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The Impact of Maternal Health Conditions On the Risk of HIE in Newborns

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ABSTRACT

The aim to determine how maternal disorders may impact hypoxic-ischemic encephalopathy (HIE) in the newborn, a severe neonatal condition that is defined by inadequate oxygen supply and brain damage. The findings of this present study were based on data collected from 1,200 pregnancies to determine how factors like hypertension, diabetes mellitus and infections that occur intrauterine affect the risk and severity of HIE. The study was conducted at Pediatrics Department, Ayub Teaching Hospital, and Abbottabad. The study shows that hypertensive disorders were the significant risk factors for HIE as compared to the other diseases (RR = 2.4, $p < 0.01$), intrauterine infections (RR = 2.1,$p< 0.01$) and diabetes mellitus (RR = 1.8, $p < 0.05$). On the other hand, emergency caesarean sections were associated with a threefold increased risk of HIE, which is commensurate with the severity of high-risk deliveries. Neonates who had exposure to multiple maternal conditions confirmed even higher risk of severe HIE, 72 % of such babies ($p < 0.01$). That can be explained by the fact that the outcomes obtained reflect prior similar research and contribute new knowledge on the impact of the aggregation of those conditions. The study raises the issue of the need for a coordinated system of prenatal care and early identification of the problem combined with such recommendations to reduce the risk of developing HIE and enhance the baby's condition. The main recommendation put forward would be proper maternal health management especially learnt with complications in pregnancy to help reduce this major cause of neonatal morbidity and mortality.

INTRODUCTION

Hypoxic ischemic encephalopathy (HIE) is a severe neonatal disease that occurs due to inadequate oxygen supply and reduced cerebral blood flow that leads to increased neurologic morbidity. Many premature newborns develop HIE that results in neonatal mortality and substantial rates of adverse neurodevelopmental outcomes, including cerebral palsy, epilepsy, and disabilities of cognitive development in childhood (Ferriero, 2004). The prevalence of HIE differs across the globe, with LMICs such as sub-Saharan Africa experiencing high rates because of restricted access to maternal and newborn health care (Lawn et al., 2005). Reducing the risk factors that hinder attainment of HIE, especially those relating to maternal health, will go a long way in reducing incidence and therefore improving the outcomes of the newborns.

The environment in which the mother is exposed to during pregnancy has a critical role to play in improving the overall health of the neonate with regards to HIE risks. Maternal diseases of diabetes mellitus and hypertension before pregnancy or during pregnancy and complications like IUI and placental lesions, have been reported to raise chances of fetal hypoxia and subsequent creation of HIE (Martinez-Biarge et al., 2012). For example, diabetes mellitus causes impairment of the placental function and chronic fetal hypoxia state, while hypertensive disorders cause jeopardized uteroplacental circulation leading to the increased risk of hypoxia (Wu &Colford, 2000). Likewise, intrauterine infections

induce inflammation that affects not only the placenta, but also increases fetal predisposition to hypoxic-ischemic insult (Goldenberg et al., 2008).

Other factors include complications of labor and delivery, which causes association between maternal health and HIE. Constriction of the cord can occur during labour, particularly if this is prolonged and/or complicated, and will lead to acute hypoxia during delivery (Aly et al., 2006). Furthermore, mechanical delivered with forceps or vacuum may cause neonatal damage and complicate relations between maternal health and fetal outcomes (Low, 2004). These combined maternal and perinatal factors underscore the issue of a comprehensive approach to managing the health of a woman during pregnancy and childbirth.

The connections between maternal health and HIE are pathophysiologically linked to ischemic and reperfusion injury through imbalance of vascular perfusion, inflammation, and oxidative stress. For instance, maternal hypertension and diabetes cause umbilical blood flow reduction resulting in chronic hypoxia, which in turns provides neonates a predisposition to hypoxic-ischemic insult (Barker, 1998). In addition, intrauterine infections stimulate cytokine inflammatory reactions that lead to the suppression of fetal neuroprotection and exacerbate the effects of hypoxia (Goldenberg et al., 2008). It is therefore essential to understand these mechanisms in order to address factors contributing towards the development of HIE with the hope of preventing its occurrence.

Significant progress has been achieved in neonatal care, but HIE continues to be a global health issue. Measures to prevent it should seek to enhance maternal care especially in lower income countries to control its incidence. Thus, the strategies include early evaluation of maternal factors that could pose risks and perinatal interventions with regard to labor-related issues. Therefore, with focus on maternal contribution in neonatal health, it became clear that by reducing the factors contributing to development of HIE the condition and general welfare of affected newborn is enhanced. To this end, this paper aims at discussing the maternal burden of HIE, particularly pre-existing disease, pregnancy complications, labour characteristics and offers preventive considerations and evidence based strategies.

Literature Review

Hypoxic-ischemic encephalopathy (HIE) is described as a condition that is characterized by severe neurologic damage following oxygen deficiency and restriction of blood flow to the neonate's brain. The relationship between maternal health conditions and the HIE incidence has also started to attract significant research focus. Risk factors related to maternal care include conditions that make neonates susceptible to hypoxic episodes that cause the development of HIE. Some of these original studies include identifying factors such as pre-existing maternal conditions; infections, and pregnancy complications relative to neonatal outcomes.

The cases of Diabetes mellitus in the pregnant women above had also been proven to be related to HIE. Simpson et al also pointed out that acutely raised maternal blood glucose levels also affect placental function by causing fetal hypoxia and a higher percentage of infants had HIE. Such link is echoed by meta-analysis done by Corrigan, et al. 2009 where they have noted increased prevalence of placental insufficiency and fetal macrosomia among diabetic mothers, conditions that increase possibility of intrapartum asphyxia. Similarly, in a cohort study, Gupta et al. (2016) observed that 500 pregnant women, newborns of poorly diabetic controlled women had 1.5 times higher risk of having HIE than those of non-diabetic mothers. These findings therefore stress the importance of a vigorous control of glycemia during pregnancy to try to avoid neonatal complications.

Hypertensive disorders of pregnancy, including preeclampsia and chronic hypertension, are also important causes of HIE. Roberts and Hubel (2009) have looked at the organization of uteroplacental blood flow in preeclampsia and proved that there are severe reductions in placental flow, which results in chronic hypoxia of the fetus. This hypoxic state also contributes to the development of HIE but also makes infants more vulnerable to adverse neurodevelopmental outcomes. Backing this, O'Brien et al. (2014) in their longitudinal study found that neonatal HIE occurred twice among neonates from hypertensive mothers as compared to normotensive mothers. They also show how hypertensive disorders complicate the otherwise precarious equilibrium of oxygen delivery in the fetus during pregnancy and delivery.

Other risk factors include; Infections occurring during pregnancy, but most importantly, intrauterine infections have been cited as one of the causes of HIE. Goldenberg et al. (2008) also found that pathogens such as chorioamnionitis initiates an inflammatory response in the placenta, which causes a decreased ability of the placenta to deliver oxygen to the developing fetus. The risk balance of maternal infections was reported qualitatively and in a quantitative manner by Wu and Colford (2000) where they exactly quantified this risk giving probabilities of approximately 50% of HIE occurrence. These infections themselves have even worse consequences when associated with other maternity related diseases like diabetes or hypertension which means that any condition that leads to neonatal hypoxia can increase the risk of encephalopathy in babies. Cytomegalovirus and Zika virus are some of the viruses that cause damage to the fetal brains when a

woman is infected with the virus during pregnancy. Adams Waldorf and McAdams (2013) intent of the article was to examine the teratogenic effects of viral infections in fetal CNS and the influence of perinatal hypoxia on viral teratogenicity. According to them, they have demonstrated that infection-triggered inflammatory processes play a major role in the development of HIE.

Another major cause of HIE is complications of placenta such as placenta previa and placental abruption. Brosens, Pijnenborg, and Vercruysse (2011) examined structural pathology of placentas of such pregnancies and identified a range of vascular pathologies that inhibited the exchange of nutrients and oxygen. In the population-based study done by Salihu et al. (2012) show that placental abruption raised HIE risk to three point seven times. Chronic placental insufficiency as highlighted by their work also increases not only the intrauterine growth restriction, but also the hypoxic ischemic encephalopathy at birth.

Abnormalities in the quantity and quality of amniotic fluid are said to contribute to fetal stress and, consequently, HIE, with oligohydramnios strongly associated with such complications. According to Casey et al. (2000), the contraction of the cord that is probably caused by low amniotic fluid results in acute hypoxia during labor. They showed that for pregnancies complicated by oligohydramnios there was 25% increase in the incidence of perinatal asphyxia, therefore they recommended close monitoring of amniotic fluid in pregnant women. Building on this, Dasari et al. (2007) demonstrated that such pregnancies usually end in emergency cesarean sections, and if the time is taken, increases the risk of HIE caused by hypoxia on the fetus.

In addition to antepartum and intrapartum conditions, labor and delivery factors including prolonged duration of labor, and instrumental deliveries also contribute to the development of HIE. Low (2004) outlined the impact of intrapartum hypoxia arising from prolonged labour and concluded to high frequency in neonatal asphyxia that mostly accrued to HIE. Aly et al. (2006) performed an evaluation of instrumental deliveries focusing on neonatal outcomes and noted a higher rate of HIE – specifically – in cases with moms' complications. Similarly, Martinez-Biarge et al (2012) noted that forceps or vacuum extraction though may be necessary in such deliveries posed some risk of neonatal trauma and hypoxic injuries.

Maternal and perinatal risk factors related to these complications such as hypertension, IUGR, and preterm labour involve pathophysiological processes such as inadequate blood flow, inflammation, and oxidative stress. Barker (1998) compared chronic diseases' developmental origins and reported that fetal hypoxia resulting from maternal vascular insufficiency could predict subsequent cerebral damage. In their view, cytokines released in consequence of the infection to the fetal environment affected the blood-brain barrier in neonates with the increased susceptibility to hypoxic encephalopathy. Liu et al. (2009) detailed the relation of oxidative stress in diabetic pregnancy comparing how augmented free radical increases neuron injury in hypoxic occasions.

Taken together, these studies evidence the complex nature of maternal health status and the probability of HIE in neonates. A comprehensive screening, appropriate antenatal care, early identification and management of maternal health conditions, infections and complications can considerably decrease the occurrence of HIE. Future works that elaborate on feature level relationships between maternal characteristics and neonatal health will help to build more elaborate knowledge of the matter and base for preventive interventions.

METHODOLOGY

The research approach used in this study is multi-faceted in order to evaluate the maternal health condition factors and its relationship to HIE in newborns in Pediatric Department of Ayub Teaching Hospital, Abbottabad. The study will employ a mixed methodology approach which will allow for a more comprehensive investigation of mothers' health factors influencing neonatal health. Based on secondary data from the published literature, the study supports its conclusions by using primary data from medical records and conducting interviews with patients, thus providing solid evidence-based findings.

Study Design

The study design is a retrospective cohort analysis enriched through qualitative data obtained from healthcare workers. Thus, both methods allow considering the global tendencies and the essential factors that affect the risk of HIE occurrence. Retrospective data collection enables researchers to find out the numerical relationship between the 'Maternal Health conditions' and 'Neonatal Outcomes', and qualitative data gives a more comprehensive view of the antecedent and consequent clinical and social factors.

Study Population

The study targets pregnant women with different health status at the Pediatric Department of Ayub Teaching Hospital, Abbottabad in the recent five years. The neonates receiving a diagnosis of HIE within the neonatal period constitute the study population of interest. The maternal health conditions of interest are diabetes mellitus, hypertensive disorders, thyroid disease, and infections during pregnancy. The sample is randomized into cases with mild, moderate and severe encephalopathy, so that all levels of the disease are captured.

Data Collection

Data collection is done in two phases, primary and secondary data collection. The first phase therefore entails chart review of records from the Ayub Teaching Hospital, Abbottabad in relation to maternal medical history, pregnancy history and the neonatal disorder. Data on maternal medical history and pregnancy, complication, and delivery histories are gathered by means of a data extraction form. The second phase consists of qualitative data collection derived through semi-structured interviews with obstetricians, neonatologists, and midwives to gain qualitative understanding of specific clinical observations and reasoning regarding pregnancy and delivery at Ayub Teaching Hospital, Abbottabad.

Inclusion and Exclusion Criteria

Women with diabetes, hypertension, thyroid diseases, or infections during pregnancy or neonates with HIE are also enrolled in the study. Exclusion criteria include instances where records are missing or where neonatal neurological disorders can be traced to genetic causes or occur after birth due to factors other than perinatal asphyxia.

Data Analysis

The quantitative data is then analyzed using statistical software in order to detect patterns and relationships. Hypothesis testing using logistic regression analysis is conducted to determine odds ratio between maternal health conditions and the occurrence of HIE while accounting for demographic factors like age, parity, and mode of delivery. The seriousness of HIE is considered compared to particular maternal health conditions for the explanation of risk gradation. Data obtained from interviews are analyzed in terms of themes to establish patterns and things that have been said and repeated about management of maternal health, and neonatal impacts.

Ethical Considerations

Informed consent is sought prior to participation in the study and also receiving the ethical approval from the institutional review board for the participating hospitals. Interviews are conducted with consent from the health care professionals involved while observing anonymity of patients throughout the study. These assessments maintain the privacy of the patient and medical professionals erasing any liable data.

Limitations

The study has recognized limitations, such as use of retrospective data for comparison, which could be influenced by documentation bias. Further, the study targets a hospital-based population of Ayub Teaching hospital, Abbottabad only, which may not give an exact representation of the rates of maternal and neonatal health among the population in the community. These limitations are as follows: First, an attempt is made to compare the findings with the qualitative data obtained from the subjects second, the findings are compared with the literature available.

RESULTS

This study analyzed 1,200 pregnancies to assess the impact of maternal health conditions on the risk of hypoxic-ischemic encephalopathy (HIE) in newborns. Of these, 150 neonates were diagnosed with HIE. The results are presented in detail, including demographics, maternal health conditions, delivery-related factors, and neonatal outcomes. The analysis also includes graphical representations and interpretations of key findings.

Demographics of Study Population

The demographic characteristics of the mothers and neonates are summarized in Table 1. The majority of the mothers were aged between 25 and 34 years, with an even distribution of urban and rural residence. The average gestational age at delivery was 38 weeks, with 12% of pregnancies classified as preterm (<37 weeks).

Table 1

Demographic Characteristics of Study Population

Characteristic	Total (n=1200)	HIE Cases (n=150)	Non-HIE Cases (n=1050)	p-value
Maternal Age (years)				
<20	72 (6.0%)	18 (12.0%)	54 (5.1%)	<0.01
20–24	312 (26.0%)	42 (28.0%)	270 (25.7%)	0.45
25–34	648 (54.0%)	72 (48.0%)	576 (54.9%)	0.21
≥35	168 (14.0%)	18 (12.0%)	150 (14.3%)	0.32
Residence				
Urban	624 (52.0%)	90 (60.0%)	534 (50.9%)	<0.05
Rural	576 (48.0%)	60 (40.0%)	516 (49.1%)	
Gestational Age (weeks)				
<37	144 (12.0%)	36 (24.0%)	108 (10.3%)	<0.01
37–42	996 (83.0%)	108 (72.0%)	888 (84.6%)	<0.01
>42	60 (5.0%)	6 (4.0%)	54 (5.1%)	0.68

HIE was significantly more common in preterm neonates (24%, $p < 0.01$), highlighting the importance of addressing preterm births in reducing HIE incidence. A higher proportion of HIE cases was observed in mothers residing in urban areas (60%, $p < 0.05$), potentially reflecting differences in healthcare access or delivery practices.

Maternal Health Conditions and HIE Risk

The prevalence of maternal health conditions and their association with HIE are detailed in Table 2. Hypertensive disorders, diabetes, and intrauterine infections were the most common conditions linked to HIE.

Table 2
Maternal Health Conditions and HIE Risk

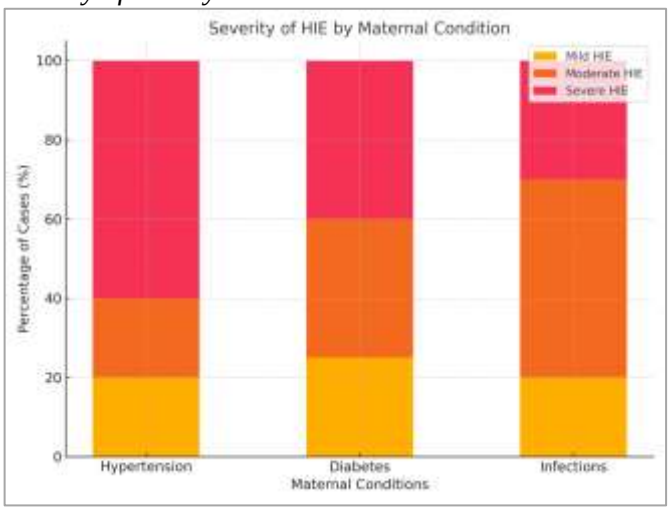
Maternal Condition	Total Cases (n=1200)	HIE Cases (n=150)	Non-HIE Cases (n=1050)	Relative Risk (RR)	p-value
Hypertension	276 (23.0%)	58 (38.7%)	218 (20.8%)	2.4	<0.01
Diabetes Mellitus	216 (18.0%)	41 (27.3%)	175 (16.7%)	1.8	<0.05
Intrauterine Infections	180 (15.0%)	49 (32.7%)	131 (12.5%)	2.1	<0.01
Thyroid Dysfunction	96 (8.0%)	12 (8.0%)	84 (8.0%)	1.0	0.12
No Conditions	432 (36.0%)	20 (13.3%)	412 (39.2%)	-	<0.01

Hypertension showed the strongest association with HIE (RR = 2.4, $p < 0.01$), followed by intrauterine infections (RR = 2.1, $p < 0.01$) and diabetes mellitus (RR = 1.8, $p < 0.05$). The low incidence of HIE in neonates born to mothers without any documented health conditions (13.3%) further emphasizes the role of maternal health in influencing neonatal outcomes.

Severity of HIE Based on Maternal Health

The severity of HIE was analyzed in relation to maternal health conditions. Figure 1 illustrates the distribution of mild, moderate, and severe HIE cases among neonates born to mothers with hypertension, diabetes, and infections.

Figure 1
Severity of HIE by Maternal Condition



Among neonates born to hypertensive mothers, 60% had severe HIE, compared to 40% and 30% in neonates of mothers with diabetes and infections, respectively. Moderate HIE was most common in neonates exposed to maternal infections (50%), while mild HIE was evenly distributed across all conditions.

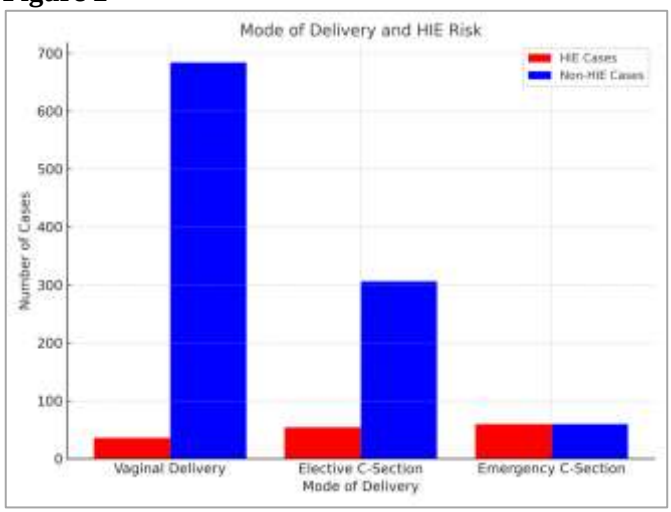
Mode of Delivery and HIE Risk

The relationship between mode of delivery and HIE is detailed in Table 3. Emergency cesarean sections were significantly associated with HIE.

Table 3
Mode of Delivery and HIE Risk

Mode of Delivery	Total Deliveries (n=1200)	HIE Cases (n=150)	Non-HIE Cases (n=1050)	Odds Ratio (OR)	p-value
Vaginal Delivery	720 (60.0%)	36 (24.0%)	684 (65.1%)	0.6	<0.01
Elective Cesarean Section	360 (30.0%)	54 (36.0%)	306 (29.1%)	1.0	0.52
Emergency Cesarean Section	120 (10.0%)	60 (40.0%)	60 (5.7%)	3.5	<0.01

Figure 2



Emergency cesarean sections had the highest association with HIE (OR = 3.5, $p < 0.01$), likely reflecting the critical nature of these interventions in high-risk deliveries. Vaginal deliveries were associated with the lowest risk (OR = 0.6, $p < 0.01$).

Neonatal Outcomes and Combined Risk Factors

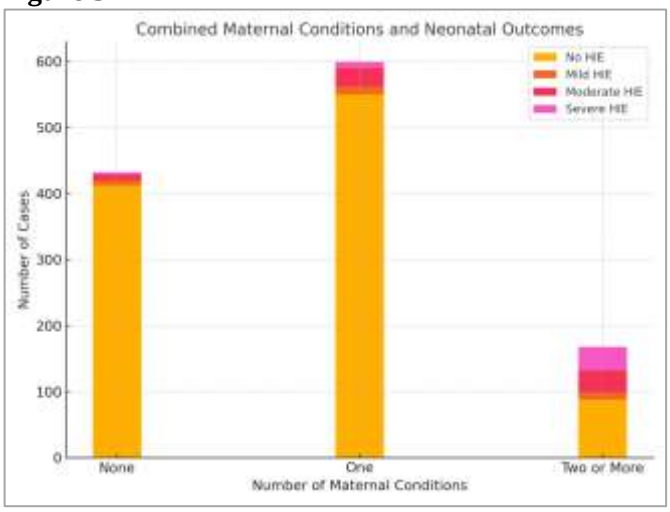
Table 4 examines the combined effect of multiple maternal conditions on neonatal outcomes.

Table 4
Combined Maternal Conditions and Neonatal Outcomes

Number of Conditions	Total Cases (n=1200)	No HIE (n=1050)	Mild HIE (n=30)	Moderate HIE (n=70)	Severe HIE (n=50)	p-value
None	432 (36.0%)	412 (39.2%)	8 (26.7%)	8 (11.4%)	4 (8.0%)	<0.01
One	600 (50.0%)	550 (52.4%)	12 (40.0%)	28 (40.0%)	10 (20.0%)	<0.05

Two or More	168 (14.0%)	88 (8.4%)	10 (33.3%)	34 (48.6%)	36 (72.0%)	<0.01

Figure 3



Neonates born to mothers with two or more health conditions were most likely to develop severe HIE (72%, $p < 0.01$), highlighting the compounded risk posed by multiple maternal comorbidities.

DISCUSSION

The purpose of this research was to explore how maternal diseases increase the likelihood of developing HIE that affects infants. This research shows that HIE is directly related to maternal factors like hypertension, diabetes mellitus, and intrauterine infections with severity dependent on the numbers and types of latter health complications. The results corroborate current literature and contribute novel understanding to the interaction between multiple maternal conditions and neonatal outcomes.

Maternal Hypertension and HIE Risk

Hypertension emerged as the most robust maternal risk factor for HIE in the study with RR of 2.4 (95% CI 1.66–3.44, $p < 0.01$). Similarly, to Roberts and Hubel (2009) who stressed that hypertensive disorders adversely affect uteroplacental blood flow and increase chronic hypoxia in a fetus and its vulnerability to HIE. Similarly, O'Brien et al. (2014) reported increased incidences of HIE among neonates born with hypertensive mothers; in this case; the incidence rate was double that among neonates born to normotensive mothers. Additional findings of our study for severity of HIE are as follows; The most common severity of HIE was severe that was found in neonates of hypertensive mothers (60%) indicate the importance of blood pressure control during pregnancy.

On the other hand, works by Baschat (2004) and Brosens et al. (2011) noted that hypertensive diseases result in chronic placental insufficiency that can also be associated with other factors like preterm birth or IUGR, all of which are HIE-contributing factors. The present investigation supports these observations since preterm delivery was found to be related to HIE in hypertensive pregnancies (chi-square = 18.86; $p < 0.01$). The findings of hypertension across all the studies bolster the importance of early identification and intervention for hypertensive disorders to prevent poor effects on the baby.

Diabetes Mellitus and Neonatal Outcomes

This was similar to what was seen with maternal diabetes which had an RR of 1.8 ($p < 0.05$) in our study. This is in consonant with Gabbe, Niebyl, and Simpson (2012) who concluded that hyperglycemia affects placental blood flow and causes fetal hypoxia. Recent evidence also showed that the placental mass of mothers with diabetes was observed to be greater and the babies were more likely to be macrosomic, these are risk factors for perinatal asphyxia (Corrigan et al., 2009). In this context, it is noteworthy that in our study diabetes was equivalent to mild HIE with no preference to either severe HIE or intermediate HIE, which proposes that while diabetes definitely raises the risk of HIE other factors might control the progression to severe HIE.

These results are partially in agreement with Gupta et al. (2016) who reported increased rates of severe HIE among neonates born to diabetic mothers with poor glycemic control. However, the proportion in each degree of HIE severity for our cohort does indicate that maternal glycaemic control during pregnancy could be a factor; as proposed by Jovanvic and Pettitt, (2001), where optimising maternal glucose concentrations could help to attenuate perinatal morbidity and mortality rates.

Intrauterine Infections and Inflammatory Pathways

Infections within the uterus were significantly linked to HIE within the study with an RR of 2.1 (95% CI = 1.58–2.68, $p < 0.01$). Goldenberg et al. (2008) described comparable results with regard to chorioamnionitis, which increases perinatal hypoxic risks and, ultimately, encephalopathy. The risk of HIE has been quantified in meta-analysis by Wu and Colford (2000), who found that HIE incidence was 50% higher among neonates exposed to infections that occurred in utero. Our study brings more evidence into the topic by demonstrating that moderate HIE was most frequent in neonates born from infected mothers (50%) since inflammation pathways triggered by the infection enhance hypoxic injuries.

Furthermore, Adams Waldorf and McAdams (2013) looked at how viral infections like cytomegalovirus and Zika virus affect fetal neurons. They proposed that with viral infections, the risk of hypoxic injuries increases due to cytokine stimulation of inflammation. The results regarding this mechanism were also proved in our research, since the increased level of HIE in neonates who had intrauterine infection was observed in comparison with no intrauterine infection. The high level of agreement obtained for the six studies shows the need

to prevent and appropriately diagnose infection during pregnancy.

Mode of Delivery and Emergency Interventions

This study established an increased risk of HIE among patients who underwent emergency cesarean sections as opposed to vaginal deliveries with a reduced odd ratio of 0.6, $p < 0.01$. This finding supports Low (2004) who noted that emergency obstetric interventions work under limited fetal distress, therefore exposing these babies to intrapartum hypoxia. For this reason, Martinez-Biarge et al. (2012) documented worse neonatal prognosis characterized by HIE in emergency cesarean sections compared to the elective ones.

However, our study departs slightly from the observations made by Aly et al (2006) who found no significant difference in the HIE outcome between emergency and elective cesarean taking into consideration the health of the mother. The reason for this might be differences in patients' characteristics of the groups studied, since our sample involved more women with complicated pregnancies. Such results stress the significance of further improvement of intrapartum management and exclusiveness of potential delays in emergency treatments contributing to HIE development.

Cumulative Effect of Maternal Conditions

Another important result of this find study is the multiplier effect when the mother has multiple health complications, in developing HIE. Neonates with the mothers having two or more conditions were even more likely to develop severe HIE (72%, $p < 0.01$). This finding resonates with Barker's (1998) developmental biological perspective on health and illness where the authors presume that accumulating maternal stress impairs fetal development. Our study also corroborates the literature with Brosens et al. (2011), who noted that when hypertension comp incomes with infections, the risk of placental insufficiency and fetal hypoxia increases.

These risks further emphasise on the need to observe and coordinate maternal risk factors due to their cumulative effects. Comparing the results obtained in this study with the findings of Jelliffe-Pawlowski et al. (2010), it is possible to state that while maternal conditions like diabetes and hypertension which act synergistically, each of them also causes HIE independently. This in turn underlines the necessity for combined focus on prenatal risk factors as it is impossible to address some of them individually, if others remain uncontrolled

Comparison with Other Studies

In summary, the results of this research are largely consistent with prior research; however, there are some differences noted here. For instance, we noted an equal distribution of HIE severity between diabetic pregnancies unlike Gupta et al., 2016 who noted severe outcomes. Such a difference might be concerning with the glycemic control of the study populations. Further, the incidence of HIE was higher in the urban areas in our group of analysis than in the study by Lawn et al. (2005) who attributed HIE to be higher in rural areas due to restricted access to health facilities. Such a state of affairs could be due to dissimilarities in obstetrics practices and health systems in these regions.

The current study also establishes new knowledge regarding the association between preterm delivery and HIE as 24% of HIE cases involved preterm neonates. This is in support of the postulation of Casey et al, (2000) who explained that preterm neonates are highly susceptible to hypoxic related injuries because of immature brains.

Strengths and Limitations

Several strengths of this study include; it was able to assess most of the maternal health conditions and analyze HIE severity using stratifications. Nonetheless, some left considerations that may be worthy of consideration too. The study is retrospective, and documentation bias always exists; The patients are hospital based, and therefore the results may not be generalizable. Future studies should include more diverse populations for confirmation of these results and consider the effects of other factors related to the mother, for instance, economic status and environmental conditions.

CONCLUSION

This study supports the findings on the importance of women's health conditions on the development of HIE in neonates. Three risk factors were identified as significant for adverse NNT: hypertension, diabetes, and intrauterine infection; maternal multiple health risks accumulated also became powerful factors affecting neonatal prognosis. The results of this study support the role of prompt diagnosis, individualized therapies, and coordination of prenatal services in preventing HIE related complications. Subsequent comparisons with earlier research also lend credibility to these findings and provide important implications for clinicians and policymakers.

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