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Association of Contribution and Adequacy Levels of Energy and Nutrients from Supplementary Foods with Perceived Breast Milk Sufficiency among Lactating Mothers in a Stunting Prevention Program

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ABSTRACT

Maternal nutrition intake, as well as nutritional status, influence breast milk production and nutrient content. To reduce stunting, the GAS KIPAS Stunting Program (*Gerakan Anak Sehat – Kolaborasi Inklusif Pengusaha Indonesia Atasi Stunting*) provided high-nutrient supplementary foods for lactating mothers. This program was implemented in several priority locations. This study analyzed the associations between contribution and the adequacy levels of energy and nutrients from supplementary foods with perceived breast milk sufficiency. Secondary data were obtained from the 2023 GAS KIPAS Stunting Program. This study used a one-group pretest–posttest pre-experimental design without a control group. Nutritional intake of supplementary foods was obtained using the Comstock method. Statistical analyses included the Wilcoxon signed-rank test and Spearman's rank correlation. The results showed no significant association between the energy and nutrient contribution of supplementary foods and perceived breast milk sufficiency. However, calcium adequacy level showed a significant positive correlation (r=0.38; p=0.039). During lactation, mothers require increased micronutrient intake to support maternal health and infant development. Conclusion: Providing supplementary foods for lactating mothers does not directly affect mothers' perceptions. These findings suggest that a larger sample size, measurement of milk production volume, and a 24-hour food recall may be needed to optimize intervention outcomes in supporting exclusive breastfeeding as a stunting prevention.

Key Messages:

- Lactating mothers gave positive reviews of supplementary food interventions, which increased adequacy levels of energy and nutrients.
- The government should sustain these lessons via collaboration with NGOs, APINDO, and local facilities like posyandu.

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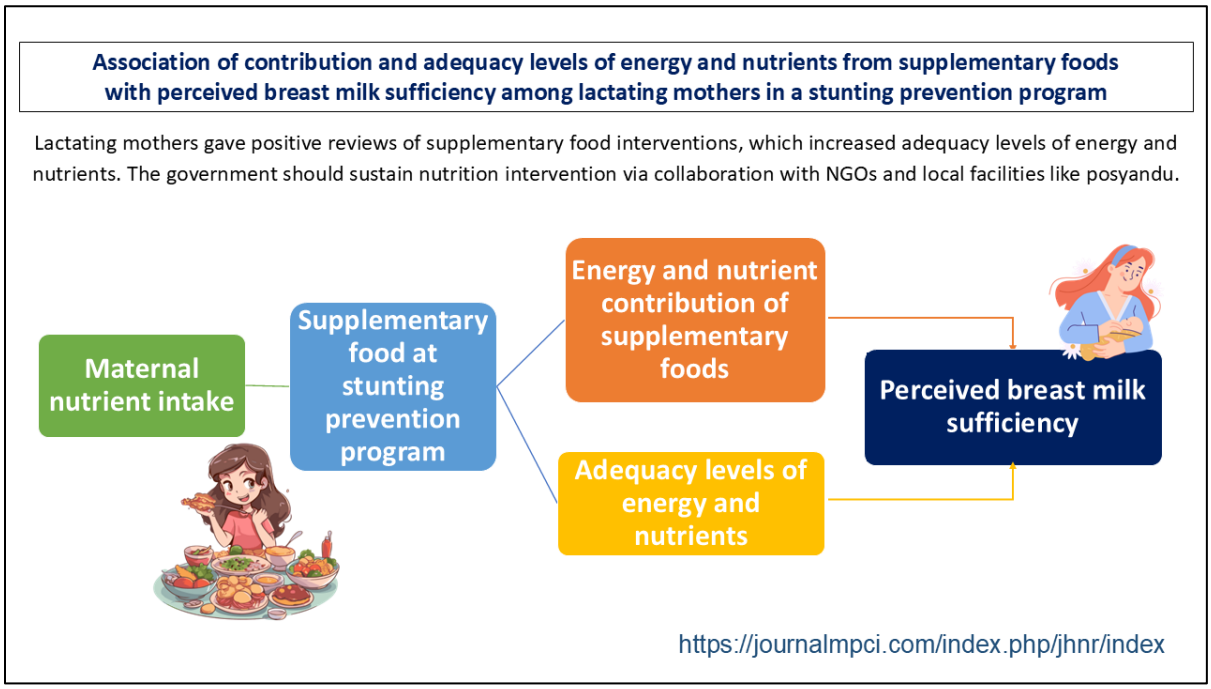
GRAPHICAL ABSTRACT



INTRODUCTION

The nutritional status of children under five years of age is a crucial indicator of the quality of children's health (1). Data from the 2024 Indonesian Nutrition Status Survey (SSGI) shows significant progress, with the prevalence of stunting decreasing to 15.6%, underweight to 13.9%, and wasting to 6.2% in 2024 (2). Specifically, the prevalence of wasting has reached the target set by the 2020-2024 National Medium-Term Development Plan (RPJMN), which is below 7% (3). However, these numbers still need serious consideration, especially regarding stunting.

The prevalence of stunting in West Java province was 26.21% in 2019 (4) and decreased to 20.2% in 2022 (5). Several districts/cities in West Java have higher stunting prevalence than the national average, including Sumedang Regency (27.6%), Bandung Regency (25%), Bogor Regency (24.9%), and Tasikmalaya City (22.4%) (5).

Exclusive breastfeeding increases infant weight (6) and prevent stunting. Unbalanced dietary patterns often hinder exclusive breastfeeding, reducing both the quantity and quality of breast milk (7,8), and also trigger Perceived Insufficient Milk Supply (PIMS), as detected by clinical indicators such as babies crying after feeding. The risk of PIMS is three times higher in mothers without Early Breastfeeding Initiation (EBI) (9,10). Consequently, lactating mothers exhibit elevated requirements for energy, vitamins, and minerals to support optimal milk production, rendering supplementary feeding an effective strategy (8,11). Structured interventions are required to optimize lactating mothers' diets during breastfeeding, thereby mitigating PIMS and promoting optimal breastfeeding practices among high-risk mothers.

The GAS KIPAS *Stunting* program aimed to accelerate the reduction of stunting by providing snacks (20% of the Recommended Daily Allowance, RDA) and lunch (30% RDA) for lactating mothers, which were nutritious, safe, and healthy (12,13), with the monitoring of the nutritional status of infants and children under five. Lunch was prioritized over breakfast (20% RDA) or evening meals to target a commonly skipped meal for busy lactating mothers, optimizing logistical feasibility, acceptance, and compliance amid morning childcare and evening duties. This program was implemented in several priority locations, including Purbalingga Regency, Bogor Regency, and Serang City. Specifically, according to the 2019 Bogor Regency Health Profile, the coverage of exclusive breastfeeding in Bogor Regency remains low at 53.12% (14), so that the supplementary food intervention of the GAS KIPAS Stunting Program has the potential to support improvements in the nutritional status of lactating mothers and increase the perceived breast milk

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adequacy. Research by Kusumawati et al. (2019) showed that supplementary food interventions, such as snacks and lunch, effectively improved nutritional status when accompanied by nutrition education (15). Therefore, this study aimed to analyze the associations between contribution and the adequacy levels of energy and nutrients from supplementary foods with perceived breast milk sufficiency.

METHODS

Design, Place, and Time of Research

This study used a pre-experimental design with a one-group pretest-posttest approach, in which variable measurements were taken before and after the intervention in a single group, without a control group. The research was conducted from August 2024 to October 2025 by analyzing secondary data from the GAS KIPAS Stunting Program, which was implemented from September 2023 to January 2024. This study uses secondary data from a nutrition intervention program in Bogor Regency.

The supplementary feeding intervention was implemented by providing snacks for five days, from Monday to Friday, with one to two different types of snacks each day. Additionally, lunch was provided once a day on Saturdays, in conjunction with balanced nutrition education for lactating mothers. Lunch was provided through three alternative menus that rotated weekly during the intervention period.

Number and Method of Subject Selection

The subjects of this study were lactating mothers and infants targeted by the GAS KIPAS Stunting Program in the Kampung Manggis and Ciapus Community Health Centers in Bogor Regency, West Java. Sampling was conducted using purposive sampling based on the following inclusion criteria: mothers with infants aged ≤6 months who were actively breastfeeding and had a Health Card (KMS). Additionally, the mothers and infants must be program targets. With these criteria, the total number of research subjects was 30 lactating mothers.

Data Collection Methods

Secondary data from the 2023 GAS KIPAS Stunting Program were collected by enumerators through in-person interviews with program participants, using a questionnaire adapted from the 2022 Indonesia Nutrition Status Survey (SSGI). The Epicollect5 mobile app supported efficient data entry and real-time submission. Secondary data include subject characteristics, acceptability of food, supplementary food contribution, adequacy levels of energy and nutrients in lactating mothers. Subject characteristics included mother's age, infant age, infant sex, mother's employment status, implementation of Early Breastfeeding Initiation (EBI), obstetric status, mother's nutritional status, and baseline energy consumption level. Researchers assess obstetric status based on pregnancy and delivery history using G (gravida/pregnancy), P (partus/delivery), and A (abortion/miscarriage) notation. Obstetric status classification refers to Redowati (2018), with the following categories: primipara (history of delivering the first child), multipara (history of delivering the second to fifth child), and grand multipara (history of delivering the sixth child or more) (16).

Lactating mothers' nutritional status was assessed using Body Mass Index (BMI). BMI classification refers to the World Health Organization (WHO) Asian Pacific Region guidelines, with five categories: underweight (<18.5 kg/m2), normal (18.5 – 22.9 kg/m2), overweight (23 – 24.9 kg/m2), obesity I (25–29.9 kg/m^2) and obesity II (≥30.0 kg/m^2) (17). Upper Arm Circumference (UAC) measurement was also performed to complement the assessment of the nutritional status of lactating mothers, with UAC ≥ 23.5 cm considered normal and UAC < 23.5 cm at risk of Chronic Energy Deficiency (CED).

The acceptance of supplementary foods was assessed using a program questionnaire. The aspects of the acceptability assessment were modified from studies by Handriani *et al.* (2023) and Meriana *et al.* (2025). The aspects were food hygiene, utensil hygiene, serving time, appearance, taste, variety, smell/aroma, and portion size. The overall acceptability score for supplementary foods was categorized as unsatisfactory (8–12), satisfactory (13–18), or very good (19–24).

Data on the contribution of supplementary foods from the GAS KIPAS Stunting Program were analyzed based on the nutritional intake of supplementary foods, estimated using the Comstock visual

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method (20), in which mothers assessed food waste using a form (Control Card), assisted by enumerators when filling out the questionnaire. Inter-rater reliability testing was not conducted for this visual assessment. However, all enumerators received training on questionnaire completion and standardized food waste categorization (fully consumed, 1/4 remaining, 1/3 remaining, 1/2 remaining, 2/3 remaining, 3/4 remaining). Nutritional intake from supplementary foods is compared with the daily Recommended Dietary Allowance (RDA), then multiplied by 100% to obtain the percentage contribution of energy and nutrients from supplementary foods to the RDA for lactating mothers.

Data on the adequacy levels of energy and nutrients in lactating mothers were collected by enumerators at baseline and endline using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). The average nutritional intake then was compared with the daily RDA. The classification according to the Ministry of Health, as cited in Budiraharti *et al.* (2022), as follows: deficit (< 70%), inadequate (70 – 89%), moderate (90 – 99%), and adequate (≥100%) (21). This consumption data can support the giving of supplementary food to lactating mothers.

The researchers obtained mothers' perceived breast milk adequacy scores from interviews conducted after the program using a questionnaire. Each question had two answer options: “Yes” (score 1) and “No” (score 0). The total score was then categorized as very insufficient (≤3), insufficient (3 – 6), and sufficient (>6). The questionnaire for assessing perceived breast milk adequacy was based on the study by Chahyanto and Roosita (2014) and Kent *et al.* (2021). The questions asked were 1) Does milk seeps out of the mother's nipple, 2) Does the baby breastfeeds for more than 10 minutes at a time, 3) Does after breastfeeding, the baby is not fussy and usually falls asleep quietly, 4) Does the mother can hear a soft swallowing sound when the baby swallows the milk, 5) Does the mother can feel tingling due to the milk flow every time the baby starts to breastfeed, 6) Does the baby breastfeeds more than six times a day, 7) Does the baby urinates more than six times a day, 8) Does the baby defecates more than three times a day, and 9) Does the mother feels that the milk is sufficient for the baby.

Data Analysis

Data analysis was performed using Microsoft Excel 2019 and IBM SPSS version 25.0 for Windows. Descriptive analysis was used for subject characteristics, acceptability of food, supplementary food contribution, adequacy levels of energy and nutrients, and perceived breast milk sufficiency. The inferential analysis used the Wilcoxon signed-rank test to examine differences in adequacy levels of energy and nutrients at baseline and endline, and the Spearman rank test to examine the association between the independent and dependent variables.

CODE OF HEALTH ETHICS

The GAS KIPAS Stunting program has gone through a review process and received approval from the Health Research Ethics Commission of the Faculty of Nursing and Health Sciences, Muhammadiyah University of Semarang, with ethical clearance number 202/KE/2023.

RESULTS

Characteristics of research subjects

Based on Table 1, most infants were aged 29 days to 5 months (86.7%) and female (56.7%). Most mothers were aged 19 – 29 years (53.3%), unemployed (93.33%), implemented EBI (66.7%), and were multipara (83.3%). The average BMI was categorized as normal (46.7%), and they had a UAC ≥ 23.5 cm (93.3%). The energy consumption level was found to be in the deficit category (63.33%). Madiyanti *et al.* (2022) found that food intake is one of the factors influencing breast milk production. Therefore, the intervention of supplementary foods, such as snacks and lunch, is expected to increase and improve the nutritional intake of lactating mothers.

The acceptance of supplementary foods

Based on Table 2, most lactating mothers considered the supplementary food to be clean (83.3%), used clean utensils (80%), and received it on time (96.7%). The majority of mothers reported that

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supplementary foods had an appealing appearance (83.3%), good taste (86.7%), variety (86.7%), a delicious aroma (86.7%), and sufficient portions (93.3%). Overall, lactating mothers (100%) assessed the supplementary foods that were given as satisfactory and acceptable.

Table 1. Characteristics of research subjects

Variable	Category	n	%
Infant age	1. 0 – 7 days	1	3.3
	2. 8 – 28 days	3	10.0
	3. 29 days – 5 months	26	86.7
Infant sex	1. Female	17	56.7
	2. Male	13	43.3
Mother's age	1. 19-29 years	16	53.33
	2. > 30 years	14	46.77
Employment status	1. Not working	28	93.33
	2. Working	2	6.67
Early Breastfeeding Initiation (EBI)	1. EBI was implemented	20	66.70
	2. Not implemented	10	33.30
Obstetric status	1. Primipara	5	16.7
	2. Multipara	25	83.3
Body Mass Index (BMI)	1. Normal	14	46.7
	2. Overweight	4	13.3
	3. Obese I	11	36.7
	4. Obese II	1	3.3
Upper Arm Circumference (UAC)	1. UAC < 23,5 cm	2	6.7
	2. UAC ≥ 23,5 cm	28	93.3
Energy adequacy level (baseline)	1. Deficit (< 70%)	19	63.33
	2. Inadequate (70 – 79%)	6	20.00
	3. Moderate (80 – 99%)	3	10.00
	4. Adequate (≥ 100%)	2	6.67

Table 2 The acceptance of supplementary foods by lactating mothers

No	Assessment aspects	Category	n	%
1	Food hygiene	Very clean	5	16.7
		Clean	25	83.3
2	Utensil hygiene	Very clean	5	16.7
		Clean	24	80.0
		Not clean	1	3.3
3	Serving time	On time	29	96.7
		Slightly late	1	3.3
4	Visual appeal	Very attractive	5	16.7
		Attractive	25	83.3
5	Taste	Very good	4	13.3
		Good	26	86.7
6	Variety	Very high variety	2	6.7
		Moderate variety	26	86.7
		Low variety	2	6.7
7	Smell/Aroma	Very pleasant	4	13.3
		Pleasant	26	86.7
8	Portion Size	Sufficient	28	93.3
		Insufficient	2	6.7

Contribution of energy and nutrients from supplementary foods

Based on Table 3, the average energy intake from snacks was 395 kcal, accounting for 17.81% of the daily RDA for lactating mothers. Lunch contributed 39.33%. Overall, the supplementary food contributed 57.14% to the RDA. These findings also show that lunch contributes ≥ 30%, thereby meeting the RDA recommendation, whereas snacks contribute < 20%.

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Table 3 The average energy and nutrient contribution of supplementary foods

Energy and nutrients	Average RDA for lactating mothers	Average intake	Contribution of nutrients to the RDA (%)
Snacks			
Energy (kcal)	2642	395,04	14,95
Protein (g)	83,38	11,70	14,03
Fat (g)	67,68	15,81	23,36
Carbohydrates (g)	411,85	50,52	12,27
Vitamin A (RE)	990,10	626,39	63,27
Vitamin C (mg)	125,06	1,76	1,41
Calcium (mg)	1250,65	59,64	4,77
Iron (mg)	18,77	1,58	8,42
		Average nutrient contribution	**17,81**
Lunchs			
Energy (kcal)	2642	756,60	28,64
Protein (g)	83,38	43,19	51,80
Fat (g)	67,68	40,68	60,11
Carbohydrates (g)	411,85	73,00	17,72
Vitamin A (RE)	990,10	875,52	88,43
Vitamin C (mg)	125,06	39,94	31,94
Calcium (mg)	1250,65	117,11	9,36
Iron (mg)	18,77	5,00	26,64
		Average nutrient contribution	**39,33**

Adequacy levels of energy and nutrients at baseline and endline program intervention

Based on Table 4, most energy and nutrient adequacy levels increased at endline, and there were significant differences between baseline and endline ($p<0.05$). These findings indicate that the program intervention significantly increases the adequacy levels of energy, protein, fat, carbohydrates, vitamin A, and iron in lactating mothers.

Table 4. The results of the Wilcoxon test on the adequacy levels of energy and nutrients in lactating mothers at baseline and endline program

Energy and nutrients	***Baseline* (%)**	***Endline* (%)**	**Δ (%)**	***p-value***
Energy	63,60	81,31	17,70	0,0001*
Protein	61,42	90,13	28,71	0,0001*
Fat	85,28	155,59	70,31	0,0001*
Carbohydrates	59,67	72,01	12,33	0,0001*
Vitamin A	116,70	166,76	50,06	0,0001*
Vitamin C	44,33	44,33	0,00	0,005*
Calcium	34,66	32,97	-1,69	0,387
Iron	55,45	164,57	109,12	0,0001*

Note: *Statistically significant at the 5% level (*p-value* < 0,05)

Perceived breast milk sufficiency

Based on Table 5, 63.33% of lactating mothers considered their milk production sufficient, and 36.7% thought it was insufficient during the supplementary food intervention. Huang *et al.* (2021) found that mothers with perceptions of insufficient milk production may lead to early decisions to stop breastfeeding. Additionally, the perceived insufficient milk supply (PSMS) may increase threefold among mothers who do not practice early breastfeeding initiation (EBI) compared with those who do (10).

Table 5. Distribution of mothers' perceptions regarding breast milk production sufficiency

Category	Perception's score	n	%
Insufficient	3 – 6	11	36,67
Sufficient	> 6	19	63,33

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DISCUSSION

Association between independent variables and dependent variables

The results showed no significant association between the contribution of energy and nutrients from supplementary foods and perceived breast milk sufficiency. Meanwhile, the study found a significant association ($p<0.05$) between the adequacy level of calcium in lactating mothers and perceived breast milk sufficiency ($r=0.38$; $p=0.039$). However, the adequacy levels of energy and other nutrients at the endline were not significant. This means that higher calcium adequacy levels can improve perceived breast milk adequacy.

Szyller *et al.* (2024) reported that calcium intake in lactating mothers can affect breast milk calcium content. Calcium content in breast milk is relatively stable, although it can still fluctuate depending on the mother's diet and condition (25). Basrowi *et al.* (2025) added that during breastfeeding, mothers need to increase their intake of micronutrients, such as calcium, to support their health and their infants' growth. The daily average calcium requirement of 1,250.65 mg in the study population (Table 3) must be sustained to prevent bone demineralization in lactating mothers (26).

The majority of lactating mothers (46.67%) were aged > 30 years and were multiparous (83.3%) (Table 1), indicating that perceived breast milk sufficiency could be influenced by previous lactation experience. Research by Huang *et al.* (2021) showed that mothers with high breastfeeding self-efficacy will believe that they can produce enough breast milk to satisfy their babies (10). The majority of mothers (66.7%) in this study population implemented Early Breastfeeding Initiation (EBI) at birth (Table 1). Saragih dan Hutabarat (2017) explained that early breast stimulation through EBI was intended to ensure that the process of milk production and delivery ran smoothly. Early breastfeeding initiation allows the baby to immediately use their sucking reflex, enabling them to breastfeed correctly. The benefits of early breastfeeding initiation include increased production of prolactin and oxytocin hormones, which stimulate the early release of colostrum (27). This condition will increase the mother's positive perception of the adequacy of breast milk production.

Strengths and Limitations

One of the main strengths of this study is its 16-week duration, which meets the minimum threshold recommended in the guidelines of supplementary feeding (12–16 weeks). This program increases the internal validity and relevance of the findings for the implementation of public health programs in Indonesia. It also examines perceived breast milk sufficiency, bridging nutritional intake findings with breastfeeding outcomes, despite not directly measuring production volume. Limitations include a small sample size and heterogeneous infant ages, which limit generalizability; subjective assessment of milk adequacy; and the lack of 24-hour dietary recalls for nutrient intake. Future stunting prevention efforts should incorporate larger samples and objective measures.

CONCLUSION

The GAS KIPAS Stunting program's supplementary food intervention received positive feedback from most lactating mothers for hygiene, serving times, appearance, taste, aroma, variety, and portion size. The average snack intake was 395 kcal (17.81% of the RDA), and lunch contributed 39.33% of the RDA. The adequacy levels of energy, protein, fat, carbohydrates, vitamin A, and iron among lactating mothers receiving the GAS KIPAS Stunting supplementary food program significantly increased from baseline to endline. There was no significant association between the energy and nutrient contribution of supplementary foods (snacks and lunch) with perceived breast milk sufficiency. Meanwhile, a significant association was found between calcium adequacy levels and perceived breast milk sufficiency. These findings indicate that although supplementary foods contribute to the nutritional adequacy of lactating mothers, they do not directly affect their perceived breast milk sufficiency. The findings recommend that further research be conducted to analyze breast milk adequacy by measuring breast milk volume, using larger samples and more extended intervention periods, and using a 24-hour food recall. The snack and lunch menus may be evaluated by periodically varying the foods served. Posyandu cadres and health workers need to educate mothers on proper breastfeeding practices, lactation support, and confidence-

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building for lactating mothers, using the breast milk adequacy perception scale as a monthly monitoring indicator to support exclusive breastfeeding.

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CONFLICTS OF INTEREST

There is no conflict of interest related to this research.

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