3.4)	< 0.01
Prenatal care	91 (65.5)	728 (81.6)	0.47 (0.30, 0.72)	< 0.01
PE/GH	12 (8.6)	54 (6.1)	1.28 (0.65, 2.50)	0.48

* ORs (with 95% CIs) and P values from a logistic regression model, which included all variables shown and hospital of delivery. Model adjusted chi-square test result significant at the alpha equals 0.01 level to partially correct for multiple comparisons.

[†] Mean (SD). CI, confidence interval; GH, gestational hypertension; OR, odds ratio; PE, pre-eclampsia.

Table 4

Adjusted risk factors for newborns experiencing a poor neonatal outcome delivered vaginally ($n = 1084$) in-hospital in Lhasa, Tibet Autonomous Region, People's Republic of China, Jan 2004–May 2005

Variable	Poor neonatal outcome		Adjusted OR(95% CI) [†]	P-value [*]
	Yes ($n = 211$) n (%)	No ($n = 873$) n (%)		
Maternal age [‡]	27.0 (5.0)	26.7 (4.4)	1.01 (0.97, 1.05)	0.63
Parity [‡]	0.5 (0.9)	0.5 (0.8)	0.95 (0.76, 1.18)	0.63
Ethnicity				
Tibetan	165 (78.2)	773 (88.5)	1.0	
Han Chinese	46 (21.8)	100 (11.5)	1.86 (1.24, 2.81)	0.00
Prenatal care	142 (67.3)	716 (82.0)	0.49 (0.34, 0.71)	< 0.01
PE/GH	19 (9.0)	51 (5.8)	1.45 (0.82, 2.56)	0.20

^{*} ORs (with 95% CIs) and P values from a logistic regression model, which included all variables shown and hospital of delivery. Model adjusted χ^2 test result significant at the alpha equals 0.01 level to partially correct for multiple comparisons.

[†] Poor neonatal outcome is present for babies who were small for gestational age, low birthweight, stillborn, died before discharge, had a 5 min Apgar of less than 4, or were transferred to another hospital after delivery.

[‡] Mean (SD). CI, confidence interval; GH, gestational hypertension; OR, odds ratio; PE, pre-eclampsia.