



## IMPACT OF MATERNAL DIABETES AND HYPERTENSION ON THE INCIDENCE OF HYPOGLYCEMIA IN PRETERM NEONATES ADMITTED AT A TERTIARY CARE HOSPITAL IN SOUTH PUNJAB

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### ABSTRACT

**Background:** Neonatal hypoglycemia is a frequent and serious complication among preterm infants, often linked to maternal medical conditions. This study investigates the impact of maternal diabetes and hypertension on the incidence of hypoglycemia in preterm neonates.

**Objective:** To assess the association between maternal diabetes and hypertension with the incidence of hypoglycemia in preterm neonates admitted at the Paeds Ward, Nishtar Hospital, Multan.

**Methods:** A prospective observational study was conducted from 15 February to 15 August 2025 at Nishtar Hospital, Multan. 168 preterm neonates (<37 weeks of gestation) admitted during the study period were enrolled according to the study's inclusion criteria. Maternal history of diabetes and hypertension was recorded. Neonatal blood glucose was measured at the time of admission and during the first 24 hours after birth. Hypoglycemia was defined as blood glucose <40 mg/dL. Data were analyzed using SPSS version 27, and associations were determined using chi-square tests and odds ratios (OR) with 95% confidence intervals.

**Results:** Among 168 preterm neonates, 38 (22.6%) developed hypoglycemia. A significant association was found between maternal diabetes and neonatal hypoglycemia (OR = 6.2; 95% CI: 2.3–16.8; p = 0.01). Similarly, maternal hypertension was significantly associated with neonatal hypoglycemia (OR = 4.1; 95% CI: 1.6–10.6; p = 0.03).

**Conclusion:** Maternal diabetes and hypertension significantly increase the risk of hypoglycemia in preterm neonates. Enhanced monitoring protocols for high-risk neonates are recommended.

### INTRODUCTION

Neonatal hypoglycemia is one of the most common metabolic disorders in the neonatal period and is particularly concerning in preterm infants due to their immature glucose regulatory

mechanisms(Lord & De León, 2024). Persistent or recurrent hypoglycemia can result in seizures, developmental delay, or even death(Rosenfeld & Thornton, 2023). Various maternal conditions, particularly diabetes mellitus and hypertension, have been implicated in the pathogenesis of neonatal hypoglycemia.

Hypoglycemia in preterm neonates is associated with high morbidity and mortality rates, ranging from 25 to 50%, which may lead to developmental disabilities in neonates (Dangi & Salvi, 2021). The physiology of preterm neonates is immature when delivered. The disconnection of the neonate from the mother and placenta at the time of birth is normal in full-term babies, but causes a sudden drop in hormonal support in preterm neonates, which may lead to hypoglycemia(Möllers et al., 2022). Research indicates that healthy infants may undergo short-term hypoglycemia as a normal adaptation to life outside of the maternal body, probably due to a drop in blood glucose levels drop even up to 25 mg/dL during the early hours after birth (Abramowski et al., 2024).

Infants who are either breastfed, formula-fed, or fed in combination have a similar blood glucose pattern. Regardless of feeding mode, glucose levels fall during the first 2 hours of life and then steadily rise over the next ninety-six hours. (Harris et al., 2020). As expected, preterm infants had a quicker decline in blood sugar than full-term newborns. Artificially fed babies tend to have slightly higher glucose and lower ketone levels compared to breastfed babies (Wight & Academy of Breastfeeding, 2021).

Neonatal hypoglycemia is an important issue in the treatment of premature infants, and physicians encounter complicated problems and requirements. The most sensitive group in neonatal care is the preterm infant, who is three times as likely to experience metabolic disturbances like hypoglycemia(Butorac Ahel, Tomulić, et al., 2022).. Such disorders can have several effects on infant health.

Maternal diabetes, whether gestational or pregestational, results in transplacental glucose delivery, leading to fetal hyperinsulinemia. After delivery, the sudden cessation of maternal glucose supply in the context of continued high insulin levels predisposes the neonate to hypoglycemia(Ornoy et al., 2021) . Similarly, hypertensive disorders during pregnancy can compromise placental perfusion, resulting in intrauterine growth restriction (IUGR) and impaired glycogen storage in the fetus, both of which increase the risk of neonatal hypoglycemia(Asif et al., 2024).

Despite these known associations, there is limited regional data examining the direct impact of maternal diabetes and hypertension on neonatal hypoglycemia, especially in preterm populations in low-resource settings such as Pakistan.

### **Objective:**

To assess the association of maternal diabetes and hypertension with the incidence of hypoglycemia in preterm neonates admitted to the Paediatric Ward, Nishtar Hospital, Multan.

### **METHODOLOGY**

**Study Design and Setting:** This prospective observational study was conducted at PeadsWard of Nishtar Hospital, a tertiary care teaching hospital in Multan, Pakistan.

**Duration:** February 15, 2024 to August 15, 2024.

**Participants:** All preterm neonates (<37 weeks gestation) admitted during the study period were included. Neonates with congenital anomalies, diagnosed inborn errors of metabolism, or those who had received glucose before blood sampling were excluded.

**Sample Size and Sampling Technique:** A total of 168 preterm neonates were included using consecutive sampling. The sample size was calculated using Open Epi version 3.01 software based on the estimated prevalence of hypoglycemia.

**Data Collection:** Maternal data were obtained from antenatal records and maternal history, including diagnosis of diabetes mellitus (gestational or pregestational) and hypertension. Neonatal blood glucose was measured using standard glucometers (Accu-check) by trained nursing and medical officers using aseptic techniques at the time of admission and after regular intervals as per the neonatal protocol of Peads ward during the first 24 hours after admission.

#### Operational Definitions:

- **Hypoglycemia:** In the present study, hypoglycemia is defined as a blood glucose level below 40 mg/dl in preterm neonates at birth or during the first 24 hours of life when blood sugar was checked by the heel-prick method with a standard glucometer by trained staff nurses or medical officers using aseptic techniques, regardless of whether feed was given to preterm neonates or not.
- **Prematurity:** In the present study, it is defined as the delivery of a baby before 37 complete weeks of gestation as confirmed by the Last Menstrual Period (LMP) of the mother of babies admitted at Peads ward, Nistar Hospital, Multan.
- **Maternal Diabetes:** In the present study, only those mothers with a documented diagnosis of diabetes in their antenatal or hospital records were classified as having maternal diabetes.
- **Maternal Hypertension:** Only those cases with a recorded diagnosis of hypertension (BP >140/90 mmHg) in the antenatal care files, labour room charts, or hospital admission notes were classified as maternal hypertension in this study.

**Ethical Considerations:** Ethical approval was obtained from the Institutional Review Board of Nishtar Medical University. Informed consent was taken from parents/guardians.

**Data Analysis:** SPSS version 27 was used for analysis. Frequencies and percentages were calculated for categorical variables. The Chi-square test was used to test associations. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. A p-value <0.05 was considered statistically significant.

**RESULTS:** Demographic characteristics of 168 preterm neonates showed that the majority were male (57.73%) and most were delivered at the same hospital where the study was conducted (76.19%). In terms of birth weight, 61.30% of neonates weighed between 1–2 kg, while only 2.97% weighed more than 3 kg. Regarding gestational age, over half (55.35%) were classified as late preterm. Hypothermia was observed in 38.69% of neonates at the time of admission. Respiratory distress syndrome (RDS) was present in 72.61% of the cases, and birth asphyxia was reported in 36.30% of neonates. These findings reflect a vulnerable neonatal population with high rates of low birth weight, respiratory complications, and perinatal risk factors. Demographics of neonates are in Table 1.

**Table 1: Demographic characteristics of preterm neonates (N=168)**

Demographic Variables		N	%
Gender	Male	97	57.73
	Female	71	42.26
Delivery Place	At same hospital	128	76.19
	At another	40	23.80
Baby weight	<1 kg	15	08.92
	1-2 kg	103	61.30
	2-3 kg	45	26.78

	>3 kg	05	02.97
Gestational Age	Extremely Preterm	17	10.11
	Very preterm	58	34.52
	Late Preterm	93	55.35
Body temperature	Afebrile	103	61.30
	Hypothermia	65	38.69
RDS	Not present	46	27.38
	Present at Birth	122	72.61
Birth Asphyxia	Not present	107	63.69
	Present at Birth	61	36.30

When considering demographics characteristics of the mothers of 168 preterm neonates. The majority of mothers were aged between 20–29 years (54.76%), while only 5.35% were above 40 years. Most deliveries were conducted via cesarean section (63.09%), and a greater proportion of mothers were multiparous (67.26%) compared to nulliparous (32.73%). Regarding maternal health, 21.42% had a history of diabetes, and more than half (51.19%) were hypertensive during pregnancy. Antenatal steroid administration was reported in 52.97% of the cases. These maternal profiles highlight several clinical risk factors commonly associated with preterm birth and neonatal complications. Table 2

**Table 2: Demographics of mothers of preterm neonates (N=168)**

Maternal Variables		N	%
<b>Maternal Age</b>	< 20 years	17	10.11
	20-29 year	92	54.76
	30-39 year	50	29.76
	> 40 years	9	05.35
<b>Mode of Delivery</b>	SVD	62	36.90
	C section	106	63.09
<b>Parity</b>	Nulliparaus	55	32.73
	Multiparraus	113	67.26
<b>History of diabetes</b>	Non-diabetic	132	78.57
	Diabetic	36	21.42
<b>History of hypertension</b>	Non-hypertensive	82	48.80
	Hypertensive	86	51.19

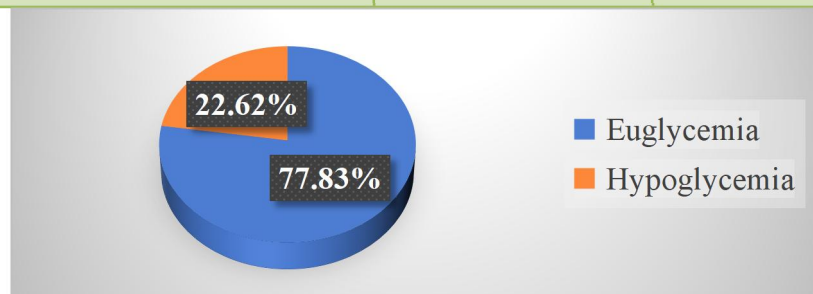
<b>History of antenatal steroid intake</b>	Not intake of steroids	79	47.02
	Steroid intake	89	52.97

Results of present study indicated, At the time of admission, 38(22.6%) neonate patients out of 168 were hypoglycemic.

After 1st hour of admission, that was reduced to 30 (17.8%). After 6 hours of monitoring 15(8.92%) neonates were hypoglycemic and 8(4.76%) were hyperglycemic. This number reduced till 24 hours only 2(1.19%) neonates were hypoglycemic Table3.

**Table 3: Incidence of hypoglycemia during the first 24 hours**

Hypoglycemia	Frequency	Percentage
<b>At admission</b>	38	22.6
<b>After 1 hour</b>	30	17.8
<b>After 6 Hours</b>	15	8.92
<b>After 12 Hours</b>	5	2.97
<b>After 24 Hours</b>	2	1.19



**Figure 1: Incidence of Hypoglycemia in Preterm Neonates (N=168)**

The association between maternal risk factors and the incidence of hypoglycemia among preterm neonates showed varying patterns. A Chi-square test was used to see if the association was statistically significant or just due to chance. p-value of less than 0.05 was considered significant with a 95 % confidence interval in a two-sided asymptomatic chi-square test.

The association between maternal health conditions and the incidence of hypoglycemia among preterm neonates revealed some significant findings. Neonates born to diabetic mothers had a higher incidence of hypoglycemia (13.69%) as compared to those born to non-diabetic mothers (8.93%). The p-value of 0.001 indicates a statistically significant association between maternal diabetes and hypoglycemia.

Similarly, neonates born to hypertensive mothers showed a higher incidence of hypoglycemia (16.67%) as compared to non-hypertensive mothers (5.95%). This association was also statistically significant, with a p-value of 0.002.

**Table 4: Association of maternal risk factors with incidence of hypoglycemia among Preterm neonates (N=168)**

Variables		Hypoglycemic		OR (95% CI)	p-value
		Yes n (%)	No n (%)		
<b>History of Diabetes</b>	Non-diabetic	15 (8.93)	117 (69.64)	6.2 (2.3–16.8)	<b>0.001</b>
	Diabetic	23 (13.69)	13 (7.74)		
<b>History of Hypertension</b>	Non hypertensive	10 (5.95)	72 (42.86)	4.1 (1.6–10.6)	<b>0.002</b>
	Hypertensive	28 (16.67)	58 (34.52)		

Calculated odds ratios indicated that maternal diabetes increased the risk of neonatal hypoglycemia by 6.2 times (95% CI: 2.3–16.8), while maternal hypertension increased the risk by 4.1 times (95% CI: 1.6–10.6).

## DISCUSSION

In this chapter, we discuss the results of a study conducted at Peads Ward Nishtar Hospital Multan, and see whether these results match previous national and international studies. Local, regional, and worldwide research has been done, yet many questions remain unanswered, particularly in poor countries. This discussion will provide an overview of different studies on this vulnerable population.

In our study, a blood glucose level less than 40 mg/dl was considered hypoglycemia for any postnatal or gestational age. This study demonstrated a strong and statistically significant association between maternal diabetes and hypertension with neonatal hypoglycemia in preterm infants. The observed incidence of hypoglycemia (22.6%) is comparable with other studies conducted in similar settings.

Hypoglycemia, or low blood sugar, is a common and potentially life-threatening condition in preterm neonates. These vulnerable neonates are at increased risk of hypoglycemia due to their immature glucose regulatory mechanisms, limited glycogen stores, and high glucose demands. Hypoglycemia can lead to serious complications, including brain damage, developmental delays, and even death (De Angelis et al., 2021). Premature infants are more prone to developing hypoglycemia (Putri et al., 2023). Despite its significance, there is a lack of data on the incidence and causes of hypoglycemia in preterm neonates in Pakistan, particularly in the Peads ward at Nishtar Hospital, Multan.

In our study at the time of admission, 38 out of 168 preterm neonates (22.6%) were hypoglycemic, at the time of admission indicating a significant burden of this condition in the study population. A hospital-based cross-sectional study in Ethiopia has a 23.59% incidence of hypoglycemia (Chanie et al., 2023). Similar results of studies on neonates with HIE admitted at the NICU in Lahore concluded that 20.8% of neonates had hypoglycemic episodes during their hospital stay (Mahmood et al., 2024). Another comparable study in Croatia found that 20.7% (92/445) of preterm neonates were hypoglycemic (Butorac Ahel, Lah Tomulić, et al., 2022).

However, the incidence of hypoglycemia in our study was higher than in some prospective studies in India where the incidence was reported as 17.3% at birth which reduced to 10.6% three hours to around seven percent at six hours and around one percent at 12 and 24 hours. (Dangi & Salvi, 2021) and 9.93% (Ansari et al., 2023). A cross-sectional analytical study in Indonesia found that 13% of the neonates were hypoglycemic (Putri et al., 2023).

In contrast, a higher incidence of hypoglycemia was found in other studies from Pakistan with 43.3% of neonates (Ibrahim et al., 2021) and 31.7% of neonates experiencing hypoglycemia within the first 24 hours (J. Khan et al., 2024).

The probability of the difference in results might be due to studying all admitted neonates regardless of their ages. Also, it may be due to different sample sizes and techniques in the study, timing (time after birth), inclusion-exclusion criteria, and duration of monitoring.

While considering maternal diabetes as a risk factor, 20.5 % of hypoglycemic neonates born to diabetic mothers in a study (Ansari et al., 2023). Similar results of an observational study in India, where 25.3 % of mothers of hypoglycemic neonates were diabetic (Chakravarthy et al., 2024). 13.48 % of diabetic mothers delivered hypoglycemic babies in another study (Chanie et al., 2023).

In the Netherlands, a higher rate of diabetic mothers, 66 % of hypoglycemic babies, was noted (Koolen et al., 2023). While in India, a study resulted in 34.7 % of diabetic mothers of hypoglycemic neonates being included (Patel et al., 2020). In a study on babies born to gestational diabetic mothers, 45% of neonates developed hypoglycemia (Arimitsu et al., 2023).

In this study, 36 (21.4%) of the mothers had a history of diabetes mellitus. Neonates born to diabetic mothers exhibited a significantly higher incidence of hypoglycemia, with 63.9% (23 out of 36) affected, compared to just 11.4% (15 out of 132) of those born to non-diabetic mothers. Notably, a study conducted in the Netherlands reported an even higher rate of 66% hypoglycemia among neonates born to diabetic mothers (Koolen et al., 2023).

In contrast the studies conducted by Atif Ansari et al., where 20.5% of hypoglycemic neonates were born to diabetic mothers (Ansari et al., 2023) and an observational study in India reported that 25.3% of mothers of hypoglycemic neonates were diabetic (Chakravarthy et al., 2024).

In contrast, a study by Chanie et al. found that 13.48% of mothers were diabetic (Chanie et al., 2023), though the rate of hypoglycemia among their neonates was also high. Similarly, a study in India by Parth Patel et al. revealed that 34.7% of mothers of hypoglycemic neonates had gestational diabetes mellitus (GDM) (Patel et al., 2020). Additionally, in a study, 45% of neonates born to mothers with GDM developed hypoglycemia (Arimitsu et al., 2023).

These comparisons highlight the varying prevalence of diabetes among mothers and its strong association with neonatal hypoglycemia across different regions and studies.

Another very important variable associated with the incidence of hypoglycemia in preterm neonates was a maternal history of hypertension. In the current study, 51.2% of mothers reported a history of hypertensive disease. Among hypertensive mothers, 32.6% of neonates developed hypoglycemia, compared to 12.2% of neonates born to non-hypertensive mothers. Similar results of study in Indonesia (33.3%) mothers of hypoglycemic neonates were hypertensive (Putri et al., 2023).

A lower rate of research conducted in India indicated that 28.5% of hypoglycemic neonates were born to hypertensive mothers (Ansari et al., 2023). In the Netherlands resulted 24 % of hypertensive mothers had hypoglycemic neonates (Koolen et al., 2023).

Higher Results of the study, where 51.9 % of mothers of hypoglycemic neonates were hypertensive (Ibrahim et al., 2021). Maternal hypertension (OR 3.07, 95% CI 1.51–6.30,  $p = 0.002$ ) was the sole risk factor for neonatal hypoglycemia in a study (Mitchell et al., 2020).

All the above studies indicated a strong association of maternal hypertension with the incidence of hypoglycemia in neonates. Slight variation might be due to variable sample size, inclusion criteria, and blood pressure measuring techniques and standards.

### **Strengths and Limitations:**

Strengths of this study include its prospective design and adequate sample size. However, being a single-center study, the findings may not be generalizable. In addition, reliance on hospital records for maternal history may introduce recall bias.

### **Implications:**

Routine and targeted glucose monitoring should be implemented in all preterm neonates born to diabetic and hypertensive mothers. This can potentially reduce morbidity through timely intervention.

### **CONCLUSION**

Maternal diabetes and hypertension significantly increase the risk of hypoglycemia in preterm neonates. Close monitoring and preventive strategies should be prioritized in high-risk pregnancies to improve neonatal outcomes.

## REFERENCES

- Abramowski, A., Ward, R., & Hamdan, A. H. (2024). Neonatal Hypoglycemia. In StatPearls. StatPearls PublishingCopyright © 2024, StatPearls Publishing LLC.
- Ansari, A., Savaskar, S. V., & Moin Tamboli, P. S. N. (2023). Study of incidence, risk factors and immediate outcome of hypoglycemia in neonates admitted in NICU. *International Journal of Contemporary Pediatrics*, 10(8), 1303.
- Arimitsu, T., Kasuga, Y., Ikenoue, S., Saisho, Y., Hida, M., Yoshino, J., Itoh, H., Tanaka, M., & Ochiai, D. (2023). Risk factors of neonatal hypoglycemia in neonates born to mothers with gestational diabetes. *Endocrine journal*, 70(5), 511-517.
- Asif, S., Shaukat, M., Khalil, K., Javed, H., Safwan, M., Alam, K., Fatima, S., Chohan, P., Hanif, H. M., & Eljack, M. M. F. (2024). Hypoglycemia and hyperglycemia in neonatal encephalopathy: A narrative review. *Medicine*, 103(36), e39488.
- Butorac Ahel, I., Lah Tomulić, K., Vlašić Cicvarić, I., Žuvić, M., BarabaDekanić, K., Šegulja, S., & Bilić Čače, I. (2022). Incidence and Risk Factors for Glucose Disturbances in Premature Infants. *Medicina*, 58(9), 1295. <https://www.mdpi.com/1648-9144/58/9/1295>
- Butorac Ahel, I., Tomulić, K. L., Cicvarić, I. V., Žuvić, M., Dekanić, K. B., Šegulja, S., & Čače, I. B. (2022). Incidence and risk factors for glucose disturbances in premature infants. *Medicina*, 58(9), 1295.
- Chakravarthy, B. S., Satyavani, A., Sindhura, V., Satyakumari, K., Raju, T. P., & Soundarya, M. L. (2024). A STUDY ON ETIOLOGY, AGE AT ONSET, CLINICAL SPECTRUM AND SHORT TERM OUTCOME OF NEONATAL HYPOGLYCEMIA IN A TERTIARY CARE. *Int J Acad Med Pharm*, 6(1), 125-130.
- Chanie, E. S., Shiferaw, S. M., Feleke, D. G., Bantie, B., Moges, N., Tasew, S. F., Alemayehu, T. Y., Teshome, A. A., Yirga, G. K., & Berhan, A. (2023). Maximizing the detection rate of hypoglycemia among preterm neonates admitted in Neonatal intensive care unit in Ethiopia, 2021. *Scientific Reports*, 13(1), 2283.
- Dangi, A. R., & Salvi, J. R. (2021). Incidence and risk factors of hypoglycemia among neonates: A prospective study. *Int J Paediatr Geriatrics*, 4(2), 10-14.
- De Angelis, L. C., Brigati, G., Polleri, G., Malova, M., Parodi, A., Minghetti, D., Rossi, A., Massirio, P., Traggiai, C., & Maghnie, M. (2021). Neonatal hypoglycemia and brain vulnerability. *Frontiers in Endocrinology*, 12, 634305.
- Harris, D. L., Weston, P. J., Gamble, G. D., & Harding, J. E. (2020). Glucose profiles in healthy term infants in the first 5 days: the Glucose in Well Babies (GLOW) Study. *The Journal of pediatrics*, 223, 34-41.
- Ibrahim, F. H., Ghaffar, M. S., Bashir, A., Mahmood, T., & Rafiq, A. (2021). Frequency of hypoglycemia in preterm newborns. *Hypertension*, 27, 51-59.
- Koolen, M. R., van Kempen, A. A. M. W., Maaskant, J. M., Reiss, I., & Vermeulen, M. J. (2023). Incidence and risk factors for early hypoglycemia in very preterm infants: the Hyporisk study. *Clinical Nutrition ESPEN*, 56, 67-72.
- Lord, K., & De León, D. D. (2024). Approach to the Neonate with Hypoglycemia. *The Journal of Clinical Endocrinology & Metabolism*, 109(9), e1787-e1795.
- Mahmood, F., Khan, H. A. S., Hotiana, N. A., Anwar, A., Iftikhar, M., & Tahira, B. (2024). Frequency of Hypoglycemia in Neonates with Hypoxic-Ischemic Encephalopathy in the Neonatal Intensive Care Unit of Sir Ganga Ram Hospital, Lahore. *Journal of Society of Prevention, Advocacy and Research KEMU*, 3(1), 71-74.
- Mitchell, N. A., Grimby, C., Rosolowsky, E. T., O'Reilly, M., Yaskina, M., Cheung, P.-Y., & Schmölder, G. M. (2020). Incidence and Risk Factors for Hypoglycemia During Fetal-to-Neonatal Transition in Premature Infants [Original Research]. *Frontiers in Pediatrics*, 8. <https://www.frontiersin.org/journals/pediatrics/articles/10.3389/fped.2020.00034>
- Möllers, L. S., Yousuf, E. I., Hamatschek, C., Morrison, K. M., Hermanussen, M., Fusch, C., & Rochow, N. (2022). Metabolic-endocrine disruption due to preterm birth impacts growth,

body composition, and neonatal outcome. *Pediatric Research*, 91(6), 1350-1360.  
<https://doi.org/10.1038/s41390-021-01566-8>

- Ornoy, A., Becker, M., Weinstein-Fudim, L., & Ergaz, Z. (2021). Diabetes during pregnancy: a maternal disease complicating the course of pregnancy with long-term deleterious effects on the offspring. a clinical review. *International Journal of Molecular Sciences*, 22(6), 2965.
- Patel, P., Gogoi, P. R., Deb, S., Paul, P., & Yesmin, S. (2020). Hypoglycemia in Exclusively Breast-fed High-Risk Neonates-A Hospital-Based Study. *Int J Pediatr Res*, 6, 066.
- Putri, A. R., Arumndari, R., Liman, C. N., Suarca, K., & Suryawan, I. W. B. (2023). Neonatal hypoglycemia and associated factors at Wangaya General Hospital. *Indonesian Journal of Multidisciplinary Science*, 3(1), 49-52.
- Rosenfeld, E., & Thornton, P. S. (2023). Hypoglycemia in neonates, infants, and children. *Endotext* [Internet].
- Wight, N. E., & Academy of Breastfeeding, M. (2021). ABM clinical protocol# 1: guidelines for glucose monitoring and treatment of hypoglycemia in term and late preterm neonates, revised 2021. *Breastfeeding Medicine*, 16(5), 353-365.