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Micronutrient Supplementation and Its Association with Prevention of Postpartum Blues and Breastfeeding Outcomes: A Prospective Cohort Study in Balikpapan City

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ABSTRACT

Background: Postpartum blues affects 37–67% of Indonesian mothers, yet the role of micronutrient supplementation as a preventive strategy remains underexplored. This study examined whether postpartum micronutrient supplementation was associated with lower incidence of postpartum blues and improved breastfeeding outcomes among postpartum mothers in Balikpapan, Indonesia.
Methods: A prospective cohort study followed 152 postpartum mothers at RS Sayang Ibu and PBM Griya Bunda Sehat, Balikpapan City, for 16 months. The exposed group (n=83) received micronutrient supplementation for six months postpartum, while the unexposed group (n=69) did not. Outcomes were assessed using the Edinburgh Postnatal Depression Scale (EPDS) and 10 Steps to Successful Breastfeeding checklist. Ethical approval was obtained (DP.04.03/7.1/07893/2023).
Results: Among supplemented mothers, 89.2% experienced no postpartum blues compared with 66.7% in the non-supplemented group. Micronutrient supplementation was significantly associated with reduced postpartum blues risk (p=0.001; OR=0.243; 95%CI: 0.10–0.57). Supplementation was also associated with improved breastfeeding success (p=0.030; OR=0.433; 95%CI: 0.20–0.93), with 83.1% achieving successful breastfeeding.
Conclusion: Postpartum micronutrient supplementation was significantly associated with lower risk of postpartum blues and better breastfeeding outcomes. These findings suggest the potential benefit of integrating supplementation into maternal health programs, in line with SDG targets 3.1 and 3.4, pending confirmation through randomized controlled trials.

INTRODUCTION

Maternal mental health represents a critical global public health challenge, affecting millions of women annually. Postpartum depression (PPD) occurs in approximately 10% of women after childbirth roughly 1 in 7 mothers with undiagnosed cases estimated to account for half of all affected women. PPD adversely affects women's psychological functioning, marital and interpersonal relationships, mother infant bonding quality, and the social, behavioral, and cognitive development of children (Amer et al., 2024; França et al., 2023). Postpartum blues also termed maternity blues or baby blues is a transient mood disturbance distinct from PPD, emerging within the first 2 weeks after delivery and resolving spontaneously in most cases.

According to systematic reviews and meta-analyses, its prevalence is approximately 39% (range: 13.7–76%, varying by culture and geography). Importantly, postpartum blues constitutes a recognized risk factor for progression to more severe postpartum mood disorders, including PPD and postpartum psychosis (Chechko, Losse, Frodl, & Nehls, 2023; Tosto et al., 2023).

In Indonesia, the prevalence of postpartum blues ranges from 37% to 67% (Manurung & Setyowati, 2021) underscoring its public health significance as an entry point to more serious mental disorders. Although psychosocial risk factors including maternal age, socioeconomic status, and spousal support have been extensively studied in the Indonesian context, a substantial gap remains in understanding the role of specific micronutrients as protective factors against postpartum blues. Indonesian data indicate that more than 50% of breastfeeding mothers experience inadequate intake of at least seven micronutrients during the postpartum period, namely iron, folic acid, vitamin B12, vitamin D, iodine, zinc, and riboflavin, particularly at 2 and 5 months postpartum (Daniels et al., 2019; Gibson et al., 2020). Historically, Indonesian maternal health programs have focused on iron and folic acid supplementation during pregnancy and postpartum vitamin A administration. The COVID-19 pandemic exacerbated maternal nutrition vulnerabilities by disrupting health service delivery and limiting access to postnatal care (Ahoya et al., 2022; Irmawati, 2023). In Balikpapan City, the rate of maternal attendance at posyandu (integrated community health posts) remains at approximately 45% far below the national target of 95% indicating systemic barriers to routine postnatal nutritional monitoring. This low attendance rate is directly relevant to micronutrient status, as posyandu is the primary platform through which postpartum supplementation, dietary counseling, and nutritional screening are delivered to Indonesian mothers. Mothers who do not attend posyandu are therefore at elevated risk of undetected micronutrient deficiency, which may in turn increase susceptibility to postpartum mood disorders (Balikpapan Health Office, 2025).

Micronutrients play a crucial role in maintaining central nervous system integrity serving as structural components of brain tissue, modulators of neurotransmitter-receptor membranes, precursors to neurotransmitter biosynthesis (including serotonin, dopamine, and norepinephrine), and regulators of neuroinflammatory pathways (Rupanagunta et al., 2023). Despite WHO guidance recommending dual micronutrient supplementation during the antenatal period, specific recommendations for the lactation phase remain limited (Irmawati, 2023; Jouanne, Oddoux, Noël, & Voisin-Chiret, 2021). Conflicting evidence from global research suggests that modern dietary transitions characterized by reduced intake of fiber, omega-3 fatty acids, and micronutrients alongside increased consumption of added sugars may contribute to elevated rates of postpartum depression (Fish-Williamson & Hahn-Holbrook, 2023). However, the role of micronutrient supplementation specifically for preventing postpartum blues in the postpartum period has not been systematically examined in the Indonesian context.

As a rapidly urbanizing city in East Kalimantan, Balikpapan presents a unique setting characterized by distinct maternal health service access patterns and local dietary practices that influence postpartum micronutrient status. By 2024, 98.71% of toddlers (aged 0–59 months) in Balikpapan had received immunization and possessed a maternal and child health record (Balikpapan Statistics, 2025). Community-based research in this setting is expected to yield evidence applicable to similar urban centers in Eastern Indonesia.

The primary objective of this study was to examine the association between postpartum micronutrient supplementation and the occurrence of postpartum blues among postpartum mothers in Balikpapan City. The secondary objective was to assess whether micronutrient supplementation was associated with improved breastfeeding success outcomes.

METHODS

This study uses a prospective cohort design with a quantitative approach. This design was chosen because it allows observation of exposure (micronutrient supplementation) of previous outcomes (postpartum blues and breastfeeding success), allowing relative risk estimation while longitudinally following participants in real-world conditions of advantage over cross-sectional designs that cannot establish temporal priorities (Vega, Maguiña, Soto, Lama-Valdivia, & López,

2021). A prospective cohort study followed postpartum mothers for 16 months, observing the course of natural exposure and subsequent outcomes without experimental manipulation.

The population comprised all postpartum mothers presenting for postnatal care at RS Sayang Ibu Hospital and PBM Griya Bunda Sehat, Balikpapan City, East Kalimantan, Indonesia. Participants were enrolled using consecutive sampling. In this cohort, the exposure (micronutrient supplementation status) was identified and documented at enrollment (days 2–14 postpartum), and participants were subsequently followed over time to assess outcomes (postpartum blues status and breastfeeding success). All participants were screened to confirm absence of postpartum blues at baseline prior to commencing supplementation, consistent with a prevention study design.

Sample size was calculated using a categorical (two-proportion) formula for comparative cohort studies. The following assumptions were applied: expected proportion of postpartum blues in the unexposed group = 30% (based on regional prevalence data), expected proportion in the exposed group = 10% (estimated 67% reduction), two-sided alpha = 0.05, and desired statistical power = 80%. This yielded a minimum of 69 participants per group. An additional 10% (14 participants) was added to account for potential dropouts, resulting in a total of 152 postpartum mothers.

Inclusion criteria: (1) primigravida and multigravida mothers on days 2–14 postpartum, (2) willing to participate and provide written informed consent, (3) domiciled in Balikpapan City, (4) proficient in Indonesian language, and (5) able to read and write. Exclusion criteria: (1) mothers with pre-existing psychiatric disorders (including a history of depression or anxiety disorder requiring treatment), (2) mothers with severe obstetric complications that precluded supplementation (e.g., gastrointestinal malabsorption disorders), and (3) mothers already consuming multiple micronutrient supplements independently of the study protocol.

Postpartum mothers in the exposed group (n=83) received micronutrient supplementation provided through community health centers (Puskesmas/clinic). The supplement formulation followed Indonesian national guidelines for pregnant and lactating women and contained: iron (60 mg ferrous sulfate), folic acid (400 µg), vitamin B12 (2.6 µg), vitamin D3 (400 IU), vitamin C (85 mg), zinc (12 mg), and calcium (1,000 mg) per daily dose. Supplementation was administered daily for six months postpartum. Adherence was monitored through monthly pill counts and self-reported consumption diaries. The unexposed group (n=69) did not receive micronutrient supplementation during the postpartum period.

The Edinburgh Postnatal Depression Scale (EPDS) was used to assess postpartum blues and depression risk. Although the EPDS was originally developed and validated for postpartum depression screening, its use for postpartum blues assessment has been supported in several studies as a standardized instrument for detecting elevated perinatal emotional distress during the early postpartum period (Manurung & Setyowati, 2021; Landman et al., 2024). Scores ≥10 were used to indicate elevated distress consistent with postpartum blues risk at early time points (days 2–14). This threshold was applied at baseline and follow-up assessments.

Breastfeeding success was evaluated using the WHO/UNICEF 10 Steps to Successful Breastfeeding checklist. Data were collected at: baseline (days 2–14 postpartum) and at 6, 11, and 16 months postpartum. The independent variable was postpartum micronutrient supplementation status (received vs. not received). Dependent variables were: (1) postpartum blues status (EPDS ≥10 vs. <10) and (2) breastfeeding success (successful vs. unsuccessful). Covariates included maternal age, education, occupation, parity, delivery mode, and household income.

Data analysis employed descriptive and analytical statistics. Bivariate analysis used Pearson Chi-Square tests. Odds Ratios (OR), Relative Risks (RR), and 95% Confidence Intervals (CI) were calculated. Although a multivariable analysis was not performed in the primary analysis due to sample size constraints, bivariate results were interpreted with awareness of potential confounding by the measured covariates. Future studies with larger samples should employ logistic regression to control confounders. Statistical significance was set at $p<0.05$. This research received ethical approval from the Research Ethics Committee (Certificate Number:

DP.04.03/7.1/07893/2023). All participants provided written informed consent prior to enrollment.

RESULTS

Sociodemographic Characteristics of Postpartum Mothers

Table 1 presents the sociodemographic profile of the 152 postpartum mothers enrolled in this study.

Table 1. Sociodemographic Characteristics of Postpartum Mothers in Balikpapan City

Variables	n	%
Age of Postpartum Mothers		
< 20 years old	5	3.3
20 – 35 years old	117	77.0
> 35 years old	30	19.7
Education Level		
Primary School	15	9.9
Junior High School	24	15.8
High School	79	52.0
College/University	34	22.4
Maternal Occupation		
Housewives	114	75.0
Employed Mothers	38	25.0
Parity		
Primipara	50	32.9
Multipara	99	65.1
Grand Multipara	3	2.0
Mode of Delivery		
Spontaneous Vaginal Delivery	134	88.2
Cesarean Section	18	11.8
Household Income		
Below Regional Minimum Wage (UMR)	46	30.3
Equal to UMR	29	19.1
Above UMR	77	50.7

The majority of postpartum mothers were aged 20–35 years (77.0%), had senior high school education (52.0%), were housewives (75.0%), were multiparous (65.1%), delivered vaginally (88.2%), and had household income above UMR (50.7%)

Table 2. Distribution of Postpartum Blues Status, Micronutrient Supplementation, Breastfeeding Information, Postpartum Condition, and Breastfeeding Success

Variables	n	%
Postpartum Blues Status at Baseline		
No Risk of Postpartum Blues	69	45.4
At Risk of Postpartum Blues	83	54.6
Provided Micronutrients		
Not Given Micronutrient	69	45.4
Provided Micronutrient	83	54.6
10 Steps to Breastfeeding Success Information		
Received Information	101	77.8
Did Not Receive Information	51	33.6
Postpartum Condition (at follow-up)		
No Postpartum Blues/Depression	120	78.9
At Risk of Postpartum Blues/Depression	32	21.2
Breastfeeding Success		
Successful Breastfeeding	116	76.3
Unsuccessful Breastfeeding	36	23.7

Among the 152 participants, 83 mothers (54.6%) were supplemented with micronutrients. At follow-up, 120 mothers (78.9%) experienced no postpartum blues or depression, and 116 mothers (76.3%) successfully breastfed. Information on the 10 Steps to Successful Breastfeeding was received by 101 mothers (66.4%).

Table 3. Association of Micronutrient Supplementation with Postpartum Blues and Breastfeeding Success in Balikpapan City

Variables	No Blues		Blues Risk		p-value	OR	95% CI
	n	%	n	%			
Micronutrient Supplementation							
Not Supplemented	46	66.7	23	33.3	0.001*	0.243	0.10–0.57
Supplemented	74	89.2	9	10.8			
10 Steps BF Information							
Not Informed	41	77.4	12	22.6	0.725	1.156	0.86–1.23
Received Information	79	79.8	20	20.2			

Table 4. Breastfeeding Success (Micronutrient Supplementation vs. Outcome):

Postpartum Blues Risk	BF Success n		BF Failure		p-value	OR	95% CI
	n	%	n	%			
Not Supplemented	46	66.7	23	33.3	0.030*	0.433	0.20–0.93
Supplemented	69	83.1	14	16.9			
Total	116	76.3	36	23.7			

Among the 69 mothers who did not receive supplementation, 23 (33.3%) experienced postpartum blues risk and 46 (66.7%) did not. Among the 83 supplemented mothers, only 9 (10.8%) experienced postpartum blues risk and 74 (89.2%) did not. Pearson Chi-Square analysis yielded p=0.001 (α=0.05), indicating a statistically significant association between supplementation and postpartum blues occurrence. An OR of 0.243 (95%CI: 0.10–0.57) indicates that supplemented mothers had approximately 76% lower odds of experiencing postpartum blues compared with non-supplemented mothers. This represents a clinically meaningful protective association.

The association between 10 Steps to Successful Breastfeeding information provision and postpartum blues was not statistically significant (p=0.725; OR=1.156; 95%CI: 0.865–1.230), indicating that receipt of breastfeeding information alone was not independently associated with postpartum blues risk in this sample.

Regarding breastfeeding outcomes, 23 of 69 non-supplemented mothers (33.3%) were unsuccessful in breastfeeding, compared with 14 of 83 supplemented mothers (16.9%). The association was statistically significant (p=0.030). An OR of 0.433 (95%CI: 0.20–0.93) indicates that supplemented mothers had approximately 57% lower odds of breastfeeding failure relative to non-supplemented mothers, suggesting a protective association of micronutrient supplementation with breastfeeding success.

DISCUSSION

Sociodemographic Characteristics and Contextual Factors

The majority of participants were aged 20–35 years the optimal reproductive age range associated with better physical and psychological preparedness for motherhood (Ahmad, Sechi, & Vismara, 2024; Manurung & Setyowati, 2021). The predominance of multiparous mothers (65.1%) and those with senior high school education (52.0%) reflects the general demographic profile of urban postpartum women in East Kalimantan. Income above the regional minimum wage in 50.7% of participants suggests relatively favorable socioeconomic conditions, consistent with Balikpapan's status as an urban center. Partner and family support remain crucial determinants of breastfeeding success and postpartum mental wellbeing (Crawford, Gallagher, Baker, Karagas, & Romano, 2023). The interaction of age, education, parity, income, and social

support creates a complex backdrop against which nutritional and psychological outcomes must be understood.

Association Between Micronutrient Supplementation and Postpartum Blues

The primary finding of this study that postpartum micronutrient supplementation was significantly associated with reduced postpartum blues risk (OR=0.243; 95%CI: 0.10–0.57; p=0.001) is biologically plausible and consistent with broader evidence on nutrition and maternal mental health. Mechanistically, key micronutrients in the supplement formulation directly support neurological function: iron is essential for synthesis of dopamine and serotonin via its role as a cofactor for tyrosine hydroxylase and tryptophan hydroxylase; folic acid and vitamin B12 facilitate one-carbon metabolism critical for methylation reactions that regulate monoamine neurotransmitter activity; vitamin D modulates serotonergic neurotransmission and exerts anti-inflammatory effects in the central nervous system; and zinc regulates glutamatergic and GABAergic activity, both implicated in mood regulation(Carretero-Krug et al., 2024; Rupanagunta et al., 2023). Postpartum depletion of these nutrients accelerated by the metabolic demands of lactation may lower the biological threshold for mood disturbance, making supplementation a physiologically rational intervention.

These findings are broadly consistent with the systematic review by (Fish-Williamson & Hahn-Holbrook, 2023) demonstrating cross-national associations between micronutrient adequacy and lower postpartum depression rates, and with (Dehghan-Banadaki, Hosseinzadeh, Madadizadeh, & Mozaffari-Khosravi, 2023) who found that poor dietary quality significantly increased depression risk in Iranian postpartum women. Although direct quantitative comparisons with published effect sizes are limited by variation in study designs, populations, and supplementation formulations, the observed OR of 0.243 in this study is within the plausible range reported in nutritional intervention literature. The consistency of directionality across studies strengthens the credibility of this association, although the magnitude may be subject to confounding given the observational design.

Micronutrient Supplementation and Breastfeeding Success

Supplementation was also significantly associated with breastfeeding success (OR=0.433; 95%CI: 0.20–0.93; p=0.030), with 83.1% of supplemented mothers successfully breastfeeding versus 66.7% in the non-supplemented group. Adequate micronutrient status particularly iron, vitamin B12, iodine, and zinc supports maternal energy, milk composition quality, and the physical and psychological capacity to sustain lactation (Carretero-Krug et al., 2024; Gibson et al., 2020). The bidirectional relationship between emotional wellbeing and breastfeeding success is well-established: mothers with lower postpartum blues risk are more likely to persist with breastfeeding (Ay & Aktas, 2021; Carretero-Krug et al., 2024), suggesting that the nutritional effect on breastfeeding may be partially mediated by mood stabilization. Breastfeeding information provision alone was not significantly associated with postpartum blues in this sample (p=0.725), indicating that knowledge transfer without nutritional support is insufficient for mood protection.

Education, Primiparity, and Vulnerability to Postpartum Blues

Mothers with low educational attainment (primary or junior high school, 25.7% combined) represent a group with elevated vulnerability to postpartum blues. Low education is associated with limited health literacy, reduced access to prenatal care, and higher rates of postpartum depression (A. Di Florio, K. Putnam, M. Altemus, 2017; Matsumura et al., 2019). First-time mothers (primiparae, 32.9%) also face disproportionate anxiety related to role transition, childbirth fear, and adaptation challenges (Brunton, Simpson, & Dryer, 2020; Jin et al., 2025). These groups should be prioritized in supplementation delivery programs, with culturally adapted health education that acknowledges literacy constraints (Papadopoulou, S.K.; Pavlidou, E.; Dakanalis, 2023).

Study Limitations

This study has several important limitations that must be acknowledged. First, the observational prospective cohort design—while appropriate for generating associative evidencedoes not permit causal inference; unmeasured confounders (e.g., baseline dietary quality, social support, antenatal mental health history) may have influenced outcomes. Second, the use of consecutive sampling, while pragmatic, may introduce selection bias if participants attending these specific facilities are not representative of all Balikpapan postpartum mothers. Third, postpartum blues is typically defined as a self-limiting condition emerging within the first 14 days postpartum; the 16-month follow-up period of this study extends beyond the conventional definition, and the distinction between persistent postpartum blues and emerging PPD at later time points requires further clarification. Fourth, the EPDS, while validated for depression screening, has limited specificity for differentiating postpartum blues from PPD in early follow-up assessments. Fifth, multivariable analysis was not performed, limiting the ability to control for potential confounders. These limitations underscore the need for future randomized controlled trials with rigorous design to confirm these associations.

CONCLUSION

The findings of this prospective cohort study suggest that postpartum micronutrient supplementation is significantly associated with lower risk of postpartum blues and improved breastfeeding outcomes among postpartum mothers in Balikpapan City, Indonesia. Supplemented mothers had approximately 76% lower odds of postpartum blues and 57% lower odds of breastfeeding failure compared with non-supplemented mothers. These associations are biologically plausible given the established roles of iron, folic acid, vitamin B12, vitamin D, and zinc in neurotransmitter synthesis and mood regulation during the postpartum period.

Given that micronutrient deficiency is highly prevalent among Indonesian postpartum women, and that the postpartum period represents a critical window for nutritional intervention, these findings indicate that extending supplementation programs beyond pregnancy may represent a practical and low-cost strategy to support maternal mental health and breastfeeding. However, these findings should be interpreted cautiously, as residual confounding cannot be excluded in the absence of randomization. Before definitive policy recommendations can be made, confirmation through well-designed randomized controlled trials ideally including cost-effectiveness analyses is needed. Future research should also evaluate long-term outcomes, assess optimal supplementation duration and composition, and examine implementation feasibility across diverse Indonesian settings. This study contributes locally contextualized evidence that may inform the development of evidence-based maternal health policies aligned with SDG targets 3.1 and 3.4.

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