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Family-based Nutritional Assistance to Improve Knowledge, Attitudes, and Nutritional Status of Pregnant Women with Chronic Energy Deficiency in Karangtengah Village

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Background: Chronic Energy Deficiency (CED) among pregnant women remains a major public health concern in Indonesia, as it increases the risk of adverse maternal and neonatal outcomes. Family support plays an important role in improving maternal nutritional practices.

Methods: A quasi-experimental study with a pretest-posttest design was conducted among pregnant women with CED in Karangtengah Village. The intervention included nutrition education, family empowerment, home visits, nutritional monitoring, counseling, and the provision of a supplementary meal guidebook based on locally available foods. Outcomes were assessed through changes in knowledge, attitudes, Mid-Upper Arm Circumference (MUAC), and body weight before and after one month of intervention.

Result: The proportion of participants with good nutritional knowledge increased from 20% to 80%, while positive attitudes toward maternal nutrition increased from 40% to 90%. Mean MUAC improved from 22.40 ± 0.83 cm to 23.05 ± 0.79 cm, and mean body weight increased from 48.20 ± 3.52 kg to 49.35 ± 3.47 kg after one month of assistance. All participants received and utilized the supplementary meal guidebook to support healthy dietary practices during pregnancy.

Conclusion: The family-based nutritional assistance program improved knowledge, attitudes, and nutritional status among pregnant women with CED. The involvement of family members, midwives, and nutrition cadres, combined with practical dietary guidance, supports the feasibility of this community-based approach to improving maternal nutrition during pregnancy.

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INTRODUCTION

Maternal and child health is a key indicator of health development and a crucial target for the program supports the achievement of the Sustainable Development Goals (SDGs), particularly Goal 3, through efforts to improve community health and promote well-being for all. Maternal nutritional status during pregnancy is a key determinant of pregnancy success and the quality of future human resources. Inadequate nutrition during pregnancy can increase the risk of obstetric complications, impaired fetal growth, premature birth, low birth weight (LBW), and stunting (Indarti et al., 2023; WHO Recommendations on Prevention and Treatment of Postpartum Haemorrhage, 2023). CED in pregnant women remains a public health problem in various developing countries, including Indonesia. CED is a condition of prolonged energy and protein deficiency and is operationally identified in Indonesia by measuring a mid-upper arm circumference (MUAC) of less than 23.5 cm. This stipulation impacts the health of both the mother and the fetus by reducing the energy reserves needed during pregnancy. (Rachmi et al., 2024).

Globally, maternal malnutrition contributes to increasing maternal and infant morbidity and mortality. Inadequate maternal nutrition is linked to fetal growth restriction and prematurity, as well as low birth weight (LBW), all of which are significant risk factors for neonatal mortality. Additionally, infants born with low birth weight are at higher risk of developmental disorders, cognitive decline, metabolic diseases, and stunting in childhood (World Health Organization, 2023). Anaemia remains one of the most prevalent nutritional disorders among women of reproductive age worldwide and constitutes a major public health concern during pregnancy. According to the World

Health Organization (WHO), anaemia affects a substantial proportion of pregnant women globally, primarily due to iron deficiency, inadequate dietary intake, recurrent infections, and increased physiological demands during pregnancy. Maternal anaemia is associated with adverse outcomes including maternal morbidity, preterm birth, low birth weight, and impaired fetal growth. Therefore, improving maternal nutritional status through adequate nutrient intake, micronutrient supplementation, and continuous nutritional monitoring is essential to support healthy pregnancy outcomes and reduce the intergenerational cycle of malnutrition (World Health Organization (WHO), 2024)

Low birth weight continues to be a global health challenge. Globally, approximately 15–20% of newborns are born with low birth weight, with the highest burden occurring in low- and middle-income countries (McCormick, 1985). Maternal undernutrition remains one of the major modifiable risk factors contributing to LBW incidence (Blencowe, H. et al., 2019). Infants born weighing less than 2,500 grams are more likely to experience growth and developmental problems, infectious diseases, and long-term metabolic disorders (UNICEF, 2023). In Indonesia, CED remains a challenge in accelerating stunting reduction efforts. Various studies have shown that CED is influenced by multidimensional factors, including maternal characteristics, education, socioeconomic status, food consumption, parity, frequency of antenatal care (ANC) visits, and nutritional knowledge. (Wati et al., 2024) Research in Banyumas Regency found that nutritional knowledge and adequate energy intake are important determinants of the incidence of CED. In Indonesia, maternal CED remains a priority issue in national health programs. Several studies have demonstrated that inadequate energy and protein intake, poor maternal knowledge, and insufficient family support contribute to maternal undernutrition (Irawan et al., 2023; Pratiwi, Y., & Nugroho, 2024)

Apart from individual factors, household characteristics also play a role in determining the nutritional status (Rachmi et al., 2024) reported that family socioeconomic conditions and household characteristics are associated with the incidence of CED in Indonesia. A family's limited ability to provide nutritious food can result in pregnant women not receiving sufficient energy and protein to meet their metabolic needs during pregnancy. Inadequate food consumption is a direct cause of KEK. The results of a systematic review by (Ningtyas, FW, Jamil, AI, & Antika, 2024) Studies show that dietary patterns and family income levels are closely related to the incidence of CED, particularly in coastal and rural areas. Family economic constraints result in low purchasing power for nutritious food, making pregnant women more susceptible to energy and protein deficits.

Cultural factors also influence consumption behavior during pregnancy. Various regions in Indonesia still recognize food taboos for pregnant women, which can reduce dietary diversity and intake of essential nutrients (Angkasa et al., 2024) reported that food taboos and low dietary diversity are associated with an increased prevalence of CED among pregnant women in rural Indonesia. These cultural practices often limit the consumption of animal protein sources and other nutritious foods that are essential during pregnancy. In addition to cultural and economic aspects, a pregnant woman's level of knowledge regarding nutritional needs during pregnancy is also a crucial factor. Lack of knowledge can lead to mothers not understanding the need for additional energy, the importance of consuming protein, iron, folic acid, and dietary variety. (Nainggolan et al., 2024) stated that low nutritional knowledge is related to the increasing incidence of KEK in pregnant women.

The issue of special economic conditions (KE) is becoming increasingly important because it is directly related to the incidence of LBW. It remains a leading cause of neonatal mortality and contributes to the increased risk of stunting. Various studies show that mothers with poor nutritional status are more likely to give birth to babies weighing less than 2,500 grams. Efforts to address CED have largely focused on providing supplementary food and nutritional supplements. However, this approach often faces obstacles in implementation due to maternal compliance, limited access, and lack of family support. Various studies have shown that nutritional behavior changes are more effective when they involve the family as the primary support system for pregnant women.

Families, especially husbands, play a crucial role in making decisions regarding nutritional needs, household budget allocation, access to healthcare services, and mothers' adherence to healthcare provider recommendations. Good family support can increase mothers' motivation to consume nutritious foods, attend antenatal care (ANC) services, and utilize available health programs. The concept of family-based intervention has been widely applied in various public health programs because it is considered capable of producing more sustainable behavior change. Family

involvement has been recognized as an important determinant of maternal health behavior because family members often influence dietary choices, healthcare utilization, and adherence to nutritional recommendations during pregnancy (Tokhi, M. et al., 2018; Yargawa J, 2020). Family involvement in education, monitoring, and mentoring allows for the creation of an environment that supports healthy nutritional practices during pregnancy. This approach is increasingly relevant in rural communities with strong social and cultural family ties.

In addition to family support, mentoring through home visits is also an effective strategy for increasing the success of nutrition interventions. Home visits allow health workers to conduct individual needs assessments, provide counseling tailored to the family's circumstances, and monitor the mother's compliance with nutrition recommendations. Home-based counseling and follow-up visits have been shown to improve maternal nutrition practices by providing individualized support and reinforcing health messages within the household environment (Salam RA, Das JK, Lassi ZS, 2020). Regular mentoring provides an opportunity to identify barriers and explore solutions together with the family. Utilizing local foods is also a crucial component of maternal nutrition interventions. Using readily available, affordable, and local food sources can enhance the program's sustainability. Education on the processing of local foods rich in energy and protein, such as fish, eggs, tempeh, nuts, and green vegetables, can help families meet the nutritional needs of pregnant women without increasing the financial burden.

Assessment of maternal nutritional status is a critical component of antenatal care, particularly in low-resource settings where simple and cost-effective screening tools are required. MUAC has been widely recognized as a practical anthropometric indicator for identifying undernutrition among adults, including pregnant women. Compared with body mass index (BMI), MUAC measurement is easier to perform, requires minimal equipment, and is less affected by gestational age-related physiological changes. Tang et al. (2013) emphasized the importance of establishing standardized MUAC cut-off points for identifying underweight adults globally and highlighted its usefulness as a screening tool in public health and nutrition programs. In Indonesia, MUAC is commonly used to identify pregnant women at risk of CED, enabling early nutritional interventions to prevent adverse maternal and neonatal outcomes (Tang, A. M. et al., 2013).

Based on preliminary assessments and coordination with village midwives and nutrition cadres in Karangtengah Village, several key problems were identified regarding maternal nutrition. Some pregnant women were found to have CED, indicated by a MUAC of less than 23.5 cm. In addition, maternal knowledge regarding nutritional requirements during pregnancy, including energy, protein, iron intake, and the utilization of local nutritious foods, was still limited. Family support in providing nutritious meals and monitoring daily dietary intake was also suboptimal. Furthermore, there was a lack of practical educational materials that could assist pregnant women in planning supplementary meals at home. These conditions may increase the risk of impaired fetal growth and Low Birth Weight (LBW). Therefore, a sustainable family-based nutritional assistance program was needed to improve maternal nutritional status and pregnancy outcomes.

Although numerous studies have demonstrated the importance of maternal nutrition interventions, evidence regarding community-based family-centered nutritional assistance programs among with CED remains limited, particularly in rural Indonesian settings. Therefore, innovative approaches that actively engage families, midwives, and community health cadres are needed to improve maternal nutritional status and support the prevention of low birth weight and stunting (de Onis, M., & Branca, 2016; Prendergast, A. J., & Humphrey, 2014).

Implementation of a family-based mentoring model is expected to increase energy and protein intake, improve the nutritional status, as indicated by increased weight and MUAC, and reduce the risk factors for low birth weight. In addition to providing benefits to both mothers and babies, this model also has the potential to be an alternative community empowerment strategy to support the national program to accelerate stunting reduction. Based on the description, this study aims to analyze the effectiveness of the Family-Based Nutritional Assistance Model on changes in the nutritional status of pregnant women with CED and on reducing risk factors for LBW babies.

METHOD

A community service activity was conducted on May 21, 2026, in Karangtengah Village, primarily targeting pregnant women experiencing CED. This activity involved various parties, including lecturers and students from the Midwifery Study Program, village midwives, and nutrition cadres as partners in the program's implementation. The primary beneficiaries of the program were the 10 pregnant women with CED, while the village midwife and nutrition cadres participated as local facilitators and partners in monitoring and follow-up activities. Program effectiveness was assessed through a pre-post evaluation design, comparing knowledge, attitudes, MUAC, and body weight before and after one month of family-based nutritional assistance. Statistical analysis was performed using a paired t-test or Wilcoxon signed-rank test, depending on data distribution, with a significance level of $p < 0.05$.

The method used in this community service activity is a family-based participatory approach (family-based nutritional assistance), a mentoring model involving pregnant women, families, midwives, and nutrition cadres in efforts to improve nutritional status during pregnancy. The activity is implemented through several stages: preparation, intervention implementation, and evaluation.

1. Preparation Stage

The preparation phase began with coordination with the village government, village midwives, and nutrition cadres to determine activity targets and develop an implementation plan. Next, pregnant women at risk of developing CED were identified based on maternal health monitoring data held by midwives and health cadres. Additionally, the community service team prepared educational materials in the form of leaflets, simple modules, and tools for anthropometric measurements.

2. Implementation Stage

The activity began with participant registration and assessment of the nutritional status of pregnant women, including mid-upper arm circumference (MUAC) and weight measurements as baseline data. This was followed by health education on the importance of adequate nutrition during pregnancy, the impact of CED on maternal and fetal health, and the risks of low birth weight (LBW) and stunting.

The educational method was interactive, using lectures, discussions, and Q&A sessions to help participants better understand the material. Furthermore, demonstrations were provided on how to create a healthy menu using readily available local ingredients high in energy and protein.

As part of the family-based mentoring model, midwives and nutrition cadres provide counseling to pregnant women on diet, meal frequency, and the importance of family support in meeting nutritional needs during pregnancy. Nutrition cadres are also encouraged to provide follow-up monitoring and mentoring through integrated health posts (Posyandu) and home visits, in accordance with the village health program.

3. Evaluation Stage

To evaluate the effectiveness of the family-based nutritional assistance program, a pre-test and post-test questionnaire was administered to all pregnant women with Chronic Energy Deficiency (CED) before and after the intervention. Furthermore, a process evaluation was conducted through participatory observation of participants during the activity and feedback discussions with midwives and nutrition cadres.

Through this participatory and family-based approach, it is hoped that the community service program can become a promotive and preventive strategy in improving the nutritional status of pregnant women with special needs (KE) and supporting efforts to LBW and stunting in Karangtengah Village.

RESULTS AND DISCUSSION

1. Result

A Community Service activity with the theme "Family-Based Nutritional Assistance Model for Improving Nutritional Status among Pregnant Women with Chronic Energy Deficiency and Reducing the Risk of Low Birth Weight" was held on May 21, 2026, in Karangtengah Village. This activity involved lecturers, students, village midwives, nutrition cadres, and pregnant women with CED as the main targets of the program.

Activity documentation has also been included to provide visual evidence of the implementation process of the family-based nutritional assistance program. The documentation covers key activities, including nutrition education sessions, family counseling, and the distribution of the supplementary meal guidebook.

Figure 1. Nutrition Education Guidebook Containing Daily Menu Recommendations



Figure 2. Distribution and Use of Multiple Micronutrient Supplements (MMS) as Part of the Nutritional Intervention



The program began with participant registration, assessment of the nutritional status, completion of a knowledge and attitude pretest, delivery of educational materials, demonstration of locally-based supplementary food menus, interactive discussions, and distribution of a 2-month Supplemental Food Menu Book for Pregnant Women with Special Needs (KE) as a guide to fulfilling nutritional needs at home. Midwives and nutrition cadres also provided support to monitor the implementation of the provided menus.

a. Respondent Characteristics

Table 1. Respondent characteristics

Variables	n	%
Age (years)		
20-25	3	30

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1. Pre-post change graph.

2. Activity documentation with scientific captions.

Variables	n	%
26-30	5	50
31-35	2	20
GPA	4	40
G1P0A0	6	60
G2P1A0		
Gestational Age		
Trimester 1	5	50
Trimester2	4	40
44 trimester 3	1	10
Education		
Elementary	2	20
Junior High	5	50
High School/ Vocational	3	30
School		
Work		
Housewife	8	80
Laborer	1	10
Trader	1	10

38 Based on Table 1, the majority of pregnant women with KEK were in the 26–30 age group, namely 5 people (50%), the 20–25 age group with 3 people (30%), and the 31–35 age group with 2 people (20%). Based on obstetric status, the majority of respondents were G2P1A0 with 6 people (60%), while 4 people were G1P0A0 (40%).

Based on gestational age, the majority of respondents were in the trimester 1 (50%), followed by the trimester 2 (40%), and trimester 3 (10%). This indicates that most pregnant women are still in the early stages of pregnancy, so nutritional interventions are expected to provide optimal benefits for fetal growth and development.

Based on education level, the majority had a junior high school education (50%), followed by a high school/vocational school education (30%), and an elementary school education (20%). Meanwhile, based on occupation, the majority of pregnant women were housewives (80%), while one each (10%) worked as a laborer and a trader.

These characteristics indicate that the target of the activity is dominated by pregnant women with a lower to middle socioeconomic background, so that family-based nutritional assistance programs and the use of local food are appropriate strategies to improve the nutritional status of pregnant women and support the prevention of LBW Babies.

b. Evaluation of knowledge and attitudes

The evaluation was conducted using pretest and posttest methods to determine changes in the knowledge and attitudes of pregnant women regarding nutritional fulfillment during pregnancy.

Table 2. Changes in the Knowledge Level of Pregnant Women with KEK

Knowledge	Pretest		Posttest	
	Amount (f)	Percentage (%)	Amount (f)	Percentage (%)
Good	2	20	8	80
Enough	5	50	2	20
Not enough	3	30	0	0
Amount	10	100	10	100

Table 3. Average Knowledge Level of Pregnant Women with KEK Before and After Mentoring

Variables	Before (Mean ± SD)	After (Mean ± SD)	Difference	% Change	p-value
Knowledge	56.0 ± 12.4	82.0 ± 8.5	+26.0	46.4%	<0.0001**

Description: Paired t-test, $p < 0.05$.

The results showed a significant improvement in participants' knowledge regarding nutritional fulfillment during pregnancy following the family-based nutritional assistance program. The mean knowledge score increased from 56.0 ± 12.4 before the intervention to 82.0 ± 8.5 after the intervention, representing a 46.4% increase ($p < 0.001$). This finding indicates that the nutrition education and mentoring activities effectively enhanced participants' understanding of balanced nutrition, energy and protein requirements, and appropriate dietary practices during pregnancy.

Table 4. Changes in Pregnant Women's Attitudes towards Nutritional Fulfillment

Attitude	Pretest		Posttest	
	Amount (f)	Percentage (%)	Amount (f)	Percentage (%)
Good	4	40	9	90
Enough	4	40	1	10
Not enough	2	20	0	0
Amount	10	100	10	100

Table 5. Average Attitude Level of Pregnant Women with KEK Before and After Mentoring

Variables	Before (Mean ± SD)	After (Mean ± SD)	Difference	% Change	p-value
Attitude	62.5 ± 10.2	85.3 ± 7.1	+22.8	36.5%	<0.0001**

Description: Paired t-test, $p < 0.05$.

Participants' attitudes toward nutritional fulfillment during pregnancy also improved significantly. The mean attitude score increased from 62.5 ± 10.2 at baseline to 85.3 ± 7.1 after the intervention, corresponding to a 36.5% increase ($p < 0.001$). The improvement in attitude suggests that the program successfully strengthened participants' awareness, motivation, and commitment to adopting healthier eating behaviors during pregnancy.

Overall, the significant increases in both knowledge and attitude scores demonstrate the effectiveness of the Family-Based Nutritional Assistance Model in promoting positive behavioral changes related to maternal nutrition. The involvement of family members, combined with continuous mentoring by midwives and nutrition cadres, likely contributed to reinforcing nutritional messages and supporting the implementation of recommended dietary practices among pregnant women with Chronic Energy Deficiency (CED).

. As a follow-up activity, all pregnant women with special needs (KE) received a Supplementary Food Menu Book for two months, which contains:

- 1) Daily menu high in energy and protein.
- 2) Utilization of local food.
- 3) Schedule for consuming additional food.
- 4) Consumption monitoring sheet.
- 5) Weight and LILA records.
- 6) Brief education on preventing LBW and stunting.

Figure 1. Pocket Book for Pregnant Women with KEK



The book serves as a platform for mentoring village midwives and nutrition cadres during community monitoring. Village midwives and nutrition cadres play a crucial role in the program's sustainability. They provide ongoing education and motivate pregnant women to implement the developed menus. Furthermore, nutrition cadres assist with monitoring through integrated health posts (Posyandu) and home visits.

Nutritional status evaluations were conducted on 10 pregnant women by measuring MUAC and BW before and one month after the intervention. The mentoring program included nutrition education, demonstrations of supplementary food menus, family counseling, and the provision of a Supplementary Food Menu Book for two months as a guide to daily consumption.

Table 6. Average LILA of Pregnant Women with KEK Before and After Mentoring

Variables	Before (Mean ± SD)	After (Mean ± SD)	Difference	p-value
LILA (cm)	22.40 ± 0.72	23.05 ± 0.68	+0.65 cm	0.002*

Description: Paired t-test, p<0.05.

Table 7. Average Body Weight of Pregnant Women with KEK Before and After Mentoring

Variables	Before (Mean ± SD)	After (Mean ± SD)	Difference	p-value
Body weight (kg)	48.20 ± 4.35	49.35 ± 4.28	+1.15 kg	0.001*

Description: Paired t-test, p<0.05.

Measurement results showed that the average weight of pregnant women increased from 48.20 ± 4.35 kg to 49.35 ± 4.28 kg after mentoring. The average weight gain was 1.15 kg, and statistical tests showed a significant difference (p=0.001).

Figure 2. Changes in Knowledge, Attitudes, MUAC, and Body Weight Before and After Family-Based Nutritional Assistance Among Pregnant Women with Chronic Energy Deficiency (n = 10)

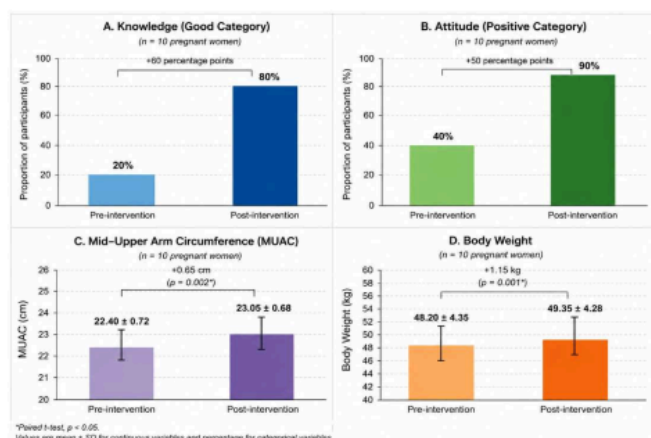


Figure 2 illustrates the changes in knowledge, attitudes, and nutritional status indicators among 10 women CED before and after participation in the family-based nutritional assistance program. The evaluation was conducted over a one-month intervention period using both categorical indicators (knowledge and attitudes) and anthropometric measurements (MUAC and body weight). The figure provides a visual representation of the observed improvements following the intervention and serves as supporting evidence of the program's effectiveness in enhancing maternal nutritional outcomes.

2. Discussion

The results of community service activities indicate that the Family-Based Nutritional Assistance Model is able to improve the knowledge, attitudes, and nutritional status after one month of assistance. This improvement is indicated by an increase in the proportion of good knowledge from 20% to 80%, positive attitudes from 40% to 90%, average MULA from 22.40 cm to 23.05 cm, and average body weight from 48.20 kg to 49.35 kg. These results indicate that interventions that combine nutrition education, family involvement, cadre assistance, and the provision of supplementary food menu books can positively affect changes in behavior and nutrition. The increase in knowledge in this activity is in line with the results of the scoping review conducted by (Septrierly et al., 2025) which states that structured and repeated nutrition education is a key factor in the success of interventions for CED. Education that incorporates behavioral and social aspects is considered more effective than one-way counseling because it can improve understanding and daily nutrition practices.

The changes in attitudes that occurred after the intervention also showed that a family-based approach can motivate pregnant women to adopt healthier eating patterns. These results are consistent with studies (Rahmawati, D., Nurhayati, S., & Putri, 2025) which states that maternal knowledge, consumption patterns, and husband or family support are important determinants in preventing CED in pregnant women. Family involvement can strengthen maternal compliance with health worker recommendations and increase the success of community nutrition programs.

Adequate nutrition is a fundamental determinant of maternal and fetal health. Pregnancy increases physiological demands for energy, protein, and micronutrients to support fetal growth, placental development, maternal tissue expansion, and metabolic adaptation. Women experiencing CED are particularly vulnerable to adverse pregnancy outcomes because prolonged inadequate dietary intake may impair fetal growth and increase the risk of maternal complications, preterm birth, and LBW infants (World Health Organization (WHO), 2023).

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1. Implications
2. Research Contribution
3. Limitations
4. Suggestions

The improvement in maternal nutritional status observed in this program, particularly the increase in body weight and MUAC, is consistent with evidence showing that adequate maternal nutrition during pregnancy contributes to better maternal and fetal health outcomes. (Black RE; Caesar GV; Susan PW; Zulfiqar AB; Parul C and others, 2013) reported that maternal undernutrition remains a major determinant of adverse pregnancy outcomes and child growth failure, especially in low- and middle-income countries. Furthermore, (Christian, P., & Stewart, 2010) emphasized that maternal micronutrient adequacy during pregnancy plays a crucial role in supporting fetal growth and reducing the risk of poor birth outcomes.

The findings of the present community service program demonstrated significant improvements in knowledge, attitudes, body weight, and MUAC among pregnant women following one month of family-based nutritional assistance. These findings suggest that nutrition education combined with continuous mentoring can effectively improve maternal awareness and promote healthier dietary behaviors. Nutrition counseling has been recognized as a key intervention for improving maternal dietary practices and increasing adherence to recommended nutritional intake during pregnancy (World Health Organization (WHO), 2023).

Energy and protein intake are particularly important for pregnant women with CED. Adequate protein consumption is essential for fetal tissue formation, placental growth, amniotic fluid production, and maternal tissue development. The WHO recommends increasing energy and protein intake among nutritionally vulnerable pregnant women to support healthy fetal growth and reduce the risk of LBW (World Health Organization (WHO), 2020). During this program, participants received a supplementary meal guidebook listing locally available foods such as eggs, fish, poultry, tempeh, tofu, and legumes. The use of locally accessible foods is important because affordability and accessibility are major determinants of dietary compliance among pregnant women in rural communities (Food and Agriculture Organization of the United Nations (FAO) et al., 2023).

Micronutrient intake is equally important during pregnancy. Iron deficiency remains one of the most common nutritional problems among pregnant women worldwide and contributes substantially to maternal anemia. Iron supplementation during pregnancy has been shown to reduce the risk of maternal anemia, low birth weight, and preterm delivery (World Health Organization (WHO), 2024). In addition, folic acid plays a critical role in neural tube development, calcium supports fetal skeletal growth, zinc contributes to cellular development and immune function, and iodine is essential for fetal neurodevelopment. The United Nations Children's Fund (UNICEF) reported that inadequate intake of these micronutrients continues to be a major contributor to poor maternal and neonatal outcomes in low- and middle-income countries (United Nations Children's Fund (UNICEF), 2023).

The provision of nutritional education combined with recommendations regarding MMS may have contributed to improvements in maternal nutritional indicators. Previous studies have shown that MMS during pregnancy can improve maternal micronutrient status and support healthy fetal development compared with iron-folic acid supplementation alone (Keats, E. C. & Haider, B. A., Tam, E., Bhutta, 2019). Similarly, (Smith, E. R. et al., 2017) found that MMS was associated with reductions in adverse birth outcomes and may provide additional benefits among nutritionally vulnerable populations.

The mentoring program also utilizes local foods such as eggs, fish, tempeh, nuts, and green vegetables. This strategy is important because the success of nutrition interventions is determined not only by the quantity of food consumed but also by the diversity of food types consumed. A meta-analysis conducted by (Tareke et al., 2024) showed that diversity of food consumption during pregnancy is associated with better pregnancy outcomes, including a reduced risk of LBW and fetal growth disorders. This activity also integrates the roles of midwives and nutrition cadres in the mentoring process. Midwives play a role in educating and monitoring the health status of pregnant women, while nutrition cadres support the program's sustainability through community-level monitoring. This collaboration aligns with the concept of community empowerment, which positions cadres as agents of health behavior change at the village level.

An average increase in the MUAC of 0.65 cm after one month of support indicates improved energy reserves in pregnant women. The MUAC is a widely used indicator to detect the risk of CED and is closely related to maternal nutritional status during pregnancy. Research (Rachmi et al., 2024) found that maternal and household characteristics influence the incidence of KEK, so that

interventions targeting families have the potential to improve the nutritional status of pregnant women more sustainably. In addition to improving MUAC, this activity also resulted in an average weight gain of 1.15 kg after one month of intervention. Weight gain during pregnancy is an important indicator of adequate energy and protein intake. These results support research (Wati et al., 2024).

The significant increase in MUAC observed after the intervention indicates an improvement in maternal nutritional reserves. MUAC is widely recognized as a practical and reliable indicator for assessing maternal undernutrition during pregnancy (Ververs, M., Antierens, A., Sackl, A., Staderini, N., & Captier, 2013). Improvements in MUAC may reflect better dietary intake and nutritional practices following participation in nutrition-focused interventions. This finding supports previous evidence suggesting that nutritional support during pregnancy can improve maternal anthropometric status (Mridha, M. K. et al., 2016).

Providing a two-month Supplemental Food Menu Book is one innovation within this program. The book contains a daily menu guide high in energy and protein based on local foods, a consumption monitoring sheet, and simple education on preventing CED and LBW. This approach supports the results of a systematic review by (Ningtyias, FW, Jamil, AI, & Antika, 2024) which states that food consumption and family income levels are direct and indirect factors influencing the incidence of CED in pregnant women. Providing practical menu guides can help families utilize affordable local food sources to meet the nutritional needs of pregnant women.

Although improvements in knowledge and attitudes were observed, these changes were not statistically significant. This suggests that while health education may enhance awareness, short-term behavioral changes may not always be immediately reflected in measurable outcomes. Similar findings have been reported in community-based nutrition programs where improvements in nutritional status were more evident than changes in knowledge scores, particularly when sample sizes were limited and intervention periods were relatively short (Stephenson, J., Heslehurst et al., 2018).

This mentoring program also involves midwives and nutrition cadres as the spearheads of community health services. The involvement of local health workers provides the benefit of ongoing monitoring after the program concludes. This model aligns with a community empowerment approach that positions cadres as agents of change in family health behaviors. The findings in this activity also support research (Hutapea et al., 2025). This indicates that maternal nutritional knowledge is the most dominant variable influencing the incidence of CED in pregnant women. Therefore, increasing knowledge through education and mentoring is a strategic step in preventing nutritional problems during pregnancy. Another aspect that supports the program's success is the involvement of families in the mentoring process. (Sumbolon et al., 2024) Research shows that the interaction between adequate protein intake and family support influences the risk of CED. The better the family support for meeting nutritional needs, the lower the risk of mothers experiencing chronic energy deficiency.

Family involvement constituted a critical component of the intervention model. Previous evidence has shown that family support significantly influences maternal dietary behavior, compliance with nutritional recommendations, and healthcare utilization during pregnancy (Nguyen et al., 2021). In many households, decisions regarding food purchasing, meal preparation, and healthcare expenditures are influenced by family members, particularly husbands. By involving family members in educational activities and nutritional counseling sessions, the program strengthened social support mechanisms and promoted shared responsibility for maternal health. This finding aligns with recommendations (18) UNICEF and WHO emphasizing family-centered approaches in maternal nutrition programs (United Nations Children's Fund (UNICEF), 2023; World Health Organization (WHO), 2023). Family involvement remains an important factor in supporting maternal nutritional practices during pregnancy. Studies have demonstrated that family and partner support can improve adherence to antenatal care recommendations, dietary practices, and supplement consumption (Yargawa, J., & Leonardi-Bee, 2015). Therefore, involving family members in future nutrition education activities may enhance the sustainability of behavioral changes among pregnant women.

The results of this community service are relevant to efforts to prevent low birth weight (LBW). Various studies have shown that maternal nutritional status is a significant factor in determining a

baby's birth weight. Umbrella review by (Arabzadeh et al., 2024) concluded that maternal malnutrition, low maternal weight, and nutritional status during pregnancy are the main determinants of LBW. Therefore, the improvement in maternal height and weight achieved through this mentoring program is expected to contribute to reducing the risk of LBW. In addition to dietary diversity, adequate energy and macronutrient intake are important factors in improving the nutritional status of pregnant women. The results of a systematic review and meta-analysis by (Khammarnia et al., 2024) explained that adequate energy and protein intake during pregnancy is associated with optimal fetal growth and a reduced risk of pregnancy complications. Therefore, support that encourages pregnant women to increase their energy and protein intake is highly relevant in preventing CED and low birth weight (LBW).

Globally, approximately 15–20% of newborns are born with LBW, and maternal undernutrition remains a major contributing factor (United Nations Children's Fund (UNICEF), 2024). Infants born with LBW face increased risks of neonatal mortality, impaired cognitive development, growth failure, and chronic diseases later in life. Consequently, interventions targeting maternal nutrition during pregnancy represent a critical strategy for improving birth outcomes and supporting long-term child health.

From a public health perspective, the results of this activity have important implications for efforts to prevent low birth weight (LBW) and stunting. Maternal nutritional status during pregnancy is a major determinant of birth weight. By improving maternal MUAC and weight gain after the intervention, it is estimated that LBW risk factors can be reduced. This supports recommendations from various international studies that maternal nutrition interventions should begin during pregnancy through a comprehensive, family-based approach.

However, this activity has limitations, including a relatively small number of participants and a one-month evaluation period. Therefore, long-term support, including delivery, is needed to determine the intervention's impact on pregnancy outcomes, particularly low birth weight (LBW) and newborn nutritional status. Overall, the Family-Based Nutritional Assistance Model integrating nutrition education, family empowerment, involvement of midwives and nutrition cadres, utilization of local foods, and provision of a two-month supplementary meal guidebook proved effective in improving the knowledge, attitudes, and nutritional status of pregnant women with CED. This model has the potential to become a sustainable community-based strategy for reducing CED, LBW, and stunting in Indonesia.

Implication

The findings suggest that family-based nutritional assistance can improve the nutritional status of pregnant women, as evidenced by significant increases in MUAC and body weight after the intervention. These results highlight the importance of involving family members in maternal nutrition programs, as family support may facilitate adherence to dietary recommendations and nutritional supplementation. The intervention model has the potential to be integrated into community-based maternal health programs to support efforts in improving maternal nutritional status during pregnancy. Although birth outcomes were not measured directly in this program, improvements in maternal nutritional status are considered important predictors of healthier pregnancy outcomes. Maternal undernutrition has been consistently associated with low birth weight and increased risk of childhood stunting (Victora, C. G. et al., 2008). Therefore, interventions that improve maternal nutritional status during pregnancy may contribute indirectly to broader efforts aimed at preventing low birth weight and stunting in future generations (de Onis, M., & Branca, 2016).

Research Contribution

This community service program contributes practical evidence regarding the implementation of a family-based nutritional assistance approach for pregnant women with CED at the community level. The program demonstrates that combining nutrition education, family involvement, dietary guidance, and Multiple Micronutrient Supplementation (MMS) can lead to measurable improvements in maternal nutritional indicators. These findings may serve as a reference for health workers and policymakers in developing nutrition interventions targeting vulnerable pregnant women.

Limitations

Several limitations should be considered when interpreting the findings. First, the program involved a relatively small number of participants ($n = 10$), which may limit the generalizability of the results. Second, the intervention period was relatively short, lasting only one month, and therefore may not fully capture long-term changes in nutritional status. Third, the study did not assess pregnancy outcomes such as birth weight, gestational age at delivery, or neonatal health indicators. In addition, improvements in knowledge and attitudes were measured descriptively and were not analyzed as direct determinants of the observed anthropometric changes.

Suggestions

Future programs should involve a larger number of participants and longer follow-up periods to evaluate the sustainability of nutritional improvements. Further studies are also recommended to assess the impact of family-based nutritional assistance on maternal and neonatal outcomes, including birth weight and pregnancy complications. Strengthening collaboration between healthcare providers, community health workers, and family members may further enhance the effectiveness and scalability of nutrition interventions for pregnant women with CED.

CONCLUSION

The Family-Based Nutritional Assistance Model effectively improved knowledge, attitudes, MUAC, and body weight among pregnant women with Chronic Energy Deficiency in Karangtengah Village. The intervention achieved these outcomes through nutrition education, family involvement, continuous mentoring, and the use of a supplementary meal guidebook based on local foods. This model has the potential to be implemented as a community-based strategy to strengthen maternal nutrition programs. Future studies with larger sample sizes and longer follow-up periods are needed to evaluate its impact on pregnancy and neonatal outcomes.

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AUTHOR CONTRIBUTION STATEMENT

HK is designing the creation of PkM proposals, presentation of proposals by the PkM Coordination Team and students regarding planning activities, coordination with the Head of the Health Center, KIA Puskesmas regarding PkM activities, coordinating the implementation of PkM activities, compiling PkM activity books, delivering PkM activity materials, and making reports. RA and FZ play the role of Compiling PkM activity books, delivering PkM activity materials, implementing PkM activities, and publishing activities in the PkM Journal. RH Compiling PkM activity books, helping prepare for the implementation of activities at the location, making and analyzing pre- and post-knowledge tests for pregnant women, implementing PkM activities, making PkM activity publication videos, and completing SPJ and PkM financial reports.

AI Disclosure Statement

The authors used OpenAI's ChatGPT as an AI-assisted writing tool to support language refinement, text organization, and manuscript editing. The AI system was not used to generate research data, perform statistical analyses, interpret results, or draw scientific conclusions. All AI-assisted outputs were critically reviewed, revised, and validated by the authors. The authors assume full responsibility for the accuracy, originality, and integrity of the manuscript.

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CONFLICTS OF INTEREST

The authors declare²³ that there are no conflicts of interest regarding the publication of this article. The authors have no competing financial, professional, or personal interests that could have influenced the work reported in this manuscript.

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