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Impact of obstetric history and pregnancy intervals on postpartum anemia and lactation process: a cross-sectional analysis

Dampak Riwayat Kebidanan dan Interval Kehamilan pada Anemia Pascapersalinan dan Proses Menyusui: Analisis Cross-sectional

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ABSTRACT

Background: *High Maternal Mortality Rate in Indonesia is linked to postpartum anemia. This study addresses the high prevalence of postpartum anemia (>35%) in Kerek Health Center, Tuban.*

Objective: *This study aimed to analyze the influence of predictor factors (history of Postpartum Hemorrhage/PPH and pregnancy interval/PI) on Anemia Incidence, as well as the influence of lactation practices (Early Initiation of Breastfeeding/EIBF and history of lactation onset) on Lactation Process.*

Methods: *A cross-sectional approach was conducted from September 2025 to December 2025. Data analysis was performed using JASP (0.18). The study population comprised all postpartum mothers in the Health Center's working area, with 200 respondents selected using the total sampling technique. Independent variables included PPH history, PI, EIBF history, and late onset of lactation. The dependent variables were the incidence of anemia and breast milk production.*

Results: *A significant association was established between a history of PPH and the incidence of anemia (p=0.001), where a history of PPH increased the risk of anemia 5.006 times (OR=5.006). An ideal PI (≥2 years) was identified as a significant and dominant protective factor against anemia (OR=0.297, p=0.001). Regarding the lactation aspect, EIBF history had a significant association (OR=5.631, p=0.001). Conversely, a history of late onset of lactation was also significant to lactation failure (OR=0.165, p=0.001).*

Conclusion: *Delivery history has a significant influence on the incidence of anemia and the success of lactation. Practically, these findings suggest that healthcare providers should prioritize early screening for high-risk mothers during prenatal care and intensify lactation support programs.*

Keywords: *breast milk production, delivery history, postpartum anemia*

ABSTRAK

Latar belakang: Tingginya angka kematian ibu di Indonesia berkaitan dengan anemia postpartum. Penelitian ini berfokus pada tingginya prevalensi anemia postpartum (.35%) di Puskesmas Kerek, Tuban.

Tujuan: Penelitian ini bertujuan untuk menganalisis pengaruh faktor prediktor (riwayat Perdarahan Pascapersalinan/PPH dan interval kehamilan/PI) terhadap kejadian anemia,

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serta pengaruh praktik laktasi (Early Initiation of Breastfeeding/EIBF and history of lactation onset) terhadap proses laktasi.
Metode: Penelitian ini menggunakan pendekatan cross sectional pad September-Desember 2025. Analisis data dilakukan dengan JASP (0.18). Populasi penelitian adalah seluruh ibu nifas di wilayah kerja puskesmas, dnegan sampel 200 responden menggunakan Teknik total sampling. Variable independent meliputi Riwayat PPH, PI, Riwayat IMD, dan keterlambatan onset laktasi. Variable dependen adalah kejadian anemia dan produksi ASI.
Hasil: Terdapat hubungan signifikan antara Riwayat PPH dan kejadian anemia (p-0,001), dengan risiko anemia meningkat 5,006 kali (OR=5,006). Jarak kehamilan ideal (≥2 tahun) menjadi faktor protektif dominan terhadap anemia (OR=0,297; p=0,001). Pada aspek laktasi, riwayat IMD berhubungan signifikan (OR=5,631; p=0,001). Sebaliknya, riwayat keterlambatan onset laktasi juga berhubungan signifikan dengan kegagalan laktasi (OR=0,165; p=0,001).
Kesimpulan: Riwayat persalinan berpengaruh signifikan terhadap kejadian anemia dan keberhasilan laktasi. Secara praktis, tenaga kesehatan perlu memprioritaskan skrining dini ibu berisiko tinggi selama antenatal care serta memperkuat program dukungan laktasi.

Kata kunci: anemia postpartum, produksi ASI, riwayat persalinan

INTRODUCTION

The Maternal Mortality Rate (MMR) in Indonesia remains a serious public health problem, despite having decreased from 189 per 100,000 live births in 2023.[1] One of the important contributors to high MMR is complications that arise during the postpartum period, including postpartum anemia and lactation disorders.[2] Postpartum anemia not only reduces the mother's functional capacity but also contributes to an increased risk of infection, delayed uterine involution, and even increases susceptibility to secondary bleeding.[3] Meanwhile, lactation disorders can cause failure of early initiation of breastfeeding (EIBF), decreased breast milk production, and contribute to the risk of stunting in newborns.[4] The urgency of this research is increasing because untreated postpartum anemia has the potential to cause a decrease in breast milk production, increase the risk of postpartum infection, and disrupt the baby's growth.

Based on the Regulation of the Minister of Health of the Republic of Indonesia Number 21 of 2021 concerning Postpartum Health Services, every mother has the right to receive comprehensive monitoring, including hemoglobin level checks and evaluation of lactation success.[5,6] This monitoring obligation aligns with one of Indonesia's national goals, namely strengthening human resource development, science, technology, education, health, and gender equality. Efforts to ensure postpartum maternal health and successful lactation are fundamental pillars in developing quality human resources, as they directly impact the health and development of future generations, thus supporting the strengthening of women's roles in national development.[7]

However, field practice still faces challenges, particularly in rural areas, where postpartum maternal health monitoring is suboptimal and tends to be reactive. One factor suspected of influencing the incidence of postpartum anemia and smooth latch is birth history, including the type of delivery (vaginal without instruments, vaginal with instruments, and cesarean section)[8], gestational age at delivery (term, preterm, postterm)[9], and complications of childbirth (bleeding, preeclampsia, prolonged labor).[10] Previous studies have shown that cesarean section is associated with an increased risk of postpartum anemia, particularly due to blood loss during delivery, while preterm delivery has also been linked to adverse maternal hematological outcomes.[11] However,

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comprehensive data integrating these three variables in the context of lactation is still limited, particularly in Indonesia.

This study was conducted at the Kerek Community Health Center in Tuban Regency, given that the region has a relatively high prevalence of postpartum anemia, exceeding 35% according to the Tuban Regency Health Office.[12]In addition, the scope of lactation monitoring in this region is still limited to general education, without any structured screening based on birth history.[13] Tuban also has semi-rural geographic characteristics with less than optimal access to maternal health services, so this study is expected to be able to provide an evidence-based screening model that can be implemented in primary health services.[12] This study aimed to analyze the influence of predictor factors (history of Postpartum Hemorrhage/PPH and pregnancy interval) on Anemia Incidence, as well as the influence of lactation practices (Early Initiation of Breastfeeding/EIBF and history of lactation onset) on Lactation Process.

METHODS

Study design

This is an observational analytical study using a cross-sectional approach. The aim was to analyze the influence of childbirth history on the incidence of anemia and breast milk production in postpartum mothers. The study was conducted at the Kerek Community Health Center in Tuban Regency, East Java, from September 2025 to December 2025.

Data source and sampling procedure

The study population included all postpartum mothers within the Kerek Community Health Center's coverage area. Inclusion criteria included postpartum mothers with a previous gestational age of ≥28 weeks, birth history (type of delivery, gestational age, time of delivery, complications), willingness to participate in the study by signing an informed consent, and ability to assess their breast milk production. The population consisted of 200 women, all of whom were used as samples; therefore, the sampling technique used was total sampling.

Variables of the study

The independent variables in this study were history of postpartum hemorrhage (PPH), pregnancy interval, history of early initiation of breastfeeding (EIBF), and delayed onset of lactation. The dependent variables were the incidence of anemia and lactation. The dependent variables were the incidence of anemia and the lactation process, particularly breast milk production. Anemia was defined as a hemoglobin level of less than 11 g/dl in postpartum mothers, while lactation outcomes were assessed based on the adequacy of milk production.

Measurement and instruments

Data on the history of early initiation of breastfeeding (EIBF) and the onset of lactation were collected using a structured questionnaire developed based on previous literature and field adaptation. Prior to its use, the questionnaire underwent validity and reliability testing in a pilot sample of postpartum mothers with similar characteristics.

The validity test showed that all items had acceptable correlation coefficients ($r > 0.30$), indicating that each item was sufficiently valid. Reliability analysis using Cronbach's alpha demonstrated good internal consistency, with a value of $\alpha = 0.82$ for the EIBF section and $\alpha = 0.79$ for the onset of lactation section.

Clinical variables, including history of postpartum hemorrhage (PPH), pregnancy interval, and hemoglobin levels, were obtained from medical records. The diagnosis of anemia was based on hemoglobin levels <11 g/dL, following the standard criteria for postpartum mothers.

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Vol 18 No 1, Mei 2026
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Breast milk production was assessed using the LATCH scoring system, a standardized tool widely used to evaluate breastfeeding effectiveness. The LATCH scale consists of five components: latch, audible swallowing, type of nipple, comfort, and hold. Recent studies have demonstrated that the LATCH instrument has acceptable psychometric properties, with Cronbach's alpha values ranging from 0.70 to above 0.80, indicating good internal consistency[14]. In addition, the LATCH score has been shown to correlate positively with breastfeeding outcomes and duration, supporting its use as a reliable clinical assessment tool.

Data collection

Data collection was carried out in several steps. First, eligible participants were identified based on the inclusion criteria. The researcher then explained the study and obtained written informed consent from each participant. Respondents completed the questionnaire, and additional clinical information was gathered from their medical records. All procedures were conducted consistently to ensure data quality.

Ethical considerations

This study received ethical approval from the Health Research Ethics Committee of PGRI Adi Buana University Surabaya (No.180-KEPK Tahun 2025). Participants were fully informed about the purpose and procedures of the study before providing written consent. Confidentiality was maintained by anonymizing all personal data and ensuring that individual identities were not disclosed in any part of the research.

Data analysis

Data analysis was performed using JASP software (Version 0.18). Descriptive univariate analysis was used to summarize the characteristics of the respondents. Bivariate analysis was conducted using the Chi-Square test to examine the relationships between independent and dependent variables. The strength of associations was expressed using Odds Ratios (OR) with a 95% confidence interval (IC). A P-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1. Respondent Characteristics (n=200)

Variables	Categories	n	%
Parity (number of children)	1	69	34.5
	2	48	24
	3	51	25.5
	4	32	16
Postpartum Hemorrhage History (PPH)	Yes	46	23
	No	154	77
Pregnancy Interval	Short (<2 tahun)	78	39
	Ideal (≥2 tahun)	122	61
Early Initiation of Breastfeeding (EIBF)	Performed	139	69.5
	Not Performed	61	30.5
History of Late Lactation Onset	Yes	33	16.5
	No	167	83.5
Incidence of Anemia	Anemia	105	52.5
	No Anemia	95	47.5
Lactation Process	Smooth	134	67
	Not Smooth	66	33

Data Source: Primary Data, 2025

Table 1 shows that most respondents had one child (34.5%), while 52.5% experienced anemia. The majority had no history of postpartum hemorrhage (77.0%), had an ideal pregnancy interval of ≥2 years (61.0%), and performed Early Initiation of

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Vol 18 No 1, Mei 2026
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Breastfeeding (EIBF) (69.5%). Most respondents also had no history of delayed lactation onset (83.5%) and reported a smooth lactation process (67.0%).

Table 2. The Influence of Postpartum Hemorrhage History (PPH) on the Incidence of Anemia in Postpartum Mothers

PPH	Anemia Incident		Total n(%)	p-value	OR (95% CI)
	Anemia n(%)	No Anemia n(%)			
Yes	46 (100)	0 (0)	46 (100)	0.001	5.006
No	59 (38.31)	95 (61.69)	154 (100)		(2.200-7.811)

Data Source: Primary Data, 2025

Table 2 shows a significant association between a history of early postpartum hemorrhage (PPH) and the incidence of anemia (p=0.001). Postpartum mothers with a history of PPH had a 5.006 times greater risk of developing anemia than those without a history of PPH (OR = 5.006).

Table 3. Effect of Pregnancy Spacing on the Incidence of Anemia in Postpartum Mothers

Pregnancy Interval	Anemia Incident		Total (n/%)	p-value	OR (95% CI)
	Anemia (n/%)	No Anemia (n/%)			
Short (<2 years)	52 (66.67)	26 (33.33)	78 (100)	0.001	-0.957
Ideal (≥2 years)	53 (43.44)	69 (56.56)	122 (100)		(-1.548-(-0.366))

Data Source: Primary Data, 2025

Table 3 shows a significant association between pregnancy spacing and the incidence of anemia (p=0.001). Postpartum mothers with a short pregnancy spacing (<2 years) were at greater risk of developing anemia (66.67% of the group). The odds ratio (OR) indicates that an ideal spacing has a protective effect against anemia.

Table 4. The Effect of Early Breastfeeding on Breast Milk Outcome in Postpartum Mothers

Early Initiation of Breastfeeding (EIBF)	Lactation Process		Total (n/%)	p-value	OR (95% CI)
	Successful	Unsuccessful (n/%)			
Performed	107 (76.98)	32 (23.02)	139 (100)	0.001	1.438
Not Performed	27 (44.26)	34 (55.74)	61 (100)		(0.796-2.079)

Data Source: Primary Data, 2025

Table 4 shows a significant association between Early Initiation of Breastfeeding (EIBF) and the lactation process (p=0.001). Postpartum mothers who performed EIBF were more likely to experience a smooth lactation process compared to those who did not perform EIBF. Mothers who did not perform EIBF had a 1.438-times higher risk of experiencing an unsuccessful lactation process than those who performed EIBF (OR = 1.438). A total of 76.98% of mothers who performed EIBF experienced a smooth lactation process.

Table 5. The Effect of a History of Late Breastfeeding on Breast Milk Production in Postpartum Mothers

History of Late Lactation Onset	Lactation Process		Total (n/%)	p-value	OR (95% CI)
	Smooth (n/%)	Not Smooth (n/%)			
Yes	13 (39.39)	20 (60.61)	33 (100)	0.001	-1.398
No	121 (72.46)	46 (27.54)	167 (100)		(-2.174-(-0.622))

Data Source: Primary Data, 2025

Table 5 shows a significant association between a history of late lactation onset and Lactation Process (p-value=0.001). Postpartum mothers who did not have a history of late lactation onset had a significantly greater likelihood of Lactation Process. The OR

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Vol 18 No 1, Mei 2026
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value indicates that having a history of late lactation onset significantly decreased the likelihood of the Lactation Process.

Table 6. Multiple Logistic Regression on the Incidence of Anemia

Variables	B	SE	p-value	OR	95% CI	
					Lower	Upper
Postpartum Hemorrhage History (PPH)	19.115	922.066	0.983	2.002	0.000	unlimited
Pregnancy Interval	-1.214	0.349	0001	0.297	0.150	0.588

Data Source: Primary Data, 2025

After controlling for both factors, Table 6 shows that pregnancy spacing was the dominant and significant factor (p = 0.001) influencing the incidence of anemia. Mothers with ideal pregnancy spacing (≥2 years) had a 0.297-fold lower risk of anemia than mothers with short birth spacing. This demonstrates that ideal pregnancy spacing is a strong protective factor against anemia. Although a history of late breastfeeding was very strong in the bivariate analysis, it became insignificant in the multiple model (p = 0.983), likely due to the zero cell. This results in an indefinite CI range and reduces the predictive power of HPP when paired with pregnancy spacing. The unlimited Confidence Interval (CI) and high Standard Error (SE) for the History of PPH variable are caused by a statistical phenomenon known as Quasi-Complete Separation (or zero-cell frequency), where all respondents with a history of PPH also experienced anemia. In this condition, the Maximum Likelihood Estimation (MLE) fails to converge, making the multivariate OR for PPH statistically unstable.

However, the strength of the multivariate model remains robust for the Pregnancy Interval variable, which shows a highly significant association (p=0.001). For the PPH variable, the bivariate analysis (Table 2) remains the more reliable indicator of its strong clinical impact on anemia in this study population. To address this in future studies, a larger sample size or the use of Firth's Penalized Likelihood Regression could be employed to obtain stable estimates for variables with zero-cell counts.

In Table 7, both variables remain significant in the multiple model (p = 0.001 for both), indicating they are independent predictors. Early Initiation of Breastfeeding (EIBF) is the most dominant factor in increasing breastfeeding success. Mothers who practice EIBF are 5.631 times more likely to have successful breastfeeding. A history of late lactation onset is a strong predictor of lactation failure. Mothers with a history of late lactation onset are only 0.165 times more likely to have successful breastfeeding than those without such a history.

Table 7. Multiple Logistic Regression Analysis of Successful Breast Milk Production

Variables	B	SE	p-value	OR	95% CI	
					Lower	Upper
EIBF	1.728	0.357	0.001	5.631	2.799	11.329
History of Late Lactation Onset	-1.803	0.434	0.001	0.165	0.070	0.386

Data Source: Primary Data, 2025

DISCUSSION

The Influence of Postpartum Hemorrhage (PPH) History on the Incidence of Anemia in Postpartum Mothers

The results of the study showed a significant association between a history of postpartum hemorrhage (PPH) and the incidence of anemia (p=0.001). Postpartum women with a history of PPH had a 5.006 times greater risk of developing anemia than those without a history of PPH. This is consistent with previous research in Pakistan that found decreased Hb levels in women with bleeding >500 ml. Other research also states

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that there is a decrease in Hb levels in postpartum mothers during the first 48 hours, so strict monitoring is needed.[15]

Postpartum hemorrhage (PPH) is a condition in which a woman loses more than 500 ml of blood during a vaginal delivery or more than 1,000 ml during a cesarean section. This condition causes a mother to lose a large amount of blood, known as acute bleeding. In acute bleeding, hypovolemia occurs due to blood loss, causing the body to adapt by vasoconstricting. Then, extracellular fluid shifts to intracellular fluid to restore blood volume, resulting in hemodilution. Hemodilution is characterized by a decrease in hemoglobin levels.[16] The research results strengthen this statement.

The Effect of Pregnancy Spacing on the Incidence of Anemia in Postpartum Mothers

The ideal pregnancy spacing when compared to previous deliveries is at least 2 years. If the spacing is too close, it falls into category 4 (too young/too old, too many, too close). This condition can turn the pregnancy into a high-risk pregnancy or prone to complications.[17] Common complications include infection, bleeding, and high blood pressure (preeclampsia and eclampsia), with bleeding remaining the leading cause of mortality and morbidity.[18]

A mother who experiences bleeding will increase the risk of anemia due to sudden blood loss.[14] Pregnancy spacing is a predictive factor for postpartum anemia. The results of the study showed a significant relationship between pregnancy spacing and the incidence of anemia (p=0.001). Postpartum mothers with short pregnancy spacing (<2 years) are at greater risk of developing anemia. This is in line with previous research that found a significant relationship between pregnancy spacing and the incidence of anemia.[17] Research in South Tapanuli also found a significant relationship between pregnancy spacing and anemia.[19]

Too close a spacing between pregnancies results in mothers not having enough time to recover from the previous pregnancy and delivery. The uterus and reproductive organs are not fully recovered, and mothers are at risk of nutritional deficiencies in subsequent pregnancies, particularly iron deficiencies, as the pregnancy process reduces iron reserves in the mother's body.[20]

The Effect of EIBF on Lactation Process in Postpartum Mothers

EIBF is the process by which a newborn baby nurses and seeks out the mother's nipple on its own for an hour or more. EIBF creates skin-to-skin contact between mother and baby, with the baby placed face down on the mother's chest immediately after birth. EIBF is incredibly beneficial for both mother and baby.[21] The mother will feel more relaxed, reducing pain caused by contractions during placental delivery and increasing uterine contractions, thus preventing postpartum hemorrhage. The baby will practice its sucking and swallowing reflexes, significantly aiding the production of colostrum, which is beneficial for the baby's immune system and serves as a marker for the beginning of breastfeeding.[22] EIBF is highly beneficial for the continuation of breastfeeding. EIBF has a significant relationship with breastfeeding success.[23]

The results of this study indicate a significant relationship between EIBF and smooth milk production. Postpartum mothers who practice EIBF are 1.438 times more likely to have smooth milk production than those who do not. EIBF is the dominant predictor of breast milk production. This aligns with previous research, which found that EIBF performed on postpartum mothers increased breast milk production 4.431 times compared to those who did not.[22] Another study found that mothers who practiced EIBF were 6.909 times more likely to increase breast milk production than those who did not.[23]

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The Influence of a History of Late Lactation Onset on the Smoothness of Breast Milk Production in Postpartum Mothers

Delayed onset of lactation is a condition in which the second lactogenesis process occurs more than 72 hours after delivery. Lactation onset can be measured by the mother's perception of when her milk comes in, characterized by breast heaviness, hardness, and swelling until colostrum is released.[24] This condition is associated with reduced milk production, shortened breastfeeding duration, failing exclusive breastfeeding, and a risk of pathological weight loss in the neonate.[25]

The study showed a significant association between a history of late onset of lactation and smooth milk production (p-=0.001). Postpartum mothers without a history of late onset of lactation were significantly more likely to have Lactation Process. These results align with previous research that found delayed onset of lactation increases the risk of irregular milk production. A case study also indicates that delayed onset of lactation can lead to low milk production in postpartum mothers.[26]

After delivery, particularly after the placenta is delivered, levels of hCG, estrogen, and progesterone decrease, triggering the anterior pituitary gland to release prolactin, which initiates milk production. This prolactin release is further stimulated by the baby's sucking on the nipple. Sucking also triggers the release of the hormone oxytocin, which pumps milk out of the breast alveoli. This ensures continued milk production. If this process is disrupted, it can disrupt milk production in postpartum mothers.[27,28]

This study provides a comprehensive overview by integrating obstetric history variables (PPH and IPI) with lactation outcomes (EIBF and lactation onset), addressing a significant data gap in Indonesia. The use of total sampling among 200 respondents ensures strong representative data for the Kerek Health Center area. Furthermore, the application of JASP software ensures modern and reliable statistical analysis. The cross-sectional design only captures conditions at a single point in time, limiting the ability to establish dynamic long-term causal relationships. Additionally, breast milk production assessment relied on maternal self-perception, which may introduce subjective bias.

The findings emphasize that obstetric history is a powerful predictor of postpartum health. The identification of IPI as a dominant protective factor against anemia (OR=0.297) and EIBFF as the key to lactation success (OR=5.631) provides a scientific basis for early risk screening by healthcare providers. Based on the study findings, healthcare providers should implement structured screening based on obstetric history, prioritizing intensive hemoglobin monitoring for mothers with a history of Postpartum Hemorrhage (PPH) or short pregnancy intervals. Postpartum family planning must be strengthened to promote an ideal inter-pregnancy interval (IPI) of ≥2 years as a dominant protective factor against anemia. To ensure lactation success, the implementation of Early Initiation of Breastfeeding (EIBFF) must be optimized, as it is the most significant driver of successful milk flow. Furthermore, targeted support is required for mothers with a history of late-onset lactation to prevent breastfeeding failure. Future research should utilize prospective cohort designs to objectively measure hemoglobin levels and milk volume throughout the postpartum period.

This study has several limitations that should be acknowledged. First, the cross-sectional design prevents the establishment of a definitive temporal or causal relationship between obstetric history and maternal outcomes. Second, data collection regarding breastfeeding practices relied on maternal recall, which is susceptible to recall bias. Third, the study did not account for external confounding factors such as maternal nutritional status and psychological well-being, which are known to influence both hemoglobin levels and lactation success. Finally, while the LATCH score is a globally recognized tool, its subjective nature may introduce inter-observer variability. Future

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research should consider a prospective cohort design and the inclusion of nutritional markers to provide a more comprehensive analysis.

CONCLUSION

Based on the analysis, this study concluded that childbirth history has a significant influence on the incidence of anemia and the lactation process in postpartum mothers. A significant influence was found between the history of Postpartum Hemorrhage (PPH) and the incidence of anemia, where a history of PPH increases the risk of anemia. In addition, short pregnancy intervals also significantly influence the incidence of anemia, while ideal pregnancy intervals act as a dominant protective factor. For the lactation aspect, a history of Early Initiation of Breastfeeding (EIBF) in previous pregnancies significantly influences the Lactation Process, and EIBF is proven to be the most dominant factor in increasing the smooth breast milk flow. Conversely, a history of late lactation onset in previous pregnancies also significantly influences the lactation process and is a strong predictor of lactation failure. Simultaneously, the history of PPH and the spacing of pregnancies influence the incidence of anemia, and the history of EIBF and late lactation onset simultaneously influence the Lactation Process, indicating that these factors in childbirth history are important independent predictors.

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