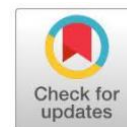


Maternal Nutritional Adequacy and Breast Milk Production Among Lactating Mothers in a Rural Primary Health Care Setting in Indonesia



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ABSTRACT

Adequate maternal nutrition during lactation is essential for maintaining maternal health and supporting optimal breast milk production. However, evidence regarding the relationship between maternal nutritional adequacy and breast milk production in primary health care settings remains limited, particularly in rural areas of Indonesia. This study aimed to examine the association between maternal nutritional adequacy and breast milk production among lactating mothers in a primary health care setting in North Aceh, Indonesia. A descriptive analytic study with a cross-sectional design was conducted from June to August 2024 among lactating mothers in the catchment area of the Nisam Primary Health Center, North Aceh, Indonesia. Total sampling was employed, and all eligible lactating mothers were included, resulting in a final sample of 41 participants. Maternal nutritional adequacy was assessed as a composite variable encompassing dietary intake, meal patterns, nutritional knowledge, and socioeconomic conditions. Breast milk production was evaluated using validated maternal-report indicators and categorized as adequate or inadequate. Data were analyzed using descriptive statistics and the Chi-square test, with statistical significance set at $p < 0.05$. Complete data were obtained from all 41 participants. Lactating mothers with adequate maternal nutritional status were more likely to report adequate breast milk production than those with inadequate nutritional status. The Chi-square analysis demonstrated a statistically significant association between maternal nutritional adequacy and breast milk production ($p < 0.05$). Maternal nutritional adequacy was significantly associated with adequate breast milk production among lactating mothers in a rural primary health care setting in North Aceh. These findings suggest that integrating routine nutritional assessment and nutrition-focused counseling into maternal and child health services may support favorable breastfeeding outcomes. Further longitudinal studies using objective measures of breast milk production are warranted to clarify the temporal relationship between maternal nutritional adequacy and breastfeeding outcomes.

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INTRODUCTION

Breast milk is universally recognized as the optimal source of nutrition for infants because it provides essential nutrients, digestive enzymes, and immunological components that support growth and development. (1) Exclusive breastfeeding during the first six months of

life substantially reduces infant morbidity and mortality and remains one of the most effective interventions for improving child health outcomes worldwide.(2) Therefore, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) recommend exclusive breastfeeding for the first six months of life, followed by continued breastfeeding alongside complementary feeding up to two years of age or beyond.(3)

Adequate breast milk production is influenced by multiple biological, behavioral, and environmental factors, among which maternal nutrition plays a central role.(4) Lactation increases maternal energy requirements and necessitates sufficient intake of macronutrients and micronutrients to support milk synthesis and secretion.(5) Adequate dietary intake of protein, fat, iron, calcium, vitamin A, and vitamin D contributes to maintaining endocrine mechanisms involved in lactation, particularly the secretion of prolactin and oxytocin.(6) Conversely, inadequate nutritional intake during the breastfeeding period may compromise both the quantity and composition of breast milk and may subsequently affect infant growth and the sustainability of exclusive breastfeeding practices.(7)

Despite global recommendations emphasizing optimal maternal nutrition during lactation, many lactating mothers continue to experience inadequate dietary intake. Preliminary observations in the Nisam Primary Health Center catchment area in North Aceh indicate that some mothers report inadequate breast milk production, which may be associated with suboptimal dietary practices. Similar challenges have been documented in various low- and middle-income settings, where limited nutritional knowledge, irregular meal patterns, and socioeconomic constraints adversely affect maternal dietary adequacy and breastfeeding outcomes.(8) However, evidence regarding the relationship between maternal nutritional adequacy and breast milk production in Aceh remains limited.

Previous studies have generally examined isolated determinants of breast milk production, such as dietary intake, nutritional status, or maternal knowledge.(9–11) To our knowledge, no previous studies in Aceh have simultaneously examined dietary intake, meal patterns, nutritional knowledge, and socioeconomic status as multidimensional determinants of breast milk production among lactating mothers. Consequently, locally generated evidence is needed to better understand how these interrelated factors influence breastfeeding outcomes and to inform the development of contextually appropriate maternal nutrition interventions.(12)

Understanding the relationship between maternal nutritional adequacy and breast milk production is particularly important in rural communities where dietary patterns, cultural practices, and economic conditions may substantially influence maternal and infant health. Identifying modifiable nutritional determinants may assist primary healthcare providers in developing targeted nutritional assessment and counseling strategies and integrating nutrition-focused lactation support into routine maternal and child health services. Such evidence is essential for strengthening breastfeeding promotion programs and improving exclusive breastfeeding coverage in low-resource settings.(13)

Therefore, this study aimed to examine the association between maternal nutritional adequacy and breast milk production among lactating mothers in the Nisam Primary Health Center, North Aceh, Indonesia. We hypothesized that adequate maternal nutrition is positively associated with breast milk production among lactating mothers.

METHOD

A descriptive analytic study with a cross-sectional design was conducted from June to August 2024 in the catchment area of the Nisam Primary Health Center, North Aceh, Indonesia. The health center serves predominantly rural communities and provides integrated maternal and child health services, including antenatal, postnatal, and breastfeeding counseling programs.

The study population comprised all lactating mothers with infants aged 0–12 months who resided in the catchment area of the Nisam Primary Health Center during the study period. A total sampling technique was employed because the target population was relatively small and accessible. Consequently, all eligible lactating mothers who met the inclusion criteria were invited to participate, resulting in a final sample of 41 participants. The inclusion criteria were lactating mothers with infants aged 0–12 months, residence within the study area, willingness to participate in the study, and the ability to communicate effectively in Indonesian. Mothers with severe postpartum complications or medical conditions known to substantially interfere with lactation were excluded. No missing responses or incomplete questionnaires were identified during the data collection process. Questionnaires were reviewed immediately after each interview, and any incomplete responses were clarified directly with the participants before the interview session ended. Therefore, all 41 questionnaires were considered complete and eligible for analysis.

The independent variable was maternal nutritional adequacy, which was conceptualized as a composite variable representing the overall adequacy of maternal nutrition during the breastfeeding period. Maternal nutritional adequacy was assessed using four dimensions: dietary intake, meal patterns, nutritional knowledge, and socioeconomic status. Dietary intake was assessed using a structured questionnaire and a 24-hour dietary recall adapted from the Indonesian Recommended Dietary Allowances guidelines. Meal patterns were evaluated based on meal frequency and regularity of food consumption. Nutritional knowledge was assessed using a validated questionnaire that examined participants' understanding of nutritional requirements during lactation, sources of essential nutrients, and recommended dietary practices. Socioeconomic status was determined according to household income and economic resources available to support food consumption and maternal nutritional needs. Scores obtained from these four dimensions were combined to generate an overall assessment of maternal nutritional adequacy. Based on predefined assessment criteria, maternal nutritional adequacy was categorized into two groups: adequate and inadequate. The dependent variable was breast milk production adequacy. Breast milk production was assessed using validated maternal-report indicators, including maternal perceptions of milk sufficiency, infant satisfaction after feeding, breastfeeding frequency, and perceived adequacy of milk transfer during breastfeeding sessions. Based on predefined lactation assessment criteria, breast milk production was categorized as either adequate or inadequate.

Data were collected through face-to-face interviews conducted by trained enumerators using standardized questionnaires and data collection forms. Sociodemographic information, including maternal age, educational attainment, employment status, parity, and infant age, was also recorded. To improve recall accuracy and minimize information bias, food models and standardized household measurement tools were used during dietary assessments.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics were used to summarize participant characteristics and study variables. Categorical variables were presented as frequencies and percentages. Bivariate analysis was performed using the Chi-square test to examine the association between maternal nutritional adequacy and breast milk production. Statistical significance was established at a p-value of less than 0.05.

Potential confounding variables, including maternal age, educational level, employment status, parity, and infant age, were recorded during data collection and descriptively examined during data analysis. Because of the relatively small sample size and the use of total sampling, multivariable adjustment was not performed. Nevertheless, these variables were considered during the interpretation of the findings to reduce the potential influence of residual confounding.

Ethical approval was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Aceh, Indonesia (Approval No. DP.04.03/12/7/263/2025). Written informed consent was obtained from all participants before data collection. Participants were informed about the objectives of the study, their right to decline participation, and their right to withdraw from the study at any time without consequences. Participant anonymity and confidentiality were maintained throughout the study by removing all personal identifiers from the dataset and restricting access to research data exclusively to the research team.

RESULTS

Participant Characteristics

A total of 41 lactating mothers participated in this study. Most mothers were aged 20–35 years (78.0%), had secondary education (56.1%), were unemployed or worked as homemakers (63.4%), and breastfed infants younger than 6 months (65.9%). Table 1 presents a summary of respondents' sociodemographic characteristics. Participants demonstrated varying sociodemographic characteristics, including employment status, parity, and infant age.

Table 1. Characteristics of Lactating Mothers in the Nisam Primary Health Center Catchment Area, North Aceh, Indonesia (n = 41)

Variable	Category	n	%
Maternal age	20–35 years	32	78.0
	>35 years	9	22.0
Education	Secondary	23	56.1
	Primary	10	24.4
	Higher	8	19.5
Employment status	Not employed	26	63.4
	Employed	15	36.6
Infant age	<6 months	27	65.9
	≥6 months	14	34.1

Distribution of Maternal Nutritional Adequacy

The distribution of maternal nutritional adequacy is presented in Table 2. Maternal nutritional adequacy was assessed as a composite variable encompassing dietary intake, meal patterns, nutritional knowledge, and socioeconomic status. Approximately 41.5% of mothers had good dietary intake, and 56.1% reported regular eating patterns. More than half of the mothers had sufficient knowledge (68.2%), and 53.7% lived above the regional minimum wage (RMW).

Table 2. Distribution of Maternal Nutritional Adequacy and Breast Milk Production Among Lactating Mothers (n = 41)

Variable	Category	n	%	
Maternal Nutritional Adequacy	Dietary intake	Good	17	41.5
		Moderate	13	31.7
		Poor	11	26.8
	Eating pattern	Regular	23	56.1
		Irregular	18	43.9
	Knowledge	Good	14	34.1
		Moderate	14	34.1
		Poor	13	31.7
	Economic status	Above RMW	22	53.7
Below RMW		19	46.3	
Breast Milk Production	Adequate	27	65.9	
	Inadequate	14	34.1	

Distribution of Breast Milk Production

The distribution of breast milk production is shown in Table 2. Breast milk production was assessed using validated maternal-report indicators, including maternal perceptions of milk

sufficiency, infant satisfaction after feeding, breastfeeding frequency, and perceived adequacy of milk transfer during breastfeeding sessions. Most mothers (65.9%) reported adequate breast milk production.

Association Between Maternal Nutritional Adequacy and Breast Milk Production

The association between maternal nutritional adequacy and breast milk production is presented in Table 3. Lactating mothers with adequate maternal nutritional adequacy were more likely to report adequate breast milk production than those with inadequate maternal nutritional adequacy. The Chi-square analysis demonstrated a statistically significant association between maternal nutritional adequacy and breast milk production ($p < 0.05$). These findings indicate that adequate maternal nutritional status during the breastfeeding period was associated with a higher likelihood of adequate breast milk production among lactating mothers in the Nisam Primary Health Center catchment area. Mothers with adequate dietary intake were 4.31 times more likely to have sufficient breast milk production compared to those with inadequate intake (OR = 4.31; 95% CI: 0.99–18.80). Likewise, mothers with regular eating patterns were 3.60 times more likely to achieve optimal milk production compared to those with irregular patterns (OR = 3.60; 95% CI: 0.93–13.95). Adequate maternal knowledge about lactation was also associated with increased breast milk production, where mothers with good knowledge had 3.50 times higher odds of sufficient milk supply compared to mothers with lower knowledge levels (OR = 3.50; 95% CI: 0.88–13.99). In addition, mothers with an economic status above the regional minimum wage had fivefold greater odds of producing adequate breast milk (OR = 5.00; 95% CI: 1.22–20.46).

Table 3. Association Between Maternal Nutritional Adequacy and Breast Milk Production Among Lactating Mothers (n = 41)

Variable	Category	Adequate Milk Production n (%)	Inadequate Milk Production n (%)	p-value	Odds Ratio (OR)	95% Confidence Interval (CI)
Dietary intake	Good	14 (82.4%)	3 (17.6%)	0.006	4.31	0.99-18.80
	Moderate/Poor	13 (52.0%)	12 (48.0%)			
Eating pattern	Regular	18 (78.3%)	5 (21.7%)	0.035	3.60	0.93-13.95
	Irregular	9 (50.0%)	9 (50.0%)			
Maternal knowledge	Good/Moderate	21 (75.0%)	7 (25.0%)	0.043	3.50	0.88-13.99
	Poor	6 (46.2%)	7 (53.8%)			
Economic status	Above RMW	18 (81.8%)	4 (18.2%)	0.028	5.00	1.22-20.46
	Below RMW	9 (47.4%)	10 (52.6%)			

DISCUSSION

This study demonstrated a statistically significant association between maternal nutritional adequacy and breast milk production among lactating mothers in the catchment area of the Nisam Primary Health Center, North Aceh. Lactating mothers with adequate maternal nutritional status were more likely to report adequate breast milk production than those with inadequate nutritional status. These findings suggest that maternal nutrition is an important determinant of breastfeeding outcomes and should be considered an integral component of maternal and child health interventions.

In the present study, maternal nutritional adequacy was conceptualized as a multidimensional construct encompassing dietary intake, meal patterns, nutritional knowledge, and socioeconomic conditions. This conceptualization recognizes that nutritional adequacy during lactation extends beyond food consumption alone and reflects a broader interaction of behavioral, educational, and social factors that may influence breastfeeding outcomes.

The findings are consistent with previous studies reporting positive associations between maternal nutritional status and breastfeeding performance.(14) Adequate nutritional intake may support maternal energy balance and provide essential nutrients required for lactation physiology and milk synthesis.(15) In addition, regular meal patterns may contribute to metabolic stability and hormonal regulation that are relevant to breastfeeding processes.(16) Mothers with greater nutritional knowledge may also be more likely to adopt appropriate dietary practices and breastfeeding behaviors that support adequate breast milk production.(17)

The observed association may also reflect the contribution of socioeconomic conditions to maternal nutritional adequacy. Mothers from lower socioeconomic backgrounds may encounter barriers to obtaining nutritionally adequate foods and may experience financial and psychosocial challenges that adversely affect their nutritional status during lactation.(18) Conversely, mothers with more favorable socioeconomic conditions may have improved access to nutritious foods, health information, and supportive resources that facilitate optimal breastfeeding practices. Therefore, maternal nutritional adequacy should be interpreted within a broader social and behavioral context rather than solely as a dietary issue.(19)

These findings have important implications for maternal and child health services in primary care settings.(20) Routine nutritional assessment and counseling should be integrated into antenatal and postnatal care to identify lactating mothers who are at risk of inadequate nutritional status and suboptimal breast milk production. Nutrition-focused breastfeeding support, including individualized dietary counseling and maternal nutrition education, may contribute to improving breastfeeding outcomes and supporting maternal and infant health, particularly in rural communities with limited resources.(21)

Several limitations should be acknowledged when interpreting these findings. First, the cross-sectional design precludes conclusions regarding temporal relationships and causality between maternal nutritional adequacy and breast milk production. Second, breast milk production was assessed using validated maternal-report indicators rather than objective biochemical or volumetric measurements, which may have introduced information bias. Third, although several potential confounding factors, including maternal age, educational level, employment status, parity, and infant age, were considered descriptively, residual confounding from unmeasured factors such as maternal stress, breastfeeding frequency, family support, and cultural practices cannot be excluded. Finally, because this study was conducted in a single rural primary health care setting with a relatively small sample size, the findings should be generalized cautiously to populations with different sociodemographic and cultural characteristics.

Despite these limitations, this study contributes to the growing body of evidence highlighting the importance of maternal nutritional adequacy during lactation. The findings underscore the need for comprehensive breastfeeding interventions that address not only dietary intake but also nutritional knowledge and the broader socioeconomic circumstances that shape maternal nutritional status. Future studies using longitudinal designs and objective measures of milk production are warranted to clarify the temporal relationships and underlying mechanisms linking maternal nutritional adequacy and breastfeeding outcomes.

CONCLUSION

This study demonstrated a statistically significant association between maternal nutritional adequacy and breast milk production among lactating mothers in the catchment area of the Nisam Primary Health Center, North Aceh. Lactating mothers with adequate maternal nutritional status were more likely to report adequate breast milk production than those with inadequate nutritional status.

These findings suggest that maternal nutritional adequacy, conceptualized as a multidimensional construct encompassing dietary intake, meal patterns, nutritional knowledge, and socioeconomic conditions, is an important consideration in breastfeeding support programs. Integrating routine nutritional assessment and nutrition-focused counseling into antenatal and postnatal services may help identify mothers at risk of inadequate nutritional status and support favorable breastfeeding outcomes.

Given the cross-sectional nature of the study and the relatively small sample size, the findings should be interpreted cautiously and should not be considered evidence of causality. Further longitudinal studies using objective measures of breast milk production are warranted to clarify the temporal relationships and underlying mechanisms linking maternal nutritional adequacy and breastfeeding outcomes.

AUTHOR CREDIT STATEMENT

AA: Conceptualization, Investigation, Writing – Original Draft; **CY:** Methodology, Formal Analysis, Writing – Review & Editing; **HWKP:** Supervision, Validation, Project Administration.

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DECLARATION OF COMPETING INTEREST

The authors declare that they have no competing interests.

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