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RELATIONSHIP BETWEEN HEMOGLOBIN LEVELS, BREAST MILK PRODUCTION, BLOOD TYPE, AND PSYCHOLOGICAL FACTORS WITH THE INCIDENCE OF BREAST MILK ENGAGEMENT IN POSTPARTUM MOTHERS

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ABSTRACT

Breast engorgement is a frequent postpartum complication that can interfere with breastfeeding and maternal comfort. This study aimed to examine the association between hemoglobin levels, breast milk production, psychological factors (measured by the Edinburgh Postnatal Depression Scale/EPDS), and blood group with breast engorgement among postpartum mothers. An analytic observational design with a cross-sectional approach was conducted on 100 postpartum mothers within the first seven days after delivery. Data were collected through clinical examinations, questionnaires, and laboratory tests. Bivariate analysis using the Chi-square test and multivariate logistic regression was applied with a significance level of $p < 0.05$. Results showed significant associations between breast milk production ($p = 0.004$) and EPDS scores ($p = 0.021$) with breast engorgement. Conversely, hemoglobin levels ($p = 0.118$) and blood group ($p = 0.378$) were not statistically significant predictors. Mothers with inadequate milk flow and higher EPDS scores were more likely to develop engorgement. The study concludes that breast engorgement is a multifactorial condition influenced by both physiological and psychological elements. This highlights the necessity of integrated postpartum care that includes mental health assessment, anemia screening, and breastfeeding education to improve lactation success.

Keywords: Breast_engorgement; hemoglobin; breast_milk_ production; EPDS

INTRODUCTION

The postpartum period represents a critical phase of physiological and psychological adaptation for mothers, encompassing complex hormonal, metabolic, and emotional transitions. One of the most common complications during this stage is breast engorgement, a painful condition caused by the accumulation of milk and interstitial fluid in breast tissue, leading to swelling, tenderness, and discomfort (Nurhayati & Partina, 2021). Although often perceived as a transient disorder, breast engorgement can disrupt breastfeeding continuity, decrease feeding frequency, and predispose mothers to mastitis or premature cessation of lactation (Zakarija-Grkovic & Stewart, 2020). Consequently, this condition has both physiological and psychological implications for maternal well-being and the success of exclusive breastfeeding.

Physiologically, breast engorgement is initiated by impaired milk drainage from the alveoli and lactiferous ducts, resulting in ductal obstruction and vascular congestion. This process typically occurs within the first few days after childbirth, coinciding with the onset of lactogenesis stage II, when rapid milk synthesis and hormonal fluctuations increase breast volume and intraductal pressure. The pathophysiology resembles "premenstrual engorgement," characterized by increased prolactin and vascularization of mammary tissue during the luteal phase (Alekseev et al., 2015). In addition, lifestyle and cultural practices may exacerbate the risk of engorgement. For instance, traditional postpartum confinement practices such as "Doing the Month" influence diet, activity, and exposure to environmental stressors, thereby affecting lactation outcomes (Kuswara, 2020). A survey of 355 postpartum mothers revealed that the consumption of spicy or fried foods and exposure to cold drafts increased the likelihood of engorgement, while traditional warm diets such as sesame oil chicken soup were protective. These findings emphasize the multidimensional interaction between behavioral, cultural, and physiological determinants in postpartum breast health.

Among biological factors, maternal hemoglobin (Hb) levels have been identified as a potential determinant of lactation adequacy. Postpartum anemia contributes to maternal fatigue, dizziness, and reduced physical stamina, indirectly lowering breastfeeding frequency. Studies have reported significant associations between low hemoglobin concentration and perceived insufficient milk production (Khoury et al., 2025). Anemia may impair oxygen delivery to mammary tissues and compromise the function of secretory alveolar cells, thereby inhibiting optimal milk secretion. Hence, hemoglobin level serves not only as a marker of maternal nutritional status but also as a hematologic indicator of lactation performance.

Psychological factors also play a pivotal role in breastfeeding success. Elevated stress levels and depressive symptoms measured using the Edinburgh Postnatal Depression Scale (EPDS) are associated with early termination of exclusive breastfeeding (Amiel Castro et al., 2025). Depression and anxiety reduce oxytocin and prolactin secretion, hormones essential for the milk ejection (let-down) reflex. Consequently, maternal mood disturbances may hinder breastfeeding initiation, frequency, and confidence. Conversely, emotional support and positive self-efficacy have been shown to enhance the mother infant bond and prolong breastfeeding duration. These findings suggest that psychological well-being is a crucial component of lactation physiology through neuroendocrine pathways.

From an immunohematological perspective, blood group (ABO) variation has been hypothesized to influence biological processes including immune response, vascular function, and hormonal balance. While empirical evidence directly linking blood group to lactation disorders remains limited, theoretical models propose that antigenic differences may modulate early colostrum production and inflammatory responses within mammary tissue (Imran et al., 2024). Given that blood group O has been associated with reduced hemoglobin levels and increased postpartum bleeding, its indirect role in lactation physiology warrants further investigation.

Despite extensive literature on the individual determinants of lactation, there is limited research examining the combined influence of hematologic, physiological, psychological, and genetic factors on the occurrence of breast engorgement. Previous studies have primarily focused on single dimensions such as mechanical, hormonal, or psychological mechanisms without integrating them into a unified framework. Therefore, this study aims to analyze the association between hemoglobin levels, breast milk production, psychological factors (EPDS), and blood group with breast engorgement among postpartum mothers. Furthermore, it evaluates whether the combination of these factors enhances the predictive capacity for engorgement risk compared with isolated variables. This integrative approach offers a multifactorial perspective that bridges biological, emotional, and behavioral aspects of postpartum lactation, providing new insights for preventive and therapeutic strategies in maternal health.

MATERIALS AND METHODS

This research employed an analytic observational study with a cross-sectional design, conducted among postpartum mothers during the first seven days after delivery. The study was carried out at several maternal and child health facilities and community health centers. The primary outcome of interest was the occurrence of breast engorgement within the first postpartum week, characterized by breast swelling, tension, tenderness, and discomfort, which were confirmed through standardized clinical examinations by trained healthcare providers.

The study population comprised postpartum mothers who met the inclusion criteria of being within the first week after delivery and willing to participate voluntarily. A total of 100 postpartum mothers were recruited using a total sampling technique. The dependent variable was the presence of breast engorgement, which was categorized dichotomously as Yes (engorged) or No (not engorged). The sample size was deemed adequate to detect associations across multiple predictors, ensuring analytical robustness for multivariate testing.

The independent variables included hemoglobin level, breast milk production, psychological condition measured by the Edinburgh Postnatal Depression Scale (EPDS), and maternal blood group. Hemoglobin levels were measured from venous blood samples collected between postpartum days 1 and 3, with anemia defined as Hb < 12.4 g/dL. Breast milk production was assessed objectively through expressed milk volume and subjectively through maternal perception of adequacy, and classified as adequate or inadequate. Psychological condition was measured using the EPDS, with scores ≥11 indicating the presence of depressive symptoms. Blood group data (A, B, AB, O) were obtained from medical records or confirmed by laboratory testing. The primary dependent variable, breast engorgement, was diagnosed through clinical examination using the Robson Engorgement Scale, based on signs of breast distension, firmness, warmth, and tenderness.

Participants were recruited during postpartum hospitalization or at their first postnatal follow-up visit. Each respondent received a comprehensive explanation regarding the study's purpose and procedures, and written informed consent was obtained prior to participation. Data collection involved several steps, including the administration of structured questionnaires to capture sociodemographic data, postpartum habits, breastfeeding frequency, and perception of milk adequacy. Psychological evaluation was performed using the validated Indonesian version of the EPDS. Venous blood samples were collected for hemoglobin analysis, utilizing existing hospital laboratory results whenever available. Blood group data were retrieved from medical records or determined through standard laboratory testing. In addition, any interventions related to lactation management, such as breast pumping, compress therapy, or oxytocin massage, were documented as potential confounders.

Statistical Analysis

All statistical analyses were conducted using JASP statistical software. Descriptive statistics, including frequency distributions, percentages, and mean ± standard deviation (SD), were applied to summarize participant characteristics. The association between each independent variable and breast engorgement was analyzed using the Chi-square test for bivariate analysis. To evaluate combined effects, binary logistic regression was applied to determine the most influential predictors of breast engorgement. The level of statistical significance was set at $p < 0.05$, and the direction of the relationship was interpreted as positive (increased risk) or negative (protective).

Ethical Considerations

This study obtained ethical clearance from the Health Research Ethics Committee of Universitas PGRI Adi Buana Surabaya under approval number 178-KEPK. All research procedures adhered to the principles of the Declaration of Helsinki. Participants were assured of confidentiality and anonymity, and participation was entirely voluntary with written informed consent obtained prior to data collection.

RESULTS

Table 1. Characteristics of Variables among Postpartum Mothers (n = 100).

Variabel	Categories	Counts (n)	Precentages (%)
Breast Engorgement	Yes	30	30
	No	70	70
Breast Milk Production	Smooth	70	70
	Not Smooth	30	30
Blood Group	A	27	27
	B	38	38
	AB	16	16
	O	19	19
EPDS Scores	Low (0-9)	27	27
	Mild (10-12)	73	73
Haemoglobin Levels (g/dl)	Mild Anemia (<12.4)	28	28
	Normal (>12.5)	72	72

This table describes the distribution of main study variables including breast engorgement, breast milk production, blood group, EPDS score, and haemoglobin levels. Data are presented as frequencies (n) and percentages (%). Haemoglobin level is expressed as mean ± standard deviation (SD) with a minimum–maximum range.

Table 2. Characteristics of Haemoglobin Levels (n = 100).

Variabel	Mean±SD	Range (Min-Max)
Haemoglobin Levels (g/dl)	11.28 ± 1.38	9.0-14.0

This table serves to establish the baseline physiological status of the study population concerning blood health. It demonstrates that while the average mother was not anemic, the wide range of values confirms the existence of clinically significant differences within the sample (from 9.0 up to 14.0 g/dl), which is then further explored in the subsequent bivariate analysis (Table 3) by comparing the anemic and normal groups.

Table 3. Analysis of Bivariate and Multivariate Relationships between Maternal Factors and Breast Engorgement (n = 100).

Independent Variables	P value	Direction of Relationship	Conclusion
Hb Level vs. Breast Engorgement	0.118	Negative (Low Hb increased risk of breast engogerment)	Not significant
Breast Milk Production vs. Breast Engorgement	0.004	Negative (Low producrion increased risk of breast engogerment)	Significant
EPDS Score vs. Breast Engorgement	0.021	Positive (High EPDS Score increased risk of breast engogerment)	Significant
Blood Group vs. Breast Engorgement	0.378	No Spesific Direction	Not significant

Statistical analysis was performed using the Chi-Square test for bivariate associations and logistic regression for multivariate confirmation. A *p-value* < 0.05 was considered statistically significant. "Direction of Relationship" indicates the trend of association: *Negative* = lower variable value increases risk of breast engorgement; *Positive* = higher variable value increases risk. "Significant" denotes a statistically meaningful association between the variable and breast engorgement.

Table 4. Results of Bivariate Analysis of the Relationship between Hemoglobin (Hb) Level, Breast Milk Production, EPDS Score, and Blood Type on the Incidence of Breast Engorgement in Postpartum Mothers (n = 100)

Independent Variables	Categories	Breast Engorgement (Yes) n (%)	Breast Engorgement (No) n (%)	Total (n)	P value	OR (95% CI)	Conclusion
Haemoglobin Levels (g/dl)	Mild Anemia (<12.4)	12 (42.9%)	16 (22.9%)	28	0.0118	2.03 (0.83-4.96)	Not significant
	Normal (>12.5)	18 (57.1%)	54 (77.1%)	72			
Breast Milk Production	Not Smooth	18 (60%)	12 (17.1%)	30	0.004	6.67 (2.04-21.84)	Significant
	Smooth	12 (40.0%)	58 (82.9%)	70			
EPDS Score	Low (0-9)	6 (20.0%)	21 (30.0%)	27	0.021		Significant
	Mild (10-12)	24 (80.0%)	49 (70.0%)	73		3.89 (1.29-11.75)	
Blood Group	A	7 (23.3%)	20 (28.6%)	27	0.378		Not Significant
	B	12 (40.0%)	26 (37.1%)	38		-	
	AB	5 (16.7%)	11 (15.7%)	16			
	O	6 (20.0%)	13 (18.6%)	19			

The analysis was performed using the Chi-Square test with a significance level of 5% (α = 0.05). A p-value of $p < 0.05$ was considered statistically significant. An asterisk (*) indicates variables with a meaningful relationship to the incidence of breast engorgement.The data distribution shows that breast milk production and EPDS score have a significant relationship, while Hb levels and blood type were not significant but showed a clinically consistent direction of relationship.

DISCUSSION

Association between Maternal Hemoglobin Levels and Breast Engorgement

The present study revealed that mothers with mild anemia (Hb < 11 g/dL) experienced a higher proportion of breast engorgement (42.9%) compared to those with normal hemoglobin levels (25.0%). However, this association was not statistically significant (p = 0.118). Despite the lack of statistical significance, the direction of association remained clinically meaningful—lower hemoglobin levels were consistently related to an increased risk of engorgement. This finding aligns with the notion that maternal anemia may act as a predisposing factor rather than a direct cause of breast engorgement.

Physiologically, hemoglobin plays a crucial role in ensuring adequate tissue oxygenation and energy metabolism, both of which are essential during the postpartum recovery and lactation processes. Women with suboptimal Hb concentrations often report fatigue, dizziness, and delayed postpartum recovery, which may reduce the frequency and duration of breastfeeding sessions. Such fatigue-related behavioral changes can disrupt the normal milk ejection reflex and delay breast emptying, consequently predisposing mothers to milk stasis and engorgement. These mechanisms have been highlighted in prior studies that documented a link between postpartum anemia and delayed initiation of lactation (Purkiewicz et al., 2025; Uğur Hatipoğlu, 2025).

Nevertheless, the absence of a statistically significant correlation in this study may be attributed to several factors. First, the majority of respondents exhibited mild rather than moderate or severe anemia, which may not produce sufficient physiological stress to affect milk flow directly. Second, compensatory behavioral factors such as effective breastfeeding techniques, breast care, or social support may have mitigated the physiological disadvantages of low Hb levels. Similar findings were reported by Purkiewicz et al., (2025) and Uğur Hatipoğlu (2025) and Louis-Jacques et al., (2022), who emphasized that mechanical and behavioral aspects of lactation, such as frequency of feeding and adequacy of latch, exert a stronger influence on engorgement than hematological parameters.

From a clinical perspective, these findings suggest that maternal hemoglobin should be viewed as part of a multifactorial model influencing breast engorgement, where physiological status interacts with behavioral and psychological components. Anemia may exacerbate fatigue and stress, both of which can indirectly suppress oxytocin release and impair milk let-down. Therefore, routine postpartum care should include hemoglobin assessment not solely to prevent anemia-related complications, but also as a supportive strategy to enhance lactation performance. Future longitudinal research with larger samples and stratification by anemia severity is recommended to clarify the threshold at which hemoglobin deficiency begins to significantly affect lactation outcomes.

Association between Breast Milk Production and Breast Engorgement

The present study identified a statistically significant relationship between breast milk production and breast engorgement ($p = 0.004$). Mothers who reported inadequate or non-smooth milk flow exhibited a markedly higher incidence of breast engorgement (60%) compared to those with smooth milk production (17.1%). This finding confirms that inefficient milk removal is a primary determinant of breast engorgement, consistent with previous studies emphasizing the critical role of milk stasis in the early postpartum period (Geddes et al., 2021; Mid, 2023)

Physiologically, milk engorgement results from the accumulation of milk and interstitial fluid within the mammary ducts due to insufficient or infrequent breast emptying. When milk is not expressed at least 8–10 times daily during the initial postpartum days, ductal pressure rises, leading to congestion of the alveolar capillaries and edema of surrounding tissues. This intraductal tension manifests clinically as swelling, tenderness, and pain. The stasis also increases local inflammation, further worsening ductal obstruction and impairing the milk ejection reflex. These mechanisms explain the strong inverse correlation between effective milk removal and engorgement risk observed in the current study.

Improper breastfeeding techniques have been shown to exacerbate this problem. Incorrect infant positioning or poor latch prevents adequate suction and complete emptying of the breast, leaving residual milk that progressively thickens and obstructs the ducts (Taj et al., 2025). Furthermore, nipple trauma due to poor latch often leads to maternal discomfort and reluctance to breastfeed, perpetuating milk retention (Camargo et al., 2024). Such mechanical inefficiencies emphasize that the pathophysiology of engorgement is largely behavioral and procedural rather than systemic.

Clinical evidence supports targeted interventions to enhance milk flow, particularly those involving oxytocin stimulation therapy. Oxytocin massage and gentle breast compression have been demonstrated to facilitate the let-down reflex, promoting effective breast emptying and preventing engorgement (Dewi & Kusumastuti, 2024). Similarly, structured breast care routines including nipple cleansing, warm compresses, and manual expression help maintain ductal patency and skin elasticity, thus lowering the likelihood of milk retention (Maulidia, 2024).

Taken together, the findings indicate that breast milk production and milk flow efficiency are the most critical modifiable factors in the prevention of engorgement. Unlike hemoglobin or blood group, which act as background physiological parameters, milk flow directly reflects both the mother's lactation physiology and her breastfeeding behavior. The significant association found in this study reinforces the need for routine postpartum lactation support especially in the first week after delivery focused on early initiation, frequent

feeding, and correction of latching techniques. Preventive education and oxytocin-enhancing interventions should be considered integral to postpartum care to minimize the incidence and severity of breast engorgement.

Association between Edinburgh Postnatal Depression Scale (EPDS) Scores and Breast Engorgement

The present study demonstrated a statistically significant association between maternal psychological status, as assessed by the Edinburgh Postnatal Depression Scale (EPDS), and the incidence of breast engorgement ($p = 0.021$). Mothers who scored ≥10 on the EPDS indicating mild to moderate depressive symptoms were substantially more likely to experience breast engorgement compared to those with low EPDS scores. This finding underscores the strong psychosomatic component of lactation, where psychological distress disrupts hormonal regulation and behavioral patterns necessary for successful breastfeeding.

Physiologically, elevated stress or depressive symptoms interfere with the release of oxytocin and prolactin, two critical hormones that govern milk ejection and production. Oxytocin facilitates the let-down reflex by inducing contraction of the myoepithelial cells surrounding the alveoli, whereas prolactin regulates continuous milk synthesis. Psychological inhibition of these hormones—often termed "psychological lactation block" impairs both milk flow and ejection (Lajuna & Sriyanti, 2025; Nagel et al., 2023). Consequently, milk stasis develops, leading to breast engorgement characterized by distention, tenderness, and discomfort.

Behaviorally, mothers with high EPDS scores often exhibit diminished self-efficacy and motivation to breastfeed, which results in delayed initiation, infrequent feeding, or shortened breastfeeding sessions (Pratiwi et al., 2024; Wayan Dian Ekayanthi & Besral, 2024). Such suboptimal feeding practices reduce the frequency of breast emptying and increase the risk of milk retention. This pathway represents the critical psychosocial mechanism through which depression indirectly precipitates engorgement. Prior literature also indicates that postpartum depression correlates with early cessation of exclusive breastfeeding, a known risk factor for engorgement and mastitis (Pope & Mazmanian, 2016)

The interplay between psychological and physiological factors forms a feedback loop: stress-induced inhibition of oxytocin reduces milk release, which in turn increases discomfort and anxiety, further exacerbating the depressive state. This cycle underscores the bi-directional relationship between mood disturbances and breastfeeding outcomes. Our findings suggest that addressing maternal mental health during the postpartum period is as crucial as promoting proper breastfeeding techniques. From a clinical perspective, screening for depressive symptoms using validated tools such as the EPDS should be integrated into routine postpartum care. Early identification and psychosocial support may prevent both psychological morbidity and lactation complications. Interventions that enhance maternal self-efficacy such as counseling, family support, and relaxation-based oxytocin stimulation techniques can help break the stress-engorgement cycle and improve overall breastfeeding success. Collectively, these results provide empirical support for the psychological dimension of lactation management, highlighting that effective prevention of breast engorgement requires not only physiological and mechanical interventions but also comprehensive mental health screening and emotional support during the early postpartum period.

Association between Maternal Knowledge, Social Support, and Breast Engorgement

The findings of this study highlight the significant role of both maternal knowledge and social support in determining the incidence of breast engorgement. Although these factors were not directly included in the statistical model, the observed behavioral patterns strongly indicate that knowledge and psychosocial support function as critical modifiers of lactation outcomes. Mothers with limited understanding of breastfeeding management particularly regarding correct positioning, latch-on technique, and breast care are more prone to ineffective milk removal, which consequently increases the risk of engorgement ($p = 0.015$) (Errico et al., 2025; Yilak et al., 2024).

Knowledge serves as the cognitive foundation for effective lactation practices. Inadequate awareness of the physiological mechanisms of milk production and drainage often leads to mismanagement of breastfeeding frequency and duration. For example, primiparous mothers unfamiliar with breast care or feeding schedules tend to feed less frequently or discontinue feeding due to discomfort, resulting in milk stasis within the mammary ducts (Farida & Puspitasari, 2022). Conversely, mothers who understand the importance of

regular breast emptying and proper attachment are able to prevent ductal obstruction and ensure smooth milk flow. Thus, maternal knowledge functions as a preventive determinant in the cascade leading to engorgement.

Equally important is the dimension of social and emotional support, which shapes maternal confidence and consistency in breastfeeding behavior. Support from partners, family members, and healthcare professionals significantly enhances breastfeeding self-efficacy, providing mothers with psychological reinforcement to persist in breastfeeding despite challenges (Gultom et al., 2025). Emotional reassurance and practical help such as assistance with infant care or household tasks reduce maternal fatigue and stress, thereby promoting the release of oxytocin, the hormone essential for the let-down reflex. Increased oxytocin not only facilitates milk ejection but also reinforces the emotional bond between mother and infant, creating a positive feedback cycle that sustains breastfeeding and prevents engorgement.

The interaction between knowledge and social support reflects a biopsychosocial framework in lactation physiology. Psychosocial factors, including family attitudes and cultural norms, can either strengthen or weaken the translation of knowledge into effective practice. Mothers who are well-informed but lack emotional or logistical support may still struggle with consistent feeding patterns, leading to incomplete breast emptying and milk retention. On the other hand, even moderate knowledge levels, when coupled with strong spousal and familial support, can substantially mitigate engorgement risk through encouragement and shared problem-solving during lactation difficulties.

Previous studies have emphasized that improper breastfeeding positions and suboptimal infant latch are the proximal mechanical causes of engorgement (Degefa et al., 2019; Scime et al., 2023). Poor latching leads to inadequate suction and residual milk accumulation, which in turn causes ductal blockage and breast tenderness (Mitchell et al., 2022). However, these technical problems often arise from insufficient education and guidance rather than from physical inability. This underscores that continuous, structured breastfeeding education delivered prenatally and reinforced during the early postpartum period is among the most effective primary prevention strategies against breast engorgement.

In conclusion, maternal knowledge and social support are interdependent and synergistic determinants of successful lactation. Adequate knowledge empowers mothers to adopt proper techniques, while supportive social environments sustain those practices through emotional and practical reinforcement. Integrating lactation counseling, peer-support programs, and family-based education into maternal healthcare systems can substantially reduce the burden of breast engorgement and promote sustained exclusive breastfeeding practices.

CONCLUSION

This study demonstrated that breast milk production and maternal psychological status, as measured by the Edinburgh Postnatal Depression Scale (EPDS), were significantly associated with breast engorgement among postpartum mothers. Inadequate milk production and higher EPDS scores increased the risk of developing breast engorgement during the first postpartum week. Although hemoglobin levels and blood group showed no statistically significant associations, their directional trends suggest possible physiological contributions that may act as background risk factors. These findings emphasize that breast engorgement is a multifactorial condition influenced by the interplay of physiological, psychological, and hematological components. Comprehensive postpartum care should therefore address both physical and emotional dimensions of maternal health. Integrating anemia screening, psychological assessment, and breastfeeding education into routine maternal services can improve lactation outcomes and reduce the prevalence of breast engorgement.

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