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Scientific Research

Risk Factors Associated with Birth Asphyxia in Rural District Matiari, Pakistan: A Case Control Study

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Abstract

Background: During the past two decades there has been a sustained decline in child mortality; however, neonatal mortality has remained stagnant. Each year approximately 4 million babies are born asphyxiated resulting in 2 million neonatal deaths and intrapartum stillbirths. Almost all neonatal deaths occur in developing countries, where the majority is delivered at homes with negligible antenatal care and poor perinatal services. Objectives: To identify socio-demographic and clinical risk factors associated with birth asphyxia in Matiari District of Sindh Province, Pakistan. Method: A matched case control study was conducted in Matiari District with 246 cases and 492 controls. Newborn deaths with birth asphyxia diagnosed through verbal autopsy accreditation during 2005 and 2006 were taken as cases. Controls were the live births during the same period, matched on area of residence, gender and age. Result: The factors found to be associated with birth asphyxia mortality in Matiari District of Sindh Province, Pakistan are maternal education, history of stillbirths, pregnancy complications (including smelly or excessive vaginal discharge and anemia), intrapartum complications (including fever, prolong or difficult labour, breech delivery, cord around child's neck, premature delivery, large baby size) and failure to establish spontaneous respiration after birth. Conclusion and Recommendation: There is an immediate need to develop strategies for early identification and management of factors associated with birth asphyxia by involving women, families, communities, community health workers, health professionals and policy makers. Community health workers should be trained for emergency obstetric care, basic newborn care including preliminary resuscitation measures to provide skilled birth attendance and encourage early recognition and referral.

Keywords

Birth Asphyxia, Prolong Labor, Antenatal Care

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1. Background

Most developing countries have witnessed substantial declines in under 5 mortality [1] while in contrast, neonatal deaths have remained stagnant with an estimated 3 million annual neonatal deaths occurring globally [2]. Recent estimates showed that annual reduction rate in neonatal mortality between 1990 and 2012 (2%) was much lower than that for children aged 1 - 59 months (3.4%) [3] [4]. Birth asphyxia (BA) is one of the leading causes of newborn mortality [5]-[7]. Each year approximately 24% of neonatal deaths occurred due to birth asphyxia [1] with an equal number of survivors with serious neurological squeals, such as cerebral palsy, mental retardation and epilepsy leading to detrimental long term consequences for both child and family [8]-[12].

Birth asphyxia is defined by the World Health Organization as "the failure to initiate and sustain breathing at birth" [13]. Birth asphyxia occurs when an inadequate amount of oxygen is delivered to the fetus, usually during labor and childbirth, leading to risk of death (stillbirth or neonatal death) or lifelong disability in the surviving infant. Cognitive and behavioral difficulties can also be expected because of the patterns of brain injury that have been associated with neonatal encephalopathy. The hippocampus and striatum are among the brain structures that can be affected [14]-[18]. These structures have been associated with specific cognitive functions such as memory and attention and hypothesized to play a role in the pathogenesis of attention deficit hyperactivity disorder (ADHD), autism and schizophrenia [19]-[23]. Other terms sometimes used for birth asphyxia include perinatal asphyxia and fetal distress. Birth asphyxia can be caused by events that have their roots in the antepartum, intrapartum, postpartum periods or combinations thereof. A recent review suggests that asphyxia is probably primarily antepartum in origin in 50% of cases, intrapartum in 40%, and postpartum in the remaining 10% of cases [24]. Definitions of birth asphyxia designed for use in hospital-based settings require evaluation of neonatal umbilical cord pH, Apgar scores, neurological clinical status, and markers of multi-system organ function, which are not feasible in community settings. Therefore, it is difficult to recognize the causes of birth asphyxia in the community due to lack of a consistent definition [25].

In 2013, lower-middle-income countries (LMIC) share 98% of the total newborn mortality burden [6] whereas more than 4 in 10 of all neonatal deaths worldwide occurred in just three countries: India, Nigeria, and Pakistan [1]. Pakistan ranks 5th in the list of countries bearing the highest neonatal mortality burden globally [1]. Birth asphyxia contributes to around 40% of the neonatal mortality burden in Pakistan and a major fraction of these deaths occurs in rural areas (74%) [26]. A majority of these women give birth at home and are either unassisted or assisted by an unskilled birth attendant, including family and traditional birth attendants (TBA). Risk factors of birth asphyxia in community and hospital based settings in developing countries have been categorized into demographic, antepartum, intrapartum and neonatal risk factors presented in (**Table 1**). The aim of this study was to explore potential risk factors associated with birth asphyxia in resource poor settings in Pakistan. This will help in targeting and scaling up of proven and cost effective interventions for preventing the identified risk factors associated with birth asphyxia in community setting.

To the best of our knowledge this is the first study to identify risk factors of BA mortality among neonates

Table 1. Antepartum, intrapartum, and infant risk factors for birth asphyxia previously reported from hospital based studies.

Community based study	Hospital based studies		
Demographic risk factors	**Antepartum risk factors**	**Intrapartum risk factor**	**Infant/postnatal**
Parental education and occupation [57]	Primiparity [45] [58]	Malpresentation [41] [46] [59]	Prematurity [60]
Cast and ethnicity [57]	Maternal fever [41]	Prolonged labor [40] [46]	Low birth weight [41] [47]
	Pregnancy induced hypertension [45] [46]	Meconium stained amniotic fluid [40] [41] [45] [59]	Intrauterine growth restriction [46] [58]
	Anemia [41]	Pre-eclampsia [41]	
	Antepartum hemorrhage [41] [45]	Premature rupture of membranes [41]	
	History of prior neonatal death [45]	Oxytocin augmentation of labor [41]	
		Umbilical cord prolapsed [46] [59]	

conducted in rural resources limited settings in Pakistan.

1.1. Material and Methods

It was a matched case control study conducted from September 2009 to January 2010 in Matiari District of Sindh Province, Pakistan. The estimated population of the area is about 5 million. The Matiari District is administratively divided into taluk as which further comprised of 19 union councils. The study area was selected on the availability of verbal autopsies data on under 5 mortality captured during the survey conducted by department of Paediatrics & Child Health in year 2005-2006. Neonatal death (0 - 28 days) rate was 50/1000 live births as per the available data. Verbal autopsies of all neonatal deaths captured during the survey were reviewed by trained Pediatricians to assign a reference standard primary cause of death. The verbal autopsy concluded that around 30% of all neonatal deaths were caused by birth asphyxia. We took these deaths as cases while controls were the live births of same area during the same period, matched on gender and age to reduce confounding by these variables.

Sample size was calculated using the proportion of birth asphyxia among controls (22.1%) from the Pakistan Demographic and Health Survey PDHS2006-07. Expecting to obtain an odds ratio of 1.5, required sample size was 246 cases over 492 controls, at 5% level of significance and 80% power.

The study teams comprised of research assistant from the local community and were trained on data collection instruments and study methodology. A structured data collection tool was designed and administered after informed verbal consent from mother of case or control child. Data was collected on a wide range of factors including household demographics, reproductive history, antenatal care seeking, maternal complication during pregnancy, labor, delivery and neonatal complications at birth. To ensure quality of data collection, project supervisor checked 5% of the total forms. The fieldwork was very closely monitored by the team leader and prior to data entry, all forms were checked for completeness and consistency as well as coding of open ended responses and area code, etc. In case of inconsistency or missing responses, the field supervisor flagged the errors and consulted the interviewers for possible explanations. All data was entered twice for the purpose of sufficient accuracy. Data quality was assured by performing dual and error checks simultaneously with data entry. A sub sample of data was checked manually for validation.

1.2. Statistical Analysis

To evaluate potential predictors for birth asphyxia mortality risk factors were grouped into four major domains: socio-demographics, antepartum, intrapartum, and postnatal or infant characteristics. Univariate distributions were explored using frequencies/proportions, and means/medians and histograms, as appropriate. Multivariate analysis was conducted via conditional logistic regression to ensure adequate statistical power and efficiency. Results are reported as the odds ratios (OR) with respective 95% CI. All potential covariates were examined independently in univariate analysis. Variables significant at a liberal $p < 0.25$ were considered for adjustment in the multivariate model. Covariates that were found insignificant at multivariate level were dropped consecutively from model after careful assessment of confounding. The final model was selected on the basis of theoretical and statistical significance of predictors. Type 1 error rate was held at 0.05 and statistical analyses were performed using STATA (version 12).

1.3. Ethical Considerations

The study protocol was examined and approved by the Aga Khan University ethics review committee.

2. Results

2.1. Socio-Demographic Risk Factors

We studied 246 cases and 492 controls. Among various socio-demographic indicators birth asphyxia was found to be significantly associated with mother and father education levels. Maternal literacy decreased the risk of mortality with birth asphyxia (OR 0.5, 95% CI: 0.3 - 0.7) while father's higher education levels possessed protective effect on mortality (OR 0.5, 95% CI: 0.3 - 0.9). Significant association was not established with major socio-demographic determinants such as socio-economic position (SES quintiles), improved water and sanitation facilities with birth asphyxia (**Table 2**).

Table 2. Socio-demographic risk factors of birth asphyxia mortality.

Exposure	Control (n = 492)	Cases (n = 246)	OR	p-value
HH characteristics				
Source of drinking water				
Tap in house	73.0	69.9	1	
Public tap	9.1	11.8	1.4 (0.8 - 2.5)	0.26
Other	17.9	18.3	0.9 (0.5 - 1.8)	0.92
Kind of toilet facilities				
Latrine with flush system	37.4	35.8	1	
Latrine without flush system	18.9	16.7	0.9 (0.4 - 1.9)	0.85
No facilities/use the fields	43.7	47.6	1.4 (0.8 - 2.4)	0.30
Wealth quintiles				
Poorest	21.1	17.1	0.6 (0.3 - 1.2)	0.17
Poorer	20.3	19.9	0.8 (0.5 - 1.6)	0.70
Middle	18.1	23.6	1.2 (0.7 - 2.2)	0.42
Richer	20.7	19.1	0.8 (0.5 - 1.5)	0.65
Richest	19.7	20.3	1	
Respondent characteristics				
Maternal education				
No formal schooling	76.8	85.8	1	
Literate (primary or above)	23.2	14.2	0.5 (0.3 - 0.7)	0.001
Maternal occupation				
Unemployed	89.2	88.6	1	
Employed	10.8	11.4	1.1 (0.6 - 1.9)	0.77
Father age				
<40 years	78.7	77.6	1	
≥40 years	21.3	22.4	1.0 (0.7 - 1.5)	0.86
Father education				
No formal schooling	46.4	54.1	1	
Primary/middle	22.6	23.6	1 (0.6 - 1.5)	0.87
Metric or above	31.1	22.4	0.5 (0.3 - 0.9)	0.01

*Wealth quintiles constructed through PCA using construction of HH, no of rooms, cooking fuel, electrification, source of drinking water and sanitation facilities.

2.2. Antepartum Risk Factors

Our data shows significant association of birth asphyxia with increasing maternal age (OR: 1.4, 95% CI: 1.1 - 2.0), poor dietary intake (OR: 2.2, 95% CI 1.4 - 3.3), reproductive history including shorter birth intervals (OR: 1.8, 95% CI: 1.2 - 2.6), prior stillbirths (OR: 2.9, 95% CI: 1.9 - 4.5) and child deaths (OR: 94, 95% CI: 30 - 295) and complications during pregnancy including self-reported high blood pressure (OR: 2, 95% CI: 1.3 - 2.9), bleeding from the vagina (OR: 3.3, 95% CI: 1.6 - 6.8), smelly or excessive vaginal discharge (OR: 3.1, 95% CI: 1.8 - 5.2), severe abdominal pain (OR: 1.7, 95% CI: 1.2 - 2.5), swelling on body (OR: 1.5, 95% CI: 1.1 - 2.2). However, maternal malnutrition and working routine did not appear to contribute to BA mortality (**Table 3**).

Table 3. Antepartum risk factors of birth asphyxia mortality.

Exposure	Control (n = 492)	Cases (n = 246)	OR	p-value
Maternal age				
<30 years	42.3	34.6	1	
30+ years	57.7	65.4	1.4 (1.1 - 2.0)	0.03
Maternal malnutrition				
Low BMI (<18.5)	28.7	26.5	0.9 (0.6 - 1.3)	0.54
Short stature (ht < 145 cm)	11.8	12.2	1.0 (0.6 - 1.7)	0.86
Food habits during pregnancy				
More or usual diet	85.3	75.2	1	
Less than usual diet	14.6	24.8	2.2 (1.4 - 3.3)	0.0003
Working habits during pregnancy				
Less than usual work	13.8	9.7	1	
More or usual work	86.2	90.2	1.5 (0.9 - 2.5)	0.1
Birth history				
Miscarriages	20.7	25.2	1.3 (0.9 - 1.8)	0.15
Still birth	12.0	26.4	2.9 (1.9 - 4.5)	<0.001
Child death	31.9	97.6	94.2 (30.1 - 295.3)	<0.001
Birth interval < 2 years	66.3	77.4	1.8 (1.2 - 2.6)	0.001
Complications during pregnancy				
Bleeding from the vagina	3.05	8.94	3.3 (1.6 - 6.8)	0.001
Smelly or excessive vaginal discharge	7.11	17.48	3.1 (1.8 - 5.2)	<0.001
Severe or persistent abdominal or back pain that was not labour pain	29.07	37.80	1.7 (1.2 - 2.5)	0.006
Swelling on body parts (hand, face, leg)	26.42	33.74	1.5 (1.1 - 2.2)	0.02
Blurring of vision	47.15	54.07	0.4 (1 - 1.9)	0.06
Severe headache	58.54	65.85	1.4 (1.0 - 2.0)	0.05
High blood pressure	30.49	41.46	2 (1.3 - 2.9)	0.001
Anaemia/pallor	21.54	29.67	1.6 (1.1 - 2.4)	0.01

2.3. Intrapartum Risk Factors

Almost half of the deliveries took place at medical facilities, proportion of hospital births being higher in cases than in controls (OR 1.6, 95% CI: 1.1 - 2.4). Complications during labor and delivery including high blood pressure (OR 2.4, 95% CI: 1.6 - 3.6), convulsions (OR 2.8, 95% CI: 1.5 - 5.2), excessive bleeding (OR 2.8, 95% CI: 1.6 - 5.1), water bag broke before labor (OR 2.8, 95% CI: 1.2 - 6.5), breech delivery (OR 6.2, 95% CI: 2.8 - 13.8), prolong labor (OR 5.2, 95% CI: 3.3 - 8.3) and baby movement stopped (OR 4.9, 95% CI: 1.7 - 13.9) were significantly associated with increased risk of birth asphyxia mortality. Exact gestational age was not available therefore mother's reported duration of pregnancy was taken as proxy and the data suggests that early ended pregnancies carried higher risk of birth asphyxia mortality (OR 5.4, 95% CI: 2.9 - 10). Delivery augmented with medicine significantly predict increased chances of birth asphyxia mortality (OR 2.2, 95% CI: 1.4 - 3.4) (**Table 4**).

2.4. Neonatal Risk Factors

Data on birth weight was not available therefore size at birth taken as proxy. Small size at birth was associated

Table 4. Intrapartum risk factors of birth asphyxia mortality.

Exposure	Control (n = 492)	Cases (n = 246)	OR	p-value
Complications occurred during labour				
High blood pressure	29.30	42.30	2.4 (1.6 - 3.6)	<0.001
Convulsions	4.50	11.00	2.8 (1.5 - 5.2)	0.001
Fever	16.10	28.50	2.4 (1.6 - 3.6)	<0.001
Excessive bleeding	5.50	12.60	2.8 (1.6 - 5.1)	0.001
Prolonged/difficult labour	13.8	37.0	5.2 (3.3 - 8.3)	<0.001
Breech delivery	1.6	10.2	6.2 (2.8 - 13.8)	<0.001
Cord around child's neck	2.2	4.1	2 (0.8 - 5)	0.13
Place of delivery				
Home	42.1	33.3	1	
Hospital	57.9	66.7	1.6 (1.1 - 2.4)	0.009
Last movement in the womb				
During labour or delivery	98.4	93.5	1	
At least one or two day prior to delivery	1.2	5.3	4.9 (1.7 - 13.9)	0.003
Pregnancy ends up				
Early	3.7	17.9	5.4 (2.9 - 10)	<0.001
In time	88.0	72.8	1	
Late	7.9	8.9	1.5 (0.8 - 2.7)	0.21
Labour type				
Spontaneous without medication	62.0	51.6	1	
Induced with medicine	9.1	12.2	1.3 (0.7 - 2.4)	0.42
Augmented with medicine	28.9	36.2	2.2 (1.4 - 3.4)	0.001
Timing of breakage of water bag				
Before labour	4.3	8.1	2.8 (1.2 - 6.5)	0.014
During labour	95.6	91.8	1	
Length of delivery and labor				
Less than 12 hours	93.1	80.9	1	
Twelve hours or more	6.7	19.1	4.3 (2.4 - 7.5)	<0.001
Outcome of delivery				
Singleton	98.8	95.9	1	
Multiple	1.2	4.1	1 (0.9 - 1.1)	0.63

with increased risk of birth asphyxia mortality (OR 2.5, 95% CI: 1.5 - 4.1) whereas being large at birth had twice more risk of mortality due to birth asphyxia (OR 4.1, 95% CI: 2.0 - 8.3). Other significantly associated neonatal risk factors were difficult breathing (OR 79, 95% CI: 29 - 214), baby not breathing immediately after birth (OR 38.4, 95% CI: 18.9 - 78.1), cyanosis (OR 301, 95% CI: 42 - 2147) and chest in drawing after birth (OR 2.3, 95% CI: 1.5 - 3.8) (**Table 5**).

2.5. Multivariate Models

Multivariate analysis yielded interesting results as some of the associations between outcome and predictors

Table 5. Neonatal risk factors of birth asphyxia mortality.

Exposure	Control (n = 492)	Cases (n = 246)	OR	p-value
Size of baby at birth				
Smaller than average	12.2	20.3	2.5 (1.5 - 4.1)	<0.001
Average	84.1	67.9	1	
Larger than average	3.5	11.8	4.1 (2.0 - 8.3)	<0.001
Failure to develop spontaneous breathing	6.9	70.6	38.4 (18.9 - 78.1)	<0.001
Color of the baby turned blue after 5 minutes of birth	2.3	67.2	301 (42 - 2147)	<0.001
Difficult breathing after birth	9.8	81.6	79 (29 - 214)	<0.001
Chest in drawing after birth	9.1	17.9	2.3 (1.5 - 3.8)	<0.001
Nostrils flare with breathing	38.2	27.4	0.4 (0.3 - 0.7)	<0.001

were not found significant after controlling the effect of other variables although these predictors have shown conspicuous relationship during bi-variate analysis. The significant mortality contributory factors were maternal education (OR: 3.2, 95% CI: 1.2 - 8.5), history of stillbirths (OR: 4.4, 95% CI: 1.8 - 10.8), smelly or excessive vaginal discharge (OR: 3.1, 95% CI: 1.1 - 8.4) or anemia (OR: 2.2, 95% CI: 1.0 - 4.9) during pregnancy, intrapartum complications such as fever (OR: 2.4, 95% CI: 1.0 - 5.6), prolong labour (OR: 3.8, 95% CI: 1.5 - 9.6), breech delivery (OR: 6.1, 95% CI: 1.2 - 31.8) and cord around child's neck (OR: 8.8, 95% CI: 1.4 - 54.5), duration of pregnancy (proxy for gestational age) (OR: 5.3, 95% CI: 1.7 - 16.8), large size of baby at birth (proxy for birth weight) (OR: 5.3, 95% CI: 1.6 - 16.9) and child didn't cry immediately after birth (OR: 53.8, 95% CI: 20.7 - 139.6) (**Table 6**).

3. Discussion

Our study demonstrates that maternal education, history of stillbirths, prenatal complications (including smelly or excessive vaginal discharge and anemia) and intrapartum complications (including fever, prolong or difficult labour, breech delivery, cord around child's neck, premature delivery, large baby size and failure to establish spontaneous respiration after birth) were significantly associated with higher risk of neonatal mortality related to birth asphyxia in Matiari District of Pakistan. To our knowledge, this is the first study to identify risk factors of birth asphyxia mortality among newborns, conducted in rural resource limited settings in Pakistan, where quality of care is inadequate to respond to emergency situations. We evaluated broad range of risk factors including socio-demographic, antenatal, intrapartum and neonatal complications.

Among the sociodemographic risk factors, our study identified maternal education as one of the factors associated with BA mortality. Similar patterns were reported by other studies conducted in rural areas of Southern Nepal and Mexico City [27] [28]. Another hospital based study conducted in Bangladesh did not find association of maternal education with BA [29]. Maternal illiteracy is a very broad indicator of poor socio-economic conditions associated with consequent malnutrition, frequent pregnancies and also influence care seeking during antepartum period. Our data also suggests that history of stillbirths is significantly associated with increased risk of birth asphyxia mortality and this finding is concordance with the findings from studies conducted in similar settings from less developed countries [30]-[33]. We did not find any association between birth asphyxia related mortality and maternal age. This finding is consistent with other studies [29] [34].

It is well known that diseases and complications during pregnancy are the most important risk factors of perinatal mortality [35]-[39]. Among antenatal risk factors, our study showed that antepartum complications (including smelly or excessive vaginal discharge and anemia or pallor) were the most important factors related to increased risk of BA mortality. Previous studies have shown similar results [40] [41]. Among intrapartum risk factors, presence of fever (indicative of infection), prolonged labor, breech delivery and cord around child's neck were found to be associated with high BA mortality. These findings are consistent with other studies [27] [29] [40]-[47]. We did not find any association of BA mortality with convulsions and vaginal bleeding. Other studies conducted in resource limited settings have reported similar results [27]. However, this could be due to self-reported and non-specific nature of data. Among neonatal risk factors, we found preterm birth to be

Table 6. Multivariate analysis of risk factors of birth asphyxia mortality.

Indicators	Adjusted OR	95% CI	p-value
Maternal education			
No formal schooling	3.2	1.2 - 8.5	0.02
Literate (primary or above)	1		
Reproductive history of stillbirth	4.4	1.8 - 10.8	<0.001
Prenatal complications			
Smelly or excessive vaginal discharge	3.1	1.1 - 8.4	0.03
Anemia/pallor	2.2	1.0 - 4.9	0.05
Intrapartum complications			
Fever	2.4	1.0 - 5.6	0.04
Prolong/difficult labor	3.8	1.5 - 9.6	0.01
Breech delivery	6.1	1.2 - 31.8	0.03
Cord around child's neck	8.8	1.4 - 54.4	0.02
When this pregnancy end?			
Early	5.3	1.7 - 16.8	<0.001
In time	1		
Late	1.2	0.3 - 4.1	0.82
Size of baby at birth?			
Smaller than average	0.4	0.1 - 1.0	0.04
Average	1		
Larger than average	5.3	1.6 - 16.9	0.01
Failure to develop spontaneous breathing	53.8	20.7 - 139.6	<0.001

significantly associated with neonatal deaths due to BA. This is in accordance with several previously published studies in similar settings [27] [29] [42] [48] [49]. Our findings are different from the statement that post maturity is an important risk factor of birth asphyxia [50] [51]. Furthermore, our study showed that small size at birth has protective effect whereas larger babies are at an increased risk of asphyxia related deaths. This finding is in contradiction with other studies conducted in [41] [42] [47] [52] [53]. However, this could be attributable to the fact that we did not collect data on gestational age and birth weight due to recall bias of last menstrual period LMP and non-availability of birth weight data. We used self-reported duration of pregnancy and size of baby at birth as a proxy of gestational age and birth weight. Failure to develop spontaneous breathing immediately after birth was also found to be an independent risk factor associated with increased risk of neonatal mortality due to BA [54].

Our findings reflect unsatisfactory perinatal and delivery services in the in resource-limited rural settings of Matiari, Pakistan. Such inadequacies and low quality care delivery has also been previously highlighted by other studies conducted in [55] [56]. Findings from our study highlight that early identification and intervening during the antenatal period have the potential to prevent asphyxia related neonatal mortality. Management of intrapartum complication through skilled birth attendant could help avoid adverse pregnancy and neonatal outcomes. There is an acute need to strengthen the training of local birth attendants as well as to evaluate tertiary care delivery facilities to assess their competence for management of intrapartum complications in these settings.

One of the limitations of our study is that our study was conducted on limited and specified geographic settings that involved less resourced rural setup. Larger studies are required to demonstrate the true associations in the population. Other limitations include potential reporting bias of maternal, infant symptoms and recall bias in verbal autopsy interviews.

4. Conclusion

Concrete and coordinated efforts are required to decrease the burden of neonatal deaths related to BA specifically in low-resource settings. Neonatal and late fetal deaths are closely linked to maternal deaths, requiring common solutions. There is an immediate need to develop strategies for identification and management of birth asphyxia by involving all pathways to survival, including women, families, communities, community health workers, health professionals and policy makers. There is a need to maintain high coverage of skilled birth attendants, promotion of birth preparedness, essential new born care including hygiene and thermal care for new born, trained community workforce for early recognition, referrals at primary health care with well equipped and trained health personnel, training of obstetricians and paramedics staff for emergency obstetric care, and basic newborn care including preliminary resuscitation measures in low resource settings where access to health services are difficult.

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Conflict of Interest

All authors declare that they have no conflicts of interest.

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Authors' Contributions

ZAB conceptualized the study and as principal investigator involved in all aspects of this study. SS participated in study design, data analysis and interpretation of data and reviewed final manuscript. SA critically reviewed the final manuscript. FT was project supervisor developed study protocol, data collection material and oversaw study implementation and writing of the manuscript. AR was statistician for this study and conducted data analysis. All authors reviewed and approved the final manuscript.

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