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Original Article

A Comparative Cross-sectional Study on Determinants of Birth Asphyxia in Referral and District Hospital Settings

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Abstract
Introduction: Birth asphyxia is a leading cause of neonatal morbidity and mortality in India. This study aimed to identify determinants of birth asphyxia among mothers delivering at a referral centre and a district hospital in the northern region of southern India.

Methods: A cross-sectional comparative study was conducted from January to June 2023 involving 334 mothers (167 from each facility) selected through purposive sampling. Data were analyzed using Excel and SPSS. Descriptive and inferential statistics, including binary logistic regression, were applied to identify factors associated with birth asphyxia.

Results: The mean maternal age was 23.83 ± 3.75 years. Maternal anemia, alcohol consumption, primiparity, and low family income were significantly associated with birth asphyxia across both settings. Moderate anemia notably increased risk at the referral centre (OR = 45.02, P = 0.01), while mild anemia was a significant risk factor at the district hospital (OR = 18.62, P = 0.002). Alcohol use markedly elevated birth asphyxia risk; conversely, abstinence was protective (Referral centre OR = 0.03, P = 0.028; district hospital OR = 0.01, P = 0.013). Dietary pattern was a significant factor only at the district hospital, with pure vegetarian mothers showing higher risk (OR = 15.89, P = 0.025). Maternal age, residence, antenatal visits, and smoking showed no significant associations.

Conclusions: Maternal anemia, alcohol consumption, primiparity, low socioeconomic status, and specific dietary patterns are key determinants of birth asphyxia. Targeted interventions to improve maternal nutrition and reduce substance use are essential to lowering birth asphyxia incidence and improving neonatal outcomes.

Introduction
Birth asphyxia, defined as the failure of a newborn to initiate and sustain adequate respiration at birth, remains a major contributor to neonatal morbidity and mortality, particularly in low-resource settings.[1,2] Despite improvements in maternal and neonatal care, it continues to pose a global health challenge, accounting for approximately 23% of neonatal deaths worldwide.[3,4] The burden is disproportionately

higher in South Asia and sub-Saharan Africa, where access to quality healthcare services varies widely.[5]

In India, even with a rise in institutional deliveries, birth asphyxia continues to be reported from both tertiary care centres and district-level facilities.[6] This persistent occurrence underscores the need to explore maternal and contextual factors that may be contributing to the problem across various healthcare levels.[7] The leading cause of perinatal asphyxia are typically complications occurring during the process of childbirth. Neonatal resuscitation protocols recommend immediate interventions such as drying, tactile stimulation, and thermal regulation. For newborns who do not respond to these measures, assisted ventilation using a bag-and-mask or an equivalent device is considered a critical step in effective management.[2] Several maternal characteristics, including age, anemia, antenatal care utilization, occupation, education, dietary practices, and substance use, have been associated with birth asphyxia.[7] However, the influence of these factors may differ between referral hospitals and district-level health institutions, where discrepancies in resources, healthcare delivery, and patient profiles are often observed.[8,9]

This study aims to examine the maternal and socioeconomic determinants of birth asphyxia in both referral and district hospital settings in southern India. The specific objective is to compare key maternal risk factors and identify context-specific determinants that can inform tailored interventions to improve neonatal outcomes.

Methods

A cross-sectional comparative study was conducted from January to June 2023 at a referral centre and a district hospital in Belagavi, Karnataka, India. Ethical approval was obtained from the Institutional Ethics Committee of KLE Academy of Higher Education and Research (KAHER), Belagavi, India and formal administrative permissions were secured from both health facilities prior to study initiation. Written informed consent was obtained from all participating mothers after explaining the purpose and procedures of the study. A total of 334 mothers and their neonates were enrolled, with 167 participants each from the referral centre and district hospital. Participants were selected using purposive sampling, and the sample size was pre-calculated. Inclusion criteria comprised mothers aged 20 years and above, admitted to labour and postnatal wards, who had spontaneous vaginal deliveries, with or without episiotomy. Mothers with premature rupture of membranes (PROM), signs of infection, known chronic illnesses (such as cardiac, renal, or endocrine disorders), pregnancy-induced complications (gestational diabetes and pregnancy-induced hypertension), or those who delivered via Caeserean section were excluded. Data were collected through structured interviews and review of medical records. The data collection tool consisted of three sections: maternal socio-demographic characteristics (Age, religion, type of marriage, education, occupation, family income, residence, dietary habits, smoking, and alcohol use); pregnancy-related variables (Parity, antenatal care visits, haemoglobin levels); and neonatal outcomes, with a focus on birth asphyxia. Birth asphyxia was defined as failure to initiate or sustain regular breathing at birth, confirmed by low Apgar scores at 1 and 5 minutes and clinical diagnosis documented by the attending paediatrician. Different independent variables are maternal age, religion, types of marital, education, occupation, monthly family income, residence, dietary pattern, smoking habit, alcohol habit, haemoglobin levels, parity and antenatal care visits and the dependent variable is birth asphyxia. Data entry was performed using Microsoft Excel with validation checks to minimize errors. Statistical analysis was carried out using SPSS version 20.0. Descriptive statistics summarized socio-demographic and clinical variables, while Chi-square tests assessed associations between maternal factors and birth asphyxia. Binary logistic regression analysis identified significant determinants of birth asphyxia. Statistical significance was set at $P < 0.05$.

Results

Different results have been shown in the figure and the tables below. Figure 1 shows the two healthcare facilities where birth asphyxia cases were recorded: the Referral Centre and the District Hospital. For each facility, two values are displayed. The Y-axis shows the scale for both the number of cases (N) and the percentage (%) of birth asphyxia. The scale ranges from 0 to 25, representing both the count of cases and the corresponding percentage values.

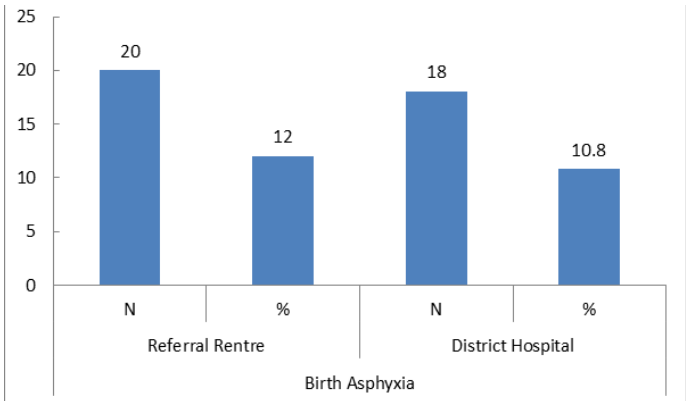

Figure 1: Birth asphyxia in referral centre versus district hospital

Table 1 indicates that the study included a total of 334 mothers, with 167 from the referral centre and 167 from the district hospital. The maternal age ranged from 20 to 40 years, with a mean age of 23.83 years and a standard deviation of ± 3.75. The findings suggest that the majority of participants were young adults.

Table 1: Descriptive statistics of maternal age of study participants (in years) from both referral centre and district hospital (N = 334)

Maternal age					
Total N	**Min**	**Max**	**Sum**	**Mean**	**SD**
334	20	40	3942.58	23.8253	3.75286

Table 2 reveals that maternal anemia, alcohol consumption, low family income, and primi parity are significant determinants of birth asphyxia among mothers delivering at both the referral centre and district hospital (N = 334). Moderate anemia markedly increased birth asphyxia risk, especially at the referral centre, while even mild anemia showed significance at the district hospital. Mothers who consumed alcohol had a substantially higher likelihood of birth asphyxia compared to non-drinkers in both settings. Additionally, primi parous mothers and those from lower-income families experienced higher rates of birth asphyxia. Other factors such as age, residence, education, antenatal visits, and smoking showed no significant impact. These results emphasize the critical role of maternal health status, substance use, and socioeconomic factors in neonatal outcomes and highlight urgent areas for intervention to reduce birth asphyxia.

Table 2: Comparison of association between demographic characteristics and birth asphyxia (Referral centre versus district hospital) (N = 334)

Birth asphyxia									
Demographic Characteristics Yes N (%)		**Referral centre**		**District hospital**		**Chi-Square (df)**	**P value**	**Chi-Square**	**P value**
		No	**Yes**	**No**					
		N (%)	**N (%)**	**N (%)**					
Age	20 to 25	18 (11.5)	138 (88.5)	15 (10.1)	133 (89.9)	4.463 (3)	0.216	2.295(3)	0.514
	26 to 30	0 (0.0)	3 (100)	2 (28.6)	5 (71.4)				
	31 to 35	0 (0.0)	4 (100)	1 (12.5)	7 (87.5)				
	≥ 36	2 (50)	2 (50)	0 (0.0)	4 (100)				
	Total	20 (12)	147 (88)	18 (10.8)	149 (89.2)				
Religion	Hindu	14 (10.3)	122 (89.7)	13 (10.4)	112 (89.6)	9.539 (2)	.008	4.543 (2)	0.103
	Muslim	2 (9.1)	20 (90.9)	2 (6.3)	30 (93.8)				
	Christian	4 (44.4)	5 (55.6)	3 (30)	7 (70)				
Residence	Urban	4 (9.3)	39 (90.7)	5 (10.2)	44 (89.8)	1.944 (2)	0.378	0.076 (2)	0.963
	Semi urban	4 (8.3)	44 (91.7)	6 (11.8)	45 (88.2)				
	Rural	12 (15.8)	64 (84.2)	7 (10.4)	60 (89.6)				
Education of mothers	Post graduate	4 (15.4)	22 (84.6)	3 (7.3)	38 (92.7)	1.641 (4)	0.801	4.2314	0.376
	Secondary level	1 (4.8)	20 (95.2)	0 (0.0)	18 (100)				
	PUC Level	8 (11.9)	59 (88.1)	8 (15.7)	43 (84.3)				
	Bachelors level	6 (12.5)	24 (87.5)	6 (11.8)	45 (88.2)				
	Illiterate	1 (20)	4 (80)	1 (16.7)	5 (83.3)				
Occupation of women	Government	8 (18.6)	35 (81.4)	6 (12.2)	43 (87.8)	3.993 (4)	0.407	2.028 (4)	0.731
	Agriculture	6 (13.6)	38 (86.4)	2 (6.3)	30 (93.8)				
	Private	3 (9.1)	30 (90.9)	3 (7.7)	36 (92.3)				
	House wife	0 (0.0)	9 (100)	1 (16.7)	5 (83.3)				
	Others	3 (7.9)	35 (92.1)	6 (14.6)	35 (85.4)				
Dietary pattern	Mixed diet	9 (12.3)	64 (87.7)	4 (6.1)	62 (93.9)	1.026 (2)	0.599	4.079 (2)	0.13
	Pure vegetarian	6 (15.8)	32 (84.2)	7 (18.9)	30 (81.1)				
	Vegetarian but consume egg	5 (8.9)	51 (91.1)	7 (10.9)	57 (89.1)				

Hb level of mothers	Normal Hb	14 (11.2)	111 (88.8)	8 (6.8)	109 (93.2)	10.422 (3)	0.015	8.309 (3)	0.040
	Moderate Anemic	4 (44.4)	5 (55.6)	2 (18.2)	9 (81.8)				
	Mild Anemic	2 (7.4)	25 (92.6)	8 (22.9)	27 (77.1)				
	Severe Anemic	0 (0.0)	6 (100)	0 (0.0)	4 (100)				
ANC visit	> 4 visits	18 (11.9)	133 (88.1)	17 (10.8)	140 (89.2)	0.005 (1)	0.946	0.007 (1)	0.935
	< 4 visits	2 (12.5)	14 (87.5)	1 (10)	9 (90)				
Parity	Primi	12 (14.5)	71 (85.5)	14 (16.1)	73 (83.9)	0.658 (1)	0.417	5.332 (1)	0.021
	Multi	8 (9.5)	76 (90.5)	4 (5)	76 (95)				
Monthly family income	< 20000	6 (6.7)	83 (93.3)	11 (10.8)	91 (89.2)	16.088(3)	0.001	1.709 (3)	0.635
	5000 – 9999	1 (9.1)	10 (90.9)	2 (20)	8 (80)				
	10000 – 19999	13 (27.7)	34 (72.3)	4 (11.8)	30 (88.2)				
	< 5000	0 (0.0)	20 (100)	1 (4.8)	20 (95.2)				
Smoking habit	Yes	2 (10)	19 (12.9)	1 (5.6)	10 (6.7)	0.137 (1)	0.711	0.035 (1)	0.852
	No	18 (90)	128 (87.1)	17 (94.4)	139 (93.3)				
Alcoholic habit	Yes	5 (25)	6 (4.1)	3 (16.7)	3 (2)	12.52 (1)	0.000	9.956 (1)	0.002
	No	15 (75)	141 (95.9)	15 (83.3)	146 (98)				

Table 3: Comparison of determinants of birth asphyxia (Referral centre versus district hospital) (N = 334)

Demographic characteristics	Determinants of birth asphyxia			P value
	Referral centre		District hospital	
	OR (95% CI)	P value	OR (95% CI)	
Residence				
Urban	1		1	
Semi Urban	0.07 (0.01, 1.14)	0.062	0.7 (0.07, 6.72)	0.753
Rural	0.34 (0.04, 3.01)	0.334	0.35 (0.05, 2.64)	0.306
Occupation				
Government service	1		1	
Agriculture	0.45 (0.07, 3.07)	0.417	0.17 (0.01, 2.55)	0.202
Private service	0.12 (0.01, 1.76)	0.122	0.11 (0.01, 1.58)	0.104
House wife	-	-	0.82 (0.03, 25.04)	0.908
Others	0.1 (0.01, 1.3)	0.079	4.67 (0.64, 34.15)	0.129
Dietary pattern of mothers				
Mixed	1		1	
Pure vegetarian	1.05 (0.12, 9.44)	0.968	15.89 (1.42, 178.26)	0.025
Vegetarian with egg	2.11 (0.35, 12.82)	0.42	5.07 (0.53, 48.23)	0.158
Monthly family income				
20000 +	1		1	
5000 – 9999	0.59 (0.03, 13.57)	0.742	7.19 (0.36, 143.71)	0.197
10000 – 19999	1.94 (0.41, 9.15)	0.402	0.47 (0.06, 4.08)	0.496
< 5000	-	-	0.02 (0, 3.32)	0.132

Table 3 presents the determinants of birth asphyxia among mothers who delivered in labour and postnatal wards, comparing the referral centre and district hospital. Residence and occupation were not significantly associated with birth asphyxia in either facility. However, in the district hospital, mothers following a pure vegetarian diet had a significantly higher risk of birth asphyxia compared to those with a mixed diet (OR = 15.89; 95% CI: 1.42–178.26; P = 0.025). Monthly family income showed no significant association with birth asphyxia in both the centres. Overall, dietary pattern, specifically a pure vegetarian diet at the district hospital, was the only significant determinant of birth asphyxia identified in this analysis.

Table 4 highlights critical determinants of birth asphyxia among mothers delivering at the referral centre and district hospital. Notably, moderate anemia at the referral centre was associated with an exceptionally high risk of birth asphyxia (OR = 45.02, 95% CI: 2.45–826.96, P = 0.01), underscoring maternal anemia as a major risk factor. Similarly, at the district hospital, even mild anemia significantly increased the risk (OR = 18.62, 95% CI: 2.84–122.14, P = 0.002), emphasizing the critical impact of maternal hemoglobin status on neonatal outcomes across healthcare settings. Additionally, abstinence from alcohol was strongly protective against birth asphyxia in both groups (Referral centre: OR = 0.03, P = 0.028; district hospital: OR = 0.01, P = 0.013), identifying alcohol consumption as a significant modifiable risk factor. Other factors such as antenatal care attendance, parity, smoking habits, and type of marriage showed no significant associations, indicating that maternal anemia and alcohol use are the predominant factors influencing birth asphyxia in this population.

Table 4: Comparison of determinants of birth asphyxia (Referral centre versus district hospital) (N = 334)

Demographic characteristics	Determinants of birth asphyxia			P value
	Referral centre		District hospital	
	OR (95% CI)	P value	OR (95% CI)	
Normal Hb	1		1	
Moderate anemia	45.02 (2.45, 826.96)	0.01	2.01 (0.05, 84.6)	0.715
Mild anemia	1.21 (0.1, 14.22)	0.881	18.62 (2.84, 122.14)	0.002
Severe anemia	-	-	-	-
Total ANC Visits				
4 ≥ ANC visits	1		1	
< 4 ANC visits	9.86 (0.59, 166.11)	0.112	3.83 (0.07, 198.52)	0.505
Parity				
Primi	1		1	
Multi	0.26 (0.05, 1.43)	0.12	0.29 (0.05, 1.67)	0.167
Smoking habit				
Yes	1		1	
No	0.4 (0.05, 3.49)	0.407	0.22 (0.01, 7.01)	0.392
Alcoholic habit				
Yes	1		1	
No	0.03 (0, 0.68)	0.028	0.01 (0, 0.37)	0.013
Type of marriage				
Non consanguineous	1		1	
Consanguineous	2.85 (0.29, 27.89)	0.368	4.85 (0.72, 32.73)	0.105

Discussion

This comparative study examined the determinants of birth asphyxia across two distinct healthcare settings - referral center and a district hospital in southern India. The findings highlight the significant influence of socioeconomic and behavioral factors, including maternal anemia, alcohol consumption during pregnancy, primiparity, low socioeconomic status, and vegetarian dietary patterns, on the risk of birth asphyxia. A key finding was the differential association of maternal anemia with birth asphyxia between the two settings: moderate anemia was significantly linked at the referral center, whereas mild anemia showed significance at the district hospital. This finding of ours is also supported by the studies in the past.[10,11] It is perhaps with biological premise that reduced maternal hemoglobin impairs oxygen delivery to the fetus, increasing susceptibility to hypoxic-ischemic injury during labor.[10,11] Alcohol consumption during pregnancy emerged as a consistent predictor in both the settings. Prenatal alcohol exposure is known to disrupt placental function and fetal oxygenation, thereby elevating the risk of birth asphyxia. These findings support the study conducted by Martini S et al.[12] The association of pure vegetarian dietary patterns with birth asphyxia at the district hospital suggests potential micronutrient deficiencies such as iron, vitamin B_{12}, and protein that are critical during pregnancy. This finding is also in congruence with Kyozuka H et al study, emphasizing the importance of balanced nutrition for fetal health.[13]

Interestingly, maternal age, antenatal care attendance, and smoking status did not significantly influence the risk of birth asphyxia in this study. This result is consistent with Sequí-Canet et al, who also found no significant link between maternal smoking and birth asphyxia.[14] Cultural factors and underreporting may explain these observations.

This study observed that low socioeconomic status was associated with increased odds of birth asphyxia. Mothers from lower-income households (Rs 5,000 – Rs 9,999) and those engaged in agricultural occupations showed higher, albeit not statistically significant, odds of birth asphyxia (OR = 7.19, 95% CI: 0.36–143.71; P = 0.197). These findings likely reflect barriers such as inadequate antenatal care, poor maternal nutrition, and delayed access to skilled delivery services. Similar associations between low socioeconomic status and adverse neonatal outcomes have been reported by Lee et al and Tegegnework et al, underscoring the significant impact of socioeconomic factors on perinatal health.[15,16]

The cross-sectional design limits causal inference, and purposive sampling restricts generalizability. Self-reported data on alcohol use and dietary habits are vulnerable to recall and social desirability biases. Additionally, the lack of objective nutritional and biochemical assessments limits deeper understanding of dietary impacts. However, despite these limitations, the study provides valuable evidence to inform maternal and child health interventions tailored to diverse healthcare contexts. Incorporating routine anemia screening, culturally appropriate nutritional counseling, and alcohol avoidance education into antenatal care could reduce the risk of birth asphyxia. Priority should be given to first-time and socioeconomically disadvantaged mothers, who are at greater vulnerability. Future studies with prospective designs and objective biomarkers are warranted to validate these findings and explore underlying mechanisms further.

Conclusions

The study demonstrated that the incidence of birth asphyxia was higher at the referral centre compared to the district hospital. Maternal anemia was identified as a significant risk factor, with moderate anemia primarily increasing risk at the referral centre, while even mild anemia significantly elevated risk at the district hospital. Alcohol consumption consistently increased the likelihood of birth asphyxia across both settings. Pure vegetarian diet is significantly linked to birth asphyxia only at the district hospital. Primiparity and low socioeconomic status were recognized as important determinants common to both settings.

Conflict of Interest: None

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