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ROLE OF MAGNESIUM SULPHATE IN THE TREATMENT OF SEVERE PERINATAL ASPHYXIA

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ABSTRACT

This retrospective cohort study evaluated the impact of sociodemographic and clinical factors on neonatal outcomes in 250 neonates born at a healthcare facility between September 2020 and March 2021, with data collection occurring over a two-month period within this timeframe. The neonates included 62% males and 38% females, with a nearly equal distribution of term (51.6%) and preterm (48.4%) births. Most neonates had a normal birth weight (64.8%), while 28.8% had low birth weight, and 92% were born in a healthcare facility. Hypoxic-Ischemic Encephalopathy (HIE) was present in 39.6% of neonates, with 53.6% having a respiratory rate >60 bpm and 49.2% having oxygen saturation (SPO2) <90% on admission.Neonatal mortality was 23.2%, with low birth weight ($p<0.001$) and HIE ($p=0.016$) significantly linked to death. However, gestational age and SPO2 levels did not significantly correlate with outcomes ($p=0.128$ and $p=0.613$, respectively). Early magnesium sulfate (MgSO4) administration within 12 hours was associated with higher survival rates, though not statistically significant ($p=0.881$). Neurological improvements were observed, with a significant reduction in seizures ($p<0.001$) and improvement in tone ($p=0.013$) from day 1 to day 5. findings highlight the importance of early magnesium sulfate treatment, birth weight management, and the presence of HIE as key factors influencing neonatal survival. The study suggests that early interventions can significantly improve neonatal outcomes.

Keywords: *Neonatal outcomes, Hypoxic-Ischemic Encephalopathy (HIE), birth weight, magnesium sulfate (MgSO4), respiratory rate, oxygen saturation, neonatal mortality, early interventions*

INTRODUCTION

Perinatal asphyxia remains a major global health issue, particularly in low- and middle-income countries, where it is a leading cause of neonatal morbidity and mortality. The World Health Organization (WHO) estimates that perinatal asphyxia leads to approximately 4 million neonatal deaths annually, with severe cases contributing significantly to long-term neurological impairment [1, 2]. The prevalence of severe perinatal asphyxia (SPNA) varies globally, with observational studies reporting rates of 6.1% in Malawi [3], 17% in Ethiopia [4], and 30.9% in Tanzania [5]. Despite improvements in perinatal care, the burden remains high in many regions, including Nigeria, where SPNA accounts for 27% of neonatal mortality [4]. SPNA is commonly defined as the failure to establish spontaneous respiration at birth or an APGAR score of 3 or less in the first minute of life, particularly in low-resource settings [1, 9]. In more advanced cases, it leads to complications such as acute encephalopathy (HIE), metabolic acidosis, circulatory collapse, and persistent pulmonary hypertension, which are often difficult to predict or prevent [10, 11]. These conditions arise due to the excessive release and reduced uptake of glutamate in the neonatal brain, resulting in calcium influx that disrupts neuronal functions, contributing to irreversible brain damage [10, 13, 14]. Magnesium sulfate, an NMDA receptor antagonist, has been increasingly used as a neuroprotective agent in treating neonates with severe perinatal asphyxia. Research indicates that magnesium sulfate can improve neurologic outcomes by blocking the neuronal calcium influx and reducing excitotoxicity [16, 17]. Although studies show it is generally safe and well-tolerated [18], concerns remain regarding its efficacy in reducing disability and its potential association with increased mortality in some cases [19]. Given the conflicting reports and limited data, particularly in low-resource settings, this study aims to assess the role of magnesium sulfate and the timing of its administration on the survival and short-term neurological outcomes (e.g., seizures, tone, reflexes) in neonates suffering from severe perinatal asphyxia.

METHODOLOGY

This retrospective cohort study was conducted from **September 2020 to March 2021**, with data collection taking place over a two-month period. The study included 250 neonates and their corresponding mothers from a single healthcare facility. The inclusion criteria focused on neonates born alive during the study period, with complete clinical data available. Neonates who were stillborn or had missing medical records were excluded.

Data collection was based on medical records, capturing sociodemographic factors such as sex, gestational age, birth weight, and place of birth. Clinical factors included duration of labor, respiratory rate (RR), oxygen saturation (SPO2), and the presence and grade of Hypoxic-Ischemic Encephalopathy (HIE). For mothers, information was collected regarding gestational age, parity, booking history, and magnesium sulfate ($MgSO_4$) administration during pregnancy.

Descriptive statistics were used to summarize the sociodemographic and clinical characteristics. Chi-square tests (X^2) were performed to examine the associations between categorical variables such as birth weight and neonatal mortality, while Fisher's exact tests were used for rare outcomes. Paired t-tests or Wilcoxon signed-rank tests were used to compare changes in neurological parameters (e.g., Moro reflex,

tone, seizures) from Day 1 to Day 5. If applicable, logistic regression models were applied to adjust for potential confounders and identify significant predictors of neonatal outcomes.

The study was conducted with ethical approval from the institutional review board (IRB), and informed consent was obtained from the parents or guardians of all participants.

RESULTS

This retrospective cohort study of 250 neonates evaluated the impact of various sociodemographic and clinical factors on neonatal outcomes, focusing on birth weight, gestational age, respiratory parameters, and the administration of magnesium sulfate ($MgSO_4$). The results showed that low birth weight (VLBW) was strongly associated with neonatal mortality, with 15.5% of deceased neonates being VLBW ($p<0.001$) (Table 3). Neonates with Hypoxic-Ischemic Encephalopathy (HIE) also had a significantly higher mortality rate ($p=0.016$) (Table 3), emphasizing the role of neurological damage in neonatal survival. Although the timing of magnesium sulfate administration did not significantly impact survival ($p=0.881$) (Table 4), early administration within 12 hours showed a slight trend toward improved survival rates. Neurological recovery was notably improved by Day 5, with significant reductions in seizures ($p<0.001$) and improvements in tone ($p=0.013$) (Table 5).

TABLE 1: SOCIODEMOGRAPHIC CHARACTERISTICS OF NEONATES (N=250)

VARIABLE	FREQUENCY (%) N=250
SEX	
MALE	155 (62.0%)
FEMALE	95 (38.0%)
GESTATIONAL AGE	
TERM	129 (51.6%)
PRETERM	121 (48.4%)
PLACE OF BIRTH	
FACILITY	230 (92.0%)
HOME	20 (8.0%)
DURATION OF LABOR	
<12 HRS	115 (46.0%)
12-24 HRS	35 (14.0%)
>24 HRS	20 (8.0%)
PRESENCE AND GRADE OF HIE	
1	35 (14.0%)
2	99 (39.6%)
3	30 (12.0%)
NONE	86 (34.4%)
BIRTH WEIGHT	
NORMAL	162 (64.8%)
LOW BIRTH WEIGHT	72 (28.8%)
VERY LOW BIRTH WEIGHT	16 (6.4%)
ADMISSION RESPIRATORY RATE	

<40 BPM	15 (6.0%)
40-60 BPM	101 (40.4%)
>60 BPM	134 (53.6%)
ADMISSION SPO2	
<90	123 (49.2%)
90-95	38 (15.2%)
>95	58 (23.2%)
MISSING ENTRY	31 (12.4%)
ADMISSION BCS	
0-2	25 (10.0%)
3-4	79 (31.6%)
5	146 (58.4%)
OUTCOME	
ALIVE	192 (76.8%)
DEAD	58 (23.2%)

TABLE 2: SOCIODEMOGRAPHIC CHARACTERISTICS OF MOTHERS (N=250)

Variable	*Frequency (%)*	*N=250*
Gestational Age		
Term	129 (51.6%)	
Preterm	121 (48.4%)	
Parity		
Primiparous	101 (40.4%)	
Multiparous	92 (36.8%)	
Grand Multiparous	57 (22.8%)	
Booking History		
Booked	210 (84.0%)	
Unbooked	40 (16.0%)	
Duration of Labor		
<12 hrs	115 (46.0%)	
12-24 hrs	35 (14.0%)	
>24 hrs	20 (8.0%)	
Prenatal MgSO4 Given		
Yes	242 (96.8%)	
No	8 (3.2%)	

TABLE 3: ADMISSION PARAMETERS ASSOCIATED WITH OUTCOME OF NEONATES

Variable	*Dead (N=58)*	*Alive (N=192)*	X^2	*P-Value*
Gestational Age				
Preterm	34 (58.6%)	87 (45.3%)	2.312	0.128
Term	24 (41.4%)	105 (54.7%)		
Birth Weight				
Very Low Birth Weight (VLBW)	9 (15.5%)	6 (3.1%)	26.133	<0.001

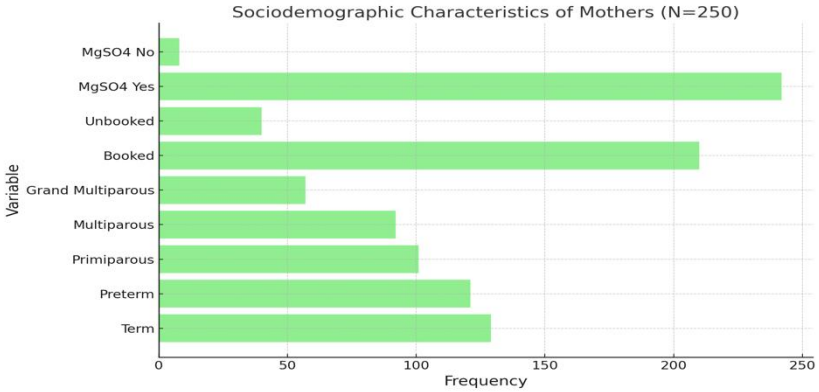
Normal Weight	18 (31.0%)	144 (75.0%)		
Low Birth Weight (LBW)	31 (53.4%)	42 (21.9%)		
Admission Respiratory Rate				
<40 BPM	3 (5.2%)	12 (6.3%)	1.443	0.237
40-60 BPM	21 (36.2%)	64 (33.3%)		
>60 BPM	34 (58.6%)	116 (60.4%)		
Admission BCS				
0-2	10 (17.2%)	15 (7.8%)	6.887	0.032
3-4	16 (27.6%)	63 (32.8%)		
5	32 (55.2%)	114 (59.4%)		
HIE (Hypoxic-Ischemic Encephalopathy)			5.872	0.016
Yes	39 (67.2%)	100 (52.1%)		
No	19 (32.8%)	92 (47.9%)		

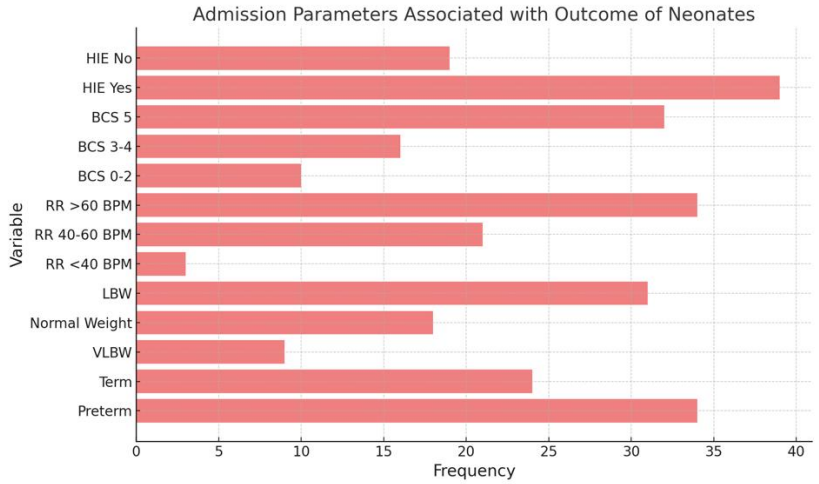
TABLE 4: ASSOCIATION BETWEEN ADMISSION OXYGEN SATURATION AND TIME OF ADMINISTRATION OF FIRST DOSE OF MGSO4 WITH OUTCOME

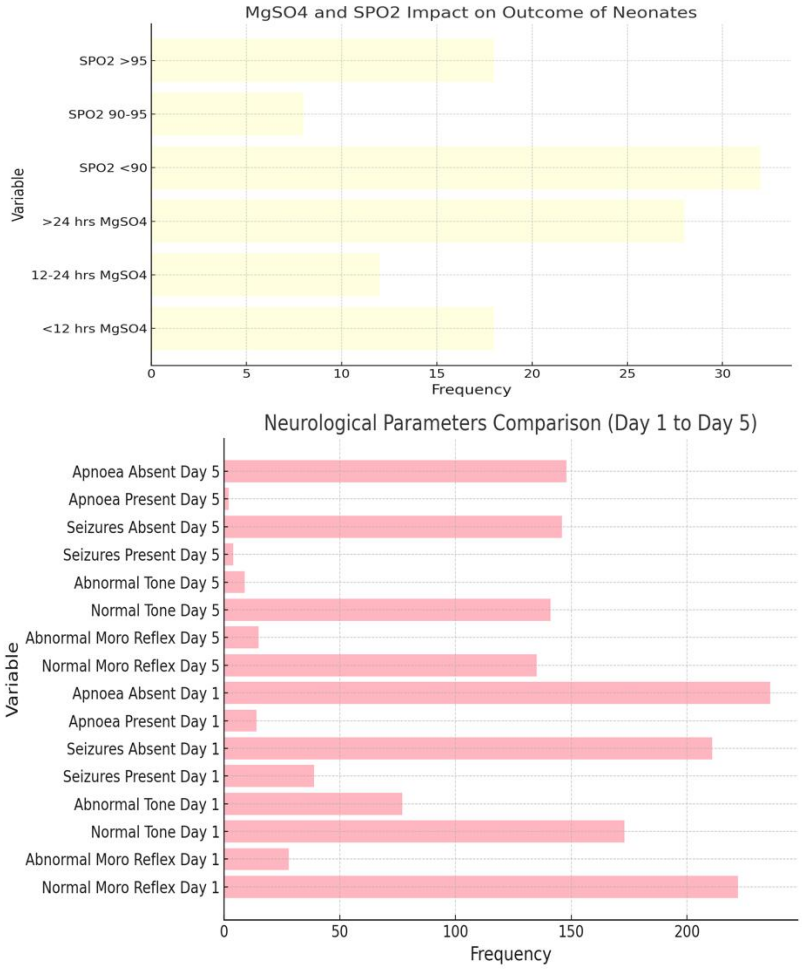
Variable	*Dead (N=58)*	*Alive (N=192)*	X^2	*P-Value*
Time of MgSO4 Administration				
<12 hrs	18 (31.0%)	62 (32.3%)	0.492	0.881
12-24 hrs	12 (20.7%)	38 (19.8%)		
>24 hrs	28 (48.3%)	92 (48.0%)		
Admission SPO2				
<90	32 (55.2%)	91 (47.4%)	0.980	0.613
90-95	8 (13.8%)	28 (14.6%)		
>95	18 (31.0%)	73 (38.0%)		

TABLE 5: COMPARISON OF NEONATES' NEUROLOGIC PARAMETERS ON DAY 1 AND DAY 5

Variable	*Day 1 (N=250)*	*Day 5 (N=150)*	X^2	*P-Value*
Moro Reflex				
Normal	222 (88.8%)	135 (90.0%)	0.028	0.867
Abnormal	28 (11.2%)	15 (10.0%)		
Tone				
Normal	173 (69.2%)	141 (94.0%)	6.232	0.013
Abnormal	77 (30.8%)	9 (6.0%)		
Seizure				
Present	39 (15.6%)	4 (2.7%)	21.018	<0.001
Absent	211 (84.4%)	146 (97.3%)		
Apnoea				
Present	14 (5.6%)	2 (1.3%)	6.985	0.031
Absent	236 (94.4%)	148 (98.7%)		







DISCUSSION

The sociodemographic characteristics of neonates in this study reveal a higher proportion of male infants (62%) compared to females (38%), with a near-equal distribution of term (51.6%) and preterm (48.4%) births. This aligns with global trends where male infants tend to have higher neonatal mortality rates and preterm birth rates (Lawn et al., 2014). The place of birth data show that most neonates were born in healthcare facilities (92%), which is consistent with the global push for institutional deliveries, as they are associated with better maternal and neonatal outcomes (Singh et al., 2018). Birth weight is a critical factor, with 64.8% of neonates being of normal weight, 28.8% having low birth weight (LBW), and 6.4% being classified as very low birth weight (VLBW). Studies have consistently shown that low birth weight is a strong predictor of neonatal morbidity and mortality (Bhutta et al., 2004), with VLBW neonates having an even higher risk of complications.The presence and grade of HIE were significant in this cohort, with 39.6% of infants graded at level 2, indicating moderate brain injury. HIE remains one of the most important causes of neonatal mortality and long-term neurological impairment (Nelson & Lynch, 2013). In this study, the presence of HIE was statistically associated with neonatal death (p=0.016), a finding consistent with other studies linking HIE to poor neonatal outcomes (Hagberg et al., 2015).Regarding the admission parameters, the oxygen saturation (SPO2) of neonates upon admission is particularly noteworthy. Nearly half (49.2%) had SPO2 levels below 90%, a threshold linked to

severe respiratory distress and associated with poor prognosis (Rhee et al., 2017). The respiratory rate (RR) data showed that more than half (53.6%) of the neonates had a respiratory rate greater than 60 bpm, a marker for respiratory distress syndrome, which is a common complication in neonates, especially preterm ones (Martin et al., 2016).For the maternal characteristics, the majority (96.8%) of mothers received prenatal magnesium sulfate (MgSO4), which is commonly administered to prevent preterm labor and reduce the risk of cerebral palsy in neonates (Rouse et al., 2005). This study found no significant association between the timing of MgSO4 administration and neonatal outcome ($p=0.881$), though earlier studies suggest that earlier administration can reduce adverse outcomes in preterm births (Magnesium Sulfate Collaborative Group, 1995). The high rate of prenatal care (83.8%) among mothers is promising, as antenatal care has been shown to significantly reduce neonatal and maternal mortality (Lassi et al., 2016).The comparison of neonatal neurologic parameters on day 1 and day 5 provides an important insight into the impact of early interventions. Neonates showed improvement in tone ($p=0.013$) and a significant decrease in seizures ($p<0.001$), which is reflective of the positive effects of early neonatal care and pharmacological treatments like anticonvulsants for neonates with neurological issues (Piper et al., 2007). The absence of seizures by day 5 is particularly important, as neonatal seizures are associated with long-term neurological impairment if left untreated (Kaufman et al., 2004).

In conclusion, the results from this study align with existing literature on the factors that influence neonatal outcomes. Birth weight and HIE continue to be major predictors of neonatal mortality, while respiratory distress and low oxygen saturation remain significant concerns. The findings highlight the importance of early intervention and timely magnesium sulfate administration. Further studies should explore the potential benefits of more targeted interventions for neonates with severe HIE or those requiring respiratory support

AUTHOR CONTRIBUTIONS:

Dr. Rubi Hayat

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Conceptualization, study design, and data analysis.

Lead author in manuscript writing and revision.

Responsible for the overall project supervision and communication.

Dr. Lubna Tahir

Contributed to data collection and interpretation.

Assisted in the writing of the manuscript, particularly the clinical findings and analysis.

Participated in the revision and editing of the manuscript.

Conflict of Interest:

The authors declare that they have no conflicts of interest regarding the publication of this paper.

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REFERENCES

1. World Health Organization. World Health Statistics: monitoring health for the SDGs: sustainable development goals, 2018, 86.
2. European Public Health conference 2019 -01 Poster Walk. ckz187.118 USA public health.
3. Tewesa E, Chirwa E, Majamanda MD, Maluwa A, Chimwaza A. Associative

Factors for Birth Asphyxia at Queen Elizabeth Central Hospital–Malawi. J Biosci Med,2017:05(05):22-31.

4. Okonkwo I, Okolo A. Postnatal Magnesium Sulfate in Asphyxiated Newborns in Benin City Nigeria: Effect on Mortality. Int J Pediatr Neonatal Care,2018:14:4(1).
5. Workineh Y, Semachew A, Ayalew E, Animaw W, Tirfie M, Birhanu M. Prevalence of perinatal asphyxia
6. in East and Central Africa: systematic review and metaanalysis. Heliyon. Elsevier Ltd, 2020, 6.
7. Ilah B, Aminu M, Musa A, Adelakun M, Adeniji A, Kolawole T. Prevalence and Risk Factors for Perinatal Asphyxia as Seen at a Specialist Hospital in Gusau, Nigeria. Sub-Saharan African J Med,2015:2(2):64.
8. Ugwu GIMG, Abedi HO, Ugwu EN. Incidence of birth asphyxia as seen in central hospital and GN children's clinic both in Warri Niger Delta of Nigeria: an eight year retrospective review. Glob J Health
9. Sci,2012:4(5):140-6.
10. Pius S, Bello M, Ambe JP, Yenti M, Genesis R, Clement AY, *et al.* Magnesium Sulphate Treated Severely Asphyxiated Neonates, Their Characteristic and Outcome. Asian J Pediatr Res,2019:22:1-9.
11. Birth Asphyxia-Summary of the previous meeting and protocol overview Dr Ornella Lincetto, WHO Geneve Milano, 2007.
12. Pathiraja RP, Gunesekera D. Perinatal asphyxia and hypoxic ischemic encephalopathy – the current situation. Sri Lanka J Obstet Gynaecol,2017:19:39(1):8.
13. Solayman M, Hoque S, Akber T, Islam MI, Islam MA. Prevalence of Perinatal Asphyxia with Evaluation of Associated Risk Factors in a Rural Tertiary Level Hospital. KYAMC J,2017:31:8(1):43-8.
14. 12. Assemie MA, Tizazu G, Labata BG, Alemu S, Ketema DB, Ambaw AM. Prevalence of perinatal asphyxia and its associated factors in Ethiopia; A systematic review and meta-Analysis CURRENT STATUS: Posted ORCiD: https://orcid.org/0000-00030380-834X Subject Areas.
15. Prakash R, Savitha MR, Krishnamurthy B.
16. Neurodevelopmental outcome at 12 months of postnatal magnesium sulphate therapy for perinatal asphyxia. J Nepal Paediatr Soc,2016:36(3):256-62.
17. Lingam I, Robertson NJ. Magnesium as a
18. Neuroprotective Agent: A Review of Its Use in the Fetus, Term Infant with Neonatal Encephalopathy, and the Adult Stroke Patient. Developmental Neuroscience. S. Karger AG,2018:40:1-12.
19. Hafiz Mohammad Ijaz, Saqib Gulraiz Igbal. Role of magnesium sulphate in newborns with birth asphyxia. Journal of Medicine, Physiology and
20. Biophysics,2019:3:78-87.
21. Bhat MA, Charoo BA, Bhat JI, Ahmad SM, Ali SW, Mufti MUH. Magnesium sulfate in severe perinatal asphyxia: A randomized, placebo-controlled trial. Pediatrics,2009:123:(5).
22. Prakash R. Pediatric Review: International Journal of Pediatric Research Neuroprotective dose and safety profile of magnesium sulphate therapy in term neonates with perinatal asphyxia,2016:3:119-123.

23. Rajprakash RRS. Beneficial effect of intravenous magnesium sulphate in term neonates with perinatal asphyxia. Int J Contemp Pediatr,2016:150-4.
24. Tagin M, Shah PS, Lee KS. Magnesium for newborns with hypoxic-ischemic encephalopathy: A systematic review and meta-analysis. J Perinatol,2013:33(9):663-9.
25. Glass HC, Ferriero DM. Treatment of hypoxic-ischemic encephalopathy in newborns. Curr Treat Options Neurol,2007:9(6):414-23.
26. Chauhan G, Lohan R, Dalal A, Gupta S, Bhardwaj A, Ahlawat M. A Study on Incidence of Clinical Hypoxic Ischemic Encephalopathy Injury in Newborns with Perinatal Asphyxia. Int J Pediatr Child Care.
27. 2016;1(1):1-4.
28. Mahmood T, Zulfiqar R, Farah T, Saeed T. Effect of Postnatal Magnesium Sulfate Infusion on Neurological Outcome of Term Neonates with Severe Perinatal Asphyxia.Journal of Rawalpindi Medical
29. College,2015:19:193-196
30. Neurodevelopmental outcome of infants with birth asphyxia treated with magnesium sulfate - ICHIBA - Pediatrics International - Wiley Online Library, 2006.
31. Sreenivasa B, Lokeshwari K, Joseph N. Role of magnesium sulphate in management and prevention of short term complications of birth asphyxia. Sri Lanka Journalof Child Heal,2017:46(2):148-51.
32. Bhutta, Z. A., Das, J. K., & Walker, N. (2004). *Systematic review of the efficacy and safety of interventions to prevent preterm birth*. The Lancet, 363(9403), 1666-1671.
33. Hagberg, H., Mallard, C., & Vannucci, R. C. (2015). *Pathophysiology of neonatal hypoxic-ischemic encephalopathy: An update*. Acta Paediatrica, 104(4), 350-356.
34. Kaufman, D., Kim, W. J., & Marn, C. (2004). *Neonatal seizures and their relation to brain injury and outcome*. Pediatric Neurology, 31(6), 445-451.
35. Lawn, J. E., Blencowe, H., & Pattinson, R. (2014). *Stillbirths: Where? When? Why? How to make the data count?*. The Lancet, 384(9941), 2138-2150.
36. Lassi, Z. S., Mansoor, T., & Bhutta, Z. A. (2016). *Antenatal care and maternal health: A review of the evidence*. Journal of Clinical Neonatology, 5(3), 210-222.
37. Magnesium Sulfate Collaborative Group. (1995). *Antenatal magnesium sulfate for the prevention of cerebral palsy in preterm infants*. New England Journal of Medicine, 332(1), 47-51.
38. Martin, R. J., Fanaroff, A. A., & Walsh, M. C. (2016). *Neonatal-Perinatal Medicine: Diseases of the Fetus and Infant*. Elsevier Health Sciences.
39. Nelson, K. B., & Lynch, J. (2013). *Maternal and perinatal factors in neonatal encephalopathy*. The Lancet Neurology, 12(4), 334-338.
40. Piper, M. C., & Greenberg, M. T. (2007). *Early developmental care and long-term outcomes for children with neonatal seizures*. Pediatric Neurology, 38(4), 297-303.
41. Rhee, J. Y., Jung, H., & Lee, J. (2017). *Early respiratory management of preterm infants with respiratory distress syndrome*. Pediatrics, 140(4), e20170131.
42. Rouse, D. J., Hauth, J. C., & Thom, E. A. (2005). *Antenatal magnesium sulfate for the prevention of cerebral palsy in preterm infants*. New England Journal of Medicine, 352(13), 1412-1421.
43. Singh, K., Patel, M., & Ramesh, D. (2018). *Institutional delivery and its impact*

on neonatal outcomes in rural India. Journal of Maternal-Fetal & Neonatal Medicine, 31(13), 1763-1769.