Original Article

Improving Nutritional Intake During Pregnancy Through Targeted Nutrition Education: A Quasi-Experimental Study

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ABSTRACT

Background: Adequate nutritional intake during pregnancy is essential to support maternal health and fetal development. One of the main factors contributing to poor nutritional status among pregnant women is the lack of knowledge and understanding of balanced nutrition. Nutrition education serves as a key strategy to improve nutritional literacy and promote healthier dietary behaviors throughout pregnancy. This research aims to examine the effect of nutrition education on improving the nutritional intake of pregnant women.

Methods: This quantitative study used a quasi-experimental pre-test and posttest design without a control group. A total of 50 pregnant women in their second and third trimesters were recruited through purposive sampling from Wara Selatan Health Center, Palopo City, Indonesia. Inclusion criteria were willingness to participate and no chronic diseases. The intervention consisted of three structured education sessions over two weeks, each lasting 45 to 60 minutes, delivered by trained health workers using visual aids and interactive discussions. Data were collected using a validated nutritional knowledge questionnaire and a 24-hour dietary recall form ($\alpha = 0.81$; $r = 0.84$). Data analysis was performed using a paired t-test via SPSS version 26 with a significance level of $p < 0.05$

Results: Research has shown that a significant increase in mean nutrient intake after the intervention: carbohydrates from 180 ± 45 g to 210 ± 50 g, protein from 60 ± 12 g to 80 ± 16 g, iron from 18 ± 6 mg to 24 ± 8 mg, vitamin A from 700 ± 200 mcg to 950 ± 250 mcg, and calcium from 800 ± 180 mg to 1000 ± 200 mg. Research has shown that p-values < 0.05, indicating statistically significant improvements after nutrition education.

Conclusion: This study shows that structured nutrition education can increase the intake of carbohydrates, protein, iron, vitamin A, and calcium in pregnant women. These findings support the importance of nutrition education as part of antenatal care. Practically, this intervention can be integrated into routine programs at Puskesmas and Posyandu through pregnancy classes and direct counseling by midwives or cadres. Simple and locally appropriate education has proven effective and can be widely applied, especially in primary health facilities.

Keywords: Pregnant women; nutrition education; dietary intake; pregnancy; health intervention.

Implications for Practice:

- Integrating Nutrition Education into Antenatal Care Services. Nutrition education has been proven effective in increasing the nutritional intake of pregnant women. It can be routinely incorporated into antenatal class programs at community health centers (Puskesmas) and integrated health posts (Posyandu).

Implications for Practice:

- Strengthening the Role of Health Workers. This research supports the need for structured and communicative nutrition education training for midwives and healthcare professionals involved in maternity care.
- Enhancing Maternal Nutrition Policy. The findings can serve as a foundation for the development of local and national policies related to maternal nutrition literacy as part of the broader strategy to prevent malnutrition and pregnancy complications.
- Improving Efficiency in Primary Healthcare Services, Structured and straightforward nutrition education can enhance service efficiency without adding to the workload burden and simultaneously improve the quality of care for pregnant women...

Introduction

Pregnancy is a very important period because it has a direct impact on the health of the mother and baby. (Yulia Herliani, SST., M.Keb. Rolita Efriani, S.ST., 2024). Malnutrition during this period can increase the risk of anemia, premature birth, and low birth weight (LBW) babies.(Ummah, 2021). As well as disorders of child development that can continue into adulthood, such as stunting and chronic diseases. (Festival, 2020). This problem not only affects individuals but also becomes a serious burden for the public health system. Therefore, improving the nutrition of pregnant women is an important step that is in line with national health goals and global targets such as the Sustainable Development Goals (SDGs)(Ministry of Health, 2023). One effective and affordable way to support this is through structured nutrition education, which can empower pregnant women to understand their nutritional needs and adopt healthier eating patterns.(Wozniak et al., 2025).

Globally, the World Health Organization (WHO) estimates that around 20 million babies are born with low birth weight annually, mostly due to inadequate maternal nutrition. UNICEF (2023) also reports that more than 800 million women and girls suffer from chronic undernutrition, with pregnant women being among the most vulnerable. This situation is exacerbated by limited nutritional knowledge, economic constraints, and poor access to quality healthcare services in many developing countries, including Indonesia(UNICEF, 2023).

This study is based on two main theories that explain changes in health behavior, the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB). These two theories are used to understand how nutrition education (independent variable) can affect changes in nutritional intake of pregnant women (dependent variable). In the HBM Theory, a person will change their behavior if they feel at risk (vulnerable), understand the benefits of change, and can overcome existing obstacles. Therefore, nutrition education in this study aims to improve pregnant women's understanding of the importance of nutrition, the risks of malnutrition, and how to overcome obstacles in consuming healthy foods (Prabowo & Wardani, 2024). Meanwhile, the TPB Theory explains that behavior is influenced by a person's intention, which is formed from attitudes towards behavior, social norms, and self-confidence to do so. In this context, nutrition education is also designed to create a positive attitude of mothers towards healthy eating patterns, strengthen support from the surrounding environment (family and health workers), and increase the confidence of pregnant women in choosing and consuming nutritious foods. By combining these two theories, this study aims to prove that proper nutrition education can be the key to improving the

quality of nutritional intake during pregnancy.

In Indonesia, nutritional issues among pregnant women remain a serious challenge. According to the 2018 Basic Health Research (Riskesdas), the prevalence of anemia in pregnant women reached 48.9%, while the 2023 Indonesian Health Profile reported that approximately 17.3% of pregnant women experience Chronic Energy Deficiency(Ministry of Health, 2023). These conditions are mostly found in remote and underdeveloped areas where access to nutritional education and information is limited(Yismaw & Teklu, 2022). Furthermore, many pregnant women still believe that "eating for two" is a correct nutritional principle when, in fact, the emphasis should be on the quality and balance of nutrients rather than just quantity(Ummah, 2021).

Maternal nutrition problems are not just domestic health issues but are also part of the Sustainable Development Goals (SDGs) targets(Hamidah, 2025), particularly Goal 2 (Zero Hunger) and Goal 3 (Good Health and Well-being)(Tarigan et al., 2022). Nutrition education is a strategic approach to achieving these goals. However, there are still significant gaps in the equitable dissemination of nutritional knowledge, particularly at the grassroots level(Rahayu et al., 2022). At the regional level, Southeast Asia contributes significantly to the burden of maternal malnutrition(Beressa et al., 2024). Pregnancies lacking appropriate dietary knowledge and practices are especially vulnerable to developmental failure, particularly during the First 1000 Days of Life(Tarigan et al., 2022). Therefore, education- and communication-based interventions such as nutrition education are vital tools to empower pregnant women in managing their diets independently and wisely(Rantesigi et al., 2022).

This research is important because it evaluates a relatively simple, low-cost intervention that can be widely implemented through primary healthcare facilities such as Puskesmas, Posyandu, or private clinics. Amid limited resources and healthcare service coverage, nutrition education offers a crucial avenue to enhance the capacity of pregnant women in maintaining their health and that of their fetus(Astuti et al., 2025). Through structured and targeted education, pregnant women can better understand their specific nutritional needs and avoid inappropriate or even harmful dietary habits. Additionally, the results of this research are expected to contribute to policies aimed at improving the quality of antenatal care (ANC), enriching educational intervention models, and strengthening the role of healthcare professionals as agents of maternal and child health promotion(Dika Juliastuti, Hendrayati, Mustamin, Fatmawaty Suaib, 2022).

Although numerous studies have shown that nutrition education can enhance the knowledge of pregnant women, the effects on dietary behavior and nutritional intake vary. For example, Rizky et al. found that a four-week educational intervention significantly improved iron intake(Rizky Tampubolon et al., 2023). In contrast, Dewi et al. reported that nutrition education had no significant effect on protein intake due to household economic constraints(Dewi et al., 2021). There is also a research gap in studies that use contextual and localized education approaches—those that consider food culture, literacy levels, and effective methods of information delivery. Therefore, this research adopts a contextual approach to nutrition education and assesses its impact on real changes in the dietary intake of pregnant women.

The theoretical framework for this research is based on two major models: the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB). HBM posits that health behavior is influenced by perceived risks, benefits, and barriers; thus, nutrition

education is expected to increase pregnant women's awareness of the importance of nutrition. TPB highlights that behavioral change is shaped by attitude, subjective norms, and perceived behavioral control, implying that education can motivate pregnant women to adopt healthier eating habits(Delima et al., 2023).

This research aims to evaluate the effect of nutrition education on the dietary intake of pregnant women. Specifically, it seeks to: (1) Analyze differences in nutritional intake before and after the nutrition education intervention; (2) Measure the effectiveness of educational methods in improving knowledge and attitudes toward healthy eating; and (3) Assess the extent to which the intervention leads to actual changes in dietary behavior during pregnancy.

Methods

Study Design

This research employed a quasi-experimental design with a pre-test and posttest approach without a control group(Amelia et al., 2023). This design was chosen to determine the effect of nutrition education on improving pregnant women's nutritional intake by comparing data collected before and after the intervention(Suriati, 2022). It allowed for the direct observation of changes in dietary behavior following the educational sessions, without random assignment of participants

Participants

Samples were selected using purposive sampling, a non-random technique in which subjects were chosen based on specific criteria aligned with the research's objectives(Amelia et al., 2023). This method was used to target pregnant women undergoing prenatal care in selected healthcare facilities who were likely to benefit from nutrition education. The inclusion criteria are: second- or third-trimester pregnant women willing to participate in the educational sessions and complete both pre- and post-intervention questionnaires, and who do not suffer from chronic diseases (eg, diabetes, chronic hypertension) that could affect eating patterns. Exclusion criteria included pregnant women with complications requiring special diets and those who failed to attend all sessions or complete post-intervention assessments. Participants were recruited through direct visits to community health centers (Puskesmas) and integrated service posts (Posyandu) where data collection was conducted. The researchers coordinated with local healthcare workers to identify eligible individuals.

The mechanism for preventing data loss was carried out by recruiting participants who were willing to attend all education sessions and fill out pre- and posttest questionnaires, and excluding pregnant women who were not fully present during the intervention (mentioned in the exclusion criteria). Thus, missing data was minimized through strict control during recruitment and implementation of the intervention. The recruitment flow diagram is a simple flow diagram with stages: Screening → Eligible → Enrolled → Completed pre-test → Completed intervention → Completed posttest. The sample in this study was 50 respondents, which was determined based on similar studies and considerations of resource and time limitations. This study used a quasi-experimental design without a control group, so the focus was on analyzing differences in pre-test and posttest in the same group. Although no statistical power analysis was performed, the number of 50 was considered sufficient for exploratory research, because it used a paired t-test to detect significant changes in nutrient intake. This is the main objective of the study, which was to evaluate the early effects of a nutrition education intervention

on pregnant women in the context of primary health care.

Instruments

The Nutrition Knowledge Questionnaire for Pregnant Women was adapted from instruments developed by the Indonesian Ministry of Health (2017) and the WHO Nutrition Guidelines (2020). It assessed maternal nutrition knowledge in the context of antenatal care. Content validity was confirmed through expert review by three professionals in public health, nutrition, and maternal health. Construct validity was evaluated using exploratory factor analysis (EFA) on a trial group of 30 respondents, identifying three key factors with loadings > 0.5. Criterion validity was demonstrated by a strong correlation with the original Ministry of Health instrument (r = 0.78).

Reliability was tested using Cronbach's alpha (α = 0.81) and a two-week test-retest correlation (r = 0.84), indicating good stability and consistency. The questionnaire contained 15 multiple-choice questions covering macronutrients, micronutrients, dietary patterns, and food safety. The scoring range was 0–15 and was used pre- and post-intervention to measure knowledge gains.

Intervention

The Nutrition Knowledge Questionnaire for Pregnant Women was adapted from instruments developed by the Indonesian Ministry of Health (2017) and the WHO Nutrition Guidelines (2020). It assessed maternal nutrition knowledge in the context of antenatal care. Content validity was confirmed through expert review by three professionals in public health, nutrition, and maternal health. Construct validity was evaluated using exploratory factor analysis (EFA) on a trial group of 30 respondents, identifying three key factors with loadings > 0.5. Criterion validity was demonstrated by a strong correlation with the original Ministry of Health instrument (r = 0.78).

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Intervention

The intervention consisted of structured nutrition education delivered over three sessions, each lasting 45–60 minutes, conducted over two consecutive weeks. The content included: Principles of balanced nutrition during pregnancy, Macronutrient and micronutrient needs for pregnant women, Healthy food choices, food safety, and anemia prevention. Educational sessions were held in antenatal class meeting rooms in the research area and facilitated by trained healthcare professionals. Educational tools included visual media such as leaflets and posters, with interactive discussions and simple demonstrations to enhance engagement. The findings from this nutrition education intervention are expected to be translated into health policies, particularly by integrating these educational materials and approaches into national antenatal care (ANC) guidelines. Implementation can be done through a pregnancy class program at the Community Health Center and Integrated Health Post, so that nutrition education becomes a routine part of efforts to prevent nutritional problems during pregnancy.

Data Collection

Data collection was conducted in January 2025 in the working area of the South Wara Community Health Center, Palopo City, where all participants were registered in the antenatal class program.

The data collection process took place in the health center's meeting room after participants had provided written informed consent. The research team consisted of the primary researcher and two trained enumerators. Before data collection, the enumerators received thorough training on the use of research instruments, interview procedures, and research ethics. Each participant was interviewed directly using the validated and reliable questionnaires. Pre-test data were collected before the first educational session, while posttest data were collected one week after the final session. This timing allowed for adequate reflection and application of the knowledge participants had gained during the intervention.

Data Analysis

All data were processed and analyzed using SPSS version 26. The analysis began with descriptive statistics to illustrate participant characteristics and average nutritional intake before and after the intervention. A normality test (Kolmogorov–Smirnov) was conducted to determine whether the data were normally distributed. Given the pre-test and posttest design without a control group, the primary analysis used paired t-tests to identify significant differences in nutritional intake before and after the educational intervention. A p-value of < 0.05 was set as the threshold for statistical significance.

Ethical Considerations

This research involved human participants; therefore, ethical considerations were strictly upheld. Key ethical concerns addressed in this research included obtaining informed consent, ensuring data confidentiality, and minimizing potential risks during both the data collection and intervention processes. The study was approved by the Research Ethics Committee of the Institute for Research and Community Service at Muhammadiyah University of Palopo, under reference number 45/KEP/III.3.AU/F/2024. Each participant received detailed written and verbal information about the research's purpose, procedures, benefits, and potential risks. Participant confidentiality was protected, and all data were anonymized. Participation was voluntary, and participants had the right to withdraw at any time without consequence.

Results

Table 1 presents the demographic characteristics of the respondents by age, educational level, and parity. Most respondents were in the productive age range of 20–30 years (60%), which is biologically associated with a lower risk of pregnancy complications compared to older age groups. This age group also tends to be more responsive to new information, including nutrition education.

Regarding education, most respondents had completed high school or vocational school (40%), followed by elementary school graduates (30%). Higher education levels are generally linked to better nutritional knowledge, thus increasing the likelihood of effectively adopting the educational content. The distribution of parity was evenly split between primigravida and multigravida respondents (50% each). Primigravida women are typically more receptive to new information and more actively engaged in antenatal programs, while multigravida women bring previous experiences that may influence their attitudes toward nutrition education.

Table 1. Distribution of Respondents by Age, Education, and Parity

Number	Respondent Characteristics	Frequency	Percentage (%)
Age			
1	20–30 years	30	60%
2	31–40 years	20	40%
	Total		100%
Education			

Number	Respondent Characteristics	Frequency	Percentage (%)
1	Did not complete elementary school	5	10%
2	Completed elementary school	15	30%
3	Completed high school/vocational school	20	40%
4	College/university	10	20%
	Total		100%
Parity			
1	Primigravida	25	50%
2	Multigravida	25	50%
	Total		100%

Table 2 shows a significant improvement in the average intake across all nutritional aspects measured after the nutrition education intervention. Carbohydrate intake increased from 180 ± 45 g to 210 ± 50 g, protein from 60 ± 12 g to 80 ± 16 g, iron from 18 ± 6 mg to 24 ± 8 mg, vitamin A from 700 ± 200 mcg to 950 ± 250 mcg, and calcium from 800 ± 180 mg to 1000 ± 200 mg. Nutrient intake increased significantly after the nutrition education intervention. Carbohydrate intake increased by 16.7%, protein by 33.3%, iron by 33.3%, vitamin A by 35.7%, and calcium by 25%. This increase shows that nutrition education has a real impact on changes in food consumption behavior in pregnant women.

Table 2. Mean Nutrient Intake of Pregnant Women Before (Pre-test) and After (Post-test) Nutrition Education

Nutritional Aspect	Pre-test (Before Education)	Posttest (After Education)	Change
Carbohydrates (g)	180 ± 45	210 ± 50	+30
Protein (g)	60 ± 12	80 ± 16	+20
Iron (mg)	18 ± 6	24 ± 8	+6
Vitamin A (mcg)	700 ± 200	950 ± 250	+250
Calcium (mg)	800 ± 180	1000 ± 200	+200

Table 3 displays the results of the paired t-tests, which show statistically significant differences ($p < 0.05$) in all nutritional components: carbohydrates ($t = -4.45$), protein ($t = -5.32$), iron ($t = 3.75$), vitamin A ($t = -4.20$), and calcium ($t = -4.00$). These values confirm that the improvements in nutrient intake were not due to chance but were a direct result of the nutrition education intervention.

Table 3. Paired t-Test Results for Nutritional Intake Before and After Nutrition Education

Nutritional Aspect	t-value	p-value
Carbohydrates	-4.45	$p < 0.05$
Protein	-5.32	$p < 0.05$
Iron	3.75	$p < 0.05$
Vitamin A	-4.20	$p < 0.05$
Calcium	-4.00	$p < 0.05$

Discussion

The findings of this research demonstrate a significant improvement in the nutritional intake of pregnant women following a structured three-session nutrition education intervention. Intake of carbohydrates, protein, iron, vitamin A, and calcium all showed substantial increases post-intervention, indicating that nutrition education can be an effective strategy to improve healthy eating behaviors among pregnant women, particularly at the primary healthcare level. These results align with the Health Belief Model (HBM), which suggests that individuals are more likely to adopt healthy behaviors when they perceive themselves to be at risk, recognize the benefits of change, and believe that their actions will produce positive outcomes. In this context, the structured education sessions enhanced pregnant women's awareness of the importance of proper nutrition during pregnancy. The findings are also supported by the Theory of Planned Behavior (TPB), which posits that attitudes, subjective norms, and perceived behavioral control influence an individual's intention and actions. The intervention appears to have positively influenced these factors,

motivating the women to make healthier dietary choices.

These results are consistent with studies by(Fitriani, Amriani, Sudin Riyadi, 2023), which found that nutrition education increased iron and animal protein intake among pregnant women in resource-limited settings. Similarly,(Astuti et al., 2025)showed that using leaflets and interactive discussions improved nutritional practices among second-trimester pregnant women in coastal areas. Rilyani et al. (2024) also reported that nutrition education delivered by midwives and nutritionists improved knowledge and compliance with micronutrient-rich food intake, particularly iron and folic acid(Rilyani et al., 2024). Yuliana et al. (2023) added that perceived benefits of healthy eating during pregnancy strongly correlate with adherence to nutritional guidance(Dewi et al., 2021). However, these findings contrast with those of Helda et al. (2025), who found no significant improvement in dietary intake following nutrition education in low-income urban areas. In that research, economic constraints limited access to nutritious foods, suggesting that improved knowledge does not always translate to behavior change without supportive conditions(Helda Okti Rulya, Ratna Dewi, Rizki Amalia, 2025).

A strength of this research lies in its simple design, which can be widely implemented in primary healthcare settings. The direct, structured educational approach did not require advanced technology or equipment but still yielded significant outcomes. This makes the intervention especially relevant in resource-limited and remote areas across Indonesia.

This research contributes empirical evidence that primary healthcare-based nutrition education can significantly improve pregnant women's dietary intake in a relatively short time. It also highlights the importance of contextual, culturally relevant educational strategies that involve local health personnel such as midwives and community health workers. Nonetheless, this research has limitations, including a relatively small sample size (n = 50) and the absence of a control group, which makes it difficult to eliminate external influences completely. Moreover, the use of 24-hour dietary recall is subjective and dependent on participants' memory, posing a risk of reporting bias.

Practically, these findings underscore the need to integrate nutrition education regularly into antenatal programs at Puskesmas and Posyandu. Training healthcare providers in effective and context-sensitive nutrition communication is also crucial. Future research should explore innovative, engaging nutrition education tools such as short videos, infographic posters, or mobile apps tailored to the local community. Larger-scale studies with control groups and long-term follow-up are also recommended to evaluate the sustained impact of nutrition education interventions.

The policy implications of the findings are significant, especially for resource-limited settings. The nutrition education intervention used in this study was simple, did not require sophisticated technology, and could be implemented without burdening the budget, making it suitable for implementation in clinics or primary health care facilities in rural areas. By utilizing existing health workers such as midwives and Posyandu cadres, this intervention can be integrated into routine antenatal care (ANC) programs on an ongoing basis.

This study used an appropriate design to evaluate changes before and after intervention in one group. However, there are several things that need to be considered in interpreting it. Because it did not involve a comparison group, the influence of external factors outside of nutrition education cannot be fully

controlled. In addition, the measurement of nutrient intake used a 24-hour recall method that relies on the memory of pregnant women, so there could be errors in reporting the food consumed. This study was also conducted on a limited number of participants and in one particular area, so the results better reflect the local context. Nevertheless, these findings still provide an important initial picture and can be the basis for further research with a wider scope.

Relevance to Clinical Practice

This research provides valuable insights for clinical practice, particularly in improving the nutritional intake of pregnant women through educational approaches. The findings demonstrate that structured nutrition education significantly enhances understanding and promotes healthy eating behaviors among pregnant women, thereby contributing to improved nutritional status and better pregnancy outcomes. Such education effectively supports pregnant women in making informed dietary choices, helping to prevent macro- and micronutrient deficiencies that may lead to conditions such as anemia and low birth weight (LBW). The study confirms its primary aim and hypothesis—assessing the effect of nutrition education on improving nutritional intake—by revealing significant increases in carbohydrate, protein, iron, vitamin A, and calcium intake following the intervention. These results reinforce the role of nutrition education in positively influencing dietary behavior, particularly when integrated into antenatal care services at primary healthcare settings like Community Health Centers (Puskesmas) and Integrated Health Posts (Posyandu). The practical application of this research includes delivering brief yet impactful education sessions during routine pregnancy check-ups, using tools such as leaflets, visual aids, and examples of locally available nutritious foods. Given that healthcare workers are often pressed for time and pregnant women may not always be available for separate counseling sessions, a simple 15-minute session at the end of antenatal visits can still deliver essential information without disrupting service flow. Tailoring educational content based on varying literacy levels and involving family members, such as husbands, can further enhance effectiveness. Therefore, it is recommended that Community Health Centers allocate dedicated time for nutrition education and provide capacity-building for midwives and health cadres to deliver engaging, accessible, and culturally appropriate materials that promote sustainable nutritional practices among pregnant women.

Conclusion

This study shows that structured nutrition education can increase the intake of carbohydrates, protein, iron, vitamin A, and calcium in pregnant women. These findings support the importance of nutrition education as part of antenatal care. Practically, this intervention can be integrated into routine programs at Puskesmas and Posyandu through pregnancy classes and direct counseling by midwives or cadres. Simple and locally appropriate education has proven effective and can be widely applied, especially in primary health facilities.

Government support is essential to ensure the sustainability of these interventions, particularly through the integration of nutrition education into formal antenatal care programs and policies. This includes providing training, allocating time, and strengthening the role of health workers in delivering nutrition materials routinely.

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CrediT Authorship Contributions Statement

Israini Suriati: Conceptualization, Methodology, Supervision, Writing - Original Draft, Software, Validation, Formal Analysis, Writing - Review & Editing
Reski Juliani: Investigation, Resources, Data Curation, Project Administration, Writing - Original Draft, Review & Editing, Visualization, Funding Acquisition

Conflicts Of Interest

There is no conflict of interest.

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