

## The Investigation of Rate of Birth Asphyxia and its Relationship with Delivery Mode at Shahid Beheshti Hospital of Isfahan during 2013, 2014, and 2015

### Abstract

**Background:** Birth asphyxia is considered as one of the biggest challenges faced by perinatal care experts. According to the WHO, in 2005, one-fourth of infant mortality cases occurred due to birth asphyxia. **Methods:** This study is a retrospective study done on the newborn population with gestational ages of 36 weeks or higher during the years 2013, 2014, and 2015 to find the relationship between the number of birth asphyxia cases and the years. As a secondary objective, the relationship between the mode of delivery and the cases of birth asphyxia were investigated using logistic regression test. The inclusion criteria consisted of three cases, namely, gestational age of 36 weeks or higher, 5 min Apgar of <5, and umbilical cord pH of <7.1. The exclusion criteria involved hydrops fetalis, cyanotic heart disease, chromosomal abnormality, and congenital infections. **Results:** From the two independent variables of the study, only the variable “year” showed a significant difference between the years 2013 and 2015 ( $P < 0.01$ ). The delivery mode did not have any statistically significant influence on the newborns’ affliction with birth asphyxia ( $P = 0.993$ ). **Conclusions:** According to the results, there is a significant difference between the rate of birth asphyxia in Iran and its global rate in 2015, and regarding its multiple growth from 2013 to 2015, conducting a more comprehensive and extensive research on birth asphyxia risk factors at a delivery time seems justified and inevitable.

**Keywords:** Birth asphyxia, cerebral palsy, hypoxic-ischemic encephalopathy

### Introduction

Birth asphyxia is still considered as one of the biggest challenges faced by perinatal care experts. According to the statistics published by the WHO in 2005, it is estimated that one million out of 4 million infant mortality cases occur due to birth asphyxia. The trend in developed countries also indicates a 2/1000 birth rate of asphyxia, resulting in a 10%–15% mortality rate at NICUs, a 10%–15% rate of cerebral palsy among the survivors, and eventually a more than 40% rate of considerable impairments such as blindness, deafness, autism, seizures, and extensive developmental delay (cognitive impairments, inability to develop fine motor skills, memory, and mood disturbances).<sup>[1-5]</sup>

Perinatal Asphyxia indicates weak or impaired blood gas exchange during the delivery process, which results in hypoxia and hypercapnia accompanied by metabolic acidosis in fetus tissues. The persistence of such process causes cardiovascular

insufficiency, hypoxic-Ischemic encephalopathy (HIE), and eventually death. During perinatal asphyxia, as a result of primary energy failure (deprivation from high-energy reserves of phosphate), cell damage can take the form of cell necrosis, commonly referred to as primary cell death. The extent of the damage depends heavily on the length and the intensity of the ischemia-hypoxia. Moreover, cell damage can occur in another form. In other words, on recovery through resuscitation, progressive cerebral edema, excitatory amino-acid accumulation at cellular level, and a procedure entailing a decrease in oxygen consumption and cell metabolism (latent phase) may result in a programmed apoptosis caused by secondary energy failure, which in turn occurs as a result of the decrease in cell energy reserves due to malfunction of the mitochondria.<sup>[6-8]</sup>

Apart from cerebral tissue damage caused by asphyxia, and due to pathologic nature of the damaged tissues in physics, we will also observe a diverse range of complications.<sup>[9,10]</sup>

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Treatments addressed to cure prenatal asphyxia have witnessed great achievements, and based on the pathology of the damage, a wide range of medicinal interventions (such as anti-seizure drugs, alpha-2 receptor agonists, cytokines like erythropoietin, anti-oxidants like N-acetyl cysteine, hormones like melatonin or opioids, as well as inert gases like xenon) and non-medicinal interventions, for example, hypothermia therapy or stem cells, have been proposed. However, given all these developments and progress, in most clinical research, neurodisability or death at 18 months among the survivors of HIE observed only an 11% decrease.<sup>[11-14]</sup>

Considering all the aspects of this doomed event, recognition of birth asphyxia risk factors and its preventive interventions must be set as the guideline for any level of pregnancy termination procedures among its target population. Although these factors apparently include maternal and fetal characteristics, the potential to provide, support, and monitor the pregnancy termination process is an influential factor, as well. If the later (human resource possessing appropriate knowledge and essential skills, as well as the defined hardware) is not carefully considered, preventing the resulting complications will pose unacceptable challenges. Research on the recognition of birth asphyxia risk factors seems limited as in the case with a prospective study, and to increase the design effect, the study must be a cluster sampling with different layers of statistical monitoring to account for a large sample population (probably in a long period). Among the few studies done regarding this approach, we can refer to the one done by Lee *et al.*; during this study done in Nepal over 4 years from 2002 to 2006, pregnancy termination of 23,662 mother/neonate was investigated and monitored based on intrapartum, antepartum, and neonatal risk factors to define the prevalence of mortality caused by birth asphyxia. The mentioned study revealed that 30% of the neonatal death was due to birth asphyxia and that prematurity (<37 weeks), maternal infections, and multiple gestation had a significantly meaningful relationship with prenatal asphyxia.<sup>[15]</sup>

In a retrospective clinical trial (case–controlled) done by Martinez-Biarge *et al.* in 2013 in two different periods, the relationship between prenatal asphyxia and prospected intrapartum/antepartum factors were studied. This study was conducted as collaboration between London Hammersmith Hospital, Madrid La Paz Hospital, and the Rome Catholic University Pediatric Neurology Department. In this study, 405 newborns (with gestational ages of 35 or more) afflicted with prenatal asphyxia born between 1992 and 2007 were compared with the newborns with no sign of HIE born between 1996 and 1997. This study, with its high statistically strength, revealed that even when considered individually, intrapartum factors and not antepartum factors, are the ones with greater influence on birth asphyxia.<sup>[16]</sup>

In a study published in 2014 in Italian Journal of Pediatrics, Aslam *et al.* conducted a retrospective (case–controlled) clinical trial from January 2011 to November 2012 in which the newborns were divided into two groups of newborns afflicted with the HIE (as the case group) and those without any symptoms of such complication (as the control group), compared to each other and statistically analyzed based on a certain set of antenatal, prenatal, and fetus indicators. This study showed that the absence of human resource with appropriate knowledge and skills plays a key role in birth asphyxia.<sup>[17]</sup>

Apparently, researchers in this field have implemented different approaches in their research based on certain priorities. In the current study, based on the concerns regarding the current Healthcare Reform Plan, we have tried to recognize the effect of such measures on affliction with birth asphyxia in the current structure of health-care system in the country. This retrospective study focused on pregnancy termination processes in the years 2013, 2014, and 2015.

## Methods

This study is a case-controlled retrospective study done on data registered on the Department of Health Care and Education database regarding newborn population with gestational ages of 36 weeks or higher at Isfahan Shahid Beheshti Hospital during the years 2013, 2014, and 2015.

This study was done initially to find the relationship between the number of birth asphyxia cases in these 3 years, as compared to the total number of births, to indicate if the strategies taken regarding the pregnancy termination procedure have had any effect on the number of birth asphyxia cases registered during the studied years. As a secondary objective, the relationship between the mode of delivery and the cases of birth asphyxia were investigated using Logistic Regression Test to identify the relationship between the delivery mode and affliction with birth asphyxia.

The inclusion criteria consisted of three indices, namely, gestational age of 36 weeks or higher,<sup>[16]</sup> 5 min Apgar of <5,<sup>[16]</sup> and umbilical cord pH of <7.1.<sup>[16]</sup> The exclusion criteria involved hydrops fetalis,<sup>[16]</sup> cyanotic heart disease,<sup>[17]</sup> chromosomal abnormality,<sup>[17]</sup> and congenital infections.<sup>[16]</sup>

In the current study, the sampling was neither random nor selective. However, all the newborns delivered at Isfahan Shahid Beheshti Hospital in years 2013, 2014, and 2015 were considered as the sample population. To conduct the study, on access to database registered on the Department of Healthcare and Education website, data regarding 13574 newborns who were born in years 2013, 2014, and 2015 (including 67 newborns afflicted with birth asphyxia) was collected and entered into the study database, and then analyzed by SPSS version 21 for factors influencing birth asphyxia and demographic indicators. The indicators

considered in this study included the mode of delivery and the year. To analyze the data by SPSS version 21, Logistic Regression test was done on the possible relationship between each indicator, namely, year and delivery mode, and the cases of birth asphyxia.

### Results

The results of the comparison made between the cases of birth asphyxia, modes of delivery, and the total annual number of births in both delivery modes are presented in Table 1.

According to the results, the rate of birth asphyxia among the newborns in years 2013 and 2014 was less than 0.3%; however, this rate had quadrupled on average from 2013 to 2015, almost reaching 1%. Meanwhile, the birth asphyxia rate among the vaginal deliveries had doubled from 0.41% in 2013–0.82% in 2015, while the same rate among section deliveries in 2015 (1.07%) had risen to five times more than that of the section deliveries in 2013 (0.18%).

Direct logistic regression was performed to assess the impact of two factors, namely, the annual deliveries and the mode of delivery on the likelihood of newborns' affliction with birth asphyxia. At first, to analyze the effect of the delivery mode on the rate of birth asphyxia, a model was proposed by the SPSS software (IBM Corp. Released 2012. IBM Statistics for Windows, Version 21.0. Armonk, NY: ISM Corp.) to predict the outcomes. It is worth mentioning that if the proposed model could predict more than 95% of the cases, we could conclude that the analysis of significance made by the model is credible and that the resulting *P* values could be used to show the significance of the observed differences. The necessary model for this analysis contained two independent variables (year, and mode of delivery). The full model containing both predictors was statistically significant,  $\chi^2 = 30.926$  ( $N = 13574$ ,  $P < 0.0005$ ), indicating that the model was able to distinguish between newborns afflicted with birth asphyxia and those who were not involved with this unfortunate process. Moreover, the model correctly classified 99.5% of cases of birth asphyxia [Table 2], which makes the reference to *P* values justifiable.

However, as shown in Table 3, only one of the independent variables, i.e., "year," made a unique statistically significant contribution to the model. "Delivery mode" did not have any significant effect on the rate of birth asphyxia. Considering the results of the analysis, the independent variable "year," with a significance of  $P < 0.01$ , was a strong predictor of birth asphyxia. As with the step-wise analysis of the years, the variance between 2013 ("year" on the table), and 2015 ("year<sup>[2]</sup>" on the table) was of a significant nature, with  $P < 0.01$  ( $P = 0.000$ ). In the meantime, the difference between years 2013 and 2014 was not statistically significant ( $P = 0.662$ ). Regarding the results from the logistic regression analysis, the delivery

**Table 1: Model prediction**

Classification table			
Observed	Predicted		Percentage correct
	Birth asphyxia		
	Yes	No	
Birth asphyxia			
Yes	0	67	0.0
No	0	13,507	100.0
Overall percentage			99.5
Omnibus tests of model coefficients			
Step 1	$\chi^2$	df	Significance
Step	30.926	3	0.000
Block	30.926	3	0.000
Model	30.926	3	0.000

**Table 2: Birth asphyxia per delivery mode per time**

Year		Vaginal	Section	Total
2013	Asphyxia count	7	5	12
	Total delivery	1698	2770	4468
	Percentage of count per total asphyxia	58.3	41.7	100.0
	Rate of asphyxia within delivery mode (%)	0.41	0.18	0.26
2014	Asphyxia count	5	5	10
	Total delivery	2135	2357	4492
	Percentage of count per total asphyxia	50.0	50.0	100.0
	Rate of asphyxia within delivery mode (%)	0.23	0.21	0.22
2015	Asphyxia count	15	30	45
	Total delivery	1817	2797	4614
	Percentage of count per total asphyxia	33.3	66.7	100.0
	Rate of asphyxia within delivery mode (%)	0.82	1.07	0.97
Total	Asphyxia count	27	40	67
	Total delivery	5650	7924	13574
	Percentage of count per total asphyxia	40.3	59.7	100.0
	Rate of asphyxia within delivery mode (%)	0.47	0.5	0.49

mode did not have any statistically significant influence on the newborns' affliction with birth asphyxia ( $P = 0.993$ ).

### Discussions and Conclusions

In this study, the only significant difference was related to the variable of year. The number of newborns afflicted with birth asphyxia had significantly increased from 2013 to 2015. This finding alone does not directly indicate a risk factor, as the variable year is not an influential variable directly affecting the independent variable of the study, i.e., birth asphyxia. However, to reach an understanding of the causes, the underlying risk factors which might have led to such significant increase must be accounted for. The

**Table 3: Logistic regression analysis**

	<i>B</i>	SE	Wald	df	Significance	Exp( <i>B</i> )	95% CI for Exp( <i>B</i> )	
							Lower	Upper
Step 1 <sup>a</sup>								
Delivery mode (1)	-0.002	0.250	0.000	1	0.993	0.998	0.611	1.630
Year			28.253	2	0.000			
Year (1)	0.188	0.429	0.192	1	0.662	1.207	0.520	2.800
Year (2)	-1.297	0.326	15.862	1	0.000	0.273	0.144	0.518
Constant	5.918	0.328	325.203	1	0.000	371.830		

<sup>a</sup>Variable(s) entered on Step 1: Delivery mode, year. SE=Standard error, CI=Confidence interval

results of the current study could be interpreted as that the birth asphyxia risk factors which have led to the outcomes in 2015 must be reviewed and investigated in detail, and that the effects of such risk factors must be compared with those of the year 2013.

As the population of newborns born in years 2013, 2014, and 2015 exceed 10,000 (above 13,000), conducting a retrospective study on all the risk factors of birth asphyxia on this population seems implausible.

As Aslam *et al.* (2013) presented, the most significant risk factors of birth asphyxia include maternal (age of mother, lack of booking status, preeclampsia, intake of diuretics and adrenergic drugs), intrapartum (home delivery by midwives, breech presentation, prolapsed umbilical cord, cephalopelvic disproportion and fever), and fetal (oligohydramnios, meconium-stained amniotic fluid, premature delivery, resuscitation of neonate preterm delivery, and low birth weight), the majority of which may be manageable by means of good prenatal care.

Nevertheless, in a study done by Martinez *et al.* (2013) to find out whether antepartum or intrapartum risk factors are a better indicator of possible affliction with HIE, they strongly pointed to the intrapartum period as the necessary factor in the development of this condition, and that antepartum risk factors alone are not attributed to HIE.

Considering the results of these two mentioned studies, we can conclude that to prioritize the risk factors for investigation in a retrospective study on a huge population, considering the intrapartum risk factors seems more logical. As a result, the researchers in this study decided to investigate one of the less attended potential risk factors, i.e., termination procedure, and to investigate whether delivery mode have an effect on affliction with birth asphyxia. Another reason which led the researchers to opt for this risk factor is that the growing popularity of cesarean section delivery mode may have been the underlying risk factor which resulted in such significant increase in the birth asphyxia rate in 2015, as compared with that of 2013.

The findings of the regression analysis done on the potential relationship between the delivery mode and the rate of affliction with birth asphyxia revealed no significant and meaningful difference ( $P = 0.993$ ), which means to the researchers' surprise, the delivery mode (caesarian section

or vaginal) had no significant influence on the affliction with birth asphyxia.

### Suggestions for further research

As a result of the current study regarding the significant difference between the rate of birth asphyxia in Iran in 2015 and the global rate of birth asphyxia, and its multiplied growth compared to that of the previous years, conducting a more comprehensive and extensive research by the involved parties in the field regarding the influential risk factors of birth asphyxia at the time of delivery seems justified and inevitable.

Although birth asphyxia risk factors of maternal age, hypertension, diabetes, anemia, antepartum hemorrhage, preeclampsia, diabetes mellitus, and others may all be of prime interest to researchers in the field, as Martinez *et al.* claims, focusing on intrapartum risk factors, rather than other fetal and antepartum risk factors, could lead to more promising results.

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### Conflicts of interest

There are no conflicts of interest.

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