KESANS: International Journal of Health and Science
2808-7178 / 2808-7380
http://kesans.rifainstitute.com/index.php/kesans/index

Nutritional Interventions and Health Education in the Prevention of Chronic Energy Deficiency in Pregnant Women: Scoping Review

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Article Information
Submitted: **27 June 2025**
Accepted: **04 July 2025**
Publish: **22 July 2025**

Keyword: *CED; Pregnant Women; Nutrition Intervention; Health Education;*

Abstract
Introduction: *Chronic Energy Deficiency (CED) among pregnant women is a persistent public health challenge with far-reaching implications for maternal and fetal outcomes. Nutritional interventions without concurrent health education are often inadequate.* ***Objective****: This review aims to examine the effectiveness of nutritional and health education strategies in the prevention of CED in pregnant women.* ***Methods:*** *Scoping review was conducted by selecting 10 peer-reviewed articles published between 2018 and 2024, identified through systematic searches in PubMed, Scopus, ScienceDirect, and Google Scholar using predetermined keywords and Boolean operators.* ***Results and Discussion:*** *The review found that integrated interventions—comprising nutrition education, health professional training, and supplementary feeding—significantly reduce CED prevalence. These interventions were most effective when sustained over time, incorporated family, and community engagement, and were embedded within primary healthcare systems.* ***Conclusion:*** *A multidimensional and context-specific approach that blends nutrition and education is vital for the effective prevention of CED in pregnant women. Strengthening policy frameworks and ensuring program sustainability are key to achieving long-term improvements in maternal health.*

How to Cite **Wiwie Putri Adila, Sari Surahmi M/Nutritional Interventions and Health Education in the Prevention of Chronic Energy Deficiency in Pregnant Women: Scoping Review, Vol. 4, No. 10, 2025**
DOI https://doi.org/10.54543/kesans.v4i10.397
e-ISSN/p-ISSN **2808-7178 / 2808-7380**
Published by **CV Rifainstitut/KESANS: International Journal of Health and Science**

Introduction

Pregnancy represents a critical phase in a woman's life, marked by significant physiological changes that elevate nutritional and energy demands. Adequate nutritional intake is fundamental for supporting fetal development, preventing obstetric complications, and ensuring maternal well-being throughout gestation and postpartum. A pregnant woman's nutritional status serves as a vital indicator not only of her health but also of the future well-being of her child, affecting generational health and societal productivity (Kumari, 2023; Brink et al., 2022)

Chronic Energy Deficiency (CED) continues to be a major public health issue in many low- and middle-income countries, including Indonesia. CED refers to long-term deficiencies in energy and protein intake, which may result from the imbalance between increased nutritional demands during pregnancy and insufficient dietary consumption. Anthropometric indicators such as Mid-Upper Arm Circumference (MUAC) and Body Mass Index (BMI) are commonly used to assess CED. The condition contributes to adverse maternal and neonatal outcomes, both directly and indirectly (Miele et al., 2021).

CED increases maternal risks of anemia, preterm birth, delayed uterine involution, and maternal mortality. Moreover, fetuses of mothers with CED are at heightened risk of low birth weight (LBW), intrauterine growth restriction, and suboptimal development of critical organs. Emerging evidence highlights the role of fetal programming in these outcomes, wherein intrauterine nutritional deficits may permanently alter metabolic processes, elevating the risk for chronic non-communicable diseases such as hypertension, coronary artery disease, and type 2 diabetes mellitus later in life (Wrottesley, Lamper, & Pisa, 2015).

In Indonesia, the 2018 Basic Health Research (Riskesdas) reported that 17.3% of pregnant women suffer from CED. This prevalence is notably higher among populations with limited socioeconomic resources, restricted healthcare access, and low education levels. Globally, 10% to 20% of women of reproductive age in developing countries are similarly affected, making CED a significant barrier to reducing maternal and infant mortality and achieving the Sustainable Development Goals (SDGs) related to maternal and child health(Kumari, 2023; WHO, 2022).

Efforts to address CED have included a range of interventions such as food supplementation programs, micronutrient supplementation (e.g., iron and folic acid), routine antenatal care (ANC), and community outreach through health volunteers. Nonetheless, studies consistently show that nutritional support alone does not yield sustainable improvements unless complemented by continuous health education. Education is key to empowering pregnant women with the knowledge and behavioral change required to improve dietary practices, comply with medical guidance, and attend regular ANC visits (Razzazi, Griffiths, & Alimoradi, 2024).

The integration of nutrition and health education creates a synergistic effect in preventing CED. Educational interventions have demonstrated increased adherence to supplementation regimens, enhanced understanding of pregnancy-related nutritional needs, and mobilized familial and community support. These outcomes are in line with policy directions at both national and international levels, promoting community-based nutrition programs, primary healthcare strengthening, and culturally adaptive maternal health education (Brink et al., 2022)

Given the urgent need and multifactorial nature of CED, this literature review evaluates the effectiveness of combined nutritional and health education interventions. The review aims to provide evidence-based recommendations to inform future programmatic and policy strategies focused on maternal nutrition.

Method

This study utilized a scoping review approach to comprehensively map the existing literature on nutritional and health education interventions for the prevention of Chronic Energy Deficiency (CED) in pregnant women. Literature searches were conducted through four major databases—PubMed, Scopus, ScienceDirect, and Google Scholar—focusing on reputable publications in the field of global maternal health. The search strategy used combinations of keywords such as "maternal nutrition intervention," "health education," "chronic energy deficiency," and "pregnancy," utilizing Boolean operators (AND/OR) to retrieve relevant articles.

Inclusion criteria encompassed scientific articles published between 2018 and 2024 that addressed nutritional and/or health education interventions among pregnant women with a focus on preventing or reducing CED. Selected studies were empirical in nature, including randomized controlled trials, quasi-experimental designs, cohort studies, cross-sectional studies, and case studies. Articles had to be available in full text and written in either English or Indonesian. Studies that did not meet these criteria—such as non-systematic reviews, editorials, opinion pieces, unpublished reports, or abstracts only—were excluded from analysis.

Article selection proceeded through several stages: (1) identification of titles and abstracts, (2) screening based on inclusion and exclusion criteria, (3) quality appraisal of methodology and topic relevance, and (4) extraction of key data including intervention type, target population, study design, primary outcomes, and conclusions. A thematic and descriptive analysis was carried out to classify findings into four key themes: (1) forms of nutritional interventions, such as micronutrient supplementation, food provision, and dietary education; (2) health education strategies, including individual counseling, group education, and community or media-based approaches; (3) intervention effectiveness assessed through indicators such as maternal weight gain, Mid-Upper Arm Circumference (MUAC), and knowledge and dietary behavior; and (4) facilitating and hindering factors in intervention implementation across social and healthcare contexts.

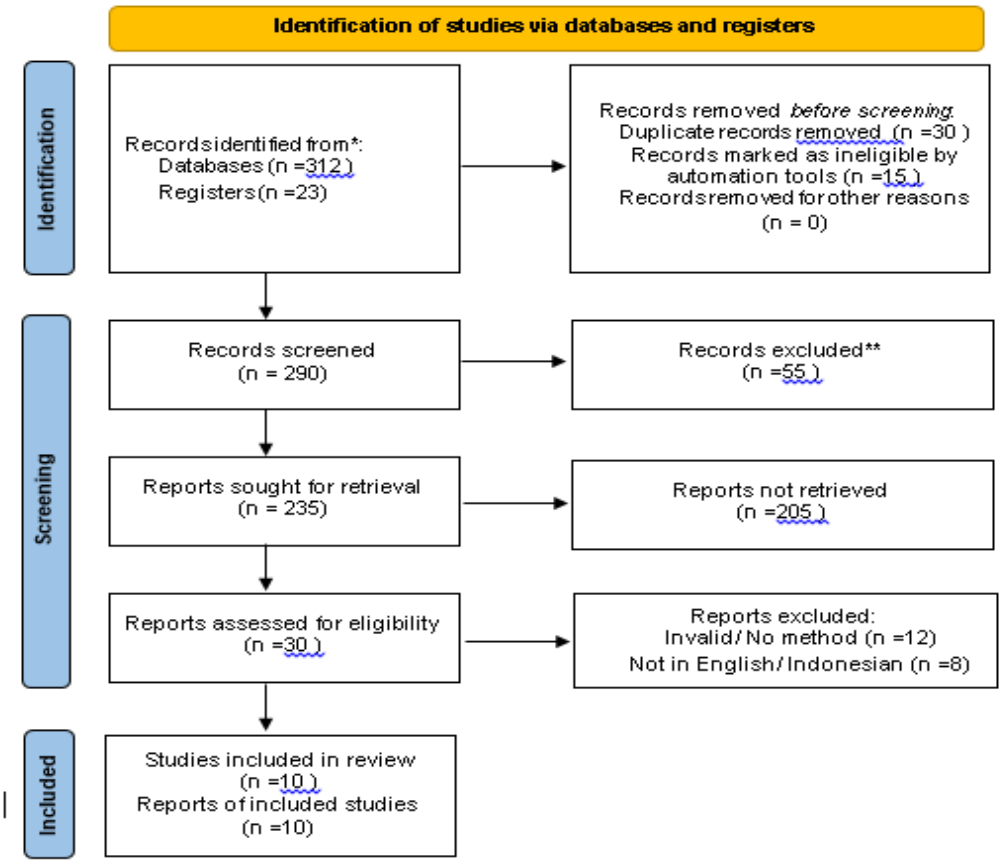

Diagram 1. Prisma Flow Diagram

Result and Discussion

1. Result

Tabel 1
Studies in Literature Review

No	Title & Authors	Objective	Method	Results & Conclusion
1	Training on Early Detection of Chronic Energy Deficiency in Pregnancy Saftarina, F. et al. (2024)	To train healthcare workers in early detection of CED and provide nutrition education to pregnant women	Health worker training, expert system-based education	91.1% of participants improved their understanding; early detection and education skills increased. Training effectively enhanced healthcare workers' capacity in preventing CED.
2	Nutrition Awareness Movement: Preventing CED in First Trimester Pregnant Women in Tundung Hamlet, Mantang Village, Central Lombok Ningsih, N. F. et al. (2025)	To improve nutritional status and reduce CED prevalence through education and community empowerment	Qualitative descriptive study, active participation of families and community	Maternal weight increased by 1.5–2 kg, normal nutritional status rose from 40% to 68%, CED decreased from 28% to 12%. Community-based nutrition education is effective in reducing CED.
3	Assistance for Pregnant Women with Chronic Energy Deficiency to Improve Nutritional Status May, L. et al. (2024)	To improve nutritional status of pregnant women with CED through education and assistance	Observation, counseling, 20-day accompaniment	Maternal weight increased, food consumption behavior improved. Intensive assistance positively impacts nutrition and eating behavior.
4	Evaluation of Nutritional Interventions in Overcoming Chronic Energy Deficiency in Pregnant Women: A Case Study Hadi, A. J. et al. (2024)	To evaluate the effectiveness of nutritional interventions in pregnant women with CED	Qualitative case study, in-depth interviews	MUAC increased, but monitoring of supplementary food intake was lacking. Nutrition interventions need integration with health services and consumption monitoring.
5	Scoping Review of Intervention Strategies for Improving Coverage and Uptake of Maternal Nutrition Services in Southeast Asia Kathuria, N. et al. (2021)	To review maternal nutrition intervention strategies in Southeast Asia	Scoping review of 22 studies	Education, home visits, supplementation, and community mobilization were effective. Diverse strategies and community participation are key to intervention success.
6	The Effect of Supplementary Feeding Interventions on Nutritional Status of Pregnant Women with Chronic Energy Deficiency Herniyatun, H. (2022)	To assess the effect of supplementary feeding on pregnant women with CED	Descriptive-analytical case study	MUAC increased from 21.8 cm to 23.82 cm after 90 days of intervention. Supplementary food (biscuits & milk) is effective in improving nutritional status.

7	Outreach on the Importance of Maternal Nutrition Knowledge and Food Intake in Preventing CED Deltu, S. N. & Sari, W. K. (2024)	To increase nutrition knowledge and awareness among pregnant women	Counseling, knowledge and food intake surveys	Nutrition knowledge and food intake improved. Nutrition education is crucial for CED prevention.
8	Determinants of Chronic Energy Deficiency (CED) Incidence in Pregnant Women: A Cross-Sectional Study in Banyumas, Indonesia Murwani, R. et al. (2024)	To identify risk factors for CED in pregnant women	Cross-sectional study, multivariate analysis	Extreme maternal age, low education, short birth intervals, low ANC visits, and low protein intake were significantly associated with CED. Improving nutritional intake and ANC is essential for prevention.
9	Nutritional Contributors to Maternal Anemia in Indonesia: Chronic Energy Deficiency and Micronutrients Masrul et al. (2020)	To assess the contribution of CED and micronutrients to maternal anemia	Meta-analysis of 10 studies	CED increased the risk of anemia by 3.8 times. Preventing CED is important to reduce maternal anemia.
10	Maternal Nutrition and Birth Outcomes: Effect of Balanced Protein-Energy Supplementation Imdad, A. & Bhutta, Z. (2012)	To assess the effect of balanced protein-energy supplementation during pregnancy	Intervention review & meta-analysis	Supplementation reduced the risk of LBW, SGA, and stillbirth. Protein-energy supplementation is effective for undernourished pregnant women.

2. Discussion

The issue of CED among pregnant women remains a major public health challenge, particularly in developing countries like Indonesia. Findings from various studies demonstrate that the prevention and management of CED require a systemic and layered approach, integrating not only nutritional supplementation but also educational, social, and healthcare interventions.

A review of ten scientific articles suggests that addressing CED in pregnant women necessitates a systemic, multidimensional, and sustainable approach. Sole reliance on nutritional supplementation has proven insufficient unless combined with ongoing education and social support. Saftarina et al. (2024) showed that training healthcare workers using expert system-based modules significantly improved early detection of CED and nutritional education, with 91.1% of participants enhancing their skills. This underscores the importance of strengthening human resource capacity as a foundation for CED prevention strategies, especially at the primary care level.

Community-based interventions involving families and local leaders also produced significant outcomes. Ningsih et al. (2025) reported that community-driven nutrition education reduced CED prevalence from 28% to 12% and improved maternal nutritional status from 40% to 68%. This study emphasizes that intervention success is influenced not only by individual knowledge but also by social environments and family support. Similarly, May et al. (2024) found that intensive 20-day mentoring significantly improved

maternal weight and dietary behavior. These interpersonal and sustained approaches demonstrated more stable and long-term effects in modifying eating habits.

Direct nutritional interventions also showed positive outcomes. (Herniyatun & Purwantini, 2022) documented an increase in MUAC from 21.8 cm to 23.82 cm following 90 days of supplementary feeding using biscuits and milk. This aligns with the meta-analysis by Imdad and Bhutta (2012), which concluded that balanced protein-energy supplementation significantly reduced the risks of low birth weight (LBW), small for gestational age (SGA), and stillbirth. However, several studies pointed out that such interventions had short-term effects if not accompanied by continuous nutritional monitoring. (Feprina, Hadi, & Ahmad, 2024) emphasized that optimal maternal nutritional status requires integration with healthcare systems that actively monitor daily intake and maternal behavior.

In terms of risk factors, (Murwani et al., 2024) identified key determinants of CED, including extreme maternal age, low education levels, inadequate antenatal care (ANC) visits, short birth intervals, and insufficient protein intake. These findings suggest that CED results from disparities in access to knowledge, healthcare services, and nutritional resources. Moreover, (Masrul, 2020) found that pregnant women with CED were 3.8 times more likely to develop anemia, which subsequently increases the risk of obstetric complications such as postpartum hemorrhage and maternal mortality. This further reinforces the link between energy and micronutrient deficiencies in affecting pregnancy outcomes.

Theoretically, these results support the social determinants of health framework, wherein CED is influenced not only by biological but also by socioeconomic and cultural factors. Training programs, community education, and individual counseling, as demonstrated in these studies, indicate that structural interventions must be complemented by interpersonal ones to achieve measurable impacts. Policy implications include the need for preventive, participatory, and context-specific community-based interventions. These should not only target pregnant women but also engage families and surrounding environments as agents of change.

Furthermore, the reviewed studies highlighted existing gaps in intervention implementation. Most research was descriptive and lacked experimental or randomized controlled trial (RCT) designs to assess long-term effectiveness. Research on cost-effectiveness, intervention variation based on local characteristics, and gender roles (e.g., husband involvement) remains limited. Therefore, further comprehensive, and longitudinal studies are required to generate robust and contextually relevant policy recommendations.

In conclusion, the evidence underscores that effective prevention of CED in pregnant women must be holistic, integrated, and long-term. Community-based educational interventions, intensive mentoring, supplementary feeding, and primary healthcare system strengthening should be implemented simultaneously and sustainably. This comprehensive approach contributes not only to improving maternal nutritional status and pregnancy quality but also to reducing maternal and neonatal mortality at the national level.

Conclusion

Based on the review and analysis of ten studies on nutritional and health education interventions for preventing Chronic Energy Deficiency (CED) in pregnant women, it can be concluded that effective management of CED must be multidimensional, integrated, and sustainable. Approaches that focus solely on nutritional provision are insufficient unless supported by education, interpersonal mentoring, and strengthened health workforce capacity. Expert system-based training, community education involving families, and supplementary feeding have proven to improve maternal nutritional status and dietary behavior. However, long-term effectiveness is highly dependent on intervention continuity and consistent monitoring. Socioeconomic risk factors, such as low education, extreme maternal age, and limited antenatal care visits, are critical determinants of CED, necessitating context-specific approaches. Coordinated interventions involving the health sector, families, and communities offer significant potential for reducing CED rates and improving pregnancy outcomes.

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