



The Effect of a Diet Based on Local Foods on Changes in Upper ARM Circumference Among Pregnant Women in the Service Area of the Sikumana Community Health Center

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Abstract

Keywords

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Chronic Energy Deficiency (CED) among pregnant women remains a significant public health issue, particularly in developing countries, where inadequate maternal nutrition contributes to adverse pregnancy outcomes. This study aimed to analyze the effect of local food-based supplementary feeding (PMT) on changes in upper arm circumference (LiLA) among pregnant women with CED in the working area of the Sikumana Health Center, Indonesia. A quasi-experimental nonequivalent control group design with pre-test and post-test was employed. The study involved 45 pregnant women, divided into an intervention group receiving 50 g of local food PMT daily for 21 days and a control group receiving standard care. Data were collected through anthropometric measurements of LiLA and analyzed using the paired sample t-test and the independent sample t-test. The results showed a significant increase in mean LiLA in the intervention group from 22.2 cm to 22.5 cm, while the control group slightly decreased from 27.8 cm to 27.7 cm. Statistical analysis confirmed a significant difference between groups ($p = 0.023$), indicating the effectiveness of local food PMT in improving maternal nutritional status. In conclusion, local food-based supplementary feeding significantly improves LiLA among pregnant women with CED. This intervention is a potential sustainable nutrition strategy that utilizes locally available food resources to address maternal undernutrition and improve pregnancy outcomes in community health settings.

INTRODUCTION

Chronic Energy Deficiency (CED) is a condition of malnutrition that has been ongoing for a long time, resulting in the unmet nutritional needs of pregnant women (Elsera et al., 2022). According to a 2017 World Health Organization (WHO) report, the prevalence of CED in pregnancy globally ranges from 35% to 75%. The WHO also notes that 40% of maternal deaths in developing countries are related to CED. The country with the highest incidence of CED in pregnant women is Bangladesh at 47%, while Indonesia occupies the fourth position after India, with a prevalence of 35.5% (Directorate General of Public Health of the Ministry of Health, 2022).

Adequate nutritional intake in pregnant women is an important factor in ensuring the fulfillment of nutritional needs during pregnancy (Izwardy, 2019; Paramitas, 2019; Rohmah, 2020). If the nutritional needs of the mother are not met, both in terms of quantity and quality,

the weight gain of the mother and fetus will be inhibited, thereby increasing the health risk for the mother and the baby to be born (Renyoet et al., 2023).

Based on 2021 data, the Directorate of Community Nutrition reported that the prevalence of CED in pregnant women in East Nusa Tenggara (NTT) was 25.1%, occupying the 2nd position in all of Indonesia. In 2023, data from the Indonesian Health Survey (SKI) reported that the prevalence of pregnant women with CED in NTT increased to 28%, occupying the 3rd position in all of Indonesia after Highland Papua and South Papua, with Kupang City as one of the districts/cities that still have pregnant women with CED.^{2,5} This data is in line with the 2018 Basic Health Research (RISKESDAS) report, which shows the percentage of pregnant women with CED in Kupang City at 40.24% (Publishing Institution of the Health Research and Development Agency, 2018).

The factors that cause CED in pregnant women are very complex, including imbalances in nutrient intake, infectious diseases, limited access to nutritious food, and low awareness about nutrition.⁴ CED can cause various health impacts, including an increased risk of abortion, fetal death in the womb, twice the risk of giving birth to babies with low birth weight (LBW), congenital defects, and physical and brain growth retardation (stunting) (Gyimah et al., 2021; Rohmawati et al., 2019).

According to the WHO (2023), approximately 35–75% of pregnant women in developing countries experience some form of undernutrition, with South Asia and Sub-Saharan Africa showing the highest prevalence. In Indonesia, the Ministry of Health reported that the prevalence of CED among pregnant women reached 24.2% in 2023, with higher rates in Eastern Indonesia, particularly in East Nusa Tenggara, where it exceeds 28%. These data indicate that maternal nutrition remains a critical issue requiring targeted interventions, especially in rural and resource-limited settings.

CED in pregnant women is commonly assessed using upper arm circumference (LiLA/MUAC), where a value below 23.5 cm indicates nutritional risk. Low LiLA is strongly associated with insufficient energy reserves, an increased risk of anemia, and poor fetal growth. In addition, dietary insufficiency during pregnancy is often influenced by socioeconomic factors, food insecurity, and limited nutritional knowledge, which further exacerbate maternal vulnerability during pregnancy (Dwitama, 2021; Kurdanti et al., 2020).

Several previous studies have explored nutritional interventions to address maternal CED. Research by Pastuty et al. (2018) demonstrated that supplementary feeding programs significantly improved maternal nutritional status in energy-deficient pregnant women. Similarly, Suswati (2023) found that local food-based supplementary feeding increased LiLA and improved energy intake among pregnant women in Indonesia. Other studies published in journals indexed in Scopus and Google Scholar also highlight that food-based interventions are more sustainable compared to conventional supplementation programs.

Despite these findings, a key gap remains in the literature regarding the effectiveness of locally formulated supplementary foods tailored to regional food availability and cultural dietary patterns. Many existing studies focus on standardized or commercially produced supplements, which may not be sustainable or acceptable in community settings. Additionally, limited research has compared intervention and control groups using rigorous quasi-experimental designs in rural Indonesian health service areas.

This gap creates urgency for developing community-based nutritional strategies that are not only effective but also culturally acceptable and economically feasible. In areas with high CED prevalence, such as East Nusa Tenggara, dependence on imported or non-local nutritional supplements often leads to low compliance and reduced long-term effectiveness. Therefore, exploring local food-based supplementary feeding becomes a practical and urgent public health priority.

The novelty of this study lies in the use of locally sourced food formulations as supplementary feeding (PMT) for pregnant women, specifically designed to improve LiLA over a defined intervention period. Unlike previous studies, this research integrates local food innovation with controlled quasi-experimental evaluation, providing stronger evidence on the effectiveness of culturally adapted nutritional interventions.

The primary purpose of this study is to analyze the effect of local food-based supplementary feeding on changes in upper arm circumference among pregnant women with CED. This includes evaluating whether a structured PMT intervention can significantly improve maternal nutritional status compared to standard care without intervention.

The contribution of this research is expected to provide evidence-based support for public health nutrition programs, particularly in strengthening maternal nutrition policies at the primary healthcare level. It also contributes to the development of sustainable food-based intervention models that can be implemented using locally available resources, reducing dependency on external supplementation.

The objectives of this study are to determine the difference in LiLA before and after intervention in the treatment group, to compare changes between the intervention and control groups, and to evaluate the effectiveness of local food PMT in improving maternal nutritional status. The expected benefit of this study is to provide practical guidance for healthcare providers, policymakers, and community health workers in designing effective, affordable, and sustainable nutrition interventions for pregnant women at risk of CED.

METHOD

This study uses a Quasi-Experiment with Control Group design, with a pre-test and post-test nonequivalent control group design, which is divided into two groups, namely the intervention group and the control group. Data collection was carried out from June 26 to August 1, 2024, at the UPTD Puskesmas Sikumana (Sikumana Health Center), Sikumana Village, Maulafa District, Kupang City, East Nusa Tenggara. This research received an ethics permit with letter number 74/UN15.21/KEPK/2024.

The population in this study is all pregnant women in the working area of the Sikumana Health Center. Sampling was done using the purposive sampling technique, a non-probability sampling method. The sample size was calculated using the Paired Numerical Analysis Formula with a type I error of 5% ($Z\alpha = 1.96$) and a type II error of 20% ($Z\beta = 0.842$), so that a minimum of 31 respondents per group was obtained. After screening 66 prospective respondents, 47 people met the inclusion and exclusion criteria and were then divided into an intervention group (26 people) and a control group (21 people). After 2 respondents met the drop-out criteria, the final sample totaled 45 people, consisting of 25 pregnant women in the intervention group and 20 pregnant women in the control group.

The inclusion criteria included pregnant women who were diligent in participating in ANC activities at the Sikumana Health Center, were willing to be respondents by signing an informed consent form, did not have an allergy to the foodstuffs in the local food PMT, and, in the intervention group, were willing to consume local food PMT in the form of biscuits made from moringa leaves (*Moringa oleifera* L.) and mung beans (*Vigna radiata* L.), as much as 50 g divided into two servings per day for 21 days. The exclusion criteria included a history of infection (malaria, worms), pregnancy complications (high blood pressure, cholesterol, blood sugar), and a history of metabolic disorders such as diabetes mellitus. The drop-out criteria included the onset of unwanted side effects, not consuming the biscuits for at least 5 consecutive days, not consuming the Rikaka biscuits for at least 7 days over 2 consecutive weeks, and withdrawing.

The intervention began with LiLA measurements before the intervention (pre-test). The intervention group was given local food PMT in the form of biscuits made from moringa leaves and mung beans, as much as 50 g divided into two servings per day for 21 days, assisted and supervised by Posyandu cadres in each village and recorded on a compliance sheet. The control group was not given local food PMT, but the frequency and type of daily food were still observed. Both groups were given education and counseling on "Isi Piringku" (Fill My Plate), "The Importance of ANC", and "Local Food PMT". After 21 days, LiLA measurements were taken again (post-test). Primary data were obtained through PMT consumption monitoring and LiLA measurement, while secondary data were obtained from the Sikumana Health Center.

Data analysis used univariate analysis to describe the characteristics of respondents as well as the LiLA pre-test and post-test data. Bivariate analysis used the Shapiro–Wilk normality test ($n < 50$), the paired sample t-test to determine the difference in mean LiLA before and after the intervention within one group, and the independent sample t-test to determine the difference in the mean change in LiLA between the intervention and control groups. Data analysis was carried out using the SPSS program.

RESULTS AND DISCUSSION

Respondent Characteristics

Based on the results of screening of 66 prospective respondents, 45 eligible respondents were obtained and divided into 25 pregnant women in the intervention group and 20 pregnant women in the control group. The complete characteristics of the respondents are presented in Table 1.

Table 1. Frequency Distribution of Respondent Characteristics

Characteristics	Intervention Groups		Control Group	
	n	%	n	%
Mother's Age				
< 19 years old	4	16	1	5
20-35 years old	20	80	12	60
≥ 35 years old	1	4	7	35
Final Education				

SD/Equivalent	2	8	2	10
Junior High School/High School/Equivalent	20	80	13	65
D3/D4/S1	3	12	5	25
Mother's Work				
Housewives	19	76	14	70
Private Employees	3	12	1	5
Civil Servants	0	0	2	10
Other*	3	12	3	15
Parity				
Primigravida	13	52	3	15
Multigravida	9	36	12	60
Largemultigravida	3	12	5	25
Pregnancy Distance				
≥ 2 years	10	40	15	75
< 2 years	2	8	2	10
First pregnancy	13	52	3	15
Marital Status				
Unmarried	8	32	5	25
Marriage	17	68	15	75
Husband's Job				
Work	17	68	15	75
Unidentified*	8	32	5	25
Home Status				
Own House	5	20	6	30
Rent/Boarding House	9	36	8	40
Parents' Home	10	40	6	30
Other*	1	4	0	0
Total	25	100	20	100

Description: Unidentified = not married/unmarried; Mother's Job (Other*) = Female student and waitress; Home status (Other*) = School Guardian.*

Based on Table 1, most of the respondents were between 20-35 years old, with the intervention group being 20 people (80%) and the control group being 12 people (60%). The majority of respondents had a junior high school/high school/equivalent education, namely 20

people (80%) in the intervention group and 13 people (65%) in the control group. The majority of respondents' occupations were housewives, with 19 (76%) in the intervention group and 14 (70%) in the control group. The parity characteristics showed that the intervention group was dominated by primigravida (52%), while the control group was dominated by multigravides (60%). Most of the respondents had a pregnancy gap of ≥ 2 years from the previous pregnancy.

Factors Affecting the Nutritional Status of Pregnant Women

Table 2. Distribution of Respondents' Frequency of Physical Activity

Physical Activity	Pre-Test		Post Test	
	Intervention n(%)	Control n(%)	Intervention n(%)	Control n(%)
Light Activity	1 (4%)	0 (0%)	0 (0%)	1 (5%)
Moderate Activity	21 (84%)	17 (85%)	22 (88%)	17 (85%)
Strenuous Activity	3 (12%)	3 (15%)	3 (12%)	2 (10%)
Total	25 (100%)	20 (100%)	25 (100%)	20 (100%)

Source: Primary data collected through respondent self-reported questionnaire.

Based on Table 2, in both the intervention and control groups, most of the respondents had moderate physical activity in the *pre test* and *post test*, namely 84% and 85% in the *pre test*, and 88% and 85% in the *post test*.

Table 3. Frequency Distribution of Respondent Intake

Characteristics	Pre Test n (%)		Post Test n(%)	
	Intervention	Controls	Intervention	Controls
Consumption of staple foods/day				
1 time/day	1 (4%)	1 (5%)	0 (0%)	0 (0%)
2 times/day	4 (16%)	1 (5%)	5 (20%)	2 (10%)
3 times/day	12 (48%)	8 (40%)	14 (56%)	11 (55%)
>3 times/day	8 (32%)	10 (50%)	6 (24%)	7 (35%)
Breakfast habits				
Yes	13 (52%)	13 (65%)	19 (76%)	17 (85%)
No	12 (48%)	7 (35%)	6 (24%)	3 (15%)
Lunch habits				
Yes	22 (88%)	18 (90%)	22 (88%)	20 (100%)
No	3 (12%)	2 (10%)	3 (12%)	0 (0%)

Dinner habits				
Yes	23 (92%)	19 (95%)	25 (100%)	20 (100%)
No	2 (8%)	1 (5%)	0 (0%)	0 (0%)
Total	25 (100%)	20 (100%)	25 (100%)	20 (100%)

Source: Primary data from dietary assessment questionnaire (food frequency/recall).

Based on Table 3, the majority of respondents in *the pre-test* consumed staple foods 3 times a day (48% of the intervention group). After the intervention, there was an improvement in breakfast habits and all respondents in both groups had dinner habits.

Univariate Analysis

Table 4. Overview of LiLA Before the Provision of Local Food PMT

Groups	n	Red (cm)	Min – Max (cm)	Std. Dev
Intervention	25	22,2	18,2 – 26,3	1,7
Controls	20	27,8	22,5 – 34,5	3,3

Source: Direct anthropometric measurement (Upper Arm Circumference/LiLA) before intervention

Based on Table 4, the average LiLA before intervention in the intervention group was 22.2 cm (SD=1.7; min=18.2 cm; max=26.3 cm), while in the control group it was 27.8 cm (SD=3.3; min=22.5 cm; max=34.5 cm).

Table 5. Overview of LiLA After the Provision of Local Food PMT

Groups	n	Red (cm)	Min – Max (cm)	Std. Dev
Intervention	25	22,5	18,6 – 25,9	1,7
Controls	20	27,7	21,9 – 34,0	3,2

Source: Direct anthropometric measurement after 21-day intervention

Based on Table 5, the average LiLA after intervention in the intervention group increased to 22.5 cm (SD=1.7; min=18.6 cm; max=25.9 cm), while in the control group it decreased to 27.7 cm (SD=3.2; min=21.9 cm; max=34.0 cm).

Table 6. Interpretation of LiLA Results After Feeding Local Food PMT

Remarks	Intervention Groups		Control Group	
	n	%	n	%
Rise	16	64	7	35
Fixed	2	8	0	0
Not Rising	7	28	13	65

Total	25	100	20	100
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Source: Derived from comparison of pre-test and post-test LiLA measurements.

Based on Table 6, as many as 16 pregnant women (64%) in the intervention group experienced an increase in LiLA, 2 pregnant women (8%) remained, and 7 pregnant women (28%) did not experience an increase. In the control group, 7 pregnant women (35%) experienced an increase in LiLA and 13 pregnant women (65%) did not experience an increase.

Bivariate Analysis

Before the bivariate analysis was carried out, a normality test was first carried out using *the Shapiro-Wilk test* because the respondents were less than 50 people. The results of the normality test showed normal distributed data ($p > 0.05$) in all groups, so a parametric test was then carried out.

Table 7. Paired Sample T-test Test Results of the Effect of Local Food PMT on Changes in LiLA of Pregnant Women

Groups	Average \pm elementary school		<i>p value</i>
	<i>Pre-Test</i>	<i>Post Test</i>	
Intervention	22.2 \pm 1.7 cm	22.5 \pm 1.7 cm	0,030
Controls	27.8 \pm 3.3 cm	27.7 \pm 3.2 cm	0,298

Source: Statistical output from SPSS based on primary LiLA measurement data

Based on Table 7, in the intervention group there was a significant difference between the average LiLA *pre test* (22.2 \pm 1.7 cm) and *post test* (22.5 \pm 1.7 cm) with *pvalue* = 0.030 ($p < 0.05$). In the control group, there was no significant difference (*pvalue* = 0.298; $p > 0.05$).

Table 8. Results of Independent Sample T-test Effect of Local Food PMT on LiLA Changes in Pregnant Women

Variable	Average LiLA Difference		<i>p value</i>
	Intervention	Controls	
LiLA	+0.3 cm	-0.1 cm	0,023

Source: Statistical analysis output from SPSS comparing intervention and control groups.

Based on Table 8, the intervention group had an average LiLA difference of +0.3 cm, while the control group experienced a decrease of 0.1 cm. The results of the independent sample t-test showed a p-value of 0.023 ($p < 0.05$), so there was a significant difference in the change in LiLA between the intervention group and the control group.

Supplementary feeding (PMT) based on local food for 21 days had a meaningful effect on changes in LiLA in pregnant women in the working area of the Sikumana Health Center. Before the intervention, the average LiLA of the intervention group (22.2 cm) was lower than that of the control group (27.8 cm), reflecting differences in nutritional status between the two

groups. Most pregnant women in the intervention group had a LiLA below the CED risk limit (< 23.5 cm), so additional intake through PMT was required to improve their nutritional status.

After 50 grams of local food PMT divided into two servings per day for 21 days, the average LiLA of the intervention group increased to 22.5 cm. Although the increase is not very large, this shows the positive impact of the PMT intervention on the nutritional status of pregnant women. On the other hand, the control group actually experienced a decrease in LiLA to 27.7 cm, indicating that without intervention, the nutritional status of pregnant women tended to stagnate or decrease.

The results of the paired sample t-test showed a significant difference in the intervention group (p-value = 0.030), which means that PMT exerts a significant influence on the increase in LiLA. In contrast, the control group showed no meaningful change (p-value = 0.298). Local food PMT given regularly for 21 days is able to increase energy and protein intake, which has an impact on increasing the body mass of pregnant women, including LiLA. LiLA is one of the indicators of nutritional status, where an increase reflects an increase in energy reserves and better nutritional status. This is in line with a study by Asmirati et al. in 2021, which also reported significant differences in LiLA before and after PMT (p < 0.05) (Asmirati et al., 2021).

These findings are also in line with research conducted by Suswati in 2023, which proved that there was an effect of local food PMT on the LiLA of pregnant women with CED in the working area of the Pulokulon II Health Center (p-value = 0.000), with an average LiLA before the intervention of 21.972 cm, increasing to 23.133 cm after the intervention.¹⁶ Similarly, Hermin's research in 2023 showed an increase in the average LiLA from 21.71 cm to 24.10 cm after the administration of Deppamil Dangke in pregnant women with CED (p-value = 0.001) (Hermin, 2023).

The characteristics of the respondents also influenced the results of the study. The majority of respondents were between the ages of 20 and 35 years, which is a mature reproductive age with relatively better nutritional conditions. The level of junior high school/high school/equivalent education among the majority of respondents affects the understanding and application of nutritional information in daily life. The intervention group, dominated by primigravida, had nutritional needs that were more focused on fetal development, so that the PMT administered effectively improved nutritional status as reflected in changes in LiLA (Ministry of Health of the Republic of Indonesia, 2020).

The majority of respondents had moderate levels of physical activity, which is important in maintaining energy balance during pregnancy (Buleleng Regency Research and Development Quality Control Team, 2020). Improved breakfast habits and more regular eating after the intervention, along with controlled physical activity, contributed to the improved nutritional status reflected in LiLA changes (Amiruddin et al., 2023). Macronutrient needs (carbohydrates, proteins, fats) and micronutrient needs (vitamins, minerals) that increase during pregnancy must be met in order to avoid nutritional deficiencies. The PMT program is one of the effective strategies to address the problem of chronic energy deficiency, especially in areas with high levels of malnutrition (Chandradewi, 2015; Pastuty et al., 2018).

The local food used in PMT also supports sustainable food availability and utilizes local resources, thus having a positive impact not only on pregnant women but also on society as a

whole. Thus, local food PMT intervention can be an effective and efficient solution for improving the nutritional status of pregnant women, especially in Kupang City.

CONCLUSION

This study concluded that there was a significant effect of giving 50 g of local food PMT divided into two servings per day for 21 days on changes in upper arm circumference in pregnant women in the working area of the Sikumana Health Center (p -value = 0.030). The average LiLA before intervention in the intervention group of 22.2 cm increased to 22.5 cm after the intervention, while the control group decreased from 27.8 cm to 27.7 cm. The characteristics of the pregnant women, most of whom are 20–35 years old, have a junior high school/high school/equivalent education, and work as housewives, also contribute to the results of this study. For subsequent researchers, it is recommended to involve a larger sample to make the results more representative and to use a more diverse variety of PMT. Primary health facilities are expected to improve nutrition education, promote the use of local food that is affordable and culturally appropriate, and provide sustainable nutrition counseling. Pregnant women are advised to consume food according to their nutritional needs and to consume the PMT given as recommended.

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