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Causes and Risk Factors for Early Neonatal Mortality in the Western Region of Mongolia

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Objectives: The incidence of perinatal, especially early neonatal mortality, has not been reducing in the western region of Mongolia, therefore, the purpose of this study was to identify causes and risk factors for early neonatal mortality in the western region of Mongolia. **Methods:** A case-control study for neonatal mortality was conducted in 5 hospitals in western Mongolia in 2014. Cases and controls were chosen from the hospitals. Associated causes and risk factors for early neonatal mortality were identified with subgroup binary logistic regression analyses. **Results:** A total of 7749 live births occurred during the study period. The early neonatal mortality rate was 11.3 per 1000 births. Obstetric complications, obstetric chronic history, abruption of placenta, preeclampsia and maternal diseases influenced early neonatal mortality. Respiratory distress syndrome (OR=29.4; 95% CI, 12.78-67.65, $p<0.05$), perinatal asphyxia (OR=5.2; 95% CI, 2.81-9.63, $p\leq0.001$), congenital malformation (OR=39.2; 95% CI, 5.11-302.1) and perinatal infections (OR =11.1; 95% CI, 3.64-34.28, $p\leq0.001$) were the leading causes of newborn death in the first week. **Conclusion:** Overall, high rates of neonatal death demonstrate the need to improve the quality of health care and the control of delivery and factors influencing early neonatal mortality should be studied further at the national level.
Keywords: Infant Mortality, Gestational Age, Perinatal Mortality

Introduction

Worldwide, 2.9 million infants die each year within 28 days of life accounting for 44% of the under-five mortality [1, 2]. Two thirds of deaths occur in the first three days of life [3]. The Action Plan for Healthy Newborn Infants in the Western Pacific Region began in 2014 to improve the quality of early, essential newborn infant care [3]. Whereas during the last few years birth rate has been increasing, incidence of perinatal mortality has not been reduced in Mongolia [4, 5]. The early neonatal mortality rate is 8.1 per 1000 births. The early neonatal mortality rate is higher in the western region of Mongolia than the national average by 3.2% [6]. Therefore, the purpose of this study was to identify causes and risk factors for early neonatal mortality in the western region of Mongolia.

Materials and Methods

1. Data collection

Our case-control study was conducted in 5 provincial general hospitals located the western region of Mongolia, i.e., Bayan-Ulgii, Govi-Altai, Zavkhan, Uvs and Khovd aimags (provinces).

During this study, we observed 84 early neonatal deaths and 168 healthy newborns. The case to control ratio was 1:2. The case group covers neonates and their mothers who gave live birth after 22 weeks of perinatal period and died in the first week.

The control group included mothers and neonates who were born before and after the perinatal death of case group. Data were collected by a questionnaire with 5 chapters and 92 questions. Obstetricians and neonatologists who work in the department of delivery in the stated hospitals collected all the data. Data collectors were trained before the study and the principle investigator checked and received all collected data. We studied risk factors of perinatal mortality by focusing on gestational age, pregnancy complications, maternal diseases, obstetric chronic history, mode of delivery and duration, and birth weight for the case/control subgroups.

2. Data analysis

Data was entered, coded, and analyzed using SPSS version 19 software. We coded and classified causes of early neonatal death by the International Classification of Diseases 10 (ICD-10). Binary logistic regression analysis was done to identify risk factors for case-control groups. The odds ratio (OR=1 no difference between groups; OR>1 effective factor; OR<1 protective factor) and 95% confidence interval (CI) were also calculated. Causes and risk factors with a p-value of <0.05 were taken as statistically significant [7, 8].

3. Ethical review

Ethical approval and clearance was obtained from the Ethical Review Board of the Mongolian National University of Medical Sciences on November 13, 2013. Since this analysis is a case-control study, we collected data only after informed consent was obtained.

Results

In the western region of Mongolia, there were a total of 10094 births, accounting for 12.4% of total national births in 2014. 7749 (76.8%) births were delivered in province center hospitals. Out of 7749 births, 127 resulted in perinatal deaths and among those deaths, 84 were early neonatal deaths. In the western region hospitals, early neonatal deaths made up 66.1% of perinatal deaths. In the western region, the stillbirth rate was 5.5 per 1000 total births, and the early neonatal mortality rate 11.3 per 1000 live births. Our study showed that the stillbirth to early neonatal mortality ratio ranged from 0.9:1 to 0.2:1 in the western provinces. High, early neonatal mortality rate in all provinces can be attributed to the quality of delivery and early newborn health care (Table 1).

Table 1. Overall birth statistics and case-control birth statistics by provinces

Category	Provinces					
	Bayan-Ulgii	Gobi-Altai	Zavkhan	Uvs	Khovd	Total
Total babies born	2155	1118	976	1650	1850	7749
Live birth	2150	1123	987	1656	1862	7765
SB[a]	8.8	7.1	0.28	4.8	3.2	5.5
ENND[b]	9.7	11.6	15.4	11.2	8.5	11.3
SB to ENND ratio	0.9:1	0.9:1	0.2:1	0.38:1	0.37:1	0.51:1
Cases ENND	21	13	13	21	16	84
Controls ENND	42	26	26	42	32	168

[a]SB = stillbirth, per 1000 total births [b]ENND = early neonatal death, per 1000 live births

Of all cases, 42 (50%) were preterm births (OR =13.38; 95% CI: 6.45-27.77). There were 30 newborns with primigravida mothers (58.3%), and these newborns had a 1.3 times increased risk of early neonatal death compared to multiparous mothers' newborns (OR =1.33; 95% CI: 0.75-2.34). Caesarean section (OR=1.90; 95% CI:1.07-3.37), instrumental delivery due to obstetric complications (OR=4.06; 95% CI:1.44-11.42), duration of labor longer than 24 hours (OR=18.26; 95% CI: 2.22-149.7), premature rupture of fetal membranes (PROM, OR=5.8; 95% CI: 2.96-11.53), and abruption of placenta (OR=3.43; 95% CI:

1.08-10.83) were associated with neonatal death within the first week of life.

Additionally, obstetric complications such as preeclampsia or eclampsia (OR =5.66; 95% CI: 2.83-11.33), obstetric chronic history (OR=2.03; 95% CI: 1.15-3.59) and maternal diseases (OR=11.9; 95%CI: 5.61-25.48) were associated with newborn deaths. Out of the mothers with obstetric chronic history, 13% had preterm births; 23.8% had miscarriage; 10% had early neonatal deaths; 7.6% had stillbirths; and 10.2% had an abortion, children with congenital malformation, and low birth weight (Table 2).

Table 2. Risk factors for early neonatal deaths in the western region of Mongolia, 2014

Variable/Category	Number of cases (%)	Number of controls (%)	OR (95% CI)
Gestational age			
Term	40 (47.6)	153 (91.1)	1
Post-term	2 (2.4)	3 (1.8)	2.5 (0.41-15.78)
Pre-term	42 (50)	12 (7.1)	13.3 (6.45-27.77)[c]
Parity			
II-IV	50 (59.5)	109 (64.9)	1
I	30 (58.3)	49 (29.2)	1.3 (0.75-2.34)
≥ V	4 (20.9)	10 (6)	0.8 (0.26-2.91)
Mode of delivery			
Vaginal	54 (64.3)	130 (77.4)	1
Caesarean section	30 (35.7)	38 (22.6)	1.9 (1.07-3.37)[a]
Instrumental	11 (13.1)	6 (3.6)	4.0 (1.44-11.42)[b]
Induced labor	34 (40.5)	68 (40.5)	1 (0.58-1.70)
Duration of labor			
<12 hours	53 (63.1)	121 (72.0)	1
12-24 hours	23 (27.4)	46 (27.4)	1.1 (0.62-2.07)
>24hours	8 (9.5)	1 (0.6)	18.2 (2.22-149.7)[b]
Birth weight (g)			
<2500	46 (54.8)	10 (6.0)	19.3 (3.68-26.15)[c]
>4000	1 (1.2)	16 (9.5)	0
2500-4000	37 (44.0)	142 (84.5)	1
Obstetric complications			
None	14 (16.6)	64 (76.2)	1
Antepartum Hemorrhage	7 (8.3)	6 (3.6)	2.4 (0.79-7.55)
Hypertensive disorder	30 (35.7)	15 (8.9)	5.6 (2.83-11.33)[c]
Obstructed labor	22 (26.2)	18 (10.7)	2.9 (1.48-5.89)[b]
Cord accidents	12 (14.3)	12 (7.1)	2.1 (0.92-5.05)
PROM	32 (38.1)	16 (9.5)	5.8 (2.96-11.51)[b]
Abruption of placenta	8 (9.5)	5 (3.0)	3.5 (1.08-10.83)[a]
Abstetric chronic history			
Yes	36 (42.9)	51 (30.4)	2.0 (1.15-3.59)[a]
Maternal diseases			
Yes	75 (89.3)	69 (41.1)	11.9 (5.61-5.48)[c]

[a] p <0.05 [b]p <0.001 [c]p <0.0001

Major causes of early neonatal deaths were respiratory distress syndrome (42 cases, 50%), perinatal asphyxia (29 cases, 34.5%), congenital malformation (16 cases, 19.0%) and perinatal infections (13 cases, 15.4%). 35 cases (41.7%) of early neonatal deaths occurred before the first 24 hours of life. Half of early neonatal deaths due to respiratory distress syndrome were associated with preterm births. 29 (34.5%) newborns died due to cerebral hypoxia and its complications. The cerebral hypoxia (82.7% with severe asphyxia and 17.3% with moderate asphyxia) can depend on the delivery plan, obstructed labor and appropriate/successful early newborn health care.

Although the quality of prenatal health care and screening is improving in Mongolia, pregnant women who live in rural areas cannot have access to prenatal screening for fetal malformation. 19% of the cases had congenital malformation (OR =39.29; 95% CI: 5.11-302.1) and died early after birth. Congenital malformations included heart defects (37.5%), multiple organs (25%), and other malformations (37.5%). 15.4% of cases had intrauterine infections and were complicated by sepsis and multiorgan dysfunction, which was shown to be responsible for the mothers' health (p<0.001) (Table 3).

Table 3. Causes of early neonatal mortality in the western region of Mongolia, 2014

Causes	ICD 10	Number (%)	OR	95%CI
1. Respiratory distress syndrome of newborn	P 22.0	42 (50)	29.41	12.78-67.65[b]
2. Asphyxia	P21	29 (34.5)	5.20	2.81-9.63[b]
2.1 Severe birth asphyxia	P21.0	24 (82.7)		
2.2 Mild & moderate birth asphyxia	P21.1	5 (17.3)		
3. Congenital malformation	Q00-Q99	16 (19.0)	39.2	5.11-302.1[b]
4. Infections specific to the perinatal period	P35-P39	13 (15.4)	11.1	3.64-34.28[a]

[a]p <0.001 [b]p <0.0001

Discussion

Perinatal mortality, stillbirth, and early neonatal mortality are major health problems in developing and underdeveloped countries. Therefore, studies in cooperation with governments in many countries have been completed to ascertain the causes and risk factors for neonatal deaths [9, 10]. The early neonatal mortality rate is 11.3 per 1000 live births in the western region of Mongolia, a statistic that is not only 3.2 times higher than national average, but is also the highest of any region in Mongolia.

A case-control study conducted between 2008 to 2010 in Hawassa University Hospital of Ethiopia showed that preterm births (OR=1.18), primigravida (p<0.05) and birth weight lower than 2500 grams (p<0.05) were factors contributing to early neonatal deaths [11]. Also, this study reported that obstetric complications such as eclampsia or preeclampsia (p<0.05), and obstructed labor (p<0.001) were leading causes of neonatal deaths. However, in our study, preterm birth was shown to be risky as primigravida.

A study done in Alexandra, Egypt noted adolescent pregnancy and elderly primigravida (OR=4.1 and 6.46), stillbirth, former newborn death (OR=12.7), and multigravida (OR=2.23) as predictors [12]. Also, Wandabwa et al. found the risk of perinatal death due to previous history of stillbirth was high (OR=3.1; 95% CI: 1.1 to 9.1) [13]. Like these studies, our study showed that obstetric chronic history (OR=2.0; 95% CI: 1.15-3.59) was a significant risk factor and such obstetric complications as preeclampsia (OR=5.66; 95% CI: 2.83-11.33), caesarean section (OR=1.90; 95% CI: 1.07-3.37), instrumental delivery (OR=4.06; 95% CI: 1.44-11.42) due to obstetric complications, duration of labor longer than 24 hours (OR=18.26; 95% CI: 2.22-149.7), PROM (OR=5.8; 95% CI: 2.96-11.53), and abruption of placenta (OR=3.43; 95% CI: 1.08-10.83) were associated with neonatal death within the first week of life. According to the research of Wandabwa et al., deaths due to placental abruption were shown to be associated with hypertension in pregnancy [13]. Patients with chronic hypertension had fifty-six times the risk of having severe abruption of the placenta [13]. As reported by Bayou et al., antepartum hemorrhage (adjusted OR=12.2) and hypertensive disorders of pregnancy (adjusted OR=3.2) are the main risk factors of perinatal mortality [11]. Our study also showed that hemorrhage caused by placental abruption (OR=3.5) and hypertension in pregnancy (OR=5.6) are primary risk factors.

In conclusion, in the western region of Mongolia, the risk of early neonatal death was high in cases of obstetric chronic history, maternal diseases, preeclampsia, and abruption of placenta. We identified obstetric complications such as preterm births, obstructed labor, duration of labor longer than 24 hours, and PROM to be risk factors. In addition, respiratory distress syndrome, asphyxia, congenital malformation, and prenatal infections were leading causes of neonatal deaths. 50% of the cases were preterm births, which shows the necessity of focusing on preterm infant health care to prevent preterm birth. Overall, high rates of neonatal death demonstrate the need to improve the quality of health care and the control of delivery and factors influencing early neonatal mortality should be studied further at the national level.

Conflict of Interest

The authors state no conflict of interest.

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