Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/19700
DOI URL: http://dx.doi.org/10.21474/IJAR01/19700

RESEARCH ARTICLE

NEONATAL OUTCOMES IN INFANTS OF DIABETIC MOTHERS: FOCUS ON HYPOGLYCEMIA, RESPIRATORY DISTRESS SYNDROME AND MACROSOMIA

Dr. Chandrashekhar Koli[1], Dr. Madhusmita Nayak[2], Dr. Yash Doshi[3] and Mr. Abhiram Behera[4]

1. Associate Professor,Department of Pediatrics, Terna Medical College and Terna Specialty Hospital and Research Centre Nerul, Navi Mumbai Maharashtra, India.
2. Associate Professor, Department of Obstetrics and Gynecology, Terna Medical College and Terna Specialty Hospital and Research Centre.
3. Department of Pediatrics, Terna Medical College and Terna Specialty Hospital and Research Centre.
4. Assistant Professor (Biostatistics), Department of Community Medicine Terna Medical College.

Manuscript Info

Manuscript History
Received: 23 August 2024
Final Accepted: 25 September 2024
Published: October 2024

Key words:-
Hypoglycaemia, RDS, Macrosomia

Abstract

Background: Infants of diabetic mothers (IDMs) face heightened risks of various neonatal complications. This study evaluates the incidence of specific complications—macrosomia, hypoglycaemia, and neonatal respiratory distress syndrome (NRDS)—in this population.

Methods: A cross-sectional observational study was conducted over 1.5 years at a tertiary hospital in Mumbai. We reviewed the medical records of infants born to mothers with diabetes (both pregestational and gestational). Data on the incidence of macrosomia (birth weight >4000 grams), hypoglycaemia (blood glucose <40 mg/dL), and NRDS (diagnosed based on clinical and radiographic criteria) were collected.

Results: Among the 50 infants studied, 8% were diagnosed with macrosomia, 46% experienced hypoglycaemia, and 20% developed NRDS. The frequency of these complications was significantly higher in IDMs compared to the general neonatal population.

Conclusion: This study reveals a high incidence of macrosomia, hypoglycaemia, and NRDS in IDMs, emphasizing the need for regular antenatal follow-up and strict glycaemic control throughout pregnancy. Enhanced monitoring and management strategies are essential to mitigate these risks and improve neonatal health outcomes.

Introduction:-

Diabetes in pregnancy raises the risk of complications for both mother and fetus.[1][2] The 1988 National Maternal and Infant Health Survey found that diabetes complicated 4% of pregnancies, with 88% being gestational diabetes, 8% non-insulin dependent, and 4% insulin dependent.[3] Historically, before insulin's discovery in 1921, maternal and fetal mortality rates were as high as 65%.[4]The introduction of insulin and specialized care has led to a nearly 30-fold reduction in morbidity and mortality among infants of diabetic mothers (IDMs).[5]However, IDMs still face increased risks, including macrosomia, hypoglycaemia, and neonatal respiratory distress syndrome (NRDS).[6][7] This study aims to assess the incidence of these complications to enhance care and outcomes for IDMs.

Corresponding Author:-Dr. Chandrashekhar Koli
Address**:-**Department of Paediatrics, Terna Medical College and Terna Hospital and Research Centre, Nerul (West), Navi Mumbai-706, Maharashtra, India.

Materials and Methods:-

Study Design:
This cross-sectional observational study was conducted to assess the incidence of complications in infants born to diabetic mothers.

Setting:
Data were collected from a municipal general teaching hospital with tertiary-level NICU care in Mumbai, specializing in high-risk obstetrics.The study period spanned from March 2009 to August 2010. A total of 50 neonates born to diabetic mothers were included.

Inclusion Criteria:
1. Mothers aged 25 to 40 years.
2. Registered for antenatal care at the same hospital.
3. All types of diabetes mellitus (Type 1, Type 2, and gestational diabetes) were included.
4. Patients on treatment or not on treatment for diabetes.
5. Gestational age at delivery between 34 and 40 weeks.
6. Mode of delivery: vaginal, cesarean, or instrumental (forceps or vacuum).

Exclusion Criteria:
1. Unregistered patients.
2. Diabetic mothers with intrauterine fetal demise (IUFD) or stillbirths.
3. Diabetic mothers with gestational age less than 34 weeks.
4. Class C to RF of the Priscilla White classification.

Data Collection:
Infants were admitted to the neonatal ICU immediately after delivery. Maternal history and physical examinations were conducted to identify congenital abnormalities. Neonates were screened for hypoglycaemia, birth asphyxia, and respiratory distress syndrome (RDS) using APGAR scores at 1 minute after birth. Birth weight was measured naked using a digital scale immediately and on the second day of life. Length and head circumference were recorded with an infantometer and a non-stretchable tape, respectively, by the same clinician.

Gestational age was assessed within 12 hours using the New Ballard scoring system and compared with the last menstrual period. Infants were categorized by comparing their weights against gestational age using Indian intrauterine growth curves into appropriate for gestational age (AGA), small for gestational age (SGA), or large for gestational age (LGA). Hypoglycemia was defined as a serum glucose concentration below 40 mg/dL.

Monitoring:
Normal infants were discharged with their mothers, while those with complications such as prematurity, very low birth weight (VLBW), birth asphyxia, or RDS were admitted to the NICU. These infants were regularly monitored for progress, including weight, glucose and electrolyte levels, and medications until discharge or death. Ethical considerations led to the exclusion of complete blood picture and further blood tests for well-looking babies. The outcomes and relative frequencies of complications were analysed for the study.

Results:-

The study included 50 infants born to diabetic mothers, with maternal age ranging from 20 to 44 years. The majority of mothers (54%) were aged 30-34 years. The parity distribution was nearly even, with 52% multiparous and 48% primiparous mothers. Gestational diabetes was the most common type of diabetes, present in 84% of the cases. Regarding treatment, 46% of the mothers received insulin, while 42% were not on any treatment. Cesarean section was the predominant mode of delivery (52%), and male infants constituted 54% of the sample. (Table 1)

The overall findings underscore the increased risk of neonatal complications, particularly hypoglycaemia and RDS, in infants of diabetic mothers. These complications were significantly associated with certain maternal factors and neonatal characteristics, highlighting the need for targeted monitoring and management strategies.

Hypoglycaemia was observed in 46% of the neonates, while 54% did not exhibit hypoglycaemia. The analysis using the chi-square test identified several significant associations:

1. Age Group: There was a statistically significant association between maternal age and neonatal hypoglycaemia ($p = 0.003$). Notably, mothers in the 35–39 age group had the highest incidence of neonates with hypoglycaemia, suggesting that older maternal age may be a risk factor for this condition.
2. Diabetes Type: The type of maternal diabetes was also significantly associated with neonatal hypoglycaemia ($p = 0.004$). Specifically, neonates born to mothers with gestational diabetes mellitus (GDM) had a higher incidence of hypoglycaemia, reinforcing the importance of monitoring blood glucose levels in neonates of GDM mothers.
3. Mode of Delivery: A significant association was found between the mode of delivery and hypoglycaemia ($p = 0.022$). Neonates delivered via cesarean section had a higher incidence of hypoglycaemia compared to those delivered vaginally. This may be due to the stress response and hormonal changes associated with cesarean deliveries, which could impact neonatal glucose regulation.
4. Birth Weight: The birth weight of the neonates was significantly associated with hypoglycaemia ($p = 0.007$). Low birth weight and macrosomia were both linked to a higher risk of hypoglycaemia, emphasizing the importance of birth weight as a risk factor in these cases.

However, no significant associations were found between hypoglycaemia and parity ($p = 0.093$), mode of treatment ($p = 0.392$), sex of the baby ($p = 0.368$), or gestational age ($p = 0.750$).(Table 2) (Figure 1)

Respiratory Distress Syndrome (RDS)

RDS was observed in 20% of the neonates, with 80% not experiencing this condition. The chi-square test results revealed several significant associations:

1. Age Group: Similar tohypoglycaemia, maternal age was significantly associated with RDS ($p = 0.003$). Mothers aged 35–39 years had a higher incidence of neonates with RDS, indicating that advanced maternal age may also be a risk factor for this complication.
2. Diabetes Type: The type of maternal diabetes was significantly associated with RDS ($p = 0.001$). Neonates born to mothers with GDM had a lower incidence of RDS compared to those born to mothers with Type I or Type II diabetes, suggesting that different types of diabetes may differently impact the risk of RDS.
3. Mode of Treatment: The mode of treatment for diabetes was significantly associated with RDS ($p = 0.010$). Neonates whose mothers were treated with insulin had a lower incidence of RDS compared to those whose mothers were treated with diet alone, highlighting the potential protective role of insulin therapy against RDS.
4. Mode of Delivery: A significant association was found between the mode of delivery and RDS ($p = 0.007$). Neonates delivered via cesarean section had a higher incidence of RDS compared to those delivered vaginally, which could be related to the lack of stress-induced cortisol release during vaginal delivery that helps in lung maturation.
5. Gestational Age: Preterm neonates (≤ 36 weeks) had a significantly higher incidence of RDS compared to term neonates ($p = 0.013$). This finding aligns with the well-established risk of RDS in preterm infants due to lung immaturity.
6. Birth Weight: Birth weight was significantly associated with RDS ($p = 0.007$). Both low birth weight and macrosomia were linked to higher incidences of RDS, indicating that extremes in birth weight pose risks for respiratory complications.

No significant associations were found between RDS and parity ($p = 0.571$) or sex of the baby ($p = 0.256$) (Table 3) (Figure 2)

Discussion:-

This study highlights the significant burden of neonatal complications, specifically hypoglycaemia, respiratory distress syndrome (RDS), and macrosomia, in infants of diabetic mothers (IDMs). The high incidence of these conditions aligns with existing literature, reinforcing the well-established risks associated with maternal diabetes.[12][13]

Hypoglycaemia emerged as the most frequent complication, affecting nearly half of the newborns.[15] This finding underscores the critical need for vigilant postnatal monitoring of blood glucose levels in IDMs. Previous studies have similarly reported elevated rates of neonatal hypoglycaemia in this population, particularly in infants born to mothers with poor glycemic control during pregnancy. The significant association between hypoglycaemia and

cesarean delivery suggests that the mode of birth may influence the risk, potentially due to the stress response and delayed initiation of breastfeeding associated with surgical delivery. Moreover, the link between hypoglycaemia and macrosomia indicates that larger infants are at a heightened risk, possibly due to the excessive insulin production stimulated by high maternal glucose levels.

RDS was observed in 20% of the infants, which is notably higher than the general neonatal population. This finding is consistent with other studies that have identified RDS as a common complication in IDMs, often attributed to delayed lung maturation. The significant association between RDS and preterm birth, as well as cesarean delivery, is in line with established knowledge, as these factors are well-known contributors to respiratory complications in newborns. The data also indicate that gestational diabetes poses a particular risk for RDS, suggesting that stricter antenatal monitoring and management of gestational diabetes might reduce the incidence of this condition.

Macrosomia, though less prevalent in this study (8%), remains a concern due to its associated risks, including birth injuries and hypoglycaemia. The significant relationship between macrosomia and type II diabetes emphasizes the impact of maternal hyperglycaemia on fetal growth. This finding supports the need for aggressive management of blood sugar levels in diabetic pregnancies to minimize the risk of excessive fetal growth.

Tables

Table 1:- Demographic variables of mothers.

Demographic Variables	No. of Mothers	Percentage
Age Group (yr)		
20 – 24	4	8.0
25 – 29	6	12.0
30 – 34	27	54.0
35 – 39	11	22.0
40 – 44	2	4.0
Total	50	100.0
Parity		
Multi	26	52.0
Primi	24	48.0
Diabetic Mellitus		
Gestational Diabetic Mellitus	42	84.0
Type I	3	6.0
Type II	5	10.0
Mode of Treatment		
Insulin	23	46.0
Diet	6	12.0
Nothing	21	42.0
Mode of Delivery		
Vaginal	24	48.0
Caesarean	26	52.0
Sex of Baby		
Female Child	23	46.0
Male Child	27	54.0
Gestational Age (wk)		
Pre Term (≤ 36 wk)	12	24.0
Term (37 – 41)	38	76.0
Post Term (≥ 42 wk)	0	0.0

Weight (kg) of Baby		
Very Low Birth Wt. (<1.5)	1	2.0
Low Birth Wt (1.5 - <2.5)	7	14.0
Normal (2.5 – 4.0)	38	76.0
Big Baby / Macrosomia (>4.0)	4	8.0

Table 2:- Frequency of Complications in Children.

Variables	Number of Mothers	Percentage
Hypoglycemia		
Yes	23	46.0
No	27	54.0
RDS		
Yes	10	20.0
No	40	80.0

Table 3:- Hypoglycemia related with demographic variables of mothers.

Variables	**Hypoglycemia**			Chisquare test	P-Value	Sig. at 5% level
	No	Yes	Total			
Age Group (yr)						
20 – 24	3	1	4	15.811*	0.003	Yes
25 – 29	5	1	6			
30 – 34	18	9	27			
35 – 39	1	10	11			
40 – 44	0	2	2			
Total	27	23	50			
Parity						
Multi	17	9	26	2.826	0.093	No
Primi	10	14	24			
Diabetes Mellitus						
Gestational Diabetes Mellitus	27	15	42	11.180	0.004	Yes
Type I	0	3	3			
Type II	0	5	5			
Mode of Treatment						
Insulin	14	9	23	1.874	0.392	No
Diet	4	2	6			
Nothing	9	12	21			
Mode of Delivery						
Vaginal	17	7	24	5.265	0.022	Yes
Caesarean	10	16	26			
Sex of Baby						
Female Child	14	9	23	0.809	0.368s	No
Male Child	13	14	27			
Gestational Age (wk)						
Pre Term (≤ 36 wk)	6	6	12	0.102	0.750	No
Term (37 – 41)	21	17	38			
Post Term (≥ 42 wk)	0	0	0			

Weight (kg) of Baby						
Very Low Birth Wt. (<1.5)	1	0	1	12.118	0.007	Yes
Low Birth Wt (1.5 - <2.5)	1	6	7			
Normal (2.5 – 4.0)	25	13	38			
Big Baby / Macrosomia (>4.0)	0	4	4			

Table 4:- RDS related with demographic variables of mothers.

Variables	**RDS**			Chisquare test	P-Value	Sig. at 5% level
	No	Yes	Total			
Age Group (yr)						
20 – 24	4	0	4	16.172	0.003	Yes
25 – 29	5	1	6			
30 – 34	25	2	27			
35 – 39	6	5	11			
40 – 44	0	2	2			
Total	40	10	50			
Parity						
Multi	20	6	26	0.321	0.571	Not
Primi	20	4	24			
Diabetes Mellitus						
Gestational Diabetes Mellitus	37	5	42	13.304	0.001	Yes
Type I	2	1	3			
Type II	0	4	5			
Mode of Treatment						
Insulin	20	3	23	9.261	0.010	Yes
Diet	2	4	6			
Nothing	18	3	21			
Mode of Delivery						
Vaginal	23	1	24	7.232	0.007	Yes
Caesarean	17	9	26			
Sex of Baby						
Female Child	20	3	23	1.288	0.256	Not
Male Child	20	7	27			
Gestational Age (wk)						
Pre Term (≤ 36 wk)	6	6	12	6.103	0.013	Yes
Term (37 – 41)	34	4	38			
Post Term (≥ 42 wk)	0	0	0			
Weight (kg) of Baby						
Very Low Birth Wt. (<1.5)	1	0	1	12.230	0.007	Yes
Low Birth Wt (1.5 - <2.5)	4	3	7			
Normal (2.5 – 4.0)	34	4	38			
Big Baby / Macrosomia (>4.0)	1	3	4			

Figures

Figure 1:- Hypoglycemia related with demographic variables of mothers.

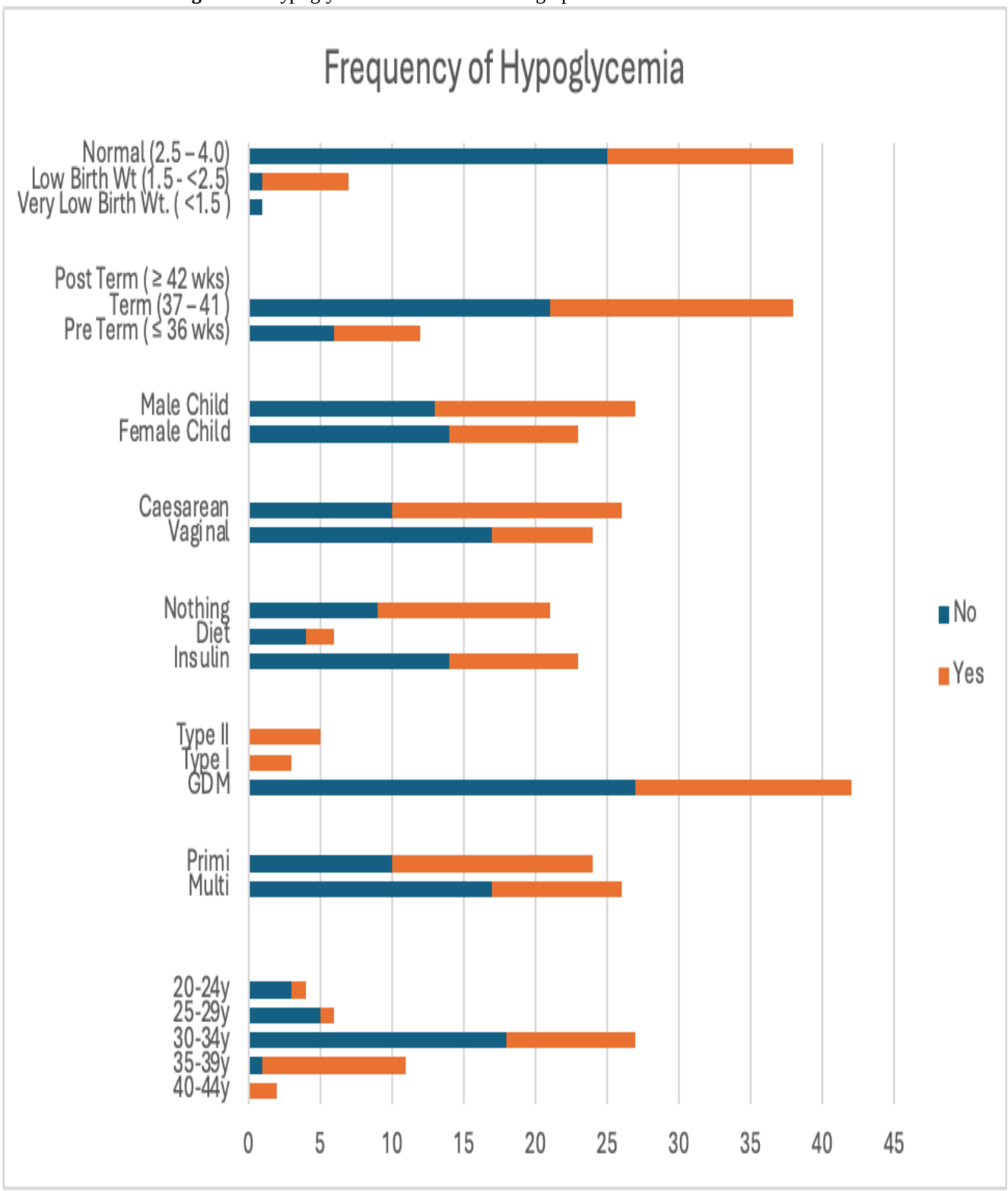
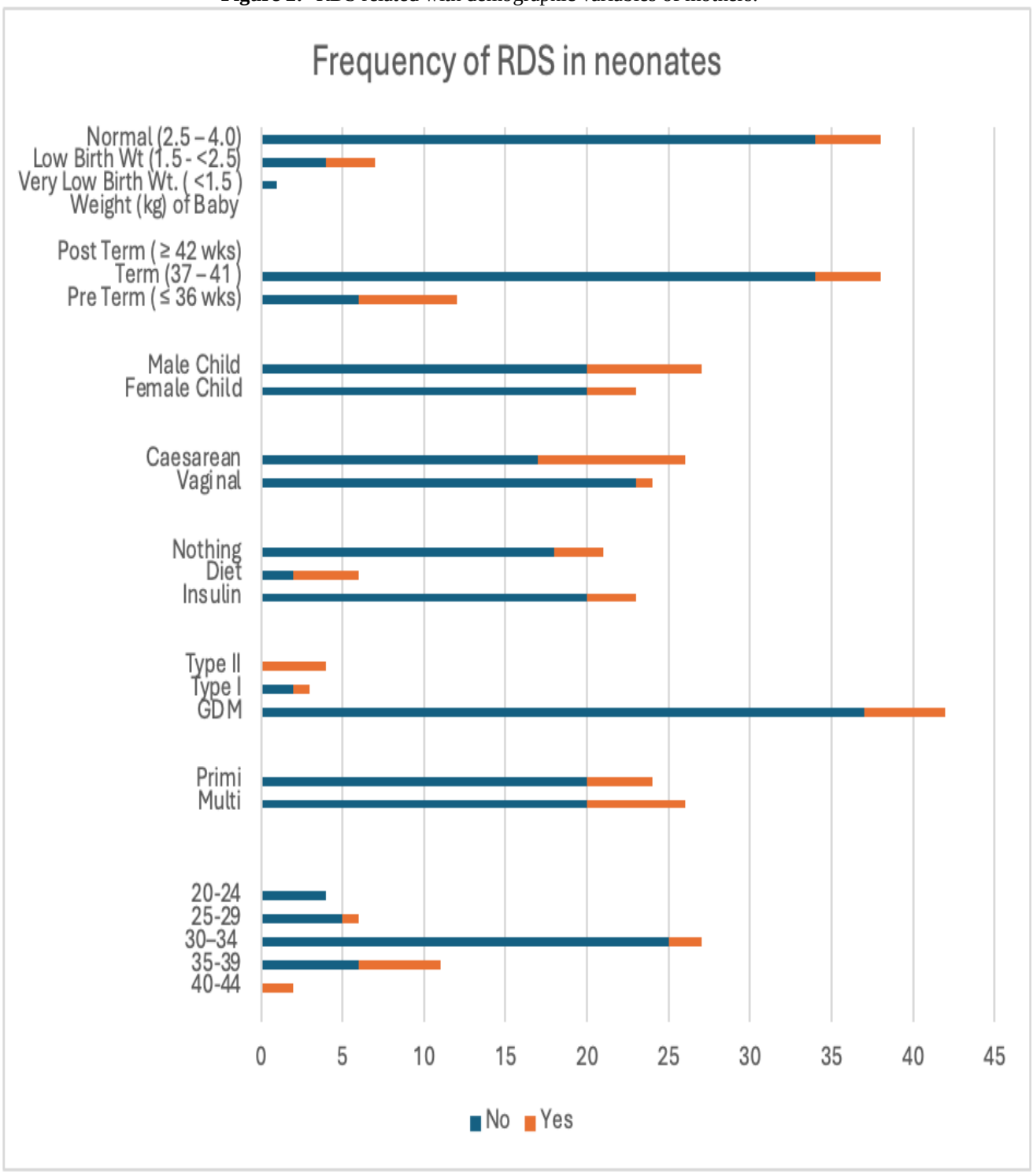


Figure 2:- RDS related with demographic variables of mothers.



Conclusion:-

The findings of this study underscore the importance of maternal factors, such as age, type of diabetes, mode of delivery, and neonatal factors, including birth weight and gestational age, in predicting the risk of hypoglycaemia and RDS in neonates born to diabetic mothers. These results suggest the need for tailored monitoring and management strategies to mitigate the risk of these complications in this high-risk population.[20]

References:-

1. White, P. (1949). Pregnancy complicating diabetes. The American Journal of Medicine, 7(5), 609-615. PMID 15396063
2. Barnes-Powell, L. L. (2007). Infants of diabetic mothers: The effects of hyperglycemia on the fetus and neonate. Neonatal Network, 26(5), 283-290. PMID 17904529
3. Allen, V. M., Armson, B. A., Wilson, R. D., et al. (2007). Teratogenicity associated with pre-existing and gestational diabetes. Journal of Obstetrics and Gynaecology Canada, 29(11), 927-934. PMID 17977497
4. Crace, C. J. (1989). How does maternal diabetes disrupt embryonic and foetal development? Diabetic Medicine, 6, 387-393.
5. Buchanan, T. A., & Kitzmiller, J. L. (1994). Metabolic interactions of diabetes and pregnancy. Annual Review of Medicine, 45, 245-260.
6. Rosenn, B., Miodovnik, M., & Tsang, R. C. (1996). Common clinical manifestations of maternal diabetes in newborn infants: Implications for the practicing pediatrician. Pediatric Annals, 25(4), 215-222.
7. Weintrob, N., Karp, M., & Hod, M. (1996). Short and long-range complications in offspring of diabetic mothers. Journal of Diabetes and Its Complications, 10(5), 294-301.
8. Gabbe, S. G., Lowensohn, R. I., Wu, P. Y., & Guerra, G. (1985). Current patterns of neonatal morbidity and mortality in infants of diabetic mothers. Diabetes Care, 8(3), 250-255.
9. Becerra, J. E., Khoury, M. J., Cordero, J. F., & Erikson, J. D. (1990). Diabetes mellitus during pregnancy and the risks for specific birth defects: A population-based case-control study. Pediatrics, 85(1), 1-9.
10. Cordero, L., Treuer, S. H., Landon, M. B., &Gabbe, S. G. (1998). Arch PediatrAdolesc Med. 152(3), 249-254.
11. Tyrala, E. (1996). The infant of the diabetic mother. Obstetrics and Gynecology Clinics of North America, 23, 221-241.
12. Robert, M. F., Neff, R. K., Hubbell, J. P., Taeusch, H. W., & Avery, M. E. (1976). Association between maternal diabetes and the respiratory distress syndrome in newborns. The New England Journal of Medicine, 294(7), 357-360.
13. Tyden, O., Eriksson, U. J., & Berne, C. (1986). Fetal lung maturation in diabetic pregnancy. Acta Endocrinol Suppl (Copenh), 277, 101-106.
14. Duvanel, C. B., Fawer, C. L., Cotting, J., et al. (1999). Long-term effects of neonatal hypoglycaemia on brain growth and psychomotor development in small-for-gestational-age preterm infants. Journal of Pediatrics, 134(4), 492-498.
15. Malformations in infants of diabetic mothers. James L. Mills, M.D., M.S. (2005). Epidemiology and Biometry Research Program, National Institute of Child Health and Human Development, NIH Bethesda, Maryland.
16. Rosenkrantz, T. S., Knox, I., Zalneraitis, E. L., et al. (1993). Cerebral metabolism and electrocortical activity in the chronically hyperglycaemic fetal lamb. American Journal of Physiology, 265(6 Pt2), R1262-1269.
17. Buchanan, T. A., & Kitzmiller, J. L. (1994). Metabolic interactions of diabetes and pregnancy. Annual Review of Medicine, 45, 245-260.
18. Combs, C. A., Gunderson, E., Kitzmiller, J. L., et al. (1992). Relationship of fetal macrosomia to maternal postprandial glucose control during pregnancy. Diabetes Care, 15, 1251.
19. Smith, B. T., Giroud, C. J., Robert, M., & Avery, M. E. (1975). Insulin antagonism of cortisol action on lecithin synthesis by cultured fetal lung cells. Journal of Pediatrics, 87(6 Pt 1), 953-955.
20. Tyrala, E. (1996). The infant of the diabetic mother. Obstetrics and Gynecology Clinics of North America, 23, 221-241.