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## Original Article

## Prevalence and causes of cesarean births among women residing at high altitude in Lhasa, Tibet: A retrospective observational study of 7365 women

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## ABSTRACT

**Objective:** Currently, there is paucity of data on the rate of vaginal deliveries and cesarean section among women in Tibet. In this study, we carried out an observational study of 7365 consecutive pregnant women in Lhasa, Tibet who gave birth at our tertiary care institution between 2012 and 2015.**Materials and methods:** In this retrospective study, we reviewed the hospital records for demographic data, obstetric history, and the number of vaginal and emergency cesarean section deliveries. The overall and annual rate of vaginal and cesarean section deliveries was calculated. Causes, indications or risks for cesarean section were also analyzed.**Results:** During the review period, 7365 neonates were delivered at our hospital, including 1690 (23.0%) deliveries via cesarean section. The yearly rate of cesarean section progressively declined from 26.7% in 2012 to 18% in 2015 ( $P < 0.001$ ). Furthermore, the annual rate of emergency cesarean section declined 53.9% between 2012 and 2015 ( $P < 0.001$ ). Fetal risk factors (39.9%) and maternal risk factors (40.3%) were the major causes of cesarean section in the women. Social factors as a cause of cesarean section fluctuated between 7.9% and 11.1%.**Conclusion:** This study has demonstrated a steady decline in the annual rate of cesarean section in women in Tibet between 2012 and 2015. A decrease in the rate of emergency cesarean section contributed substantially to this decline. Moreover, approximately 10% caesarian sections were performed without clear indications, highlighting the need for strengthening prenatal counseling for pregnant women in Tibet.© 2019 Taiwan Association of Obstetrics & Gynecology. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Introduction

Cesarean delivery offers a surgical procedure, if appropriately performed and medically indicated, that could be life-saving for the baby or the mother. However, cesarean section is also associated with intrinsic risks including risk of death [1]. China has witnessed a steady increase in the rate of cesarean deliveries [2,3], which increased from 3.4% in 1988 to 39.3% in 2008 according to a survey of 34 482 live births in China between 1988 and 2008 [4], and this

increase occurs across the urban-rural divide and the socioeconomic divide. The 2004–2008 WHO Global Survey on Maternal and Perinatal Health reported an overall vaginal delivery rate of 53.8% for women in China and 46.2% for delivery via caesarian section including 11.6% deliveries without indications and 34.6% with indications for caesarian section [1], suggesting that not an insignificant proportion of pregnant women underwent caesarian section without clear indications for the procedure.

Tibet is an autonomous region in China and is located at an altitude of 3000–5000 m above sea level. Lhasa is the capital city of Tibet and is situated at an altitude of 3658 m above sea level. Slightly more than 75% of inhabitants of the city are ethnic Tibetans. Currently, there is paucity of data on the rate of vaginal deliveries and cesarean section among women in Tibet. Our previous studies suggest that in this rarified altitude, acclimatized inhabitants of

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Tibet may exhibit different disease profiles from low altitude inhabitants [5,6]. Levine et al. [7] surveyed 550,166 women and found that women residing in high altitude (3000–4340 m) had a significantly lower rate of cesarean section (20.6%) than those residing in moderate or low altitude (28.0% and 26.6%, respectively) ( $P < 0.001$ ). Yangzomet al. [8] reported a significantly higher rate of cesarean section among 1639 Tibetan women (18.0%) versus 601 non-Tibetan women (13.8%) ( $P < 0.001$ ) and cesarean section was associated with significantly lower mortality (2.8%) than vaginal delivery (4.5%) with a reduced risk of mortality [(OR 0.62 95%CI (0.34–1.12)].

In this study, we carried out an observational study of 7365 consecutive pregnant women in Lhasa who gave birth at our tertiary care institution between 2012 and 2015 with the overall and annual rate of caesarian section as the primary outcome. Causes and indications of cesarean section were also analyzed.

## Subjects and methods

### Subjects

In this retrospective cohort study, we reviewed the mode of delivery by 7365 consecutive pregnant women residing in Lhasa, Tibet who gave birth at the Department Obstetrics and Gynecology, Lhasa People's Hospital, Tibet, China between January 2012 and December 2015. All women giving birth at the hospital during the study period were included. Women who delivered their babies at the hospital lived in close proximity to their place of residency; therefore, the altitude at the hospital site of delivery (3658 m above sea level) was used to define the altitude of residency.

The study protocol was approved by the local ethics committee of Lhasa People's Hospital. No consent was required because of the retrospective nature of the study. Personal data were anonymized in the paper.

### Data collection

The hospital records were reviewed for demographic data, obstetric history (current pregnancy and parity), and the number of live deliveries, the number of vaginal deliveries and the number of deliveries via planned or emergency cesarean section. The overall and annual rate of vaginal deliveries and delivers via cesarean section was calculated. In addition, the annual rate of planned and emergency cesarean section was calculated. Causes, indications or risks for cesarean section were also documented according to the Expert Consensus on Cesarean Section by the Chinese Medical Association Obstetrics and Gynecology Committee [9] in the following 4 categories: 1) fetal risk factors: fetal distress, macrosomia, fetal intrauterine growth restriction (IUGR), oligohydramnios, umbilical cord prolapse, multiple births, and abnormal fetal presentation; 2) maternal risk factors: various childbirth complications (preeclampsia, placenta previa, placental abruption and others), uterine scar, and genital tract deformity; 3) dystocia: fetopelvic disproportion, failure to progress and others; 4) social factors: advanced maternal age, family requests, nuchal cord and maternal requests. We classified cesarean deliveries as emergency if the pregnant woman was diagnosed with acute fetal distress, vaginal bleeding, uterine rupture, maternal death with fetus alive, or eclampsia before the onset of labor, or planned if the decision to undergo caesarian section was made before onset of labor. Funnel shaped pelvis was confirmed via vaginal examinations by two senior obstetricians before true labor ( $TO < 8$  cm and  $TO +$  the posterior sagittal diameter at the plane of the outlet  $< 15$  cm). Cephalopelvic disproportion referred to the occurrence of signs of difficult labor during attempted vaginal labor, including

flatulence and urine retention, and labor did not progress despite aggressive treatment. It was diagnosed by vaginal examination revealing cervix edema, arrested descent of fetal head, caput succedaneum and fetal head molding and was not a MRI-based diagnosis.

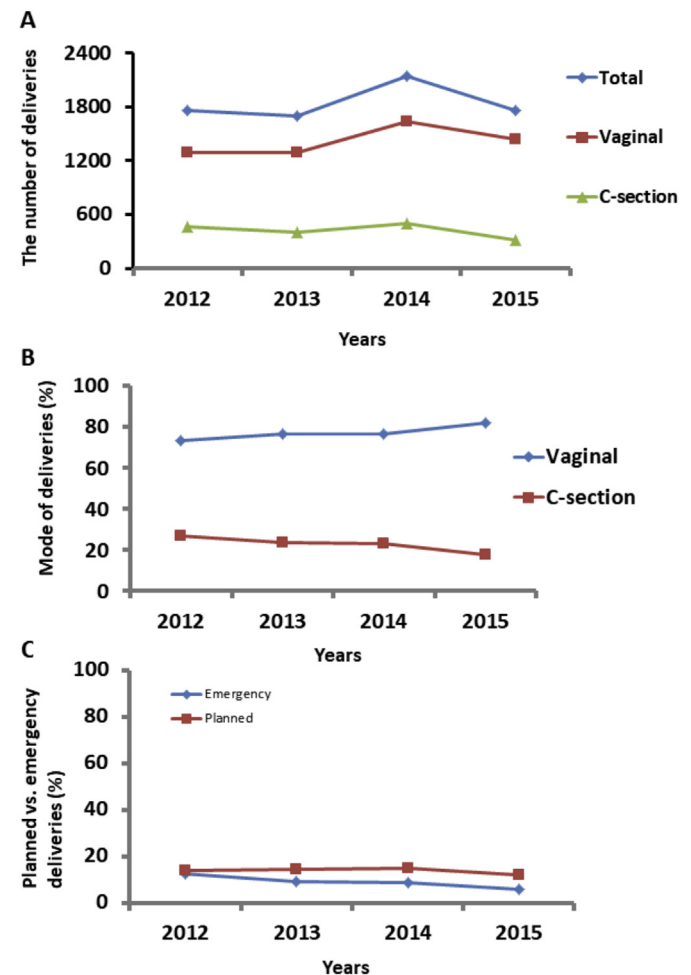
### Statistical analysis

Our analysis was restricted to live births and the primary outcome of this study was the percentage of births by cesarean section of all causes. Data were consolidated into Excel databases and analyzed with SPSS25.0 software. Chi square test for trend was performed to detect association. A  $P < 0.05$  was considered statistically significant.

## Results

### Prevalence of cesarean section by pregnant women in Tibet between 2012 and 2015

Between January 2012 and December 2015, totally 7365 neonates were delivered at our hospital (Fig. 1A). Among them, 5674 (77.0%) neonates were born via vaginal delivery and 1690 (23.0%) neonates via cesarean section. Moreover, the yearly rate of vaginal delivery steadily increased from 73.3% in 2012 to 82% in 2015 while



**Fig. 1.** (A) The number of deliveries by pregnant women in Lhasa, Tibet between 2012 and 2015. (B) The percentage of vaginal versus caesarian section deliveries. (C) The percentage of planned versus emergency caesarian section deliveries.

the rate of cesarean section progressively declined from 26.7% in 2012 to 18% in 2015 ( $P < 0.001$ ) (Fig. 1B). The yearly rate of cesarean section in 2015 was 18% lower than that in 2012 ( $P < 0.001$ ). However, the annual rate of planned cesarean section largely remained steady and fluctuated between 12.1% and 14.8% ( $P = 0.18$ ) (Fig. 1C). By contrast, the annual rate of emergency cesarean section progressively declined from 12.8% in 2012 to 5.9% in 2015, with a statistically significant 53.9% reduction in the annual rate of emergency cesarean section ( $P < 0.001$ ), suggesting that decline in the rate of emergency cesarean section led to a significant decline in the overall rate of cesarean section.

#### Causes of cesarean section by pregnant women in Tibet

Fetal risk factors (39.9%) and maternal risk factors (40.3%) were the major causes of cesarean section in pregnant women residing in Lhasa, Tibet (Table 1). Fetal risk factors as a cause of cesarean section decreased from 40.4% in 2012 to 35.6% in 2015 while maternal risk factors markedly increased from 35.3% in 2012 to 47.0% in 2015. Specifically, uterine scar remained the most common (26.7%) cause for cesarean section for the study population, followed by abnormal fetal presentation (17.9%) and fetal stress (15.6%) and cephalopelvic disproportion (10.4%) (Table 2). Uterine scar remained the most frequent cause of cesarean section in all four years from 2012 to 2015 and showed a steady increase from 2012 (20.9%) to 40% in 2015. Fetal distress along with uterine scar remained the most frequent (20.9%) cause of cesarean section in 2012, but was the third most frequent (7.9%) cause of cesarean section in 2015. Furthermore, the rate of cephalopelvic disproportion fluctuated between 9.0% and 12.6% over the 4 years. Interestingly, social factors as a cause of cesarean section fluctuated between 7.6% and 11.1%.

#### Parity, age, education, and residential area and prevalence of cesarean section

Multiparous women had a significantly higher rate (27.7%) of emergency cesarean section than nulliparous women (13.8%) ( $P < 0.001$ ). They also had a significantly higher rate (45.7%) of planned cesarean section than nulliparous women (12.8%) (Table 3). In addition, women aged less than 35 years accounted had a significantly higher rate of emergency cesarean section (34.8%) and planned cesarean section (48.7%) versus those aged 35 years and above (4.8% and 11.8%, respectively) ( $P < 0.001$ ). We found no statistically significant difference in the rates of emergency or planned cesarean section in urban versus rural residents ( $P = 0.10$ ). We also did not find statistically significant difference in the rates of emergency or planned cesarean section in women receiving primary school education versus those receiving middle school or higher education ( $P = 0.13$ ). Women engaged in physical labor or office work also did not show any statistically significant difference in the rates of emergency or planned cesarean section ( $P = 0.10$ ).

## Discussion

This study investigated so far the largest cohort of pregnant women in Tibet who reside at an altitude of 3658 m above sea level for mode of deliveries. We found that the overall rate of vaginal delivery was 77.0% and the overall rate of delivery via cesarean section was 23.0%. This overall rate of cesarean section is far lower than that reported for women in other parts of China, which ranges from 39.3% to 46.2% [1,4]. Furthermore, the annual rate of delivery via cesarean section was 18% for 2015, which is identical to that reported for a smaller cohort of women in Tibet by Yangzomet *et al.* [8] and is similar to that (20.6%) by Levine *et al.* [7] who found a significantly lower rate of cesarean section in women residing in high altitude than those residing in moderate or low altitude.

Despite that China has seen a progressive rise in the rate of cesarean deliveries across the urban-rural divide and the socioeconomic divide [2,3], our study has demonstrated a steady decline in the annual rate of cesarean section from 26.7% in 2012 to 18% in 2015. This is largely due to a marked 54% reduction in the annual rate of emergency cesarean section, which declined from 12.8% in 2012 to 5.9% in 2015, while the annual rate of planned cesarean section remained steady, indicating that decline in the rate of emergency cesarean section contributed significantly to the decline in the overall rate of cesarean section. The 2004–2008 WHO Global Survey on Maternal and Perinatal Health reported that approximately one in four women who underwent caesarian section did not have clear indications for the procedure [1]. In the current study, approximately one in ten women underwent caesarian section without clear indications. This is similar to the rate of cesarean section due to social factors (13%) in a cross-sectional study in China [10,11]. In Tibet, the parity of pregnant women is high and the average childbearing age is younger, and prenatal education is provided for ethnic minorities, regardless of the parity of the pregnant woman. Over the past decades standardized obstetrics and gynecology training has been provided for obstetricians and gynecologists, and midwives, which could contribute to the use of clear indications for cesarean section. Furthermore, pregnant women and their families tend to choose cesarean section mostly when they are multiparous. In such cases, women often require simultaneous sterilization procedure during cesarean section. In addition, Tibetans have unique social and cultural concepts and customs. Cesarean section is often used to deliver neonate on a specific date and at a specific time according to Buddhism calculation in order to achieve auspicious well-being. Therefore, improving health education, counseling pregnant women about the benefit of vaginal delivery and risks associated with cesarean section, could help reduce choosing cesarean sections due to social factors.

Fetal risk factors and maternal risk factors together accounted for approximately 80% of all cesarean sections. Fetal stress was the third most frequent cause of cesarean section and was present in 15.6% of our study cohort. This is higher than the rate (12.3%) reported by Yangzomet *et al.* [8] who also noted an apparently higher

**Table 1**  
Causes of cesarean section in pregnant women in Tibet from 2012 to 2015 (N = 1661) [N (%)].

Year	Fetal risk factors	Maternal risk factors	Dystocia factors	Social factors
All	663 (39.9)	670 (40.3)	176 (10.6)	152 (9.2)
2012	190 (40.4)	166 (35.3)	52 (11.1)	52 (11.1)
2013	172 (42.8)	152 (37.8)	36 (9.0)	37 (9.2)
2014	188 (37.5)	203 (40.4)	63 (12.5)	38 (7.6)
2015	113 (35.6)	149 (47.0)	25 (7.9)	25 (7.9)
$\chi^2$	1.7	-3.27	0.64	1.88
P	0.09	0.001	0.52	0.06

**Table 2**

Specific causes of cesarean section in pregnant women in Tibet from 2012 to 2015.

Indications for cesarean section	All (N = 1691)		2012(N = 470)		2013(N = 402)		2014(N = 501)	
	N (%)	Rankings	N (%)	Rankings	N (%)	Rankings	N (%)	Rankings
Uterine scar	451 (26.7)	1	98 (20.9)	1	96 (23.9)	1	140 (28.0)	1
Abnormal fetal presentation	302 (17.9)	2	62 (13.2)	3	74 (18.4)	3	105 (21.0)	2
Fetal distress	264 (15.6)	3	98 (20.9)	1	78 (19.4)	2	63 (12.6)	3
Cephalopelvic disproportion	176 (10.4)	4	52(11.1)	4	36(9.0)	5	63(12.6)	3
Social factors	152 (9.0)	5	52 (11.1)	4	37 (9.2)	4	38 (7.6)	5
Preeclampsia/eclampsia	116 (6.9)	6	40 (8.5)	6	32 (8.0)	6	29 (5.8)	6
Oligohydramnios	43 (2.5)	7	18 (3.8)	7	9 (2.2)	8	4 (0.8)	13
Intrahepatic cholestasis of pregnancy	37 (2.2)	8	11 (2.3)	8	9 (2.2)	8	14 (2.8)	7
Multiple births	33 (2.0)	9	6 (1.3)	12	6 (1.5)	10	9 (1.8)	9
Placenta previa	30 (1.8)	10	8 (1.7)	10	11 (2.7)	7	7 (1.4)	11
Funnel pelvis	26 (1.5)	12	7 (1.5)	11	1 (0.2)	14	11 (2.2)	8
Macrosomia	11 (0.7)	13	2 (0.4)	14	4 (1.0)	12	5 (1.0)	12
Umbilical cord prolapse	10 (0.6)	14	4 (0.9)	13	1 (0.2)	14	2 (0.4)	14
Placental abruption	10 (0.6)	15	2 (0.4)	14	3 (0.7)	13	2 (0.4)	14
Others	29 (1.7)	11	10 (2.1)	9	5 (1.2)	11	9 (1.8)	9

**Table 3**

Cesarean section rates stratified by residence, education, occupation, parity and age.

	Residence		Education		Occupation		Parity		Ages	
	Urban	Rural	Primary school	Middle school or higher	Physical labor	Office work	Nulliparous	Multiparous	<35 years	≥35 years
Emergency cesarean section	339 (20.0)	330 (19.5)	387	312	371	328	241 (13.8)	485 (27.7)	588 (34.8)	81 (4.8)
Planned cesarean section	476 (28.1)	547 (32.3)	604	419	584	439	224 (12.8)	799 (45.7)	824 (48.7)	199 (11.8)
$\chi^2$	2.78		2.3		2.71		27.78		15.8	
<i>p</i>	0.10		0.13		0.10		<0.001		<0.001	
Social factor associated cesarean section	72		73	75 70	74	71	49 (2.8)	96 (5.5)	117	28
Other causes of cesarean section	743		804	914 661	881	696	416 (23.8)	1188 (67.9)	1295	252
$\chi^2$	0.14		2.16		1.26		4.21		0.88	
<i>p</i>	0.71		0.14		0.26		0.04		0.35	

rate of fetal distress (13.3%) in ethnic Tibetans *versus* non-Tibetans (9.0%) residing in high altitude. Lhasa has a high average altitude with a cold climate and less oxygen composition, which results in a lower body oxygen level. During pregnancy, the need for oxygen in the body increases significantly. The mother and fetus are more likely to be in a state of chronic hypoxia. Maternal hypoxia is associated with increased maternal metabolism and intrauterine hypoxia. These result in metabolic disorders and make the fetus more prone to abnormal heart rate and neonatal asphyxia during delivery. In our clinical practice, we employed electronic fetal monitoring to assess prenatal and intrauterine fetal status during delivery. Electronic fetal monitoring is sometimes utilized to determine the methods of delivery. It has been reported that the use of intrapartum cardiotocography in low-risk women may lead to the inappropriate use of cesarean section in this group of women [12]. The method has a high predictability and sensitivity to intrauterine hypoxia, but with a low specificity and a high false positive rate [13], which may falsely lead to the choice of cesarean section for delivery on some occasions in order to avoid neonatal asphyxia, medical disputes and other adverse outcomes. Of note, with increased training of the medical staff in the use and interpretation of electronic fetal monitoring findings, fetal distress declined from the top indication (20.9%) for cesarean section in 2012 to the 3rd place (7.9%) in 2015. This is also in accordance with the significant decline the rate of emergency cesarean section from 12.8% in 2012 to 5.9% in 2015 while the rate of planned cesarean section largely held steady over the same period.

Abnormal fetal position was the third leading indication for cesarean section in the study cohort. There are several different

types of abnormal presentations. A breech presentation is the most common abnormal fetal position and tends to have a higher rate of birth trauma/complications and thus pregnancy is often ended with cesarean section. Its success rate reaches 70%. The success rate of vaginal delivery after an external cephalic version is approximately 60% [14,15]. However, due to possible intraoperative complications, which may lead to premature birth, placental abruption and premature rupture of the membrane, and technical issues, such as lack of experience and guardianship, the operation has not yet been widely accepted by pregnant women and their families. Thus, the prevalence of abnormal fetal position as an indication for cesarean delivery remains high. For breech presentation, cesarean section, either antepartum or intrapartum was found to be associated with improved perinatal outcomes [16].

Under rarefied conditions in Lhasa, the incidence of preeclampsia is significantly higher than in plain areas [17,18]. Adverse events such as uterus/placental vasospasm, inadequate placental perfusion, fetal intrauterine growth restriction and fetal distress are more common in pregnant women with preeclampsia. Studies have shown that as high altitude increases the incidence of preeclampsia and maternal perinatal mortality [19]. Preeclampsia ranked second among all maternal-associated indications for cesarean delivery. Notably, the percentage of preeclampsia as a cause for cesarean section declined from 8.5% in 2012 to 4.7% in 2015 in our cohort, which may be due to improved perinatal health care and standardization of prenatal examination in Lhasa.

The study also has several limitations. The study was carried out at a tertiary care institution in Lhasa and the findings may not be applicable to the primary and secondary care settings in Tibet.

Second, the study is retrospective; a causal relationship cannot be inferred from the study findings.

In conclusion, this study, which so far covered the largest cohort of pregnant women residing in high altitude in Tibet, has demonstrated a steady decline in the annual rate of cesarean section in women in Tibet between 2012 and 2015. A decrease in the rate of emergency cesarean section contributed substantially to this decline in the cesarean section rate. Moreover, approximately ten percent of caesarian sections in women in Tibet were performed without clear indications, highlighting the need for strengthening prenatal counseling for pregnant women in Tibet.

### Conflicts of interest

There is no conflict of interest.

### References

- [1] Souza JP, Gulmezoglu A, Lumiganon P, Laopaiboon M, Carroli G, Fawole B, et al. Cesarean section without medical indications is associated with an increased risk of adverse short-term maternal outcomes: the 2004–2008 WHO Global survey on maternal and perinatal health. *BMC Med* 2010;8:71.
- [2] Tang S, Li X, Wu Z. Rising cesarean delivery rate in primiparous women in urban China: evidence from three nationwide household health surveys. *Am J Obstet Gynecol* 2006;195(6):1527–32.
- [3] Klemetti R, Che X, Gao Y, Raven J, Wu Z, Tang S, et al. Cesarean section delivery among primiparous women in rural China: an emerging epidemic. *Am J Obstet Gynecol* 2010;202(1): 65 e1–e6.
- [4] Feng XL, Xu L, Guo Y, Ronsmans C. Factors influencing rising caesarean section rates in China between 1988 and 2008. *Bull World Health Organ* 2012;90(1): 30–9, 9A.
- [5] Ren Y, Cui F, Lei Y, Fu Z, Wu Z, Cui B. High-altitude pulmonary edema is associated with coagulation and fibrinolytic abnormalities. *Am J Med Sci* 2012;344(3):186–9.
- [6] Ren Y, Fu Z, Shen W, Jiang P, He Y, Peng S, et al. Incidence of high altitude illnesses among unacclimatized persons who acutely ascended to Tibet. *High Alt Med Biol* 2010;11(1):39–42.
- [7] Levine LD, Gonzales GF, Tapia VL, Gasco M, Sammel MD, Srinivas SK, et al. Preterm birth risk at high altitude in Peru. *Am J Obstet Gynecol* 2015;212(2): 210. e1–e8.
- [8] Yangzom Y, Qian L, Shan M, La Y, Meiduo D, Hu X, et al. Outcome of hospital deliveries of women living at high altitude: a study from Lhasa in Tibet. *Acta Paediatr* 2008;97(3):317–21.
- [9] Obstetrics Subgroup, C.S.o.O., et al. The expert consensus on cesarean delivery operation (2014). *Zhonghua Fu Chan Ke Za Zhi* 2014;49(10):721–4.
- [10] Li G, Zou L, Li C, Hen Y, Yuan Y, Wang X, et al. Cesarean delivery rate and indications in mainland China: a cross sectional study in 2011. *Zhonghua Fu Chan Ke Za Zhi* 2014;49(10):728–35.
- [11] Peng FS, Lin HM, Lin HH, Tu FC, Hsiao CF, Hsiao SM, et al. Impact of clinical audits on cesarean section rate. *Taiwan J Obstet Gynecol* 2016;55(4):530–3.
- [12] Intermittent auscultation for intrapartum fetal heart rate surveillance: American college of nurse-midwives. *J Midwifery Women's Health* 2015; 60(5):626–32.
- [13] Raghuraman N, Cahill AG. Update on fetal monitoring: overview of approaches and management of category II tracings. *Obstet Gynecol Clin N Am* 2017;44(4):615–24.
- [14] Wang XY, Hang YB, Lin L. Analyzing influencing factors of external cephalic version for breech presentation in singleton pregnancies. *Chin J Obstet Emerg* 2016;5(2):110–3.
- [15] Bin YS, Roberts CL, Nicholl MC, Ford JB. Uptake of external cephalic version for term breech presentation: an Australian population study, 2002–2012. *BMC Pregnancy Childbirth* 2017;17(1):244.
- [16] Lumbiganon P, Laopaiboon M, Gülmezoglu AM, Souza JP, Taneepanichskul S, Ruyan P, et al. Method of delivery and pregnancy outcomes in Asia: the WHO global survey on maternal and perinatal health 2007–08. *Lancet* 2010; 375(9713):490–9.
- [17] Julian CG. High altitude during pregnancy. *Clin Chest Med* 2011;32(1):21–31 [vii].
- [18] Qiao C, Yang XM, Lin QD. Advanced research in epidemiology of preeclampsia. *Chin J Family Plan & Gynecol* 2013;5(6):5–8.
- [19] Wang LQ, Yang DH, Li Y. Clinical analysis on 28 cases of hypertension disorder complication pregnancy in plateau areas. *Chin J Gen Pract* 2011;9(2):187–9.