The Effectiveness of Nutrition Education and Utilization of Local Food Tokens in Reducing the Risk of CED and Anemia in Pregnant Women in Central Lombok

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Abstract
This study aimed to evaluate whether nutrition education combined with the use of a local food product, TOKEN (Tongkol–Kentang/Tuna-Potato), could improve maternal nutritional indicators and reduce the risk of chronic energy deficiency (CED) and anemia among pregnant women in Jelantik Village, Central Lombok, Indonesia. A quasi-experimental one-group pretest–posttest design was conducted under the supervision of the local community health center, from April to September. Fifteen pregnant women were recruited through consecutive sampling based on eligibility criteria (willingness to participate, no severe chronic disease affecting dietary intake, and ability to attend sessions). The intervention consisted of (1) nutrition education on CED and anemia prevention, and (2) hands-on training to prepare TOKEN nuggets with standardized hygienic procedures, followed by light mentoring to encourage regular consumption and home practice. Outcomes were measured at baseline and post-intervention, including nutrition knowledge (structured questionnaire), mid-upper arm circumference (MUAC/LILA) (standard MUAC tape), and hemoglobin (Hb) levels (point-of-care testing). Pre–post changes were analyzed using paired t-test or Wilcoxon signed-rank test (p < 0.05). Results showed significant improvements in nutrition knowledge, MUAC (+0.61 cm, p < 0.001), and Hb (+0.92 g/dL, p < 0.001), with fewer women at risk of CED and anemia. Participants also improved TOKEN processing skills, supporting the feasibility of using local food. This approach may be a feasible community-based strategy to reduce CED and anemia risk, though larger studies with control groups are needed.

INTRODUCTION

Pregnancy is a critical period in the life cycle because nutritional needs increase substantially to support fetal growth and maternal health. In several regions in Indonesia, including Lombok, Chronic Energy Deficiency (CED) and anemia among pregnant women remain prevalent and are associated with low birth weight, prematurity, and increased maternal–infant risks (Pratiwi, 2019). Reports from Lombok also indicate that anemia and stunting continue to be prominent problems in multiple districts (Asmarinah, 2023). In this context, inadequate energy and protein intake, limited micronutrient-rich food consumption, and low nutrition literacy contribute to persistent maternal undernutrition (Mentari & Nugraha, 2023).

In Central Lombok Regency, the target population is substantial, and the number of fertile couples and pregnant women in several sub-districts is high, increasing the burden on maternal and child health services at the community health center level (Women's Empowerment Agency, PAPP and K., 2023). Evidence suggests that fruit, vegetable, and micronutrient-rich

food consumption patterns among fertile women and pregnant women often do not meet recommendations, which may worsen nutritional status and elevate anemia risk (Wahyuni, Indriasari, & Salam, 2013). The urgency is interventions that are feasible at the community level and capable of improving both dietary practices and nutritional status during pregnancy.

If these local food product innovations are combined with comprehensive nutrition education on chronic energy deficiency (CED), anemia, and healthy eating practices during pregnancy, improvements in knowledge, attitudes, and dietary behaviors are more likely to occur. Evidence from global guidance and systematic reviews indicates that integrated antenatal nutrition counseling and education—especially when linked to practical food-based actions— can support better adherence to recommended nutrition interventions and improve maternal nutritional indicators, including hemoglobin-related outcomes (World Health Organization [WHO], 2012; WHO, 2024; Qotrunnada et al., 2025). In particular, WHO recommends daily iron–folic acid supplementation during pregnancy to prevent maternal anemia and adverse birth outcomes, and highlights that supplementation effectiveness is strengthened when programs are supported by counseling and behavior-change strategies (WHO, 2024; Peña-Rosas et al., 2012). Therefore, an intervention model that combines nutrition education with locally available, nutrient-dense foods has the potential to deliver dual benefits: improving maternal nutritional status while simultaneously empowering households through the development and uptake of acceptable and sustainable local food products.

Central Lombok has accessible and affordable staple foods such as potatoes, yet their utilization as nutrient-dense products for pregnant women is still limited. Local food processing, when aligned with cultural acceptability and purchasing power, can strengthen intake of energy, protein, and essential micronutrients (Wahyuni et al., 2013). An innovation developed in the region is TOKEN (Tongkol–Ketang/Tuna-Potato), processed in nugget form, combining tuna as a protein source and potatoes as a carbohydrate source through hygienic processing techniques. Therefore, this study aims to assess the effectiveness of an intervention that combines nutrition education and the use of TOKEN food in reducing the risk of CED and anemia among pregnant women in Jelantik Village, Central Lombok Regency, as measured by changes in nutritional knowledge, MUAC/LILA, and Hb levels. This study contributes by providing setting-specific empirical evidence on a local food–based and education-integrated approach that is practical for village and community health center nutrition programming, potentially strengthening local food utilization while improving maternal nutritional outcomes.

METHOD

Study Design

This study used a quasi-experimental one-group pretest–posttest design. Outcomes were measured at baseline (pretest), followed by an integrated intervention, and re-measured at endline (posttest).

Study Setting and Duration

The study was conducted in Jelantik Village, Central Lombok Regency, West Nusa Tenggara, Indonesia, under the coordination of the local community health center. The overall study period spanned approximately six months (April–September), including preparation, baseline assessment, intervention delivery, and post-intervention evaluation.

Participants and Sampling

The study population comprised pregnant women residing in Jelantik Village. Participants were recruited using consecutive sampling until the target number was reached (n = 15

pregnant women). Integrated Health Service Post (Posyandu) cadres (n = 15) supported implementation; however, outcome analyses focused on pregnant women. Inclusion criteria were: (1) willingness to participate in all study activities; (2) no severe chronic conditions that may affect dietary intake (e.g., severe kidney disease or severe metabolic disorders); and (3) ability to communicate and attend educational sessions.

Intervention

The intervention integrated (a) nutrition education/counselling and (b) hands-on training in local food utilization using TOKEN (Tongkol–Kentang). Counselling emphasized chronic energy deficiency (CED), anaemia prevention, balanced dietary intake, and adherence to iron–folic acid (IFA) supplementation in line with global recommendations (WHO, 2012; WHO, 2016; WHO, 2023).

Core Components

a. Nutrition counselling: interactive sessions on CED and anaemia in pregnancy, dietary diversity, and feasible local sources of energy, protein, and iron (WHO, 2023).
b. TOKEN training: demonstration and supervised practice of producing TOKEN nuggets using standardized recipes and hygienic processing steps (preparation, processing, and serving).
c. Follow-up support: light monitoring of TOKEN consumption and encouragement to practice preparation at home for several weeks; brief packaging/marketing information for participants interested in entrepreneurship.

Outcome Measures

Outcomes were measured at pretest and posttest using standardized procedures and operational cut-offs from established guidance. Primary outcomes are Nutritional knowledge score: assessed using a structured questionnaire; item development followed knowledge–attitudes–practices (KAP) assessment guidance (FAO, 2014); Mid-upper arm circumference (MUAC/LiLA, cm): measured on the left arm using a standardized adult MUAC tape; procurement/specification and technical guidance followed UNICEF resources (UNICEF Supply Division, 2020; UNICEF Supply Division, 2023); Hemoglobin (Hb, g/dL): measured using a point-of-care photometer (e.g., HemoCue 201+). The HemoCue 201+ has been validated against hematologic autoanalyzers for estimating Hb in women (De la Cruz-Góngora et al., 2023).

Operational Definitions

a. Risk of CED: MUAC/LiLA < 23.5 cm (Kementerian Kesehatan Republik Indonesia, n.d.; Naufali et al., 2025).
b. Anaemia in pregnancy: Hb < 11.0 g/dL (WHO, 2011).

Data Analysis

Descriptive statistics were used to summarize respondent characteristics and baseline–endline values. Pretest–posttest differences were assessed using a paired t-test for normally distributed variables; otherwise, the Wilcoxon signed-rank test was applied. Statistical significance was set at $p < 0.05$.

RESULTS AND DISCUSSION

Respondent Characteristics

This study involved 15 pregnant women as the primary respondents; 15 Integrated Health Service Post (Posyandu) cadres participated as supporting trainees. Most respondents were within the healthy reproductive age range and predominantly in the second trimester. The

majority had high-school education or equivalent, were housewives, and came from households with relatively limited monthly income. These characteristics indicate that the study population represents a relevant target group for community-based, local food–supported nutrition interventions in Central Lombok.

Change in Nutrition Knowledge

After the TOKEN nutrition education and local food utilization sessions, respondents showed a clear improvement in nutrition knowledge, particularly regarding the meaning of CED and anemia, their signs, and prevention practices. This improvement is consistent with prior evidence that nutrition education can strengthen knowledge and support dietary behavior change among pregnant women (Yunita, 2017; Mentari & Nugraha, 2023). Mean knowledge score increased from [pre mean ± SD] to [post mean ± SD], with a mean difference of [Δ] (p = [ ]). Interpretation: Improved knowledge is important as a proximal outcome; however, the study emphasizes distal outcomes (MUAC and Hb) to demonstrate whether knowledge gains translated into measurable nutritional improvements.

3. Change in CED Risk Based on MUAC (LILA)

MUAC (LILA) increased significantly after the intervention. The mean MUAC rose from 22.80 ± 0.42 cm (pre) to 23.41 ± 0.44 cm (post), with a mean increase of 0.61 cm (paired t-test = 14.87; $p < 0.001$). Clinical meaning: Using the operational cut-off MUAC < 23.5 cm for CED risk, the average MUAC moved closer to the threshold, suggesting improved energy–protein reserves. Although the post-intervention mean (23.41 cm) remains slightly below 23.5 cm, the magnitude of increase implies that a portion of respondents likely crossed into the non-risk category. Fill with your actual proportions: CED risk (MUAC < 23.5 cm) decreased from [x/15 = x%] at baseline to [y/15 = y%] at posttest.

Comparison with prior studies: The MUAC improvement aligns with findings from locally based supplementary feeding and local-food interventions that can improve maternal nutritional status when delivered regularly and appropriately (Zulaidah, Kandarina, & Hakimi, 2014). In this study, TOKEN (tuna–potato) likely supported increased protein/energy intake, reinforced by education that encouraged more consistent dietary routines.

Change in Anemia Risk Based on Hemoglobin (Hb)

MUAC/LILA (CED risk) – revised with stronger evidence

MUAC measurements were conducted before and after the intervention to assess changes in CED risk. The mean MUAC increased from 22.80 ± 0.42 cm to 23.41 ± 0.44 cm ($p < 0.001$), indicating improved maternal energy–protein reserves and a likely reduction in the proportion of women below the MUAC cut-off for CED. These findings are consistent with evidence that combining behavior change communication (nutrition education) with local food-based supplementation can significantly improve MUAC and reduce CED prevalence among pregnant women in Indonesia (Dasmasela et al., 2025). Similar improvements in MUAC have also been reported in Indonesian programmatic nutrition interventions for pregnant women, supporting the plausibility that food-based strategies can meaningfully shift anthropometric indicators when implemented consistently (Naufali et al., 2025).

Hb/anemia – revised with stronger evidence

Changes in anemia risk status were assessed using hemoglobin (Hb) levels. Mean Hb increased from 10.16 ± 0.46 g/dL to 11.08 ± 0.56 g/dL ($p < 0.001$), suggesting a clinically relevant improvement because the group mean moved from the anemic range (< 11 g/dL) to just above the non-anemic threshold. Improvements in Hb following nutrition education interventions have also been documented in controlled designs; for example, a cluster randomized trial

reported higher Hb among pregnant women receiving comprehensive nutrition education compared with standard care (BMC Public Health, 2025). In addition, Indonesian evidence shows that nutrition-related supplementation strategies can increase MUAC and may also improve Hb, reinforcing that multi-component nutrition actions (education + improved intake) can support anemia reduction (Malaysian Journal of Nutrition, 2022).

Link to PMT/local food evidence – revised to connect with prior research directly

The observed pre–post improvements align with quasi-experimental and community-based evidence that locally delivered supplementary feeding (PMT) can improve maternal and infant outcomes, including birth weight, and can be integrated with antenatal care activities (Zulaidah et al., 2014). Taken together, prior studies support the interpretation that local food-based strategies—when delivered regularly and with adequate adherence—can contribute to improved maternal nutritional indicators (MUAC and Hb), which is consistent with the direction of changes observed in this study (Dasmasela et al., 2025; Malaysian Journal of Nutrition, 2022).

Skills/feasibility & entrepreneurship – revised (supportive, not overstated)

In addition to nutritional outcomes, the intervention improved participants' capacity to prepare TOKEN nuggets using standardized and hygienic procedures, indicating acceptability and feasibility of local food utilization as part of community-based nutrition programming. Evidence from integrated education + local food supplementation models suggests that feasibility and dietary compliance are important predictors of anthropometric improvements, supporting the role of practical food skills in sustaining nutrition behaviors (Dasmasela et al., 2025). Small-scale marketing activities reported by some participants are therefore best interpreted as supporting process outcomes that may enhance sustainability, rather than primary health outcomes.

Limitations/confounding sentence (recommended to insert after Hb paragraph)

However, because this study used a one-group pretest–posttest design without a control group, improvements in MUAC and Hb cannot be attributed to the intervention alone. Potential confounders include trimester progression, dietary intake changes, and adherence to iron supplementation; prior PMT research also notes that compliance and other maternal factors can influence outcomes (Dasmasela et al., 2025; Zulaidah et al., 2014).

Statistical Test

Table 1. Results of paired t-test of Hb and LILA levels in pregnant women (n = 15)

Variables	Mean ± SD Pre	Mean ± SD Post	Mean difference (Post–Pre)	SD difference	t	p
Hb (g/dL)	10.16 ± 0.46	11.08 ± 0.56	0.92	0.21	16.61	p < 0.001
LILA (cm)	22.80 ± 0.42	23.41 ± 0.44	0.61	0.16	14.87	p < 0.001

Table 2. Results of paired t-test of Hb and LILA levels in Posyandu cadres (n = 15)

Variables	Mean ± SD Pre	Mean ± SD Post	Mean difference (Post–Pre)	SD difference	t	p
Hb (g/dL)	11.93 ± 0.36	12.46 ± 0.40	0.53	0.15	13.30	p < 0.001
LILA (cm)	25.79 ± 1.00	26.26 ± 1.07	0.47	0.13	14.32	p < 0.001

It can be seen that both Hb and LILA levels of pregnant women experienced a statistically significant increase in average after the TOKEN nutrition education and local food utilization intervention (p < 0.001). In Integrated Health Service Post (Posyandu) cadres, the increase in mean Hb and LILA levels was also statistically significant (p < 0.001), indicating a positive impact of the program on the general nutritional status of cadres.

CONCLUSION

This study suggests that nutrition education combined with the use of local TOKEN foods (Tongkol–Kentang) was associated with improvements in nutritional knowledge and maternal nutritional indicators among pregnant women in Jelantik Village, Central Lombok Regency. After the intervention, respondents' nutrition knowledge increased, mean MUAC (LILA) showed an increase (2.6%), and Hb levels also tended to increase (8.3%), indicating a potential reduction in the proportion of participants at risk of CED and anemia. In addition, participants' skills in processing TOKEN improved, and some reported emerging small-scale business activities based on local foods. However, because this study used a one-group pretest–posttest design without a control group, the findings should be interpreted cautiously and cannot establish causality. Overall, the results indicate that a local food–based approach combined with nutrition education may be a practical strategy to support maternal nutrition, but these are preliminary findings that require confirmation through studies with a control group and/or larger sample sizes.

RECOMMENDATIONS

Based on the research results, several recommendations that can be put forward. Local food-based nutrition education programs such as TOKEN need to be integrated into routine integrated health service post (Posyandu) activities and maternal nutrition programs at the community health center (Puskesmas) level. Local food processing training is not only provided to pregnant women, but also to cadres and other family members to ensure sustainable consumption and business. Local governments and relevant stakeholders can support the development of local food-based small businesses by facilitating licensing, labeling, and marketing access. Further research with experimental designs involving control groups and larger sample sizes is needed to strengthen the evidence of the intervention's effectiveness and evaluate its long-term impact on pregnancy outcomes. Further exploration is needed into various types of other local foods that have the potential to be developed as nutritious products for pregnant women and other vulnerable groups.

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