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ORIGINAL ARTICLE

A Case Control Study on Determinants of Birth Asphyxia Among Newborns Delivered in a Tertiary Care Hospital of Kolkata

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INTRODUCTION:

Birth asphyxia is a serious public health problem worldwide. It accounts for an estimated 0.92 million neonatal deaths annually and is associated with another 1.1 million intrapartum stillbirths , as well as an unknown burden of long-term neurological disability and impairment.[1]Asphyxia is an insult to the fetus or newborn due to hypoxia and / or ischemia to various organs of sufficient magnitude and duration to produce more than fleeting functional and / or biochemical changes.[2] With modern obstetric care only a small percentage of newborn infants are not pink and vigorous by 1-2 minutes of age.[3] Approximately 70% of infants requiring resuscitation come from predictably high risk situation such as the delivery of preterm infant who manifests signs of asphyxia during the second stage of labour.[4]

Incidence of severe perinatal asphyxia (causing death or severe neurological impairment) ranges from 1/1000 in resource rich to 5-10/1000 in resource poor settings.[5] In spite of major advances with sophisticated monitoring technology and knowledge of fetal and neonatal pathology, birth asphyxia or more appropriately, Hypoxic Ischemic Encephalopathy (HIE), remains a serious condition, causing significant mortality and long-term morbidity. Although the understanding of pathophysiology after birth asphyxia has been more extensively discussed, there has been little change in the magnitude of asphyxia.

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Paucity of local data on the magnitude and impact of this preventable condition provided the impetus for this study

Objective: To determine the various covariates (Socio-demographic, Antenatal, Intranatal and Neonatal) of birth asphyxia among newborns in a tertiary care hospital of Kolkata.

MATERIALS AND METHODS:

It was a Case Control study conducted in Medical College, Kolkata from May 2012 to April 2013. The study population comprised of all babies born in the Obstetrics wards of Medical College, Kolkata.

Sample size: Using the reported[6] exposure rates of various risk factors like primigravida (antenatal risk factor), prolonged labour, normal vaginal delivery (intranatal risk factor) and low birth weight incidence (neonatal risk factor) among controls, the required sample size was highest for low birth weight incidence (neonatal risk factor). Low birth weight was reported to be 28% in India[7]. Considering a 95% confidence level and 80% power and anticipated risk (OR) to be 2.5 among the cases (asphyxiated babies) the minimum sample size calculated using the Epi Info 7 software was 82 in each arm. Using Design effect of 1.75 the minimum sample size required for the present study in each arm was 145.

Sampling: Cases (with birth asphyxia)[5] were defined as a baby born with Apgar score < 7 at 5 minutes and Controls (without birth asphyxia) were defined as babies born with Apgar score ≥ 7 at 5 minutes of birth. An asphyxiated baby with Apgar <7 at 5 minutes was selected as a case and the next consecutive delivery of a baby with Apgar score ≥7 at 5 minutes of birth were taken as control. From previous hospital record it was estimated that on an average twice a week data collection would be sufficient to complete the required sample size. So data collection was done twice a week and data of all cases born on those two days with their controls were collected. To reduce any bias, days of data collection was changed every month so that all the days of week were included. In this way 145 cases and 145 controls were finally included in the study.

Exclusion criteria: Newborns with obvious congenital malformations.
Tools and techniques: A pre designed and pretested schedule was used which consisted of two parts viz. Socio-demographic part and medical details. Face and content validity of the schedule was ensured by the faculty from All India Institute of Hygiene & Public Health and

Medical College, Kolkata. Socio-demographic and obstetrical history were obtained during an interview of the mothers 12-24 hours after delivery. Medical details were taken from records wherever available.

Ethical considerations: Clearance was obtained from the Institutional Ethics Committee of All India Institute of Hygiene & Public Health, Kolkata. Mothers were explained about the study and informed consent was taken prior to the interview.

STATISTICAL ANALYSIS:

Data were entered into MS Excel and analyzed with Epi-info7 software. For categorical risk factors, contingency tables were used and the strength of association was measured using the odds ratio. For the final model estimation of odds ratio multivariate model of analysis was carried out using an additive stepped approach.

RESULTS:

The present case control study was to find out the various socio-demographic, antenatal, intranatal and neonatal determinants of birth asphyxia. Data from 145 cases and 145 controls was analysed.

Socio-demographic factors: Majority of cases and controls were Hindus (53.80% and 63.45% respectively) and the rest were Muslims. Most of the study participants belonged to general caste i.e. 68.97% vs. 66.20% among cases and controls respectively. Mean per capita income among cases and controls were Rs. 1046.37±531.71 and Rs. 1210.17±602.65 respectively. The difference was statistically significant. Mean age of mothers among cases and controls was 21.8±3.4 years and 22.5±3.3 years respectively. Among cases 56.6% fathers and among controls 35.2% had history of addiction to one or more substances.

Antenatal factors: Among cases 79.31% and among controls 67.59% were primi mothers. The difference was statistically significant (OR 1.84; 95% CI: 1.08, 3.13). Maternal complications during pregnancy such as swelling of hands, face or feet among cases and controls were 24.14% and 13.10% respectively with odds ratio of 2.11 (95% CI: 1.14, 3.90).

Intranatal factors: Among cases 62.07% and among controls 51.03 % had normal delivery.

This difference was found to be statistically significant. Babies born with presence of cord round the neck were at higher risk of being born asphyxiated (OR 3.28; 1.26, 8.53). Babies born with meconium stained liquor was found to have 8.79 times (CI: 4.70, 16.43) more risk of birth asphyxia than the babies born with clear liquor. Babies born after prolonged labour had higher risk of being asphyxiated with odds ratio of 7.39(CI: 3.75, 14.55).

Neonatal factors: Birth asphyxia was higher among the male babies (OR 1.80 95% CI: 1.13, 2.87). Preterm babies among cases and controls were 14.48% and 12.41% respectively. The mean birth weight (kg) among cases and control group was 2.31±0.44 and 2.57±0.41 respectively and the difference was statistically significant.

The various socio-demographic, antenatal, intranatal and neonatal factors which had statistically significant association with birth asphyxia were entered in multivariate logistic regression analysis. Statistical models were made by entering the various risk factors of birth asphyxia according to their domains in a step wise manner as shown in the table 3. In the final model including all the potential explanatory variables in the multivariable regression, history of addiction of father, primigravida, antepartum swelling of hands, face or feet, meconium stained liquor, cord round the neck, prolonged labour, lowbirth weight and male baby were the significant predictors of birth asphyxia.

Table 1: Association of socio-demographic risk factors with birth asphyxia among the newborns (n=290)

Variables	**Cases No. (%)**	**Controls No. (%)**	**OR (95% CI)**
Age of mother (in yrs.)			
<20	35 (24.13)	33 (22.75)	1.08(0.63-1.86)
20-24	82 (56.55)	65 (44.82)	Ref.
25-29	24 (16.55)	41 (28.27)	
≥ 30	4 (2.74)	6 (4.13)	
Religion			
Hindu	78 (53.80)	92 (63.45)	0.67 (0.42-1.07)
Muslim	67 (46.20)	53 (36.55)	Ref.
Caste			
General	100 (68.97)	96 (66.20)	1.13 (0.69-1.86)
Others(SC,ST,OBC)	45(31.03)	49 (33.80)	Ref.
Type of family			
Nuclear	49 (33.10)	59 (40.68)	0.74 (0.46-1.19)
Joint	97 (66.89)	86 (59.31)	Ref.
Per capita monthly income (in Rs.)			

< 1000	100 (68.97)	83 (57.24)	**1.66* (1.03-2.69)**
≥ 1000	45 (31.03)	62 (42.76)	**Ref.**
Maternal education			
Illiterate	50 (34.48)	42 (28.97)	1.67 (0.95-2.89)
Primary	33 (22.76)	25 (17.24)	
Middle	35 (24.14)	38 (26.21)	
Secondary and above	27 (18.62)	40 (27.58)	Ref.
Mothers occupation			
Home maker	140 (96.55)	133 (91.72)	2.53 (0.87-7.36)
Working mother	5 (3.44)	12 (8.27)	Ref.
Fathers education			
Illiterate	39 (26.89)	45 (31.03)	1.45 (0.87-2.42)
Primary	15 (10.35)	23 (15.86)	
Middle	55 (37.93)	30 (20.69)	
Secondary and above	36(24.83)	47 (32.42)	Ref.
Fathers occupation			
Professional	3 (2.07)	12 (8.28)	**Ref.**
Skilled labour	19 (13.10)	13 (8.97)	**4.27* (1.98-15.47)**
Semiskilled labour	42 (28.97)	43 (29.25)	
Unskilled labour	81 (55.86)	77 (53.10)	
Mothers addiction			
None	140 (96.56)	139 (95.86)	Ref.
Smokeless tobacco	5 (3.44)	6 (4.14)	1.21 (0.36-4.05)
Fathers addiction			
None	63 (43.45)	94 (64.83)	**Ref.**
Tobacco only	74 (51.03)	48 (33.10)	**2.40* (1.50-3.85)**
Alcohol and other	8 (5.51)	3 (2.07)	

*** Significant at the level of 95%**

Table 2. Association of birth asphyxia with antenatal, intranatal and neonatal risk factors (n=290).

Variables	**Cases No. (%)**	**Controls No. (%)**	**OR (95% CI)**
A. **ANTENATAL RISK FACTORS**			
1.Gravida			
Primi	115 (79.31)	98 (67.59)	**1.84* (1.08-3.13)**
Multi	30 (20.69)	47 (32.41)	**Ref.**
2.Antenatal visits			
< 3	56(38.62)	38 (26.21)	1.40 (0.86-2.27)
≥ 3	89 (61.38)	107 (73.79)	Ref.
3.Plurality			
Singleton pregnancy	143 (98.62)	142 (97.93)	1.51 (0.25-9.18)
Multiple pregnancy	2 (1.38)	3 (2.07)	Ref.

4.Maternal complication			
Swelling of hands, face or feet **present**	35 (24.14)	19 (13.10)	**2.11* (1.14-3.90)**
Swelling of hands, face or feet **absent**	110 (75.86)	126 (86.90)	**Ref.**
5.Pallor			
Present	40 (27.59)	48 (33.10)	0.77 (0.47-1.27)
Absent	105 (72.41)	97 (66.90)	Ref.
6.Rh status of mother			
Rh negative	1 (0.69)	3 (2.07)	0.33 (0.03-3.19)
Rh positive	144 (99.31)	142 (97.93)	Ref.
B. **INTRANATAL RISK FACTORS**			
1.Mode of delivery			
Normal delivery	90 (62.07)	74 (51.03)	**1.67 (1.04-2.66)**
Other (caesarean, instrument)	55 (37.93)	71 (48.97)	**Ref.**
2.Cord round the neck			
Present	18 (12.41)	6 (4.14)	**3.28* (1.26-8.53)**
Absent	127 (87.59)	139(95.86)	**Ref.**
3.Meconium stained liquor			
Present	73 (50.34)	15 (10.34)	**8.79* (4.70-16.43)**
Absent	72 (49.66)	130 (89.66)	**Ref.**
4.Prolonged labour			
Yes	58 (40.0)	12 (8.28)	**7.39* (3.75-14.55)**
No	87 (60.0)	133 (91.72)	**Ref.**
C. **NEONATAL RISK FACTORS**			
1.Gestational age			
Preterm (28-37 weeks)	21 (14.48)	18 (12.41)	1.19 (0.61-2.35)
Term (38-42 weeks)	122 (84.14)	121 (83.45)	Ref.
Post term (>42 weeks)	2 (1.38)	6 (4.14)	
2.Birth weight			
<2.5 Kg	99 (68.28)	61 (42.07)	**2.96* (1.83-4.79)**
≥ 2.5 Kg	46 (31.72)	84 (57.93)	**Ref.**
3.Sex of the baby			
Male	89 (61.38)	68 (46.90)	**1.80* (1.13-2.87)**
Female	56 (38.62)	77 (53.10)	**Ref.**

*** Significant at the level of 95%**

Table 3: Multivariable logistic regression showing the determinants of birth asphyxia in an additive stepped approach

COVARIATES	Cases	Controls	Model 1	Model 2	Model 3	Model 4

	(n=145) No. (%)	**(n=145) No. (%)**	**AOR (95%CI)**	**AOR (95%CI)**	**AOR (95%CI)**	**AOR (95%CI)**
SOCIO-DEMOGRAPHY AND LIFESTYLE						
Fathers occupation-Professional	3 (2.1)	10 (6.9)	0.83 (0.68,1.02)	0.85 (0.69,1.05)	0.84 (0.66,1.07)	0.82 (0.63,1.08)
Father with history of addiction	82 (56.6)	51 (35.2)	**1.40* (1.07,1.84)**	**1.58* (1.20,2.10)**	**1.60* (1.15,2.22)**	**1.79* (1.21,2.65)**
Per capita monthly income < Rs.1000	100 (68.9)	84 (57.9)	1.13 (0.84,1.53)	1.15 (0.84,1.57)	1.14 (0.79,1.64)	1.01 (0.66,1.54)
ANTENATAL						
Primigravida	113 (77.9)	98 (67.6)	-	**2.36* (1.37,4.06)**	**2.32* (1.23,4.37)**	**3.37* (1.57,7.21)**
Swelling of hands, face or feet in antenatal period.	35 (24.1)	19 (13.1)	-	**0.30* (0.15,0.61)**	**0.43* (0.19,0.96)**	**0.20* (0.07,0.59)**
INTRANATAL						
Normal delivery	90 (62.1)	74 (51.0)	-	-	0.72 (0.46,1.13)	1.43 (0.84,2.42)
Meconium stained liquor	73 (50.3)	15 (10.3)	-	-	**4.25* (2.04,8.83)**	**10.55* (4.06,27.41)**
Cord round the neck	18 (12.4)	6 (4.13)	-	-	**7.73* (2.42,24.64)**	**10.22* (2.86,36.42)**
Prolonged 2nd staged labour	58 (40.0)	12 (8.27)	-	-	**4.13* (1.7,9.63)**	**10.61* (3.65,30.79)**
NEONATAL						
Birth weight <2.5Kg	99 (68.3)	61 (42.1)	-	-	-	**5.45* (3.11,9.55)**
Male baby	89 (61.4)	68 (46.9)	-	-	-	**0.41* (0.20,0.83)**

* $p<0.05$

DISCUSSION:

Perinatal asphyxia is a global problem causing serious sequelae regarding morbidity and mortality. Twenty three percent of all the new born deaths are caused by birth asphyxia.[8] It is important to be aware of factors that may predispose a newborn to hypoxic insult at birth with the aim of formulating strategies. These factors may be ante partum in origin in 50% of the cases, intrapartum in 40% and postpartum in remaining 10%.[9] The reduced availability of skilled care during delivery in developing countries, intrapartum causes may have greater

contribution[10.] The aim of this study was to determine avoidable risk factors that may predispose a neonate to hypoxic insult at birth. In the present study, we used an Apgar score of less than 7 at 5 minutes to define asphyxia in infants. In our study there was no significant association between birth asphyxia and education level of the mother. However, a community based cohort study in South Nepal[11] revealed a significant increase in asphyxia with decreasing education level of the mothers (OR 0.57 95%CI 0.40-0.83). Significant association (OR 1.74, 95%CI 1.33-2.28) of gravida with birth asphyxia was observed like the present study. In the present study, there was no significant association between ante natal visits and birth asphyxia but other studies[12, 13] have shown inappropriate antenatal care as a significant predictor of birth asphyxia. This may be due to the fact that the study was done in a tertiary care level hospital where most of the mothers were registered and had appropriate antenatal care. In this study no statistical significance was found between birth asphyxia and multiple pregnancies although other studies[11, 12] have shown multiple pregnancies to be associated with birth asphyxia significantly. This might be due to very small percentage of multiple pregnancies in the present study. A similar study[14] done among Swedish urban population also found significant association of cord round the neck with birth asphyxia similar to this study. Meconium stained liquor was significantly associated with asphyxia in present study and was similar to most of other studies.[11, 12, 15] The significant association between sex of the baby and birth asphyxia in univariate analysis of this study was found to be similar to other studies.[13, 16] However, it was not observed in multivariate analysis. Study done by Butt et al[13] did not find any statistically significant association between gestational age and birth asphyxia as was found in this study. Study done in South Nepal by Lee et al. [11] showed that in multivariable analysis, low paternal education, primiparity, swelling of hands and feet of mothers, multiple birth, premature baby, male baby, as the significant predictors of birth asphyxia. In this study, it was found that addiction of father, primigravida, antepartum swelling of hands, face or feet, meconium stained liquor, cord round the neck, prolonged labour, lowbirth weight and male baby were the significant predictors of birth asphyxia in multivariable analysis.

CONCLUSION:

In developing countries, perinatal asphyxia remains a major cause of death and disability. Most perinatal asphyxia is strongly associated with pregnancy related complications such as fetal intrapartum problems like prolonged second stage of labour, cord round the neck, mode

of delivery and meconium stained liquor. The incidence of asphyxia and its consequences can be reduced by early identification and effective management of intranatal complications.

REFERENCES:

1. Lawn JE, Manandhar A, Haws RA, Darmstadt GL. Reducing one million child deaths from birth asphyxia--a survey of health systems gaps and priorities. Health Res Policy Syst [Internet]. 2007 Jan [cited 2015 May 7];5(1):4. Available from: http://www.health-policy-systems.com/content/5/1/4
2. Cloherty J, Eichenwald E, Stark A. Manuals of neonatal care. 5th ed. Lippincott Williams & Wilkins (LWW); 536-537 p.
3. Behran R. Nelson textbook of pediatrics. 15th ed. WB Saunders company; 1996. 470 p
4. Ciliford Roberton N. Textbook of Neonatology. First. Churchill Livingstone; 1988. 239-40 p.
5. McGuire W. Perinatal asphyxia. BMJ Clin Evid [Internet]. 2007 Jan [cited 2015 May 7];2007. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2943784&tool=pmcentrez&rendertype=abstract
6. Shireen N, Nahar N, Mollah A. Risk Factors and Short-Term Outcome of Birth Asphyxiated Babies in Dhaka Medical College Hospital. Bangladesh J Child Heal. 2010;33(3):83–9.
7. Unicef. The State of the World's Children 2009: Maternal and Newborn Health [Internet]. Children. 2009. [cited 2015 Jan 10]Available from: http://www.unicef.org/sowc09/docs/SOWC09-FullReport-EN.pdf
8. Lawn JE, Cousens S, Zupan J. 4 million neonatal deaths: when? Where? Why? Lancet [Internet]. Elsevier; 2005 Jan 3 [cited 2015 Jan 10];365(9462):891–900. Available from: http://www.thelancet.com/article/S0140673605710485/fulltext
9. Dilenge M, Majnemer A, MI S. Long-term developmental outcome of asphyxiated term neonates. J Child Neurol. 2001;16(11):781–92.
10. Azra Haider B, Bhutta ZA. Birth asphyxia in developing countries: current status and public health implications. Curr Probl Pediatr Adolesc Health Care [Internet]. Jan

[cited 2015 May 7];36(5):178–88. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16631096

11. Lee ACC, Mullany LC, Tielsch JM, Katz J, Khatry SK, LeClerq SC, et al. Risk factors for neonatal mortality due to birth asphyxia in southern Nepal: a prospective, community-based cohort study. Pediatrics [Internet]. 2008 May [cited 2015 Apr 8];121(5):e1381–90. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2377391&tool=pmcentrez&rendertype=abstract

12. Majeed R, Memon Y, Majeed F, Shaikh NP, Rajar UDM. Risk factors of birth asphyxia. J Ayub Med Coll Abbottabad [Internet]. Jan [cited 2015 Apr 11];19(3):67–71. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18444595

13. Butt TK, Farooqui R, Khan MAU. Risk factors for hypoxic ischemic encephalopathy in children. J Coll Physicians Surg Pak [Internet]. 2008 Jul [cited 2015 May 7];18(7):428–32. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18760067

14. Milsom I, Ladfors L, Thiringer K, Niklasson A, Odeback A, Thornberg E. Influence of maternal, obstetric and fetal risk factors on the prevalence of birth asphyxia at term in a Swedish urban population. Acta Obstet Gynecol Scand [Internet]. 2002 Oct [cited 2015 May 7];81(10):909–17. Available from: http://www.ncbi.nlm.nih.gov/pubmed/12366480

15. Shrestha M, Shrestha L, Shrestha P. Profile of Asphyxiated Babies at Tribhuvan University Teaching Hospital. J Nepal Paediatr Soc [Internet]. 2009 Jan 30 [cited 2015 May 7];29(1):3–5. Available from: http://www.nepjol.info/index.php/JNPS/article/view/1592

16. Futrakul S, Praisuwanna P, Thaitumyanon P. Risk factors for hypoxic-ischemic encephalopathy in asphyxiated newborn infants. J Med Assoc Thai [Internet]. 2006 Mar [cited 2015 May 7];89(3):322–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16696415