

Predictive Factors of Asymptomatic Hypoglycemia in Late Preterm Infants: A Retrospective Case–Control Study

Achiraya Thunturanon, Tipawan Daramas,* Jongjai Jongaramraung

Abstract: Asymptomatic hypoglycemia is a common but often overlooked issue in late preterm infants, which can lead to negative neurodevelopmental outcomes. Identifying predictive factors is essential for early detection and intervention. However, published evidence regarding asymptomatic hypoglycemia among late preterm infants in Thailand remains limited. This retrospective case-control study encompassed 586 late preterm infants (293 cases and 293 controls) born and admitted to a university hospital in Bangkok between January 2017 and December 2022. Data were extracted from electronic medical records. The instruments employed included Infant and Maternal Record Forms. Data analysis was conducted using descriptive statistics and multiple logistic regression.

The study revealed that 53.9% of infants with asymptomatic hypoglycemia were female, with an average gestational age of 35.4 ± 0.75 weeks. The mean point-of-care glucose testing one hour post-birth was 34.8 ± 5.09 mg/dL. Significant predictive factors for asymptomatic hypoglycemia in infants were identified, including being small for gestational age, large for gestational age, and experiencing prolonged fasting before delivery for more than six hours. Collectively, these three factors accounted for only 10.4% of the risk of asymptomatic hypoglycemia in late preterm infants. Therefore, further studies should include other factors such as maternal medications, infant feeding practices, and metabolic disorders. Based on these findings, nurses must remain vigilant for the development of asymptomatic hypoglycemia in these infants to prevent severe complications or long-term effects on infant brain development and health. Furthermore, maternal education should also emphasize responsive feeding practices and recognition of warning signs of neonatal hypoglycemia in high-risk infants.

Keywords: Asymptomatic hypoglycemia, Glucose testing, Late preterm infants, Nursing, Predictive factors, Retrospective case-control, Thailand

Received 13 February 2026; Revised 12 May 2026;

Accepted 18 May 2026

Introduction

Hypoglycemia is a common condition among premature infants, with a reported incidence of 19–52% in this population.¹ The incidence of hypoglycemia may be as high as 50% among late preterm infants at 34 weeks' gestation, depending on the screening

Achiraya Thunturanon, RN, Graduate student, Master of Nursing Science Program in Pediatric Nursing, Ramathibodi School of Nursing, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Thailand. E-mail: achi_th@hotmail.com

Correspondence to: *Tipawan Daramas,* RN, PhD (Nursing), Dip. APPN, Cert. in Nurse Practitioner, Assistant Professor, Ramathibodi School of Nursing, Faculty of Medicine Ramathibodi Hospital, Mahidol University & Faculty of Nursing; Kasem Bundit University, Thailand. E-mail: tipawan.dar@kbu.ac.th; <https://orcid.org/0000-0001-7103-9437>*

Jongjai Jongaramraung, RN, PhD. (Nursing Science), Assistant Professor, Ramathibodi School of Nursing, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Thailand. E-mail: jongjai.jon@mahidol.ac.th

criteria applied and underlying risk factors.² Late preterm birth, in combination with factors such as small gestational age (SGA), large gestational age (LGA), respiratory distress, hypothermia, neonatal infection, and maternal gestational diabetes, increases susceptibility to hypoglycemia, particularly within the first 1–6 hours after birth. Late preterm infants may present with either symptomatic or asymptomatic hypoglycemia.³ Hypoglycemia reduces cerebral glucose availability, which may lead to brain injury and subsequently impair physical growth as well as cognitive and intellectual development.^{4–6} In severe cases, hypoglycemia can result in mortality, prolonged hospitalization, and increased healthcare costs. Moreover, neonatal illness may cause significant parental distress and interfere with parent–infant bonding, as affected infants often require separation for clinical management.^{6,7}

Late preterm infants are defined as those born between 34 weeks and 36 weeks and six days of gestation. The incidence of late preterm births has been increasing. In the United States, the rate of infants born before 37 weeks of gestation was 10.4% in 2024.⁸ The rate of late preterm infants also rose slightly, from 7.69% in 2024 to 7.72% in 2025.⁹ Although late preterm infants may have weights similar to full-term infants, they are still considered at risk for postnatal complications due to immature organ function and physiology.^{9–12} Late preterm infants are at a higher risk of developing hypoglycemia compared to their full-term counterparts due to their relatively lower glycogen stores.¹³ Following umbilical cord clamping, these infants are abruptly deprived of maternal glucose supply while simultaneously experiencing increased metabolic demands for energy production, predisposing them to hypoglycemia. Neonatal blood glucose levels typically decline within the first hour after birth, reaching approximately 25–30 mg/dL.¹⁴ The American Academy of Pediatrics (AAP) guidelines recommend treatment for asymptomatic hypoglycemia when blood glucose levels fall below

40 mg/dL, considering the infant's risk factors.¹⁵ However, many infants with hypoglycemia do not exhibit symptoms, leading to delayed diagnosis and treatment. Therefore, identifying risk factors for asymptomatic hypoglycemia in infants can enhance care efficiency.¹⁶

Literature Review and Conceptual Framework

This study utilized a physiological framework to understand the development of hypoglycemia in late premature infants. Typically, the fetus receives glucose from the mother through the placenta, serving as the primary energy source. Glucose is utilized to synthesize glycogen, which is stored in the liver and accumulates during the third trimester.^{3,6} Upon birth, the umbilical cord is cut, and maternal glucose is no longer available. Consequently, the infant must rely on glycogen stores for energy, which is limited in late preterm infants. Following birth, the high energy demand can lead to low blood sugar levels.

The literature review indicated that asymptomatic hypoglycemia in late preterm infants is associated with both neonatal and maternal factors. Neonatal factors include SGA, LGA,^{17,18} birth asphyxia, meconium-stained amniotic fluid (MSAF),^{18,19} neonatal sepsis,²⁰ and hypothermia.²¹ Infants with SGA have reduced glycogen and fat stores, leading to decreased glucose production.²² Conversely, LGA infants, having received excess glucose in utero, may experience hypoglycemia after birth when glucose supply ceases. Evidence suggests that late preterm infants with SGA or LGA are at higher risk for asymptomatic hypoglycemia compared to those of appropriate gestational age (AGA).^{15,22}

Birth asphyxia increases energy demands for respiration, raising glucose requirements, while late preterm infants have limited glucose production capacity.^{3,18} Some studies have linked low APGAR scores with hypoglycemia, although other studies

have found no significant correlation.^{19,21} MSAF may indicate fetal distress due to hypoxia, which can affect glucose levels.^{23,24} Neonatal sepsis is defined as the presence of infection in an infant within the first 72 hours of birth. Most cases are primarily associated with premature rupture of membranes (PROM).³ In this study, the hospital used for data collection defined PROM as rupture of membranes occurring for ≥ 12 hours prior to delivery. Preterm infants are particularly vulnerable due to immature immune systems, necessitating increased energy for infection response, which can result in hypoglycemia.^{3,25,26} However, some studies have not found a relationship between sepsis and hypoglycemia.^{21,27} Hypothermia can also contribute to hypoglycemia, as maintaining body temperature requires significant glucose. Preterm infants with temperatures below 36.5°C are at a higher risk for asymptomatic hypoglycemia.^{21,26,28,29}

Maternal factors influencing hypoglycemia incidence in late preterm infants include gestational diabetes mellitus (GDM),^{18,21} fasting duration, and the type of intravenous fluids administered during fasting.²² Infants of mothers with GDM may experience hypoglycemia after birth due to cessation of glucose supply.^{18,21} A study found that infants born to mothers with GDM who received insulin were 5.75 times more likely to develop asymptomatic hypoglycemia compared to those without this factor.²¹ Prolonged fasting before cesarean sections can also lower maternal and fetal glucose levels, potentially leading to hypoglycemia in the infant.²² Prior to cesarean section (C/S), mothers are required to abstain from food and water, which results in low blood glucose levels in the mothers and the babies. Mothers who receive intravenous fluids with no glucose experience hypoglycemia due to the increased energy expenditure in relieving pain, which may also lead to fetal and neonatal hypoglycemia.²²

Prior studies have examined risk factors for neonatal hypoglycemia in infants born at 35–37 weeks' gestation, whereas fewer studies have specifically

focused on late preterm infants at 34 weeks' gestation and beyond. Moreover, there is limited published evidence on asymptomatic hypoglycemia in late preterm infants in Thailand. In the present retrospective study, we therefore reviewed the literature on asymptomatic neonatal hypoglycemia, identified infant-related risks including SGA, LGA, birth asphyxia, MSAF, neonatal sepsis, and hypothermia as infant-related factors, as well as GDM, duration of maternal fasting, and type of intravenous fluids administered during fasting as maternal variables. These evidence-based risk factors were integrated into our study design to investigate the high-risk neonates and to inform nursing surveillance and preventive strategies aimed at reducing morbidity associated with late preterm neonatal hypoglycemia.

Study Aim

This study aimed to determine the predictive power of neonatal factors (SGA, LGA, birth asphyxia, MSAF, neonatal sepsis, and hypothermia) and maternal factors (GDM, fasting time before delivery, and type of intravenous fluid administration during fasting) on the development of asymptomatic hypoglycemia in late preterm infants.

Methods

Design: A retrospective case-control study was conducted, and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were used to guide the writing of this paper.

Sample and Setting: The sample consisted of late preterm infants with a gestational age of 34 weeks to 36 weeks and six days who were born and admitted to the neonatal ward or neonatal intensive care unit (NICU) of a university hospital in Bangkok, Thailand, between January 2017 and December 2022. Participants were selected using purposive sampling according to the predefined inclusion criteria. The sample

consisted of cases defined as infants with blood glucose levels below 40 mg/dL within the first hour after birth without clinical signs of hypoglycemia, including sweating, poor latch, hypotonia, tachypnea, apnea, or seizures. The controls were defined as those with blood glucose levels greater than 40 mg/dL within one hour postpartum and no clinical symptoms of hypoglycemia. The infants with severe congenital malformations and those born to mothers with hypertension, body mass index > 25 kg/m,² preeclampsia, or those taking medications affecting blood glucose levels were excluded from the study.

The study hospital's screening protocol required blood glucose testing for all late-preterm infants at 1 hour after birth. Capillary blood samples were taken after the infants' heels were warmed. Blood glucose concentrations were determined using point-of-care testing (POCT). The glucometer was calibrated every day by LEBMED.

The sample size was estimated based on prior research by Cummings et al.,¹⁷ who examined factors associated with asymptomatic hypoglycemia in preterm infants. The standard formulas for case-control studies were used to determine the sample size,³⁰ resulting in a minimum of 183 participants in the case group, for a total of 366 participants. Accounting for a multiple correlation coefficient of 0.512 (very large size) in multivariable analysis,³¹ the sample size was increased to at least 498 participants. To mitigate potential data loss, a 15% margin was added, resulting in a total required sample size of 586 infants.

Ethical Considerations: Ethical approval was granted by the Human Research Ethics Committee, Faculty of Medicine Ramathibodi Hospital, Mahidol University (COA. MURA2023/416) and the studied hospital (COA No. 1170/2024). The study was conducted in accordance with the Declaration of Helsinki. Given the retrospective nature, the requirement for informed consent was waived by the ethics committees. Confidentiality and privacy of patient data were strictly maintained; all data were anonymized and handled securely to protect participant identities.

Research Instruments: The instrument consisted of a Demographic Data Questionnaire, divided into two parts to collect information on infants and mothers.

Infant and Maternal Record Forms: The primary investigator (PI) developed this questionnaire based on literature reviews to extract personal data on infants and mothers from electronic medical records. *The infants' data* included gender, gestational age, delivery method, birth weight, postnatal temperature, type of hypoglycemia, blood glucose level below 40 mg/dL one hour after birth, APGAR score, meconium-stained fluid, and neonatal sepsis. *The mothers' data* included age, type of gestational diabetes and treatment, maternal fasting time before delivery, and intravenous fluid administration during fasting. The data collection form was reviewed for content appropriateness, accuracy, and completeness by a neonatal nursing expert who was a member of the research team. As the form was developed specifically for retrospective data collection from medical records, pilot testing was not conducted prior to data collection.

Data Collection: After obtaining ethical approval, the PI contacted the relevant department at the study hospital to explain the details and survey the list of eligible late preterm infants. Medical records were retrieved from the hospital's electronic system, and data were recorded using the infant and maternal record forms. Data on asymptomatic hypoglycemia were obtained from electronic medical records (EMR), specifically from pediatrician summaries.

Data Analysis: The collected data were analyzed using SPSS (version 29). Descriptive statistics were used to analyze the demographic characteristics. Multiple logistic regression was conducted to identify predictive factors of asymptomatic hypoglycemia in late preterm infants. The fitness of the regression model was assessed using the Hosmer-Lemeshow test, which indicated a good fit (p-value > 0.05). Multicollinearity and autocorrelation were tested. Variance Inflation Factors (VIFs) ranged from 1.01 to 1.17, indicating no multicollinearity among

independent variables. In addition, to control for major confounding variables and identify independent determinants of asymptomatic hypoglycemia, the crude odds ratio (COR) from univariate logistic regression was used, with variables selected for the multivariate model if $p < 0.05$.

Results

The study included 586 infants (293 cases and 293 controls). The majority of cases (158, 53.9%) were female, and the majority of controls (157, 53.6%) were male. The average gestational ages of cases and controls were 35.37 ± 0.75 and 35.30 ± 0.79 weeks, respectively. The mean birth weight of cases and controls was $2,458.89 \pm 462.14$ and $2,495.00 \pm 365.67$ grams, respectively.

Although gender, gestational age, and birth weight did not differ significantly, birth weight for gestational age differed significantly between cases and controls. Most of the cases (242, 82.6%) and the controls (270, 92.2%) were AGA. Regarding the fifth-minute APGAR score, almost all infants in both the case and control groups had a score of 10. Concerning the meconium-stained amniotic fluid, neonatal sepsis, and membrane rupture lasting more than 12 hours before birth, nearly all infants in both groups had none of these problems. Regarding body temperature, most infants in both the case and control groups had a temperature of 37°C . The mean glucose level one hour post-birth was lower in the case group (34.80 ± 5.09 mg/dL) than in the control group (60.62 ± 11.65 mg/dL) (Table 1).

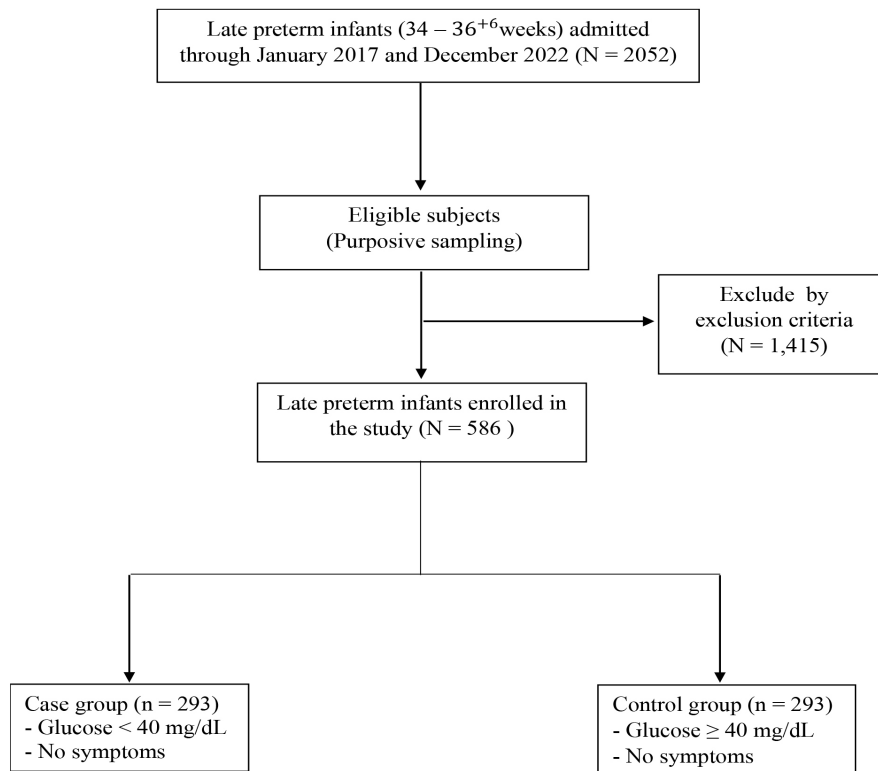


Figure 1. Enrollment of late preterm infants screened for asymptomatic hypoglycemia

Table 1. Demographic characteristics of infants in the case and control group (n = 586)

Demographic data	Case (n = 293) n (%)	Control (n = 293) n (%)	p-value
Gender			
Female	158 (53.9)	136 (46.4)	0.069 ^c
Male	135 (46.1)	157 (53.6)	
Gestational age (week)			
34	49 (16.7)	59 (20.1)	0.560 ^c
35	88 (30.0)	86 (29.4)	
36	156 (53.2)	148 (50.5)	
Birth weight (gram), Mean $\pm$ SD	2,458.89 $\pm$ 462.14	2,495.00 $\pm$ 365.67	0.295 ^t
Min–Max	(1172–4070)	(1186–3604)	
Birth weight for gestational age			
Appropriate gestational age	242 (82.6)	270 (92.2)	0.002 ^c
Small gestational age	29 (9.9)	14 (4.8)	
Large gestational age	22 (7.5)	9 (3.1)	
1–min APGAR score, Median (IQR)	9 (8–9)	9 (8–9)	0.947 ^m
Min–Max.	(4–9)	(4–9)	
5–min APGAR Score, Median (IQR)	10 (9–10)	10 (9–10)	0.213 ^m
Min–Max.	(5–10)	(5–10)	
Neonatal asphyxia			
No asphyxia	288 (98.3)	286 (97.6)	0.876 ^f
Mild asphyxia	4 (1.4)	6 (2.0)	
Moderate asphyxia	1 (0.3)	1 (0.3)	
Meconium–stained amniotic fluid			
No	290 (99.0)	288 (98.3)	0.725 ^f
Yes	3 (1.0)	5 (1.7)	
Slightly yellowish green	2 (66.7)	3 (60.0)	
Dark green	1 (33.3)	2 (40.0)	
Neonatal sepsis			
No	291 (99.3)	293 (100)	0.499 ^f
Yes	2 (0.7)	0 (0.0)	
Time to rupture or leakage of membranes 12 hours or more before delivery			
No	252 (86.0)	263 (89.8)	0.164 ^c
Yes	41 (14.0)	30 (10.2)	
Postpartum body temperature (°C), Mean $\pm$ SD	37.01 $\pm$ 0.37	37.04 $\pm$ 0.38	0.465 ^t
Min–Max.	(35.7–38.5)	(36.0–38.5)	
Hypothermia			
No	282 (96.2)	281 (95.9)	0.832 ^c
Yes	11 (3.8)	12 (4.1)	
Point-of-care testing (POCT) for glucose at 1 hour after birth (mg/dL), Mean $\pm$ SD	34.80 $\pm$ 5.09	60.62 $\pm$ 11.65	< 0.001 ^t
Min–Max	(14–39)	(43–97)	

Note. t = Independent t-test, m = Mann–Whitney U test, c = Chi-square test, f = Fisher's exact test

Most mothers in cases (172, 58.7%) and controls (183, 62.5%) were less than 35 years of age. Cesarean sections were higher in the case group (234, 79.9%) than in the control group (192, 65.5%). Mothers of hypoglycemic infants had longer mean fasting duration (8.10 hours) than controls (6.24

hours). Regarding prenatal fluids, 240 (81.9%) mothers in the case group received glucose-containing intravenous fluids prenatally, compared with 198 (67.6%) in the control group. Additionally, most mothers in both groups had no problem with diabetes mellitus during pregnancy (Table 2).

Table 2. Demographic characteristics of mothers in the case and control group (n = 586)

Demographic data	Case (n = 293) n (%)	Control (n = 293) n (%)	p-value
Age (years), Mean $\pm$ SD	32.53 $\pm$ 5.57	31.60 $\pm$ 5.61	0.044 ^t
Min-Max	(16-44)	(16-45)	
< 35	172 (58.7)	183 (62.5)	0.352 ^c
$\geq$ 35	121 (41.3)	110 (37.5)	
Method of delivery			
Normal labor	59 (20.1)	101 (34.5)	< 0.001 ^c
Cesarean section	234 (79.9)	192 (65.5)	
Duration of fasting before delivery (hours), Mean $\pm$ SD	8.10 $\pm$ 3.58	6.24 $\pm$ 3.77	< 0.001 ^t
Min-Max	(1-24)	(1-24)	
Less than or equal to 6 hours	104 (35.5)	178 (60.8)	
More than 6 hours	189 (64.5)	115 (39.2)	
Prenatal intravenous fluid administration			
None	3 (1.0)	5 (1.7)	< 0.001 ^f
Glucose type	240 (81.9)	198 (67.6)	
Non-glucose type	50 (17.1)	90 (30.7)	
Gestational diabetes mellitus			
No	254 (86.7)	245 (83.6)	0.296 ^c
Yes	39 (13.3)	48 (16.4)	
Class A1 Type	17 (43.59)	36 (75.0)	
Class A2 Type	22 (56.41)	12 (25.0)	

Note. t = Independent t-test, c = Chi-square test, f = Fisher's exact test

Multiple logistic regression analyses indicated that SGA, LGA, and a maternal fasting period of more than 6 hours were significantly associated with an increased risk for asymptomatic hypoglycemia in late preterm infants. Infants with SGA were 2.31 times more likely to develop asymptomatic hypoglycemia, while LGA infants had a 2.73 times higher likelihood compared to AGA infants. Furthermore,

infants born to mothers who fasted for more than six hours had a 2.81 times greater chance of developing asymptomatic hypoglycemia than those whose mothers fasted for less than or equal to six hours. These three factors collectively explained 10.4% (Nagelkerke R²) of the risk for asymptomatic hypoglycemia in late preterm infants (Table 3).

Table 3. Multivariable analysis of predictive factors of asymptomatic hypoglycemia in late preterm infants (n = 586)

Factors	Univariable analysis		Multivariable analysis	
	Crude OR (95%CI)	p-value	Adjusted OR (95%CI)	p-value
Sex				
Female	1.35 (0.98–1.87)	0.069	1.35 (0.95–1.91)	0.096
Male	1.00 Reference		1.00 Reference	
Gestational age (week)				
34	1.00 Reference		1.00 Reference	
35	1.23 (0.76–1.99)	0.396	0.92 (0.57–1.49)	0.748
36	1.27 (0.82–1.97)	0.289	1.11 (0.74–1.65)	0.628
Birth weight for gestational age				
Appropriate gestational age	1.00 Reference		1.00 Reference	
Small gestational age	2.31 (1.19–4.48)	0.013	2.08 (1.05–4.10)	0.035
Large gestational age	2.73 (1.23–6.04)	0.013	2.58 (1.14–5.83)	0.023
Neonatal asphyxia				
No	1.00 Reference		1.00 Reference	
Yes	0.71 (0.22–2.26)	0.561	0.54 (0.15–1.92)	0.338
Meconium-stained amniotic fluid				
No	1.00 Reference		1.00 Reference	
Yes	0.60 (0.14–2.52)	0.481	0.58 (0.12–2.87)	0.505
Neonatal sepsis				
No	1.00 Reference			
Yes	- -	NA		
Time to rupture or leakage of membranes				
12 hours or more before delivery				
No	1.00 Reference		1.00 Reference	
Yes	1.43 (0.86–2.36)	0.165	1.09 (0.63–1.89)	0.765
Hypothermia				
No	1.00 Reference		1.00 Reference	
Yes	0.91 (0.40–2.11)	0.832	0.78 (0.31–1.97)	0.597
Fasting time before delivery > 6 hours	2.81 (2.01–3.93)	< 0.001	2.73 (1.95–3.83)	< 0.001
Gestational diabetes mellitus				
No	1.00 Reference		1.00 Reference	
Yes	0.78 (0.50–1.24)	0.296	0.66 (0.40–1.09)	0.107

Note. Cox & Snell R^2 = 0.078, Nagelkerke R^2 = 0.104

OR = odds ratio, CI = confidence interval, 1.00 = reference category

Discussion

The analysis of predictive factors of asymptomatic hypoglycemia in late preterm infants revealed that SGA infants were 2.31 times more likely to experience this condition compared to AGA infants. This is attributed to SGA infants often receiving inadequate nutrients from their mothers, leading to reduced glycogen and fat accumulation, which are crucial for glucose production. Infants with low glycogen stores are unable to generate sufficient glucose after birth, particularly when energy demands increase.^{22,32} This is in line with a study by Thompson-Branch and Havranek,³³ who examined risk factors for hypoglycemia in late preterm and full-term infants and found that SGA infants had a higher risk of developing moderate-to-severe hypoglycemia compared with AGA infants.³³ This finding aligns with a study by Park et al.,³⁴ who identified SGA status as the strongest independent predictor of hypoglycemia in late preterm infants. They found that infants born with SGA had a 2.44-fold increased risk of developing low blood sugar relative to those with appropriate birth weight for gestational age.³⁴

Moreover, LGA infants were 2.73 times more likely to develop asymptomatic hypoglycemia than AGA infants. This is due to LGA infants receiving excessive glucose in utero, resulting in rapid growth and increased insulin production. At birth, the cessation of maternal glucose supply, combined with elevated insulin levels, can lead to a rapid decline in blood glucose levels, resulting in hypoglycemia.⁴ This is consistent with a study by Turner et al.,¹⁵ which examined the risk factors of hypoglycemia in infants born by cesarean section, and found that the risk of asymptomatic hypoglycemia in LGA infants was twice that of AGA infants.

In addition, maternal fasting for more than six hours before delivery was identified as a significant predictor of asymptomatic hypoglycemia, increasing the likelihood by 2.81 times compared to those fasting for shorter durations. This may be because, before

a cesarean section, mothers are required to abstain from food and water for different periods of time. Fasting for more than six hours before delivery results in a drop in the maternal and fetal blood sugar levels, which may lead to asymptomatic hypoglycemia. This finding underscores the importance of monitoring maternal glucose levels during preoperative fasting, particularly before cesarean sections.^{21,22} This is also consistent with the work of Chen et al.²¹ who found that prolonged fasting before delivery significantly decreased infants' glucose levels, which increased the risk of asymptomatic hypoglycemia in late preterm infants. In addition, it is also consistent with a study by Buaprakong et al.,²² which examined the predictive factors of hypoglycemia in a total of 260 infants born by cesarean section and found that the risk of hypoglycemia in infants born to mothers who fasted for more than or equal to six hours was 26.41 times that of infants born to mothers who fasted for less than six hours, with statistical significance. In this study, hypothermia was not associated with asymptomatic hypoglycemia in late preterm infants, which may be explained by the low prevalence of hypothermia (3.8%). Similarly, no significant association was found between neonatal sepsis and asymptomatic hypoglycemia, likely due to its low incidence (0.7%). Birth asphyxia and meconium-stained amniotic fluid were also not associated with the outcome, possibly because of their small proportions in the study population (2.05% and 1.37%, respectively). Gestational diabetes was likewise not associated with asymptomatic hypoglycemia, which may be attributed to the limited number of affected mothers in both groups, reducing the statistical power to detect a significant relationship.

Limitations

This study has several limitations. As a retrospective review, it is inherently subject to potential issues, including incomplete data and unmeasured confounding. Although efforts were made to minimize

confounding by applying exclusion criteria for factors known to influence neonatal blood glucose levels, residual confounding cannot be entirely ruled out. In addition, only infants identified as at risk for hypoglycemia were included in the screening process; therefore, the findings are limited to identifying additional risk factors for asymptomatic hypoglycemia in late preterm infants and may not be generalizable to the broader neonatal population. Maternal body mass index (BMI) > 25 kg/m² has been associated with gestational diabetes mellitus (GDM) A1, while higher levels of obesity are linked to GDM A2 and hypertensive disorders of pregnancy. Increased maternal BMI is also associated with higher birth weight, which may elevate the risk of LGA, as well as severe preeclampsia and intrauterine hypoxia. For these reasons, mothers with BMI > 25 kg/m² were excluded from this study. Maternal hypertension can impair uteroplacental perfusion, resulting in fetal undernutrition, intrauterine growth restriction, and low birth weight. Furthermore, antihypertensive medications (e.g., propranolol) may adversely affect neonatal glucose regulation and increase the risk of postnatal hypoglycemia. Accordingly, mothers with hypertension were excluded to reduce the influence of these factors on neonatal blood glucose levels. Finally, a blood glucose threshold of < 40 mg/dL was applied based on point-of-care testing (POCT); however, capillary measurements may underestimate plasma glucose levels by approximately 10–15%.

Conclusions and Implications for Nursing

Practice and Future Research

This study showed that SGA, LGA, and prolonged fasting periods of more than six hours were associated with an increased risk for asymptomatic hypoglycemia in infants. This study developed a predictive model incorporating both neonatal and maternal factors; however, it showed a low Nagelkerke R²,² indicating limited explanatory power. Nevertheless, the prediction and management of risk factors for

asymptomatic hypoglycemia in late preterm infants remain important in clinical practice, as they influence treatment decisions and patient outcomes. Therefore, nurses and other healthcare professionals should implement comprehensive monitoring protocols for asymptomatic hypoglycemia in infants identified as high-risk, including SGA, LGA, and those born to mothers with prolonged fasting periods. Regular blood glucose assessments should be conducted within the first few hours after birth, and appropriate interventions should be initiated promptly to mitigate the risk of severe complications and long-term developmental issues. Future studies should consider increasing the sample size, particularly by adopting a higher control-to-case ratio (e.g., 1:2 or 1:3), and by incorporating multicenter recruitment to enhance statistical power and generalizability. In addition, further investigation of other potential contributing factors, such as maternal medication use during pregnancy and socioeconomic determinants of maternal and neonatal care, is needed. Moreover, refinement of predictive models, together with external validation using a broader range of clinically relevant variables, may improve their predictive accuracy and clinical applicability.

Acknowledgment

Sincere appreciation is extended to all participants in this study. The publication of this study was supported by Ramathibodi School of Nursing, Faculty of Medicine Ramathibodi Hospital, Mahidol University.

Author Contributions

Conceptualization, Method and design: AT, TD
Data collection, Drafting the manuscript: AT
Data analysis and interpretation: AT, TD
Editing the manuscript: TD
Revising the manuscript: AT, TD
Final approval of the manuscript: TD, JJ

Declaration of AI used for Scientific Writing

The authors declare that artificial intelligence tools were used in the preparation of this manuscript solely for language editing, grammar correction, and improving readability and precise writing.

References

1. Deyo-Svendsen M, Herrmann S, Andrist C, Phillips M, Svendsen MC, Svendsen RO. Prevention of neonatal hypoglycemia with oral glucose gel for high-risk newborns. *WMIJ*. 2021;120(1):51-3. PMID: 33974766.
2. Saifi A, Chauhan RS, Singh A. Incidence and risk factors of neonatal hypoglycaemia in term and preterm infants. *Int J Med Pharm Res*. 2026;7(2):1747-52. doi: 10.5281/zenodo.19578116.
3. Abramowski A, Ward R, Hamdan AH. Neonatal hypoglycemia. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2026 Jan [cited 2026 May 1]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK537105/>
4. May RW, Gamble GD, McKinlay CJD, Harris D, Harding JE. Measures of neonatal glycemia from blood glucose concentrations and neurodevelopmental outcomes at 2 years. *Pediatr. Res*. 2026;1-12. doi: 10.1038/s41390-026-04958-w.
5. Wei X, Franke N, Alsweiler JM, Brown GTL, Gamble GD, McNeill A, et al. Neonatal hypoglycemia and neurocognitive function at school age: a prospective cohort study. *J Pediatr*. 2024;272:114119. doi: 10.1016/j.jpeds.2024.114119.
6. Harding JE, Alsweiler JM, Edwards TE, McKinlay CJ. Neonatal hypoglycaemia. *BMJ Med*. 2024;3(1):e000544. doi: 10.1136/bmjmed-2023-000544.
7. Gupta Basuray R, Painter A, Thakrar SB, Westphal K. Neonatal hypoglycemia. *Pediatr Clin North Am*. 2025;72(4):597-604. doi: 10.1016/j.pcl.2025.04.002.
8. Warren M. Explains the nation's stagnant preterm birth rate and widening disparities highlighted in the 2025 report [Internet]. 2025 Nov 17 [cited 2026 May 5]. Accompanied by: Video at: <https://www.contemporaryobgyn.net/view/united-states-receives-d-on-2025-march-of-dimes-report-card>
9. Gotkine E. CDC: 2024 to 2025 saw decline in number of births, fertility rate in US [Internet]. Douglas: Medical Xpress; 2026 Apr 9 [cited 2026 May 1]. Available from: <https://medicalxpress.com/news/2026-04-cdc-decline-births-fertility.html>
10. Boyle EM, Mielewczyk FJ, Mulvaney C. Late preterm and early term birth: challenges and dilemmas in clinical practice. *Semin Fetal Neonatal Med*. 2024;29(6):101564. doi: 10.1016/j.siny.2024.101564.
11. Goode RH, German KR, Kuo DZ. Neurodevelopmental outcomes of moderate to late preterm infants: a population at risk. *NeoReviews*. 2025;26(11):e743-54. doi: 10.1542/neo.26-11-068.
12. World Health Organization. WHO recommendations for care of the preterm or low-birth-weight infant [Internet]. Geneva: World Health Organization; 2022 Nov 1 [cited 2026 May 1]. Available from: <https://www.who.int/publications/i/item/9789240058262>
13. Thawaro J. Comparison of clinical outcomes of late preterm infants with full-term infants in Nongbualamphu Hospital. *Sanpasitthiprasong Med J*. 2021;42(2):53-61 (in Thai).
14. Booranavanich K, Saengrat P. Outcome of newborns with gestational age 34-36 weeks whose mothers were diagnosed with premature rupture of membranes: comparison between induction and expectant management. *Vajira Med J*. 2018;62(1):21-32. Available from: <https://he02.tci-thaijo.org/index.php/VMED/article/view/195774/136081> (in Thai).
15. Turner D, Monthé-Drèze C, Cherkerzian S, Gregory K, Sen S. Maternal obesity and cesarean section delivery: additional risk factors for neonatal hypoglycemia? *J Perinatol*. 2019;39(8):1057-64. doi: 10.1038/s41372-019-0404-z.
16. Detintaranarak J. Incidence and risk factors of neonatal hypoglycemia in high-risk infants, Nakhonpathom Hospital. *Reg 4-5 Med J*. 2023;42(2):187-97 (in Thai).
17. Cummings CT, Ritter V, LeBlanc S, Sutton AG. Evaluation of risk factors and approach to screening for asymptomatic neonatal hypoglycemia. *Neonatology*. 2022;119(1):77-83. doi: 10.1159/000520512.
18. Wang D, Zhou X, Ning J, He F, Shi J, Jin X. Risk factors for neonatal hypoglycemia: a meta-analysis. *BMC Endocr Disord*. 2024;24(1):166. doi: 10.1186/s12902-024-01700-7.

19. Ruiz NM, García Íñiguez JP, Rite Gracia S, Samper Villagrasa MP. Prospective study on influence of perinatal factors on the development of early neonatal hypoglycemia in late preterm and term infants. *An Pediatr (Engl Ed)*. 2022;96(3):230–41. doi: 10.1016/j.anpede.2021.04.007.
20. Prayoga AW, Saputra IMY, Arimbawa IM, Kardana IM. Clinical characteristics of neonatal hypoglycemia. *Acad Clin Pediatr*. 2025;2(1):8–11. doi: 10.4103/ACPed.ACPed_27_24.
21. Chen YS, Ho CH, Lin SJ, Tsai WH. Identifying additional risk factors for early asymptomatic neonatal hypoglycemia in term and late preterm babies. *Pediatr Neonatol*. 2022;63(6):625–32. doi: 10.1016/j.pedneo.2022.04.011.
22. Buaparakong S, Thampanichawat W, Rungamonrat S. Predictive factors of hypoglycaemia in neonates delivered by means of caesarean sections. *J Thai Nurs Midwife Counc*. 2019;34(1):59–73. Available from: <https://he02.tci-thaijo.org/index.php/TJONC/article/view/155838> (in Thai).
23. Tatichayanon S. Incidence and associated risk factors of meconium aspiration syndrome in meconium-stained amniotic fluid at Kratumbaen Hospital. *J Nurs Siam Univ*. 2022;23(44):49–60. Available from: <https://he01.tci-thaijo.org/index.php/nursingsiamjournal/article/view/255590> (in Thai).
24. Avagliano L, Massa V, Bulfamante G. Meconium-stained amniotic fluid and histologic signs of fetal distress in stillbirths. *Eur J Obstet Gynecol Reprod Biol*. 2021;266:55–62. doi: 10.1016/j.ejogrb.2021.09.016.
25. Hoermann H, Roeper M, Friesl L, Kurz C, Tautz J, Dzierko M, et al. Association of neonatal hypothermia with neonatal hypoglycemia. *Front Endocrinol (Lausanne)*. 2025;16:1641140. doi: 10.3389/fendo.2025.1641140.
26. Kurz C, Roeper M, Welters A, Mayatepek E, Meissner T, Kummer S, et al. Relationship of neonatal hypothermia and hypoglycemia in late preterm and term born neonates. *Mol Cell Pediatr*. 2025;12:15. doi: 10.1186/s40348-025-00204-1.
27. Na Songkla P, Sompeewong P, Sartsuk C. Sensitivity and specificity of immature granulocyte count for diagnosis of neonatal sepsis at Prapokklao Hospital. *J Prapokklao Hosp Clin Med Educat Center*. 2020;37(1):51–60. Available from: <https://he02.tci-thaijo.org/index.php/ppkjournal/article/view/206815> (in Thai).
28. World Health Organization. Thermal protection of the newborn: a practical guide. Geneva: WHO; 1997. 64 p.
29. Chaonarin P, Deawprasert T, Ariyapana P, Keeratavanitsatian S. Prevention of hypothermia in the newborn. *Thai J Nurs*. 2021;70(4):52–9. Available from: <https://he02.tci-thaijo.org/index.php/TJN/article/view/250333> (in Thai).
30. Rosner BA. Fundamentals of biostatistics. 6th ed. Belmont (CA): Thomson Brooks/Cole; 2006. 868 p.
31. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. New York: Routledge; 2013. 567 p. doi: 10.4324/9780203771587.
32. Committee on Fetus and Newborn; Adamkin DH. Postnatal glucose homeostasis in late-preterm and term infants. *Pediatrics*. 2011;127(3):575–9. doi: 10.1542/peds.2010-3851.
33. Thompson-Branch A, Havranek T. Neonatal hypoglycemia. *Pediatr Rev*. 2017;38(4):147–57. doi: 10.1542/pir.2016-0063.
34. Park H, Kim JS, Lee S. Early-onset hypoglycemia in late preterm infants: small-for-gestational-age as an independent risk factor. *Pediatr Neonatol*. Forthcoming 2026. doi: 10.1016/j.pedneo.2026.04.008.

ปัจจัยทำนายการเกิดภาวะน้ำตาลในเลือดต่ำแบบไม่แสดงอาการในทารกเกิดก่อนกำหนดระยะท้าย : การศึกษาย้อนหลัง

อชิรญา ทรทุรานนท์ ทิพวัลย์ ดารามาศ* จงใจ จงอร่ามเรือง

บทคัดย่อ: ภาวะน้ำตาลในเลือดต่ำแบบไม่แสดงอาการในทารกเกิดก่อนกำหนดระยะท้ายเป็นปัญหาสำคัญที่มักถูกมองข้ามซึ่งอาจส่งผลกระทบต่อพัฒนาทางระบบประสาทของทารก การค้นหาปัจจัยทำนายการเกิดภาวะน้ำตาลในเลือดต่ำแบบไม่แสดงอาการของทารกจะช่วยให้การดูแลรักษาทารกเป็นไปอย่างมีประสิทธิภาพและรวดเร็วขึ้น อย่างไรก็ตามหลักฐานงานวิจัยที่ตีพิมพ์เกี่ยวกับภาวะน้ำตาลในเลือดต่ำแบบไม่แสดงอาการในทารกเกิดก่อนกำหนดระยะท้ายในประเทศไทยยังมีอยู่อย่างจำกัด การศึกษาครั้งนี้เป็นแบบการศึกษาย้อนหลังเทียบกลุ่มกรณีและกลุ่มควบคุม (retrospective case-control study) โดยกลุ่มตัวอย่าง จำนวน 586 ราย เป็นทารกเกิดก่อนกำหนดระยะท้ายที่รับการรักษาที่โรงพยาบาลมหาวิทยาลัยแห่งหนึ่งในกรุงเทพมหานคร ระหว่างเดือนมกราคม พ.ศ. 2560 ถึงเดือนธันวาคม พ.ศ. 2565 เก็บข้อมูลโดยใช้แบบบันทึกข้อมูลของทารก และแบบบันทึกข้อมูลของมารดา วิเคราะห์ข้อมูลทั่วไปโดยใช้สถิติเชิงพรรณนา และวิเคราะห์ปัจจัยทำนายโดยใช้สถิติถดถอยโลจิสติก

ผลการศึกษาพบว่ากลุ่มที่มีภาวะน้ำตาลในเลือดต่ำแบบไม่แสดงอาการส่วนใหญ่เป็นทารกเพศหญิง คิดเป็นร้อยละ 53.9 อายุครรภ์เฉลี่ย 35.37 ± 0.75 สัปดาห์ ค่าระดับน้ำตาลในเลือด (POCT glucose) ของทารกหลังเกิด 1 ชั่วโมงเฉลี่ยเท่ากับ 34.80 ± 5.09 มิลลิกรัมต่อเดซิลิตร ปัจจัยเสี่ยงที่สามารถทำนายการเกิดภาวะน้ำตาลในเลือดต่ำแบบไม่แสดงอาการในทารกเกิดก่อนกำหนดระยะท้าย ได้แก่ ทารกมีน้ำหนักแรกเกิดน้อยกว่าอายุครรภ์ (small gestational age) ทารกมีน้ำหนักแรกเกิดมากกว่าอายุครรภ์ (large gestational age) และมารดามีระยะเวลาการจมน้ำและอาหารก่อนคลอดมากกว่า 6 ชั่วโมง โดยปัจจัยทั้ง 3 ปัจจัยสามารถร่วมกันทำนายการเกิดภาวะน้ำตาลในเลือดต่ำแบบไม่แสดงอาการในทารกเกิดก่อนกำหนดระยะท้ายได้ร้อยละ 10.4 อย่างไรก็ตาม ควรมีการศึกษาเพิ่มเติมเกี่ยวกับปัจจัยที่อาจเกี่ยวข้องกับการเกิดภาวะน้ำตาลในเลือดต่ำแบบไม่แสดงอาการในทารกเกิดก่อนกำหนดระยะท้าย เช่น การได้รับยาของมารดา แนวทางการให้นมในทารก และความผิดปกติของระบบเมตาบอลิซึม จากผลการศึกษาดังกล่าว โรงพยาบาลควรมีการติดตามและเฝ้าระวังภาวะน้ำตาลในเลือดต่ำแบบไม่แสดงอาการในทารกเกิดก่อนกำหนดระยะท้ายอย่างใกล้ชิดเพื่อป้องกันภาวะแทรกซ้อนรุนแรงหรือผลกระทบต่อพัฒนาการของสมองและสุขภาพของทารกในระยะยาว นอกจากนี้ ควรให้ความรู้แก่มารดาเรื่องการให้นม และการสังเกตสัญญาณเตือนของภาวะน้ำตาลในเลือดต่ำในทารกแรกเกิดที่มีความเสี่ยงสูงด้วย

Pacific Rim Int J Nurs Res 2026; 30(4) 922-934

คำสำคัญ: ภาวะน้ำตาลในเลือดต่ำแบบไม่แสดงอาการ การตรวจระดับน้ำตาล ทารกเกิดก่อนกำหนดระยะท้าย การพยาบาล ปัจจัยทำนาย การศึกษาย้อนหลังเทียบกลุ่มกรณีและกลุ่มควบคุม ประเทศไทย

อชิรญา ทรทุรานนท์ นักศึกษาหลักสูตรพยาบาลศาสตรมหาบัณฑิต สาขาวิชาการพยาบาลเด็ก โรงเรียนพยาบาลรามาธิบดี คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล E-mail: achi_th@hotmail.com
ติดต่อที่ : ทิพวัลย์ ดารามาศ* ผู้ช่วยศาสตราจารย์ โรงเรียนพยาบาลรามาธิบดี คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล และ คณะพยาบาลศาสตร์ มหาวิทยาลัยเกษมบัณฑิต คณะนิติเวชพยาบาลศาสตร์ มหาวิทยาลัยเกษมบัณฑิต E-mail: tipawan.dar@kbu.ac.th; <https://orcid.org/0000-0001-7103-9437>
จงใจ จงอร่ามเรือง ผู้ช่วยศาสตราจารย์ โรงเรียนพยาบาลรามาธิบดี คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล E-mail: jongjai.jon@mahidol.ac.th