นิพนธ์ต้นฉบับ

Factors associated with birth asphyxia in Pattani Hospital, Thailand

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Abstract:

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Based on Apgar scores at 1 minute, we investigated determinants for birth asphyxia (score 7 or less) and newborn mortality (score 0) based on labour charts for 2,894 infants born at Pattani Hospital in southern Thailand during 2001. The birth asphyxia morbidity rate (score 1-7) was 5.0%, the mortality rate (score 0) was 2.2%, and the incidence rate of birth asphyxia was 73.5 per 1,000 live births. We used ordinal logistic regression to construct a predictive model for the risks of birth asphyxia mortality and morbidity, and found seven risk factors related to the mother's pregnancy (maternal age, cultural

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background, number of prenatal care visits, place of prenatal care, HIV condition, medical/obstetric complications, and birth weight), and two further risk factors related to the delivery (type of induction of labour and type of delivery).

Key words: *birth asphyxia, Apgar score, newborn, mortality and morbidity*

บทคัดย่อ:

การวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาปัจจัยเกี่ยวกับมารดาและทารกที่มีความสัมพันธ์กับการเกิดภาวะขาดออกซิเจนในเด็กแรกเกิดที่มีคะแนน Apgar ใน 1 นาที เท่ากับหรือต่ำกว่า 7 ในโรงพยาบาลปัตตานี จากประวัติเด็กที่คลอดในโรงพยาบาลปัตตานีในปี พ.ศ. 2544 จำนวน 2,894 ราย สถิติที่ใช้ในการวิเคราะห์ข้อมูล คือ การถดถอยพหุแบบลอจิสติค ผลการศึกษาพบว่าเด็กแรกเกิดที่มีคะแนน 0 มีจำนวนร้อยละ 2.2 คะแนน 1-7 จำนวนร้อยละ 5 อุบัติการณ์ของการเกิดภาวะการขาดออกซิเจนในโรงพยาบาลปัตตานีเท่ากับ 73.5 ต่อพันการเกิดมีชีพ ปัจจัยเกี่ยวกับมารดาที่มีผลต่อการภาวะการขาดออกซิเจน ได้แก่ อายุ พื้นฐานทางวัฒนธรรม จำนวนครั้งที่ฝากครรภ์ สถานที่ฝากครรภ์ ประวัติการตรวจเชื้อ HIV ภาวะแทรกซ้อนทางสูติกรรม และน้ำหนักของทารก ปัจจัยเกี่ยวกับการคลอด ได้แก่ การใช้ยาเร่งคลอดและชนิดของการคลอด

คำสำคัญ: *ภาวะขาดออกซิเจน, คะแนน Apgar, ทารกแรกเกิด, ตายปริกำเนิดและการเจ็บป่วย*

Introduction

Over 8 million infants die before their birthday each year, and nearly all of the 5.1 million deaths in the neonatal period occur in developing countries. Although the causes of neonatal deaths are not always easy to assess, the World Health Organization estimates that 85 percent of them are caused by infections, birth asphyxia, birth injury, and problems related to preterm birth.[1]

Asphyxia, a lack of oxygen or an excess of carbon dioxide caused by the interruption in breathing, is the result of the failure of the gas exchange organ.[2, 3] It is the most common cause of cerebral birth injury in the perinatal period. According to the World Health Organization, nearly 4 million newborns suffer from birth asphyxia, with at least 800,000 dying and an equal number developing sequelae such as epilepsy, mental retardation, cerebral palsy, and learning disabilities.[4] The incidence of asphyxia in full-term infants varies between 2.9 and 9.0 cases per thousand in industrialized countries. The incidence of birth asphyxia is much higher in developing countries.[5]

The Apgar score is evaluated by medical attendants after birth by summing five components based on skin color, heart rate, respiratory effort, muscle tone and reflex irritability, each assigned the score of 0, 1, or 2.[6] The Apgar score gained rapid and almost universal acceptance and has stood the test of time.[7] Low Apgar scores at 1 and 5 minutes after delivery (Apgar-1 and Apgar-5) are excellent indicators for the identification of those infants who need resuscitation, as recommended by the American College of Obstetricians and Gynecologists.[8] An Apgar-1 score below 7 could be fatal without further appropriate treatment, especially in a preterm baby with a birth weight below 1,500 grams.[9]

In Thailand the neonatal mortality rates in 1999 and in 2000 were 10.2 per 1,000 total births and 10.2 per 1,000 total births, respectively. Birth asphyxia was reported as a cause of neonatal mortality at the third rank in 1999-2000. However, the rate of asphyxia in infants increased from 21.1 in 1999 to 24.3 per 1000 in 2000.[10]

In Pattani Province, the incidence rates of birth asphyxia for each year from 1998 to 2000 were 84.7, 68.5, and 49.8 per 1,000 live births, respectively. In 2000 the perinatal mortality rate was found to be 25.7 per 1,000 total births and the incidence rate of birth asphyxia was 65.3 per 1,000 live births in Pattani Hospital.[11] National Public Health Plan No.8 (1997-2001), planned to reduce the birth asphyxia rate to 30 per 1,000 live births.[12] However, the

average incidence rate of birth asphyxia at 12 hospitals in Pattani Province in 2002 was found to be as high as 48.1 per 1,000 live births.[13]

It is thus important to find out what factors are associated with birth asphyxia in Pattani Province. In this study, maternal and delivery factors associated with birth asphyxia in Pattani Hospital are investigated and a predictive model is developed based on these risk factors using ordinal logistic regression.

Materials and methods

Selection of data

The sample comprised all newborns in 2001 from women who went into labour at Pattani Hospital and had complete labour charts including Apgar-1 scores. This sample does not reflect births in Pattani Province as a whole, because there were other hospitals, and not all births occurred in hospitals. According to the Pattani Public Health Province Office Report,[13] of the 11,880 births in the province in the year from October 2000 to September 2001, 24% deliveries were in Pattani Hospital, 33% in other hospitals, 7% at other locations with assistance from a qualified health attendant, and 36% at other locations assisted by a traditional birth assistant.

Determinants and outcome

Nine categorical determinants were considered, as follows: cultural background (Islamic, other), education (none, primary school, junior high school, senior high school, diploma, bachelor's degree, miscellaneous), occupation (housewife, government officer, farmer, in business, labourer, gardener, other occupation), place of prenatal care (Pattani Hospital, private clinic, health centre, community hospital, other hospitals, hospital centre, mothers' health care centre, unknown), medical or obstetric complications (49 groups), use of induction of labour (none, Oxytocin, Mistopolol, both), HIV condition (negative, positive with AZT, positive without AZT, not checked), delivery type (normal, caesarean, vacuum, spontaneous breech delivery, forceps, partial breech extraction), and gender. In addition, seven continuous determinants were measured: maternal age, number of prenatal care visits, gestational age, number of previous pregnancies (gravidarum), number of abortions, hematocrit level, and birth weight. The outcome was birth asphyxia in three categories defined by the Apgar-1 score as 0, 1-7, and 8-10.

Statistical methods

Preliminary statistical analysis involved examining the frequency distributions of the determinants and their univariate associations with the outcome. For categorical determinants this analysis used floating odds ratios and Pearson's chi-squared test for independence.[14] In cases where the frequency for a categorical determinant class was small, it was aggregated with other classes having comparable associations with the outcome. We used ordinal logistic regression[15] to investigate the relations between the continuous determinants and the outcome, and also to construct a predictive model for the risks of birth asphyxia mortality and morbidity. The analysis strategy involved first fitting a model with all determinants included, and then refitting the model after omitting determinants with p-values greater than 0.05 using backward elimination.

Results

Distributions of determinants

The subjects investigated in this study sample comprised 2,894 babies of women who went into labour in the hospital. These babies comprised 2,835 singletons, 28 sets of twins and one set of triplets, so the number of women giving birth was 2,864.

For each birth at most one medical or obstetric complication was recorded. There were 1,460 births with no such complications (50.4%). Table 1 lists the complications recorded. The most common complications were previous caesarean birth (13.9%), cephalic pelvic disproportion (7.1%), breech presentation (4.1%), stage 2 prolongation (2.9%), post-term labour (2.5%) severe pregnancy-induced hypertension (PIH) (2.2%), multiple births (2.2%), and preterm labour (1.9%).

Table 1 Medical and obstetric complications recorded

Complication	Count
Previous caesarean	403
Cephalic pelvic disproportion	206
Breech presentation	120
Stage 2 prolongation	83
Post-term labour	72
Severe PIH	64
Twins	56
Pre-term labour	56
Stage 1 Prolongation	56
PROM	54
Mild PIH	40
Foetal distress	22
DFIU	22
Placenta previa	21
Membrane leak	12
Pregnancy with thalassemia	12
Transverse lie	11
Postpartum haemorrhage	9
Abruption placenta	8
Foetal movement	8
Eclampsia	7
Retain placenta	6
Occiput presentation	6
Chronic hypertension	5
Prolapsed cord	4
Face presentation	4
Gestational diabetes	4
Pregnancy with urethra infection	4
Fever	4
Birth with midwife at home	4
Triplets	3
Oligohydramnios	3
Thick meconium	3
Hydrocephalus	3
Uterus rupture	3
Overt diabetes	3
Heart disease	3
Condyloma	3
APH	2
Foetal anomaly	2
Gestational oedema	1
Birth before admission	1
Amniotic embolism	1
Chronic hypertension + accrevate	1
Pregnancy with malaria	1
Asthma	1
Anaemia	1
Other	16

Table 2 shows the distribution of the other categorical determinants. The majority of the babies' mothers were Muslim (61.5%), and the rest were Buddhists, with the exception of two who were Christians. With respect to occupation, 62.1% were housewives, 20.4% were labourers, 8.6% were in business, and 5.2% were government officers, 2.4% gardeners, and 0.8% farmers. The most common level of educational attainment was primary school (39.6%). For the remainder, 17.8% had completed junior high school, 12.5% had completed senior high school, 6.5% had a diploma, 8.0% had a bachelor's degree, and 8.3% had some other educational qualification, while 7.3% had no education. For 40.8% of the babies their mother's place of prenatal care was Pattani Hospital, another 28.2% went to a private clinic, 19.2% went to a health centre, 10.7% to a community hospital, and 0.7% to other hospitals. While most deliveries were normal (57.3%), 36.1% had caesarean deliveries, 3.9% vacuum-assisted, 1.4% had spontaneous breech delivery, 1.2% used forceps, and 0.1% had partial breech extraction. While 95.3% of the babies were born without induction of labour, 2.4% used Oxytocin, 2.0% induced with Mistopolol, and 0.3% used both drugs. For 5.8%, the mothers were not tested for HIV, 92.2% tested negative, and 2.1% were found to be positive. There was a slight newborn gender ratio in favour of males (50.9%).

Turning to the continuous determinants, the maternal ages ranged from 15 to 52 with mean 27.9 years and standard deviation 6.2 years. The number of prenatal care visits ranged from 0 to 24 with mean of 6.7 and standard deviation 3.2. Gestational age at birth ranged from 26 to 45 weeks, with mean 39.0 weeks and standard deviation 2.1 weeks. Gravidarum ranged from 1 to 16 with median, mean, and

standard deviation 2, 2.55, and 1.73 respectively. The number of abortions ranged from 0 to 5. For most of the babies (84.3%), their mothers had never had an abortion, and 13.1% had had one abortion.

Table 2 Distributions of other categorical determinants

Determinant	Category	Count	Percent
Cultural background	Islamic	1,780	61.5
	Other	1,114	38.5
Occupation	Housewife	1,796	62.1
	Government officers	149	5.2
	Farmer	22	0.8
	Business	250	8.6
	Labourer	591	20.4
	Gardener	70	2.4
	Miscellaneous	16	0.6
Education	None	210	7.3
	Primary school	1,146	39.6
	Junior high school	515	17.8
	Senior high school	361	12.5
	Diploma	189	6.5
	Bachelor's degree	233	8.0
	Miscellaneous	240	8.3
Place of prenatal care	Pattani Hospital	1,180	40.8
	Private clinic	817	28.2
	Health centre	557	19.2
	Community hospital	309	10.7
	Other hospitals	17	0.6
	Hospital centre	4	0.1
	Mother health care centre	6	0.2
	Unknown	4	0.6
Delivery type	Normal	1,657	57.3
	Caesarean	1,045	36.1
	Vacuum	113	3.9
	Spontaneous breech delivery	40	1.4
	Forceps	36	1.2
	Partial breech extraction	3	0.1
Induction of labour	None	2,757	95.3
	Oxytocin	69	2.4
	Mistopolol	59	2.0
	Both	9	0.3
HIV	Negative	2,667	92.2
	Positive with AZT	51	1.8
	Positive without AZT	8	0.3
	Not checked	168	5.8
Gender of newborn	Male	1,473	50.9
	Female	1,421	49.1

The result of the regrouping of categories with small counts was as follows. Induction of labor (used, not used) and HIV condition (negative, other) became binary variables. Occupation was regrouped into four categories (housewife, government officer, labourer, other miscellaneous occupation), and place of prenatal care was classified into five categories (Pattani Hospital, private clinic, health centre, community hospital, elsewhere). By aggregating categories with counts below 56 into a single category and combining triplets and twins into a single category (multiple births), the number of categories for medical/obstetric complications was reduced to nine (including one category containing miscellaneous complications), and delivery type was grouped into four categories (normal, caesarean, spontaneous breech delivery or partial breech extraction (SBE) and other).

Associations between outcome and categorical determinants

Table 3 shows the chi-squared statistics and corresponding p-values for the associations between the outcome and each categorical determinant. Only gender was not statistically significant, and all the other determinants apart from occupation had p-values below 0.0005.

Table 3 Associations between outcome and categorical determinants

Determinant	Pearson χ^2	df	P-value
Occupation	15.3	6	0.0180
Education	85.3	12	<0.0005
Cultural background	44.8	2	<0.0005
Place of prenatal care	111.2	8	<0.0005
Complications	445.8	18	<0.0005
Induction of labour	39.6	2	<0.0005
HIV condition	66.4	2	<0.0005
Delivery type	125.3	6	<0.0005
Gender	0.6	2	0.7560

For each of these associations the statistically significant odds ratios are shown in Table 4. Because the outcome was ordinal with three categories, we calculated two sets of odds ratios for each determinant, one taking mortality (Apgar-1 score 0) as the adverse event, and the other taking mortality-plus-morbidity (Apgar-1 score 0-7) as the adverse event. Babies whose mother had one of the miscellaneous medical / obstetric complications had the highest risk of mortality. Other risk factors for mortality were delivery by spontaneous breech delivery, having Islamic mothers, having prenatal care in a health centre, having mothers with no education, and mother having severe PIH. The results were similar when the outcome was broadened to include morbidity as well, but with the additional risk factors among the medical/obstetric complications and caesarean birth. The protective factors comprised having no medical/obstetric complications, having a negative HIV condition, not requiring induction of labour, getting prenatal care in a private clinic or in Pattani Hospital, and having mother's occupation as a government officer.

Ordinal logistic regression

We first fitted the ordinal logistic regression models separately for each determinant, including the continuous determinants, and found that 14 of the 16 determinants had statistically significant associations with the outcome. These comprised the eight categorical determinants with p-values below 0.05, together with six of the seven continuous variables. The only continuous variable not found to be related to the outcome was the number of abortions. The results are shown in Table 5.

Table 5 also shows the result of fitting the ordinal logistic regression model with all the determinants included, while Table 6 shows the reduced model obtained by omitting determinants that were not statistically significant at the 0.05 level using backward elimination.

Table 4 Categorical determinants with statistically significant Odds ratios

Determinant	Odds ratios		95% CI	
Apgar-1 score	0 vs 1-10	0-7 vs 8-10	0 vs 1-10	0-7 vs 8-10
Occupation				
Government officer vs other	-	0.29	-	0.11-0.77
Education				
None vs other	2.71	2.16	1.79-4.11	1.64-2.82
Miscellaneous vs other	-	1.81	-	1.38-2.38
Cultural background				
Islamic vs other	3.51	2.24	1.95-6.30	1.74-2.89
Place of prenatal care				
Pattani Hospital vs other	0.5	0.52	0.33-0.77	0.41-0.66
Health centre vs other	2.72	2.37	1.92-3.86	1.93-2.90
Private clinic vs other	0.45	0.57	0.26-0.77	0.43-0.74
Complications				
None vs other	0.09	0.17	0.03-0.24	0.12-0.24
Previous caesarean vs other	0.44	0.49	0.20-0.98	0.33-0.74
Breech presentation vs other	1.11	1.66	0.50-2.50	1.13-2.42
Stage 2 prolongation vs other	0.65	2.53	0.16-2.59	1.74-3.69
Severe PIH vs other	2.64	3.41	1.37-5.09	2.33-5.03
Multiple births vs other	1.95	2.28	0.85-4.45	1.43-3.63
Miscellaneous vs other	7.70	3.89	5.22-11.34	3.15-4.78
Induction of labour				
Not used vs used	0.30	0.47	0.19-0.47	0.34-0.65
HIV condition				
Negative vs other	0.29	0.42	0.20-0.43	0.32-0.54
Delivery type				
Normal vs other	0.95	0.42	0.67-1.35	0.34-0.53
Caesarean vs other	0.83	1.85	0.57-1.20	1.52-2.26
SBE vs other	3.80	3.68	1.94-7.47	2.30-5.90

Table 5 Univariate and multivariate analysis for ordinal logistic regression model

Determinant	Univariate analysis			Multivariate analysis		
(* referent categories)	Coef	SE	P-value	Coef	SE	P-value
Occupation			0.005			0.730
Housewife*	0*			0*		
Government officer	1.839	0.717	0.010	0.860	0.783	0.272
Labourer	0.432	0.204	0.034	-0.020	0.234	0.931
Other	-0.206	0.200	0.303	-0.039	0.234	0.866
Education			0.000			0.055
None*	0*			0*		
Primary school	0.961	0.215	0.000	0.461	0.255	0.071
Junior high school	1.343	0.269	0.000	0.727	0.320	0.023

Table 5 (continued)

Determinant (* referent categories)	Univariate analysis			Multivariate analysis		
	Coef	SE	P-value	Coef	SE	P-value
Senior high school	1.736	0.336	0.000	0.849	0.384	0.027
Diploma	1.576	0.405	0.000	0.530	0.468	0.257
Bachelor's degree	2.270	0.488	0.000	1.402	0.559	0.012
Other qualification	0.263	0.260	0.311	0.065	0.309	0.311
Maternal age	-0.066	0.011	0.000	- 0.039	0.017	0.019
Cultural background						
Islamic*	0*			0*		
Other	1.171	0.187	0.000	0.594	0.225	0.008
Prenatal care visits	0.161	0.024	0.000	0.074	0.031	0.017
Place of prenatal care			0.000			0.032
Pattani Hospital*	0*			0*		
Community hospital	-1.267	0.228	0.000	-0.301	0.266	0.259
Health centre	-1.539	0.190	0.000	-0.653	0.243	0.007
Private clinic	-0.002	0.235	0.992	-0.002	0.265	0.993
Elsewhere	-0.975	0.625	0.118	-0.979	0.662	0.139
Gestational age at birth	0.210	0.026	0.000	0.072	0.040	0.072
Gravidarum	-0.183	0.034	0.000	0.041	0.061	0.506
Number of abortions	-0.088	0.140	0.530	-0.032	0.177	0.857
Complications			0.000			0.000
None*	0*			0*		
Previous caesarean	-0.959	0.381	0.012	-0.400	0.425	0.346
CPD	-1.229	0.435	0.005	-0.933	0.483	0.054
Breech presentation	-2.556	0.362	0.000	-1.153	0.452	0.011
Stage 2 prolongation	-3.092	0.359	0.000	-1.930	0.425	0.000
Post-term labour	-1.828	0.523	0.000	-1.804	0.564	0.001
Severe PIH	-3.554	0.363	0.000	-1.924	0.421	0.000
Multiple births	-3.027	0.396	0.000	-1.655	0.466	0.000
Pre-term labour	-2.604	0.451	0.000	-1.162	0.537	0.030
Miscellaneous other	-3.406	0.272	0.000	-2.574	0.311	0.000
Induction						
Not used*	0*			0*		
Used	-1.137	0.237	0.000	-0.828	0.299	0.006
HIV status						
Negative*	0*			0*		
Other	-1.300	0.187	0.000	-0.795	0.241	0.001
Delivery type			0.000			0.000
Normal*	0*			0*		
Caesarean	-1.149	0.162	0.000	-1.049	0.230	0.000
SBE	-2.515	0.357	0.000	-1.838	0.469	0.000
Other delivery type	-1.090	0.294	0.000	-0.969	0.378	0.010
Gender						
Male*	0*			0*		
Female	0.107	0.144	0.459	0.110	0.166	0.507
Hematocrit level	0.040	0.019	0.044	0.007	0.022	0.764
Birth weight	0.001	<0.001	0.000	0.001	< 0.001	0.002

Table 6 Reduced ordinal logistic regression model for birth asphyxia

Determinant (* referent categories)	Coef	SE	P-value
Maternal age	-0.041	0.012	0.001
Cultural background			
Islamic*	0*		
Other	0.577	0.217	0.008
Number of prenatal care visits	0.099	0.029	0.001
Place of prenatal care			0.006
Pattani Hospital*	0*		
Community hospital	-0.443	0.256	0.084
Health centre	-0.763	0.237	0.001
Private clinic	-0.015	0.259	0.954
Elsewhere	-0.984	0.658	0.135
Complications			0.000
None*	0*		
Previous caesarean	-0.315	0.421	0.455
CPD	-0.877	0.478	0.066
Breech presentation	-1.103	0.449	0.014
Stage 2 prolongation	-1.961	0.420	0.000
Post-term labour	-1.685	0.556	0.002
Severe PIH	-2.048	0.414	0.000
Multiple births	-1.742	0.456	0.000
Pre-term labour	-1.504	0.507	0.030
Miscellaneous other	-2.584	0.305	0.000
Induction of labour			
Not used*	0*		
Used	-0.881	0.294	0.003
HIV condition			
Negative*	0*		
Other	-0.839	0.239	0.001
Delivery type			0.000
Normal	0*		
Caesarean	-1.092	0.222	0.000
SBE	-1.959	0.460	0.000
Other delivery type	-0.953	0.365	0.009
Birth weight	0.0007	0.0001	0.000

Discussion

The three most statistically significant risk factors (complications, delivery type, and birth weight) all had p-values less than 0.0005. Among the complications, previous caesarean birth and CPD were not found to be associated with a risk of birth asphyxia; breech presentation and pre-term labour were marginally significant, while the highest risk factors were found to be stage 2 prolongations, post-term labour, severe PIH, multiple births, and other complications. It is noteworthy that the complications including breech presentation, prolongation of stage 2, post-term labour and severe PIH were strongly associated with birth asphyxia.

With breech presentation there is a greater probability of prolapsed and compressed umbilical cord more than with cephalic presentation. This may be a cause of birth asphyxia. Furthermore, hypertension in pregnancy can cause a decrease in blood supply to the fetus that may result in birth asphyxia. These results are consistent with other studies.[16-18]

Among the delivery types, spontaneous breech delivery was the strongest risk factor for birth asphyxia, followed by Caesarean and other delivery types. This is in accordance with the previous studies.[16, 18] Those delivery types were selected to help mothers and babies to avoid incidental cephalo pelvic disproportion, fetal distress and related problems. For this reason, newborns who had abnormal deliveries could have had low Apgar-1 scores.

We found birth weight to be associated with birth asphyxia. This result is consistent with the earlier findings.[16, 19, 20] From these studies, babies with weight below 2,500 grams were at risk of having birth asphyxia.

The next strongest risk factor was found to be HIV infection (p = 0.001), followed by maternal age (p = 0.001), number of prenatal care visits (p = 0.001), induction of labour (p = 0.003), place of prenatal care (p = 0.006) and cultural background (p = 0.008).

The result of induction of labour from this study is in accordance with the study of risk factors for delivery of low Apgar score newborn below 7 at 1 minute at Raijavithi Hospital[21] but disagrees with the finding at Prachuakhirikhan Hospital.[20] The medicine for induction of labour has a suppression effect on the respiration of newborns, which may result in low Apgar-1 scores.

Cultural background is defined as Islamlic or other. This is not a risk factor for birth asphyxia but rather a covariate or confounder, because of the known fact that the Islamic women tend to deliver their babies at the hospital to a lesser extent than non-Islamic women.

The incidence of asphyxia was indirectly related to maternal age. From this study we found that pregnant women aged more than 44 years were at risk of having birth asphyxia. Similarly, the study of birth asphyxia factors at Khon-Kaen Hospital[17] showed that birth asphyxia was significantly related to maternal age greater than 30 years (p-value 0.05). In contrast the study of the causes of birth asphyxia at Srisangwal Hospital[18] showed no evidence that maternal age was significantly associated with birth asphyxia.

In this study maternal education was not associated with birth asphyxia. Our result agrees with a study of factors influencing birth asphyxia at Uttaradit Hospital, where the author found no evidence that maternal education was significantly associated with birth asphyxia (p-value = 0.77).[19]

Conclusions

From this study, we used ordinal logistic regression to construct a predictive model for the risks of birth asphyxia mortality and morbidity, and found seven risk factors related to the mother's pregnancy (maternal age, cultural background, number of prenatal care visits, place of prenatal care, HIV condition, medical/obstetric complications, and birth weight), and two further risk factors related to the delivery (type of induction of labour and type of delivery).

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